

**LINKS FOR ELECTRONIC NAVIGATION OF THE:**

***STANDARD SPECIFICATIONS FOR HIGHWAY  
CONSTRUCTION (2004)***

**Note:** This page does not exist in the hard-copy, spiral bound edition of the Standard Specifications for Highway Construction (2004).

This page has been added to the electronic version of the Standard Specifications to help guide the user by providing automated links, which are identified by blue text.

“Click” on the desired location from the following:

**SECTION TITLES**

**TABLE OF CONTENTS (VOLUME 1)**

**TABLE OF CONTENTS (VOLUME 2)**

**INDEX OF STANDARD DRAWINGS (VOLUME 1)**

**INDEX OF STANDARD DRAWINGS (VOLUME 2)**

We made every effort to ensure that this on-line publication is accurate and current. However, we provide this electronic file only as a convenience. In case of discrepancies between the electronic version and the paper document, the paper document has precedence.



**Note:**

**This page does not exist in the hard-copy, spiral bound edition of the Standard Specifications for Highway Construction (2004).**

**This page has been added to the electronic version of the Standard Specifications to maintain even and odd numbered pages.**





# STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

2004

**EFFECTIVE  
JANUARY 1, 2004**

Construction Engineering Section  
Construction and Maintenance Branch  
Ministry of Transportation



**Canadian Cataloguing in Publication Data**

British Columbia. Ministry of Transportation and  
Highways.

Standard specifications for highway construction  
effective February 1,...-- 1991 -

Annual.

ISSN 1188-0120 = Standard specifications for  
highway construction (Victoria)

1. Roads - Specifications - British Columbia. I.  
Title.

TE27.B7B74

625.7

C91-092305-1



# NOTICE TO USERS

## SECTIONS 100 to 599 - VOLUME ONE

## SECTIONS 600 to 999 - VOLUME TWO

All text changed or added since the 2003 edition is shown with double underlining and vertical bar in the margin.

New or completely revised sections are noted in the footer (no double underlining or vertical bar).

### To obtain the Standard Specifications for Highway Construction Volume - 1 & 2 - 2004

- Order online at **www.publications.gov.bc.ca**, click on browse the index and in the “keywords” field type in 7680001898, the Queen’s Printer stock number, select the item and click the “add to shopping cart” button. You will require a Visa or MasterCard to process this order. (Visa and/or MasterCard information is stored on our secure server)
- Mail in a Company Cheque, Money Order or Certified Cheque payable to the Minister of Finance to:  

Queen’s Printer,  
Government Publication Services,  
Box 9452, Stn Prov Govt  
Victoria BC V8W 9V7
- Phone toll free 1 800 663-6105 or locally in Victoria at 387-6409, with your Visa or MasterCard Number and we will place the order for you.

To view the electronic version of these specifications go to:

[www.th.gov.bc.ca/Publications/const\\_maint/contract\\_serv/standardspecs.htm](http://www.th.gov.bc.ca/Publications/const_maint/contract_serv/standardspecs.htm)

For technical content please contact:

Senior Specifications and Construction Technician  
Construction and Maintenance Branch  
Ministry of Transportation  
940 Blanshard Street Level 4C  
PO Box 9850 STN PROV GOVT  
Victoria BC V8W 9T5

Telephone: (250) 356-5540  
Facsimile: (250) 356-7276



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



# SECTION TITLES

## VOLUME ONE CONTAINS THE FOLLOWING SECTIONS:

SECTION 107 - GLOSSARY OF TERMS  
SECTION 108 – SAMPLE FORMS  
SECTION 115 - MAJOR WORKS CONSTRUCTION AGREEMENT – GENERAL CONDITIONS  
SECTION 117 - MINOR WORKS CONSTRUCTION AGREEMENT – GENERAL CONDITIONS  
SECTION 125 - VALUE ENGINEERING - PROPOSAL GUIDELINES  
SECTION 135 – CONSTRUCTION SITE SAFETY  
SECTION 145 – GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE  
CONSTRUCTION  
SECTION 165 - PROTECTION OF THE ENVIRONMENT  
SECTION 194 - TRAFFIC MANAGEMENT FOR WORK ZONES  
SECTION 200 - CLEARING AND GRUBBING  
SECTION 201 - ROADWAY AND DRAINAGE EXCAVATION  
SECTION 202 - GRANULAR SURFACING, BASE AND SUB-BASES  
SECTION 204 - ROCK CUTS  
SECTION 205 - RIPRAP  
SECTION 206 - ROCK BOLTS  
SECTION 207 - SLOPE MESH FOR ROCK CUTS  
SECTION 208 - DRAINS FOR ROCK CUTS  
SECTION 209 - SHOTCRETE FOR ROCK CUTS  
SECTION 211 - PORTLAND CEMENT CONCRETE  
SECTION 213 - TIMBER BRIDGES - CONSTRUCTION  
SECTION 214 - TIMBER PILING CONSTRUCTION  
SECTION 215 - BRIDGES  
SECTION 216 - PAINTING OF STEEL STRUCTURES  
SECTION 218 - CONCRETE FOR MINOR WORKS  
SECTION 232 - METAL BIN-WALL  
SECTION 303 - CULVERTS  
SECTION 308 - COATING SYSTEMS  
SECTION 312 - STEEL TRAFFIC BARRIERS AND WOOD POSTS  
SECTION 316 - STEEL AND WIRE FENCE MATERIALS  
SECTION 317 - P.E. PLASTIC DRAINAGE PIPE  
SECTION 318 - PVC PLASTIC DRAINAGE PIPE  
SECTION 320 - CORRUGATED STEEL PIPE  
SECTION 321 - TRAFFIC PAINT  
SECTION 407 - FOUNDATION EXCAVATION  
SECTION 412 - REINFORCING STEEL



- SECTION 413 - BRIDGE DECKS AND HIGH-DENSITY CONCRETE OVERLAYS
- SECTION 415 – MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS
- SECTION 416 – MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS
- SECTION 418 - CONCRETE BRIDGE DECK SEALANTS - SILANE SURFACE TREATMENT OF NEW PORTLAND CEMENT CONCRETE
- SECTION 419 - CONCRETE BRIDGE DECK WATERPROOFING SYSTEM - PREFABRICATED MEMBRANE
- SECTION 421 - STRUCTURAL STEELWORK
- SECTION 422 - MISCELLANEOUS STEELWORK
- SECTION 501 - HOT MIXED ASPHALT PAVEMENT
- SECTION 502 – END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION - NEW
- SECTION 503 - BASE PREPARATION AND BASE PROCESSING
- SECTION 504 - PAVEMENT DRAINAGE
- SECTION 507 - PRODUCTION AND STOCKPILING OF ASPHALT MIX
- SECTION 508 – END PRODUCT SPECIFICATION FOR GRADED AGGREGATE SEAL COAT - NEW
- SECTION 511 - COLD MILLING
- SECTION 514 - HOT IN-PLACE RECYCLE
- SECTION 515 – END PRODUCT SPECIFICATION FOR HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT - NEW
- SECTION 521 - ASPHALT STABILIZED BASE COURSE MIXED IN PLACE
- SECTION 531 - ASPHALT SURFACE TREATMENTS
- SECTION 536 - PAVEMENT CRACK SEALING
- SECTION 541 - RUBBLE MASONRY
- SECTION 582 - CONCRETE CURB AND GUTTER AND STORM DRAINAGE
- SECTION 586 - PLANT MIXED PORTLAND CEMENT TREATED BASE COURSE



# SECTION TITLES

## VOLUME TWO CONTAINS THE FOLLOWING SECTIONS:

SECTION 604 - STEEL TRAFFIC BARRIER CONSTRUCTION  
SECTION 635 - ELECTRICAL AND SIGNING  
SECTION 741 – FENCE CONSTRUCTION  
SECTION 751 - TOPSOIL AND LANDSCAPE GRADING  
SECTION 754 - PLANTING OF TREES, SHRUBS, AND GROUND COVERS  
SECTION 757 – REVEGETATION SEEDING  
SECTION 766 - IRRIGATION  
SECTION 769 - PROTECTION AND RETENTION OF VEGETATION  
SECTION 903 - TIMBER - MATERIALS  
SECTION 904 - TIMBER (TREATED AND UNTREATED) - FABRICATION AND HANDLING  
SECTION 905 - TIMBER - GLUED LAMINATED  
SECTION 906 - ROUND TIMBER PILES  
SECTION 908 - PRESERVATIVE TREATMENT - WOOD PRODUCTS  
SECTION 909 - TREATED WOOD FENCE POSTS  
SECTION 913 - REINFORCEMENT FOR CONCRETE  
SECTION 917 - WIRE ROPE  
SECTION 931 - PORTLAND CEMENT  
SECTION 933 - ADMIXTURES FOR PORTLAND CEMENT CONCRETE  
SECTION 941 – PRECAST REINFORCED CONCRETE BARRIERS  
SECTION 951 - ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE  
SECTION 952 – CONTRACTOR SUPPLY ASPHALT AND PAVING MATERIALS FOR  
HIGHWAY USE  
SECTION 971 - PLASTIC TRAFFIC CONES  
SECTION 991 - CALCIUM CHLORIDE AND SODIUM CHLORIDE



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



# TABLE OF CONTENTS

VOLUME ONE

NOTE: \* = CHANGED OR ADDED

## SECTION 107 - GLOSSARY OF TERMS

NOT INCLUDED .....	107-1
--------------------	-------

## SECTION 108 – SAMPLE FORMS

<u>PART A - GENERAL</u> .....	<u>108-1</u>
<u>108.01 General</u> .....	<u>108-1</u>
<u>PART B – STATUTORY DECLARATIONS</u> .....	<u>108-1</u>
<u>108.11 Major Works</u> .....	<u>108-1</u>
<u>108.12 Minor Works And Operational Services</u> .....	<u>108-1</u>

## SECTION 115 - MAJOR WORKS CONSTRUCTION AGREEMENT - GENERAL CONDITIONS

NOT INCLUDED .....	115-1
--------------------	-------

## SECTION 117 - MINOR WORKS CONSTRUCTION AGREEMENT - GENERAL CONDITIONS

NOT INCLUDED .....	117-1
--------------------	-------

## SECTION 125 - VALUE ENGINEERING - PROPOSAL GUIDELINES

125.01 Definitions .....	125-1
125.02 Guiding Principles for VEP Evaluation .....	125-1
125.03 Value Engineering Proposal Submissions .....	125-1
125.04 Implementation of a VEP .....	125-2

## SECTION 135 – CONSTRUCTION SITE SAFETY

135.01 Definitions .....	135-1
135.02 Base Safety Program .....	135-1
135.03 Prime Contractor – The Site .....	135-2
135.04 Designated Prime Contractor – The Specified Area .....	135-3
135.05 Site and Specified Area Notice Process .....	135-4
135.06 Contractor Obligations to Coordinate with the Designated Prime Contractor – The Specified Area .....	135-5
135.07 Contractor’s Health and Safety Records .....	135-6

## SECTION 145 – GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

145.01 General Requirements .....	145-1
145.02 Reference Information .....	145-1



145.03	Value Engineering Proposals.....	145-1
145.04	Scope of Work.....	145-1
145.05	Quantities and Dimensions.....	145-1
145.06	Unit Prices.....	145-1
145.07	Pre-construction Meeting.....	145-1
145.08	Mobilization.....	145-1
145.09	Authority of the Ministry Representative.....	145-2
145.10	Power, Telegraph, Telephone Lines and Other Utilities.....	145-2
145.11	Permits.....	145-2
145.12	Inspection of Work.....	145-2
145.13	“Ministry Representative’s Instruction” and “Contractor’s Declaration”.....	145-3
145.14	Protection and Restoration of the Work.....	145-3
145.15	Materials Supplied by the Contractor.....	145-3
145.16	Materials Supplied by the Ministry.....	145-4
145.17	Operation of Pavement Brooms on Highway.....	145-5
145.18	Supply and Maintain Facilities.....	145-5
145.19	Weighing Materials.....	145-6
145.20	Weather.....	145-6
145.21	Layout of Work and Calculation of Quantities.....	145-7
145.22	Access to Site.....	145-8
145.23	Accommodation of Traffic.....	145-8
145.24	Alterations to Drawings and Plans.....	145-8
145.25	Use of Explosives.....	145-8
*	145.26 Work in Ministry Pits or Quarries.....	145-9
	145.27 Highway Right-of-Way.....	145-10
	145.28 Protection of Land Subdivision Monuments, Roads and Property.....	145-10
	145.29 Haul Routes and Overloads.....	145-11
	145.30 Health and Safety.....	145-11
	145.31 Faulty Work.....	145-12
	145.32 Temporary Excavation.....	145-12
	145.33 General Sign Requirements.....	145-12

### SECTION 165 - PROTECTION OF THE ENVIRONMENT

165.01	General.....	165-1
165.02	Planning and Scheduling.....	165-2
165.03	Compliance, Enforcement and Payment.....	165-5
165.04	Erosion, Sediment, and Drainage Control.....	165-6
165.05	Clearing and Grubbing.....	165-9
165.06	Stripping Operations.....	165-10
*	165.07 Earthwork Operations (Subgrade Construction).....	165-10
	165.08 Borrow and Sand / Gravel Pits.....	165-11
	165.09 Detour, Access and Haul Roads.....	165-12
	165.10 Instream Works.....	165-12
	165.11 Ditch Maintenance.....	165-14
	165.12 Bridge Maintenance.....	165-14
	165.13 Servicing and Operation of Equipment.....	165-14
	165.14 Waste Disposal and Toxic/Hazardous Materials.....	165-15
	165.15 Pesticides.....	165-17
	165.16 Air and Noise Pollution.....	165-17



165.17 Use of Water .....	165-17
165.18 Support Facilities .....	165-17
165.19 Protection of Livestock and Wildlife .....	165-18
165.20 Archaeological and Paleontological Discoveries .....	165-18
165.21 Resolution of Disputes .....	165-19

## SECTION 194 - TRAFFIC MANAGEMENT FOR WORK ZONES

PART A - GENERAL .....	194-1
194.01 General .....	194-1
194.02 Definitions .....	194-1
194.03 Standard Documents .....	194-1
* 194.04 Traffic Control Supervisor .....	194-1
* 194.05 Compliance with Acts and Regulations .....	194-2
PART B – PLANNING AND SCHEDULING .....	194-1
* 194.11 Provide Traffic Management Plan .....	194-1
194.12 Traffic Management Plan Review .....	194-2
PART C – TRAFFIC MANAGEMENT OPERATIONAL DETAILS .....	194-2
* 194.21 Speed Zones .....	194-2
194.22 Use of Channelling Devices and Taper Rates .....	194-2
194.23 Equipment on the Travelled Way .....	194-2
194.24 Roadway Configuration .....	194-2
194.25 Roadway Condition .....	194-2
194.26 Closures .....	194-3
194.27 Detours .....	194-3
194.28 Access to Property .....	194-3
194.29 Winter Lay-Up .....	194-3
194.30 Delays .....	194-3
PART D – TRAFFIC CONTROL DEVICES .....	194-3
* 194.41 Traffic Signals .....	194-3
194.42 Pilot Cars .....	194-4
194.43 Use of Flagpersons .....	194-4
* 194.44 Traffic Signs .....	194-4
* 194.45 Barricades, Lights, Delineators, Traffic Lines .....	194-4
194.46 Changeable Message Signs .....	194-5
PART E – GENERAL MAINTENANCE .....	194-6
* 194.51 Maintenance .....	194-6
PART F - PAYMENT .....	194-6
194.61 Payment .....	194-6

## SECTION 200 - CLEARING AND GRUBBING

200.01 Clearing .....	200-1
200.02 Disposal of Material .....	200-1
200.03 Grubbing .....	200-1
200.04 Danger Trees .....	200-2
200.05 Payment for Danger Trees .....	200-2
200.06 Mail Boxes .....	200-2
200.07 Removal of Existing Signs and Symbols .....	200-2



200.08 Quantities and Payment .....	200-2
-------------------------------------	-------

## SECTION 201 - ROADWAY AND DRAINAGE EXCAVATION

DESCRIPTION	
201.01 General.....	201-1
201.02 Extent of Work .....	201-1
MATERIALS	
201.11 Description of Material Types .....	201-1
201.12 Unsuitable Material.....	201-2
CONSTRUCTION	
201.31 Rock Cuts.....	201-2
201.32 Dangerous, Loose and Overhanging Rock .....	201-2
201.33 Overbreak in Solid Rock .....	201-2
201.34 Surplus Material.....	201-2
201.35 Enlargement of Excavation.....	201-3
201.36 Rock Embankments .....	201-3
201.37 Earth Embankments.....	201-3
201.38 Frozen Material.....	201-4
201.39 Snow Removal.....	201-4
* 201.40 Bridge End Fill .....	201-4
201.41 Transition Sections .....	201-4
201.42 Slopes and Slides .....	201-4
201.43 Ditches .....	201-5
201.44 Borrow .....	201-5
201.45 Haul and Overhaul.....	201-5
201.46 Watering .....	201-5
201.47 Finishing of Roadway.....	201-5
201.48 Surcharge Pre-consolidation.....	201-5
201.49 Back Slope Stabilization.....	201-6
MEASUREMENT	
* 201.81 Borrow .....	201-6
201.82 Excavation .....	201-6
201.83 Overhaul .....	201-6
201.84 Watering .....	201-6
201.85 Compaction.....	201-6
PAYMENT	
201.91 Borrow .....	201-6
201.92 Excavation .....	201-6
201.93 Overhaul .....	201-6
201.94 Watering .....	201-6
201.95 Allowable Overbreak.....	201-6
201.96 Embankment.....	201-6
201.97 Compaction.....	201-7
201.98 Surcharge Removal.....	201-7

## SECTION 202 - GRANULAR SURFACING, BASE AND SUB-BASES

PART A - SCOPE OF SPECIFICATION .....	202-1
---------------------------------------	-------



202.01 Preliminary and General.....	202-1
PART B - MATERIALS .....	202-1
202.02 General Classification of Aggregate .....	202-1
202.03 General Description of Work .....	202-1
202.04 Aggregate Quality .....	202-2
202.05 Aggregate Gradation .....	202-2
202.06 Select Granular Sub-base .....	202-4
202.07 <u>Bridge End Fill</u> .....	202-4
202.08 - 202.09 Not Used .....	202-4
PART C - USE OF DESIGNATED PITS OR QUARRIES .....	202-4
202.10 Source of Supply .....	202-4
202.11 Development of Pit or Quarry .....	202-4
202.12 Use of All Materials .....	202-5
202.13 Unsuitable Materials.....	202-5
202.14 - 202.15 Not Used .....	202-5
202.16 Change of Designated Pit or Quarry .....	202-5
202.17 Pit Cleanup .....	202-5
202.18 Work in Ministry Pits or Quarries.....	202-6
202.19 Not Used.....	202-6
PART D - CONTRACTOR SUPPLIED AGGREGATES .....	202-6
202.20 Preliminary and General.....	202-6
202.21 Development and Clean Up of Private Pits or Quarries.....	202-6
202.22 Development of Ministry Pits or Quarries for Optional Use.....	202-6
202.23 Contractor to Pay All Costs.....	202-6
* 202.24 Surplus Aggregate.....	202-6
PART E - PRODUCTION OF CRUSHED AGGREGATE .....	202-6
202.25 Equipment and Plant .....	202-6
202.26 Working of Pit.....	202-7
202.27 Crushing Operations.....	202-7
202.28 Stockpiling .....	202-7
202.29 Not Used.....	202-8
PART F - CONSTRUCTION METHOD .....	202-8
202.30 Weather and Job Conditions.....	202-8
* 202.31 <u>Bridge End Fill</u> .....	202-8
202.32 Thickness of Granular Courses .....	202-8
202.33 Construction of Crushed Base or Select Granular Sub-base .....	202-8
202.34 Construction of 25 mm Crushed Base Course .....	202-9
202.35 Equipment for Watering.....	202-10
202.36 Proof Rolling.....	202-10
202.37 Benkelman Beam Testing.....	202-10
202.38 - 202.39 Not Used .....	202-10
PART G - MEASUREMENT AND PAYMENT .....	202-10
202.40 Water Applied to the Highway.....	202-10
202.41 Development and Cleanup of Designated Pits and Quarries.....	202-10
202.42 Stockpile Reject Aggregate.....	202-11
202.43 Blending Materials for Stabilizing Aggregates on the Highway.....	202-11
202.44 Crushed Aggregate in Stockpile.....	202-11
202.45 Advance Payment - Crushed Surfacing and Crushed Base.....	202-11
202.46 Crushed Surfacing and Base Supplied by the Contractor and Constructed in Place.....	202-12
202.47 Crushed Surfacing and Base Produced from Designated Pits and Quarries and Constructed in Place .....	202-12



202.48	Select Granular Sub-base Supplied by the Contractor and Constructed in Place .....	202-12
202.49	Select Granular Sub-base Produced from Designated Pits and Constructed in Place .....	202-12
202.50	Adjustment for Stockpiling .....	202-13
202.51	Haul on Crushed Surfacing, Base and Sub-base Aggregate .....	202-13

## SECTION 204 - ROCK CUTS

DESCRIPTION		
204.01	Scope .....	204-1
* 204.02	Definitions .....	204-1
* 204.03	Quality Control .....	204-2
* 204.04	Submittals .....	204-2
MATERIALS		
204.11	Explosives and Related Products .....	204-3
CONSTRUCTION		
204.31	Permits and Regulations .....	204-3
204.32	Supervision .....	204-3
204.33	Personnel .....	204-3
204.34	Safety .....	204-4
204.35	Flyrock Control .....	204-4
204.36	Other Damage .....	204-4
* 204.37	Subgrade and Ditch Areas .....	204-4
* 204.38	Blasting Test Section(s) .....	204-4
* 204.39	Overburden Removal and Setback .....	204-5
* 204.40	Backline and Production Holes .....	204-5
* 204.41	Backline Holes .....	204-5
* 204.42	Presplit Blasting .....	204-5
204.43	Cushion Blasting .....	204-6
* 204.44	Production Blasting .....	204-6
204.45	Vibration Control and Monitoring .....	204-6
204.46	Air Concussion and Noise Control .....	204-7
* 204.47	Excavation Backslope Stabilization .....	204-7
204.48	Special Use of Excavated Rock .....	204-7
MEASUREMENT		
204.81	Type A Excavation .....	204-7
* 204.82	Excavation Backslope (Smooth Wall) .....	204-7
PAYMENT		
* 204.91	Type A Excavation .....	204-7
* 204.92	Excavation Backslope (Smooth Wall) .....	204-7

## SECTION 205 - RIPRAP

205.01	General .....	205-1
205.02	Material .....	205-1
205.03	Preparation .....	205-1
205.04	Foundations .....	205-1
205.05	Filter Blankets .....	205-1
205.06	Loose Riprap .....	205-1
205.07	Hand-Laid Riprap .....	205-2



205.08 Grouted Riprap .....	205-2
205.09 Measurement and Payment .....	205-2

### SECTION 206 - ROCK BOLTS

DESCRIPTION	
206.01 Scope .....	206-1
206.02 Codes and Standards .....	206-1
206.03 Quality Control .....	206-1
206.04 Submittals .....	206-1
MATERIALS	
206.11 Materials .....	206-1
CONSTRUCTION	
206.31 Execution .....	206-2
MEASUREMENT	
206.81 Rock Bolts .....	206-3
PAYMENT	
206.91 Rock Bolts .....	206-3

### SECTION 207 - SLOPE MESH FOR ROCK CUTS

DESCRIPTION	
207.01 Scope .....	207-1
MATERIALS	
207.11 Slope Meshing Materials .....	207-1
207.12 Grout .....	207-1
207.13 Conformance Documents .....	207-1
CONSTRUCTION	
207.31 Anchor Installation .....	207-1
207.32 Soil Anchors .....	207-2
207.33 Cable and Mesh Installation .....	207-2
MEASUREMENT	
207.81 Slope Mesh .....	207-2
PAYMENT	
207.91 Slope Mesh .....	207-2

### SECTION 208 - DRAINS FOR ROCK CUTS

DESCRIPTION	
208.01 Scope .....	208-1
MATERIALS	
208.11 PVC Pipe Materials .....	208-1
CONSTRUCTION	
208.31 Drilling .....	208-1
208.32 PVC Pipe Installation .....	208-1
MEASUREMENT	
208.81 Lined Drains .....	208-1



## PAYMENT

208.91 Lined Drains .....	208-1
---------------------------	-------

**SECTION 209 - SHOTCRETE FOR ROCK CUTS**

## DESCRIPTION

209.01 General.....	209-1
209.02 Quality Control .....	209-1
209.03 Submittals .....	209-1
209.04 Definitions .....	209-2

## MATERIALS

209.11 Materials .....	209-3
209.12 Performance Requirements .....	209-5

## CONSTRUCTION

209.31 Batching, Mixing and Conveyance.....	209-5
209.32 Preconstruction Testing .....	209-5
209.33 Weather Conditions .....	209-6
209.34 Surface Preparation.....	209-6
209.35 Drainage.....	209-6
209.36 Existing Rock Bolts .....	209-7
209.37 Application .....	209-7
209.38 Curing and Protection .....	209-8
209.39 Construction Testing.....	209-8
209.40 Shotcrete Deficiencies and Repair .....	209-10
209.41 Shotcrete Evaluation .....	209-10

## MEASUREMENT

209.81 Shotcrete .....	209-10
------------------------	--------

## PAYMENT

209.91 Shotcrete .....	209-10
------------------------	--------

**SECTION 211 - PORTLAND CEMENT CONCRETE**

211.01 General.....	211-1
211.02 Inspection.....	211-1
211.03 Materials .....	211-1
211.04 Storage and Handling of Materials .....	211-3
211.05 Proportioning of Mixes.....	211-4
211.06 Batching.....	211-5
211.07 Mixing .....	211-7
211.08 Delivery .....	211-7
211.09 Acceptance.....	211-8
211.10 Construction Joints .....	211-9
211.11 Placing .....	211-9
211.12 Consolidation.....	211-10
211.13 Finishing Top Surfaces .....	211-11
211.14 Curing .....	211-11
211.15 Dimensional Tolerances .....	211-12
211.16 Finishing Formed Surfaces .....	211-12
211.17 Hot Weather Concreting .....	211-14



211.18 Cold Weather Concreting .....	211-15
211.19 Underwater Concreting .....	211-16
211.20 Measurement and Payment .....	211-17

### **SECTION 213 - TIMBER BRIDGES - CONSTRUCTION**

213.01 Materials .....	213-1
213.02 Logs for Cribs and Log Stringers .....	213-1
213.03 Work Practice .....	213-1
213.04 Handling and Storing Materials .....	213-1
213.05 Framing .....	213-1
213.06 Field Treatment .....	213-1
213.07 Preparation of Laminated Decks for Wearing Surface .....	213-2
213.08 Basis of Payment .....	213-3

### **SECTION 214 - TIMBER PILING CONSTRUCTION**

214.01 Materials .....	214-1
214.02 Pile Lengths .....	214-1
214.03 Handling of Piles .....	214-1
214.04 Hammer .....	214-1
214.05 Leads .....	214-1
214.06 Preparation for Driving .....	214-1
214.07 Driving .....	214-2
214.08 Additional Equipment .....	214-2
214.09 Accuracy of Driving .....	214-2
214.10 Pile Heads .....	214-3
214.11 Surplus Treated Piling .....	214-3
214.12 Payment .....	214-3

### **SECTION 215 - BRIDGES**

215.01 General .....	215-1
----------------------	-------

### **SECTION 216 - PAINTING OF STEEL STRUCTURES**

216.01 Scope .....	216-1
216.02 Definitions .....	216-1
216.03 Surface Preparation .....	216-1
216.04 Pretreatment .....	216-2
216.05 Application of Paint .....	216-3
216.06 Stripe Painting .....	216-4
216.07 Recoating .....	216-5
216.08 Shop Painting .....	216-5
216.09 Field Repair of Shop Painting .....	216-5
216.10 Field Painting .....	216-6
216.11 Maintenance Painting .....	216-7
216.12 Special Coating .....	216-8



216.13 Inspection.....	216-8
216.14 Measurement and Payment.....	216-9

### SECTION 218 - CONCRETE FOR MINOR WORKS

218.01 General.....	218-1
218.02 Cement.....	218-1
218.03 Aggregates.....	218-1
218.04 Grading of Aggregates.....	218-1
218.05 Classes of Concrete.....	218-1
218.06 Classification and Proportioning of Concrete Mixtures.....	218-1
218.07 Machine Mixing.....	218-2
218.08 Duration of Mixing.....	218-2
218.09 Hand Mixing.....	218-2
218.10 Retempering.....	218-2
218.11 Forms.....	218-2
218.12 Depositing Concrete.....	218-3
218.13 Basis of Payment.....	218-3

### SECTION 232 - METAL BIN-WALL

232.01 Scope.....	232-1
232.02 Provision of Metal Bin-Wall.....	232-1
232.03 Materials.....	232-1
232.04 Construction.....	232-1
232.05 Measurement and Payment.....	232-1

### SECTION 303 - CULVERTS

DESCRIPTION	
303.01 Scope.....	303-1
MATERIALS	
303.11 Concrete Pipe.....	303-1
303.12 Corrugated Steel Pipe.....	303-1
303.13 Polyethylene Pipe.....	303-1
303.14 PVC Pipe.....	303-1
303.15 Structural Plate Corrugated Steel Pipe/Pipe-Arch (Field Assembled) Culverts.....	303-1
CONSTRUCTION	
303.31 Concrete, Corrugated Steel and Plastic Pipes.....	303-1
303.32 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts.....	303-2
MEASUREMENT	
303.81 Concrete, Corrugated Steel and Plastic Pipe Culverts.....	303-2
303.82 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts.....	303-2
PAYMENT	
303.91 Concrete, Corrugated Steel and Plastic Pipe Culverts.....	303-2
303.92 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts.....	303-2



**SECTION 308 - COATING SYSTEMS**

308.01 Scope .....	308-1
308.02 Definitions .....	308-1
308.03 Standards and Specifications .....	308-1
308.04 System Selection Table .....	308-2
308.05 Not Used .....	308-3
308.06 System Selection Criteria .....	308-3
308.07 Coating Systems .....	308-4

**SECTION 312 - STEEL TRAFFIC BARRIERS AND WOOD POSTS**

312.01 Scope .....	312-1
312.02 Standards of Reference .....	312-1
312.03 General .....	312-1
312.04 Steel Beam Guardrail .....	312-1
312.05 Guardrail Accessories .....	312-3
312.06 Wood Posts .....	312-4

**SECTION 316 - STEEL AND WIRE FENCE MATERIALS**

316.01 Scope .....	316-1
316.02 Applicable Documents .....	316-1
316.03 Type A & B Fence Fabrics .....	316-1
316.04 Type D Fence Chain Link Fabric .....	316-2
316.05 Chain Link Fabric and Accessories on Rock Slopes .....	316-4
316.06 Barbed Wire .....	316-4
316.07 High-tensile Wire .....	316-4
316.08 Brace, Tension and Tie Wire .....	316-5
316.09 Steel Fence Posts on Rock (Excluding Chain Link Fence) .....	316-5
316.10 Steel Pipe Posts, Rails and Braces - Chain Link Fencing .....	316-5
316.11 Gates and Hardware .....	316-7
316.12 Accessory Material .....	316-8
316.13 Packaging and Marking .....	316-9
316.14 Inspection .....	316-9
316.15 Sampling .....	316-9
316.16 Rejection and Retests .....	316-9

**SECTION 317 - P.E. PLASTIC DRAINAGE PIPE**

317.01 Scope .....	317-1
317.02 Applicable Documents .....	317-1
317.03 Materials .....	317-1
317.04 Joining Systems .....	317-1
317.05 Requirements .....	317-2
317.06 Marking .....	317-2
317.07 Test Methods .....	317-2
317.08 Inspection .....	317-3
317.09 Quality Assurance .....	317-3



**SECTION 318 - PVC PLASTIC DRAINAGE PIPE**

318.01 Scope .....	318-1
318.02 Applicable Documents .....	318-1
318.03 Materials .....	318-1
318.04 Quality of Work .....	318-1
318.05 Joining System .....	318-2
318.06 Requirements .....	318-2
318.07 Physical Properties .....	318-4
318.08 Marking .....	318-4
318.09 Test Methods .....	318-5
318.10 Inspection .....	318-5
318.11 Quality Assurance .....	318-5

**SECTION 320 - CORRUGATED STEEL PIPE**

320.01 Scope .....	320-1
320.02 Materials .....	320-1
320.03 Fabrication from Culvert Sheet .....	320-3
320.04 Coupler Systems .....	320-9
320.05 Pipe Arch Corrugated Steel Pipe Construction .....	320-10
320.06 Perforated Corrugated Steel Pipe .....	320-10
320.07 Structural Plate Corrugated Steel Pipe Construction .....	320-11
320.08 Asphalt Coated Pipe .....	320-13
320.09 Inspection, Quality of Work, and Quality Control .....	320-14

**SECTION 321 - TRAFFIC PAINT**

321.01 Scope .....	321-1
321.02 Not Used .....	321-1
321.03 General Requirements .....	321-1
321.04 Detailed Requirements .....	321-1
321.05 Packaging .....	321-2
321.06 Delivery .....	321-2
321.07 Release for Shipment .....	321-2
321.08 Labelling .....	321-2
321.09 Rejection .....	321-3
321.10 Non-Delivery Penalty .....	321-3
321.11 Qualification Procedures and Ministry Test Methods .....	321-3

**SECTION 407 - FOUNDATION EXCAVATION**

407.01 Scope .....	407-1
407.02 Extent of Work .....	407-1
407.03 Description of Material Types .....	407-1
407.04 Method of Measurement .....	407-1
407.05 Quantities and Payment .....	407-1



**SECTION 412 - REINFORCING STEEL**

DESCRIPTION	
412.01 Scope .....	412-1
MATERIALS	
412.11 General .....	412-1
CONSTRUCTION	
412.31 Bending .....	412-1
412.32 Handling and Storage .....	412-2
412.33 Placing and Fastening .....	412-2
412.34 Splicing of Bars .....	412-4
MEASUREMENT	
412.81 General .....	412-5
PAYMENT	
412.91 General .....	412-5

**SECTION 413 - BRIDGE DECKS AND HIGH-DENSITY CONCRETE OVERLAYS**

DESCRIPTION	
413.01 General .....	413-1
CONSTRUCTION	
413.31 Bridge Decks .....	413-1
413.32 High-Density Concrete Overlays .....	413-2
MEASUREMENT	
413.81 General .....	413-3
PAYMENT	
413.91 General .....	413-3
413.92 High-Density Concrete Overlays .....	413-3

**SECTION 415****MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS**

DESCRIPTION	
415.01 Scope .....	415-1
415.02 General .....	415-1
415.03 Working Drawings .....	415-1
415.04 Alternative Details .....	415-2
415.05 Quality Control .....	415-2
415.06 Quality Assurance .....	415-2
MATERIALS	
415.11 Materials Supplied by the Contractor .....	415-3
415.12 Storage of Materials .....	415-3
415.13 Premixed Aggregates .....	415-3
415.14 Forms .....	415-3
415.15 Ministry's Office .....	415-3
CONSTRUCTION	
415.31 Reinforcing Steel .....	415-4
415.32 Stressing .....	415-4
415.33 Forms .....	415-4



415.34	Admixtures .....	415-5
415.35	Measurement of Materials .....	415-5
415.36	Mix Requirements.....	415-5
415.37	Batching and Mixing .....	415-5
415.38	Handling and Placing Concrete .....	415-5
415.39	Vibration.....	415-5
415.40	Test Cylinders .....	415-6
415.41	Surface Finish .....	415-6
415.42	Curing .....	415-7
415.43	Draped Strands.....	415-7
415.44	Transfer of Force to Concrete Members.....	415-7
415.45	Protective Coating for Ends of Strands.....	415-7
415.46	Tolerances.....	415-7
415.47	Repairs to Members .....	415-8
415.48	Handling, Storing and Loading of Members .....	415-8
415.49	Placement of Concrete in Keyways .....	415-8
415.50	Post-Tensioning .....	415-8
QUALITY CONTROL PROGRAM		
415.61	Quality Control Program .....	415-8
415.62	Quality Objectives and Policies.....	415-9
415.63	Scope of the Quality Control Program .....	415-9
415.64	Range of Capability .....	415-9
415.65	Drawings and Specifications .....	415-9
415.66	Material Control.....	415-10
415.67	Pre-Pour Inspection and Reporting.....	415-10
415.68	Concrete Control.....	415-10
415.69	Post Pour Inspection and Reporting.....	415-10
415.70	Correction of Non-Conformities.....	415-11
415.71	Welding.....	415-11
415.72	Calibration of Measurement and Test Equipment .....	415-11
415.73	Records Retention.....	415-11
415.74	Hold Points .....	415-12
MEASUREMENT		
415.81	Precast Concrete Members .....	415-12
PAYMENT		
415.91	Supply and Fabrication.....	415-12
415.92	Shipping and Erection.....	415-12

## SECTION 416

### MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS

DESCRIPTION	
416.01	Scope..... 416-1
416.02	General Requirements..... 416-1
MATERIALS	
416.11	Anchorage..... 416-1
416.12	Ducts..... 416-1
416.13	Condition .....
416.14	Epoxy..... 416-1
416.15	Grout..... 416-1



EQUIPMENT	
416.21 Stressing Equipment.....	416-2
416.22 Grout.....	416-2
CONSTRUCTION	
416.31 Anchorages.....	416-2
416.32 Ducts.....	416-2
416.33 Placement and Protection of the Tendons and Other Accessories .....	416-2
416.34 Stressing .....	416-3
416.35 Grouting .....	416-3
416.36 Cropping.....	416-4
416.37 Anchorage Recesses .....	416-4

### SECTION 418

#### CONCRETE BRIDGE DECK SEALANTS

##### SILANE SURFACE TREATMENT OF NEW PORTLAND CEMENT CONCRETE

418.01 Scope .....	418-1
418.02 Silane Solution .....	418-1
418.03 Contractor's Qualification.....	418-1
418.04 Job Site Conditions.....	418-1
418.05 Surface Preparation .....	418-1
418.06 Silane Application .....	418-1
418.07 Safety and Health Hazards .....	418-2
418.08 Measurement and Payment .....	418-2

### SECTION 419

#### CONCRETE BRIDGE DECK WATERPROOFING SYSTEM PREFABRICATED MEMBRANE

DESCRIPTION	
419.01 Scope .....	419-1
MATERIALS	
419.11 General .....	419-1
419.12 Delivery and Storage .....	419-1
419.13 Quality Assurance .....	419-1
CONSTRUCTION	
419.31 Applicator's Qualification.....	419-1
419.32 Job Site Conditions.....	419-1
419.33 Surface Preparation .....	419-1
419.34 Priming .....	419-2
419.35 Membrane Application.....	419-2
419.36 Paving.....	419-3
419.37 Protection of the Environment .....	419-4
419.38 Safety and Health Hazards .....	419-4
MEASUREMENT	
419.81 General .....	419-4
PAYMENT	
419.91 General .....	419-4



**SECTION 421 - STRUCTURAL STEELWORK**

DESCRIPTION	
421.01 Scope.....	421-1
421.02 Prefabrication Meeting .....	421-1
421.03 Alternative Details .....	421-1
421.04 Working Drawings.....	421-1
421.05 Quality Control .....	421-2
421.06 Quality Assurance.....	421-2
421.07 Quality and Details of Welds.....	421-3
421.08 Design Specifications .....	421-3
MATERIALS	
421.11 Materials .....	421-3
421.12 Material Storage and Care .....	421-4
421.13 Fabrication .....	421-4
421.14 Ministry's Plant Office .....	421-4
EQUIPMENT	
421.21 Qualifications and Equipment .....	421-4
421.22 Welding Procedures.....	421-4
421.23 Butt Joints .....	421-5
421.24 Assembly and Welding Sequences .....	421-5
CONSTRUCTION	
421.31 Preparation of Material .....	421-5
421.32 Marking.....	421-6
421.33 Assembly of Weldments.....	421-6
421.34 Preheat and Interpass Temperatures .....	421-6
421.35 Welding.....	421-6
421.36 Shear Connector Studs.....	421-7
421.37 High-Strength Bolts .....	421-7
421.38 Bent Plates .....	421-7
421.39 Shop Assembly of Bolted Connections .....	421-7
421.40 Dimensional Tolerances .....	421-7
421.41 Machined Surfaces.....	421-7
421.42 Galvanizing or Metallizing (if required).....	421-7
421.43 Shop Painting.....	421-7
421.44 Marking and Shipping .....	421-8
421.45 Field Assembly .....	421-8
421.46 Straightening Bent Material after Fabrication .....	421-8
421.47 Misfits.....	421-8
421.48 Erection Tolerances .....	421-8
421.49 Field Painting.....	421-9
421.50 Unpainted Weathering Steel .....	421-9
421.51 Touch-up of Galvanizing and Metallizing.....	421-9
QUALITY CONTROL PROGRAM	
421.61 Quality Control Program .....	421-9
421.62 Quality Objectives and Policies.....	421-10
421.63 Scope of the Quality Control Program .....	421-10
421.64 Range of Capability .....	421-10
421.65 Drawings and Specifications .....	421-10
421.66 Material Control.....	421-11
421.67 In-Progress Inspection and Reporting.....	421-11



421.68	Correction of Non-conformance .....	421-11
421.69	Welding .....	421-12
421.70	Heat Treatment .....	421-12
421.71	Non-destructive Testing .....	421-12
421.72	Calibration of Measurement and Test Equipment .....	421-12
421.73	Records Retention .....	421-12
421.74	Hold Points .....	421-12
421.75	Transportation and Installation Procedures .....	421-13
	PAYMENT	
421.91	Payment .....	421-13

## SECTION 422 - MISCELLANEOUS STEELWORK

	DESCRIPTION	
422.01	Scope .....	422-1
422.02	Adherence to Drawings .....	422-1
422.03	Working Drawings .....	422-1
422.04	Inspection .....	422-1
422.05	Rejections .....	422-1
	MATERIALS	
422.11	Materials .....	422-1
422.12	Storage of Materials .....	422-1
	CONSTRUCTION	
422.31	Welding .....	422-1
422.32	Welding Operators .....	422-1
422.33	Flame Cutting .....	422-1
422.34	Bent Plates .....	422-1
422.35	Shop Painting .....	422-1
422.36	Galvanizing (if required) .....	422-2
422.37	Metallizing (if required) .....	422-2
422.38	Installation .....	422-2
422.39	Field Painting (if required) .....	422-2
422.40	Touch-Up of Galvanizing and Metallizing .....	422-3
422.41	Clean-up .....	422-3
	PAYMENT	
422.91	Payment .....	422-3

## SECTION 501 - HOT MIXED ASPHALT PAVEMENT

	PART A - GENERAL .....	501-1
501.01	Preliminary and General .....	501-1
501.02	General Description of Work .....	501-1
501.03	Asphalt Pavement Classifications .....	501-1
	PART B - MATERIALS .....	501-1
501.11	Definitions .....	501-1
501.12	Supply and Handling of Asphalt Materials .....	501-2
501.13	Standard Tests .....	501-2
501.14	Asphalt Mix Aggregate Requirements .....	501-2
501.15	Asphalt Mix Design .....	501-4



501.16	Asphalt Mix Requirements .....	501-5
501.17	Asphalt Pavement .....	501-6
	PART C - EQUIPMENT AND PLANT .....	501-6
501.21	Requirements for the Pressure Distributor and Liquid Asphalt Storage.....	501-6
501.22	Requirements for all Mixing Plants .....	501-7
501.23	Requirements for Batch Plants and Continuous Plants.....	501-7
501.24	Special Requirements for Batch Plants.....	501-8
501.25	Special Requirements for Continuous Plants.....	501-8
501.26	Special Requirements for Drum Mixers .....	501-9
501.27	Requirements for Hot Storage Silos .....	501-10
501.28	Requirements for Mixing Plants Producing Sulphur Extended Asphalt Mix .....	501-10
	PART D - CONSTRUCTION .....	501-10
501.31	Spray Prime Coat and Tack Coat.....	501-10
501.32	Stockpiling Aggregates.....	501-11
501.33	Mixing Plant Operation .....	501-11
* 501.34	Hauling the Asphalt Mix .....	501-12
501.35	Placing the Asphalt Mix .....	501-12
501.36	Compacting the Asphalt Mix .....	501-13
501.37	Shouldering.....	501-14
	PART E - PAYMENT AND DEDUCTIONS.....	501-15
501.41	General.....	501-15
501.42	Schedule Items.....	501-15
501.43	Surplus Aggregate in Stockpile .....	501-16
501.44	Supplementary Aggregate.....	501-17
501.45	Blending Additives .....	501-18
501.46	Adjustment for Haul .....	501-18
501.47	Extra Handwork.....	501-18
501.48	Single Stockpile .....	501-18
501.49	Reducing of Top Size of Aggregate .....	501-18
501.50	Accommodation for Inspection Trailer including Supply of Water and Electricity .....	501-18
501.51	Surplus Mix .....	501-19

## **SECTION 502 – END PRODUCT SPECIFICATION** **FOR ASPHALT PAVEMENT CONSTRUCTION**

	<u>PART A - GENERAL</u> .....	502-1
502.01	<u>Preliminary and General</u> .....	502-1
502.02	<u>General Description of Work</u> .....	502-1
502.03	<u>Definitions Relevant to End Product Specification</u> .....	502-1
502.04	<u>Quality Control</u> .....	502-2
502.05	<u>Supply of Aggregates, Asphalt Materials, Asphalt Mix Design and Job Mix Formula</u> .....	502-5
	<u>PART B – PAYMENT ADJUSTMENTS</u> .....	502-9
502.11	<u>Density</u> .....	502-9
502.12	<u>Asphalt Content</u> .....	502-11
502.13	<u>Aggregate Gradation</u> .....	502-12
502.14	<u>Material Application Rate</u> .....	502-12
502.15	<u>Surface Segregation</u> .....	502-13
502.16	<u>Smoothness</u> .....	502-14
	<u>PART C – ACCEPTANCE AND REJECTION</u> .....	502-16
502.21	<u>Acceptance at Reduced or Adjusted Payment</u> .....	502-16



<u>502.22 Rejection For Workmanship Defects .....</u>	502-16
<u>502.23 Appeal Testing .....</u>	502-16
<u>502.24 Overlays as a Corrective Measure .....</u>	502-17
<u>PART D – PAYMENT .....</u>	502-17
<u>502.31 General .....</u>	502-17
<u>502.32 Surplus Aggregate In Stockpile .....</u>	502-19

### **SECTION 503 - BASE PREPARATION AND BASE PROCESSING**

503.01 Base Preparation.....	503-1
503.02 Base Processing.....	503-1

### **SECTION 504 - PAVEMENT DRAINAGE**

DESCRIPTION	
504.01 Scope .....	504-1
MATERIALS	
504.11 Materials.....	504-1
CONSTRUCTION	
504.31 Asphalt Curbs .....	504-1
504.32 Location of Drainage Outlets .....	504-1
504.33 Excavation.....	504-1
504.34 Drainage Outlets.....	504-2
504.35 Dishing, Spillways and Completion.....	504-2
MEASUREMENT	
504.81 Pavement Drainage Outlets .....	504-2
504.82 Corrugated Metal Pipe.....	504-2
504.83 Asphalt Concrete Mix .....	504-2
504.84 Asphalt Curb .....	504-2
PAYMENT	
504.91 Pavement Drainage Outlets .....	504-2
504.92 Corrugated Metal Pipe.....	504-2
504.93 Asphalt Concrete Mix .....	504-3
504.94 Asphalt Curb .....	504-3

### **SECTION 507 - PRODUCTION AND STOCKPILING OF ASPHALT MIX**

507.01 General .....	507-1
507.02 Aggregate .....	507-1
507.03 Asphalt Material.....	507-2
507.04 Mix Design.....	507-2
507.05 Mixing Requirements .....	507-2
507.06 Hauling .....	507-2
507.07 Stockpiling .....	507-2
507.08 Measurement .....	507-3
507.09 Payment.....	507-3



**SECTION 508 – END PRODUCT SPECIFICATION FOR GRADED AGGEGATE SEAL COAT**

<u>PART A - GENERAL</u> .....	508-1
<u>508.01 Preliminary and General</u> .....	508-1
<u>508.02 General Description of Work</u> .....	508-1
<u>PART B – SUPPLY OF MATERIALS</u> .....	508-1
<u>508.11 Asphalts</u> .....	508-1
<u>508.12 Aggregates</u> .....	508-1
<u>508.13 Graded Aggregate Seal Design</u> .....	508-1
<u>PART C – EQUIPMENT</u> .....	508-1
<u>PART D – CONSTRUCTION</u> .....	508-1
<u>508.31 Requirements</u> .....	508-1
<u>PART E – QUALITY CONTROL AND QUALITY ASSURANCE</u> .....	508-2
<u>508.41 Quality Control by the Contractor</u> .....	508-2
<u>508.43 Quality Assurance</u> .....	508-3
<u>PART F – END PRODUCT ASSESMENT</u> .....	508-3
<u>508.51 General</u> .....	508-3
<u>508.52 Surface Deficiency Definitions</u> .....	508-3
<u>508.53 End Product Evaluation</u> .....	508-3
<u>508.54 Deficiency Repair and Replacement</u> .....	508-4
<u>508.55 Attention to Potential Safety Hazards</u> .....	508-4
<u>PART G – MEASUREMENT AND PAYMENT</u> .....	508-4
<u>508.61 Pament for Acceptable End Product</u> .....	508-4
<u>508.62 Claims for Vehicular Damage</u> .....	508-4

**SECTION 511 - COLD MILLING**

DESCRIPTION	
511.01 Scope.....	511-1
EQUIPMENT	
511.21 Milling Machine .....	511-1
511.22 "Kill" Switch.....	511-1
511.23 Audible Back Up Warning Device .....	511-1
CONSTRUCTION	
511.31 Traffic Control Person .....	511-1
511.32 Pavement Removal .....	511-1
511.33 Disposal of Material.....	511-1
MEASUREMENT	
511.81 General.....	511-2
PAYMENT	
511.91 General.....	511-2
511.92 Asphalt Mix .....	511-2
511.93 Contractor .....	511-2

**SECTION 514 - HOT IN-PLACE RECYCLE**

DESCRIPTION	
514.01 Scope.....	514-1



MATERIALS	
514.11 Rejuvenating Agent-Requirements .....	514-1
514.12 Asphalt Mix.....	514-1
EQUIPMENT	
514.21 General .....	514-1
514.22 Processing Equipment .....	514-1
514.23 Rejuvenating Agent Equipment .....	514-2
CONSTRUCTION	
514.31 Preliminary .....	514-2
514.32 Recycling.....	514-2
514.33 Compaction and Finishing.....	514-2
MEASUREMENT	
514.81 General .....	514-3
514.82 Rejuvenating Agent.....	514-3
514.83 Additional Virgin Mix.....	514-3
PAYMENT	
514.91 General .....	514-3
514.92 Rejuvenating Agent.....	514-3
514.93 Additional Virgin Mix.....	514-3

### **SECTION 515 – END PRODUCT SPECIFICATION FOR HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT**

<u>PART A – GENERAL</u> .....	515-1
<u>515.01 General</u> .....	515-1
<u>515.02 General Description of Work</u> .....	515-1
<u>515.03 Definitions Relevant to End Product Specification</u> .....	515-1
<u>515.04 Quality Control</u> .....	515-2
<u>515.05 Supply of Virgin Aggregates, Asphalt Materials, Asphalt Admix Design and Job Mix Formula</u> ..	515-5
<u>PART B – PAYMENT ADJUSTMENTS</u> .....	515-6
<u>515.11 Density</u> .....	515-6
<u>515.12 Smoothness</u> .....	515-7
<u>PART C – ACCEPTANCE AND REJECTION</u> .....	515-8
<u>515.21 Acceptance at Reduced or Adjusted Payment</u> .....	515-8
<u>515.22 Rejection for Workmanship Defects</u> .....	515-8
<u>515.23 Appeal Testing</u> .....	515-9
<u>515.24 Cold Milling and Re-Paving as a Corrective Measure</u> .....	515-9
<u>PART D – PAYMENT</u> .....	515-10
<u>515.31 General</u> .....	515-10
<u>515.32 Surplus Aggregate in Stockpile</u> .....	515-11

### **SECTION 521 - ASPHALT STABILIZED BASE COURSE MIXED IN PLACE**

DESCRIPTION	
521.01 Scope .....	521-1
EQUIPMENT	
521.21 General Condition of Plant and Equipment .....	521-1
521.22 Pressure Distributor.....	521-1
521.23 Blade Graders .....	521-2



521.24 Pulverizing and Rotary Mixing Machines .....	521-2
521.25 Compaction Equipment .....	521-2
CONSTRUCTION	
521.31 Method I.....	521-3
521.32 Method II .....	521-4
MEASUREMENT	
521.81 Spray Asphalt.....	521-4
521.82 Process Base Gravel.....	521-4
PAYMENT	
521.91 Payment .....	521-4

### SECTION 531 - ASPHALT SURFACE TREATMENTS

DESCRIPTION	
531.01 Scope.....	531-1
531.02 Description of Work .....	531-1
531.03 Types of Chip Seals .....	531-1
531.04 Types of Graded Aggregate Seals .....	531-1
MATERIALS	
531.11 Asphalt Materials.....	531-1
531.12 Coating and Anti-Stripping Additives .....	531-1
531.13 Mineral Aggregate Supply.....	531-1
531.14 Mineral Aggregate - Method of Test .....	531-1
531.15 Mineral Aggregate - Physical Requirements .....	531-1
531.16 Chip Seal Aggregates - Requirements .....	531-2
531.17 Graded Aggregate Seal - Requirements.....	531-2
531.18 Presealing Sand.....	531-3
531.19 Blinding Sand .....	531-3
EQUIPMENT	
531.21 General.....	531-3
531.22 Pressure Distributor .....	531-4
531.23 Mechanical Spreader.....	531-5
531.24 Rollers.....	531-5
531.25 Power Brooms .....	531-6
531.26 Blade Graders .....	531-6
531.27 Water Truck .....	531-6
531.28 Sign Truck .....	531-6
531.29 Tanks, Mobile Asphalt Heating, & Storage.....	531-6
CONSTRUCTION	
531.31 Temperature and Weather.....	531-7
531.32 Traffic Control.....	531-7
531.33 Preparation of Roadway .....	531-7
531.34 Sweeping.....	531-7
531.35 Patching .....	531-8
531.36 Pre-Seal Treatment .....	531-8
531.37 Single Pass Surface Treatment.....	531-8
531.38 Double Pass Surface Treatment.....	531-10
MEASUREMENT	
531.81 Surface Treatment.....	531-10
531.82 Flag Persons .....	531-10



531.83 Pilot Cars .....	531-10
531.84 Asphalt Binder .....	531-10
531.85 Aggregates .....	531-10
531.86 Stockpile Bases .....	531-10
PAYMENT	
531.91 Surface Treatment .....	531-10
531.92 Flag Persons .....	531-11
531.93 Pilot Cars .....	531-11
531.94 Asphalt Binder .....	531-11
531.95 Aggregates .....	531-11
531.96 Stockpile Bases .....	531-11

### SECTION 536 - PAVEMENT CRACK SEALING

DESCRIPTION	
536.01 Scope .....	536-1
536.02 Purpose .....	536-1
MATERIALS	
536.11 Asphaltic .....	536-1
536.12 Sand .....	536-1
536.13 Dust Cover .....	536-1
EQUIPMENT	
536.21 Router .....	536-1
536.22 Cleaner .....	536-1
536.23 Melter .....	536-1
536.24 Filler Tools .....	536-1
CONSTRUCTION	
536.31 General .....	536-1
536.32 Rubberized and Elasticized Asphalt Sealants .....	536-2
536.33 High Float Emulsified Asphalt .....	536-2
536.34 Warranty .....	536-2
MEASUREMENT	
536.81 General .....	536-2
PAYMENT	
536.91 General .....	536-2

### SECTION 541 - RUBBLE MASONRY

DESCRIPTION	
541.01 Scope .....	541-1
MATERIALS	
541.11 Materials .....	541-1
CONSTRUCTION	
541.31 Preparation .....	541-1
541.32 Construction .....	541-1
MEASUREMENT	
541.81 General .....	541-1
PAYMENT	
541.91 General .....	541-1



**SECTION 582 - CONCRETE CURB AND GUTTER AND STORM DRAINAGE**

DESCRIPTION	
582.01 Scope.....	582-1
MATERIALS	
582.11 Drain Pipe .....	582-1
582.12 Salt Glazed Clay Sewer Pipe .....	582-1
582.13 Concrete Pipe .....	582-1
582.14 Corrugated Steel Pipe .....	582-1
CONSTRUCTION	
582.31 Portland Cement Concrete Curb and Gutter .....	582-1
582.32 Catch Basins .....	582-1
582.33 Manholes.....	582-1
582.34 Storm Drains .....	582-1
582.35 Placing .....	582-1
582.36 Special Jointing Material .....	582-2
582.37 Bedding and Backfilling.....	582-2
582.38 Concrete End Walls .....	582-2
MEASUREMENT	
582.81 Portland Cement Concrete Curb and Gutter .....	582-2
582.82 Catch Basins .....	582-2
582.83 Manholes.....	582-2
582.84 Storm Drains .....	582-2
582.85 Bedding and Backfill .....	582-2
582.86 Concrete End Walls .....	582-2
PAYMENT	
582.91 Portland Cement Concrete Curb and Gutter .....	582-2
582.92 Catch Basins .....	582-2
582.93 Manholes.....	582-2
582.94 Storm Drains .....	582-2
582.95 Bedding and Backfill .....	582-2
582.96 Concrete End Walls .....	582-2

**SECTION 586 - PLANT MIXED PORTLAND CEMENT TREATED BASE COURSE**

DESCRIPTION	
586.01 Preliminary and General.....	586-1
586.02 General Description of Work.....	586-1
MATERIALS	
586.11 Cement.....	586-1
586.12 Water.....	586-1
586.13 Aggregate.....	586-1
EQUIPMENT	
586.21 Mixing Plant .....	586-1
586.22 Cement Treated Base Spreader .....	586-1
586.23 Water Distributors .....	586-2
CONSTRUCTION	
586.31 Mixing .....	586-2
586.32 Spreading and Compaction.....	586-2
586.33 Protection and Cover .....	586-3



586.34 Maintenance .....	586-3
MEASUREMENT	
586.81 Cement Treated Base.....	586-3
586.82 Water .....	586-3
PAYMENT	
586.91 Cement Treated Base.....	586-3
586.92 Water .....	586-3



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



SP135-01	Construction Site Safety Sign
SP145-01	Scale House
SP194-02	Standard Temporary Highway Delineator
SP201-01	Special Slope Treatment
SP207-01	Slope Mesh Layout
SP207-02	Slope Mesh - Sections
SP207-03	Slope Mesh - Details
SP207-04	Slope Mesh - Details
SP207-05	Soil Anchor Concrete and Reinforcement for Slope Mesh Installations
SP209-01	Shotcrete Test Panel Form
SP209-02	Shotcrete Spider Plate Detail
SP211-01	Surface Evaporation Rate
SP214-01	Pile Shoe Type A
SP218-01	Typical Retaining Wall
1-SP232	Metal Bin Wall Type 2 Designs A, B, & C
2-SP232	Metal Bin Wall Type 2 Designs D, E, & F
3-SP232	Metal Bin Wall Type 1
SP303-01	End Walls for 450 mm to 1050 mm Pipe
SP303-02	End Walls for 1200 mm to 1650 mm Pipe
SP303-03	Pipe Culvert Layouts for End Walls
SP303-04	End Wall for Skewed Culvert
SP303-05	Concrete Cradle for Culvert Pipe
SP303-06	Subdrain
SP303-07	Subdrain Flushout
1-SP312	W-Beam Barriers on Timber Posts G4 and Thrie-Beam Barrier on Timber Posts G9
2-SP312	BCT - Breakaway Cable Terminal Assembly (Timber Posts)
6-SP312	Steel Guardrail Beam Parts
7-SP312	Steel Guardrail BCT End Assembly Parts
8-SP312	Steel Guardrail BCT Assembly Parts
9-SP312	Steel Guardrail TBT Assembly Parts
10-SP312	Steel Post Typical Details - Steel Guardrails
SP312-11	Curved Rails
SP419-01	Bridge Deck - Membrane Application Typical Detail Work - Curb, Parapet or Barrier
SP419-02	Bridge Deck - Membrane Application Typical Detail Work - Bridge Deck Edge
SP419-03	Bridge Deck - Membrane Application Typical Detail Work - Drain and Weep Hole
SP419-04	Bridge Deck - Membrane Application Typical Detail Work - Joint and Cracks
SP419-05	Bridge Deck - Membrane Application Typical Detail Work - Bridge End
SP419-06	Bridge Deck - Membrane Application Typical Detail Work - Bridge End
SP419-07	Bridge Deck - Membrane Application Typical Detail Work - Bridge End
SP419-08	Bridge Deck - Membrane Application Typical Detail Work - Bridge End



SP501-01	Diagrammatic Asphalt Circulating and Proportioning System - Drum Mix Plants
SP501-02	Diagrammatic Asphalt Circulating and Proportioning System - Batch Mixing Plants
SP501-03	Diagrammatic Asphalt Circulating and Proportioning System – Continuous Mix Plants
SP501-04	Tar Paper Let Down
SP504-01	Drainage Curbs Type-A, Type-B & Integral Asphalt
SP504-02	Installation of Asphalt Spillways
SP504-03	Installation of Curb, Barrier and Cast Iron Catch Basin
SP531-01	Grading Chart for Seal-Coat Cover Aggregates
SP541-01	Typical Section Thru Rock Paving
SP582-01.01	Combined Curb and Gutter
SP582-01.02	Mountable Curb and Gutter
SP582-01.03	Valley Curb and Gutter
SP582-01.04	Island or Median Curb
SP582-02.01	Precast Reinforced Concrete Catch Basin
SP582-02.02	Precast Reinforced Concrete Variable Depth Catch Basin
SP582-02.03	Cast in Place Concrete Catch Basin
SP582-02.04	Corrugated Steel Catch Basin
SP582-02.05	Cast Iron Catch Basin Box and Adaptor Plate
SP582-03.01	Precast Reinforced Concrete Manhole
SP582-03.02	Cast in Place Concrete Manhole
SP582-03.03	Prefabricated Concrete Tee Manholes Pipe Sizes – 300 mm to 675 mm
SP582-03.04	Prefabricated Concrete Tee Manholes Pipe Sizes – 300 mm to 675 mm
SP582-03.05	Prefabricated Concrete Tee Manholes Pipe Sizes – 750 mm to 3050 mm
SP582-03.06	Prefabricated Concrete Tee Manholes Pipe Sizes – 750 mm to 3050 mm
SP582-03.07	Corrugated Steel Manhole - Main Smaller than Riser
SP582-03.08	Corrugated Steel Manhole - Main Larger than Riser
SP582-04.01	Cast in Place Inlet Structure
SP582-05.01	Type 'A' Catch Basin Grate (Freeway Grate)
SP582-05.02	Type 'B' Catch Basin Grate (Bicycle Safe Grate)
SP582-05.03	Single Inlet Catch Basin Frame
SP582-05.04	Twin-Inlet Catch Basin Frame
SP582-05.05	Grate Installation - Depressed Gutter
SP582-05.06	Trapping Hood
SP582-05.07	Asphalt Apron
SP582-06.01	Manhole Cover
SP582-06.02	Manhole Frame
SP582-07.01	Concrete Sidewalk and Driveway Entrance
SP582-07.02	Sidewalk Ramp
SP582-07.03	Island Ramp
SP582-08.01	Reinforced Concrete Steps



## **SECTION 107**

### **GLOSSARY OF TERMS**

The Glossary of Terms is not included in the 2004 edition of the *Standard Specifications for Highway Construction*.

The Glossary of Terms will be incorporated into each Tender Document and Contract Document Package using the 2004 edition of the *Standard Specifications for Highway Construction*.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 108

### SAMPLE FORMS

#### PART A – GENERAL

**108.01 General** -This Section provides sample copies of forms which the Contractor may be required to execute and submit to the Ministry in accordance with the Contract. Blank copies of these forms are available from the Ministry Representative.

#### PART B – STATUTORY DECLARATIONS

**108.11 Major Works** – The form attached as Appendix

“A” (Ministry form H0394A) is used to meet the Statutory Declaration requirements of the Major Works General Conditions.

**108.12 Minor Works and Operational Services** – The form attached as Appendix “B” (Ministry form H0394F) is used to meet the Statutory Declaration requirements of the Minor Works General Conditions or Operational Services General Conditions.

NEW SECTION



## APPENDIX A – MAJOR WORKS


**BRITISH  
COLUMBIA**
**Ministry of  
Transportation**
**STATUTORY DECLARATION**

IN THE MATTER OF THE EVIDENCE ACT, 1996 RSBC c.124 AND IN THE MATTER OF CERTAIN DISBURSEMENTS TO BE MADE IN CONNECTION WITH THE AGREEMENT

dated the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ between:

**HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA,  
AS REPRESENTED BY THE MINISTER OF TRANSPORTATION**  
(the Province)

and:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(the Contractor)

pertaining to Project Number \_\_\_\_\_ Contract ID \_\_\_\_\_

I, \_\_\_\_\_, being a  
(PRINT OR TYPE FULL NAME AND POSITION OR TITLE)

duly authorized representative of and agent for the Contractor on the above-referenced Project do solemnly declare and attest that, all of the Contractor's obligations under the Agreement arising as of this date have been performed and that all accounts for labour, subcontracts, products, materials, construction machinery, equipment and any other indebtedness and obligations which may have been incurred by the Contractor up to the date the previous Progress Estimate have been paid in full or remain in good standing.

I MAKE THESE SOLEMN DECLARATIONS, conscientiously believing them to be true and knowing that they are of the same legal force and effect as if made under Oath.

DECLARED BEFORE ME AT THE )

\_\_\_\_\_ )  
of \_\_\_\_\_, in the )

Province of British Columbia, on this )

\_\_\_\_\_ day of \_\_\_\_\_, )

\_\_\_\_\_ )  
A Commissioner for taking Affidavits for British Columbia )

\_\_\_\_\_  
Signature of Contractor's Authorized Representative



## APPENDIX B – MINOR WORKS and OPERATIONAL SERVICES


**BRITISH  
COLUMBIA**
**Ministry of  
Transportation**
**STATUTORY DECLARATION**

IN THE MATTER OF THE EVIDENCE ACT, 1996 RSBC c.124 AND IN THE MATTER OF CERTAIN DISBURSEMENTS MADE IN CONNECTION WITH THE AGREEMENT

dated the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ between:

**HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA,  
AS REPRESENTED BY THE MINISTER OF TRANSPORTATION**  
(the Province)

and:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(the Contractor)

pertaining to Project Number: \_\_\_\_\_ Contract ID \_\_\_\_\_

I, \_\_\_\_\_, being the  
(PRINT OR TYPE FULL NAME AND POSITION OR TITLE)

duly authorized representative of and agent for the Contractor, solemnly declare and attest that all of the Contractor's obligations under the Agreement have been performed as of this date.

I MAKE THIS SOLEMN DECLARATION, conscientiously believing it to be true and knowing that it is of the same legal force and effect as if made under Oath.

DECLARED BEFORE ME AT THE

\_\_\_\_\_ )

of \_\_\_\_\_, in the \_\_\_\_\_ )

Province of British Columbia, on this \_\_\_\_\_ )

\_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ )

\_\_\_\_\_ )  
A Commissioner for taking Affidavits for British Columbia

\_\_\_\_\_  
Signature of Contractor's Authorized Representative



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 115

### MAJOR WORKS CONSTRUCTION AGREEMENT

#### GENERAL CONDITIONS

The Major Works Construction Agreement – General Conditions is not included in the 2004 edition of the *Standard Specifications for Highway Construction*.

The Major Works Construction Agreement – General Conditions will be incorporated into each Major Works Tender Document and Contract Document Package using the 2004 edition of the *Standard Specifications for Highway Construction*



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 117

### MINOR WORKS CONSTRUCTION AGREEMENT

#### GENERAL CONDITIONS

The Minor Works Construction Agreement – General Conditions is not included in the 2004 edition of the *Standard Specifications for Highway Construction*.

The Minor Works Construction Agreement – General Conditions will be incorporated into each Minor Works Tender Document and Contract Document Package using the 2004 edition of the *Standard Specifications for Highway Construction*



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 125

### VALUE ENGINEERING - PROPOSAL GUIDELINES

**Note:** This Section shall only be used when stated in the Special Provisions.

#### 125.01 Definitions

**125.01.01 VEP** means a value engineering proposal which has been set out in writing by the Contractor to the Ministry in accordance with these guidelines.

**125.01.02 Summary VEP** means a brief summary of a VEP, including the anticipated cost and timing of developing the VEP, submitted by the Contractor to the Ministry.

**125.01.03 Implemented VEP** means a value engineering proposal which has been accepted and implemented by means of a Supplemental Agreement or Work Order.

**125.01.04 Net Cost Savings** means an amount determined by the Ministry on the basis of the Contract Price before implementation of the VEP minus the adjusted Contract Price determined after the implementation of the VEP less the following costs, which are subject to negotiation:

- the Contractor's costs of developing the VEP.
- the Ministry's costs of evaluating the VEP.
- the anticipated additional administration and project management costs to the Ministry resulting from the implementation of the VEP.

**125.01.05 Value Engineering Incentive** means an amount calculated pursuant to written agreement between the Ministry and the Contractor, which will generally be equal to 50 percent of the Net Cost Savings realized by the Ministry due to the implementation of the VEP.

#### 125.02 Guiding Principles for VEP Evaluation

**125.02.01** To be considered, a VEP must be perceived by the Ministry to provide a tangible benefit to the Ministry, such as:

- a) a reduction in the total cost of the Project; or
- b) an improvement to the product which the Ministry expects will reduce the life cycle costs; or
- c) a change in the Construction Schedule which will be beneficial to the Ministry; or
- d) a reduction or transfer of risk which will benefit the Ministry;

and should result in a product which is functionally equal or superior to that which would result in the absence of the VEP.

**125.02.02** A VEP should not:

- a) impair the functionality and characteristics of the Project, including, but not limited to, the service life, economy of operation, ease of maintenance, aesthetic considerations, preliminary engineering commitments, or design and safety standards.
- b) be similar to a change in the Plans or specifications under consideration by the Ministry for the Work at the time the VEP is submitted to the Ministry.
- c) increase the anticipated life cycle costs of the Project.

**125.02.03** To be eligible for a Value Engineering Incentive, a VEP must propose a change to the Work which meets the same constraints, assumptions and considerations as those which governed the original design of the Work, as it is defined in the Agreement. Where Changed Conditions, or other changes, have occurred and have already created the need for a Change To Work, a VEP which responds to this need will not normally be eligible for a Value Engineering Incentive, and in any case will be eligible only for a reduced incentive.

**125.02.04** A VEP may involve:

- a) a material or product substitution.
- b) a change to the Work method.
- c) a Work sequencing change, including changes to traffic routing or detour sequences, changes to structure or roadway construction sequences.
- d) a change to the design or engineering of the Project which provides a marked departure from the product as defined in the Contract Document Package.

#### 125.03 Value Engineering Proposal Submissions

**125.03.01** Prior to presenting a VEP, the Contractor will prepare a Summary VEP and submit it to the Ministry for consideration.

**125.03.02** The Ministry will evaluate the Summary VEP and will advise the Contractor whether or not the Ministry would be willing to consider, without obligation, the VEP described in the Summary VEP.



**125.03.03** A VEP should contain the following information:

- a) a statement that the proposal is submitted as a VEP.
- b) a detailed description of the VEP and the manner in which the VEP should be implemented (by Supplemental Agreement or Work Order).
- c) a detailed description of the Items and quantities, Plans, specifications, designs, Completion Date, Milestone Dates or other elements under the Agreement which would be changed, altered, modified or replaced by the implementation of the VEP.
- d) plans and working drawings needed to analyze the VEP and determine the impact of the VEP on the Project.
- e) an itemized cost analysis of the Net Cost Savings.
- f) the date, which must be not less than two weeks after the date of the VEP, by which the VEP must be

implemented in order to maximize the cost reduction during the remainder of the Agreement.

**125.03.04** Any request by the Contractor for substitution of material or method will only be considered if submitted as a VEP.

**125.04 Implementation of a VEP**

**125.04.01** To implement a VEP, the Ministry Representative will prepare a Supplemental Agreement or a Work Order which will set out the Net Cost Savings, the Change To Work required to realize the Net Cost Savings, and the adjustment to the Contract Price(s) and payment terms resulting from the VEP, in accordance with these guidelines.

**125.04.02** The Ministry will retain the right to utilize a VEP, or part thereof that has been accepted for the Project, on any other or subsequent projects without any obligation to the Contractor, unless the Contractor has provided written notice in the Summary VEP and the VEP regarding patented materials or processes involved in the VEP.



## SECTION 135

### CONSTRUCTION SITE SAFETY

**135.01 Definitions** - In this Section, except as otherwise expressly provided herein:

**a) Base Safety Program** means the occupational health and safety program that the Contractor will initiate and maintain, as described in this Section.

**b) Designated Prime Contractor** means the Contractor, or another contractor, designated by the Province pursuant to Subsection 135.04.01 to discharge the responsibilities of the Prime Contractor for the Specified Area.

**c) Designated Qualified Coordinator** means the person designated by the Designated Prime Contractor to discharge the responsibilities of the Qualified Coordinator for the Specified Area.

**d) Designated Qualified Person** means the person designated by the Designated Prime Contractor to discharge the responsibilities of the Qualified Person for the Specified Area.

**e) Designated Supervisor** means the person who is designated by an Employer at a Multiple-Employer Workplace to discharge the responsibilities of a supervisor as described in the Workers Compensation Act and the Regulation.

**f) Employer** means an employer as defined in the Workers Compensation Act, and includes the Contractor.

**g) Joint Committee** means the joint health and safety committee established and maintained by the Contractor in compliance with the Workers Compensation Act and the Regulation, and

**Joint Committees** means additional committees that may be established by the Contractor in compliance with the Workers Compensation Act and the Regulation.

**h) Multiple Employer Workplace** means a workplace where workers of 2 (two) or more employers are working at the same time, and includes the Site and the Specified Area.

**i) Notice of Project** means the notice of project described in the Regulation.

**j) Notice of Unsafe or Harmful Condition or Act** means the written notice that the Contractor will deliver to any Employer pursuant to Subsection 135.05, in the form set out in [Appendix A](#) of this Section.

**k) Other Persons** means any person or persons, other than Workers working on the Project, who, for whatever reason or purpose, are on the Site or the Specified Area.

**l) Prime Contractor** means a prime contractor as defined in the Workers Compensation Act.

**m) Qualified Coordinator** means the person, who meets the qualifications of a qualified coordinator described in the Regulation, and who is appointed by the Prime Contractor to discharge for the Site, the responsibilities of a qualified coordinator as described in the Workers Compensation Act and the Regulation.

**n) Qualified Person** means the person who meets the qualifications of a qualified person described in the Workers Compensation Act and the Regulation, and who is designated by the Prime Contractor to discharge for the Site the responsibilities of a qualified person as described in the Workers Compensation Act and the Regulation.

**o) Regulation** means the British Columbia Regulation 296/97 entitled *Occupational Health and Safety Regulation* prescribed under the Workers Compensation Act, as amended from time to time.

**p) Safety Officer** means the person so designated by the Province pursuant to this Agreement.

**q) Specified Area** means that part or those parts of the Site and any lands adjoining or overlapping the Site that are designated as the Specified Area in the Special Provisions of the Contract Document Package or in a written notice that may be issued by the Ministry Representative from time to time pursuant to Subsection 135.04.01.

**r) Workers** means the employees, workers, servants, agents or invitees of Employers, including of the Contractor, at the Site or at the Specified Area.

**s) Workers Compensation Act** means the Workers Compensation Act, R.S.B.C. 1996, c.492 as amended from time to time.

**t) Workers' Compensation Board** means the Workers' Compensation Board constituted under the Workers Compensation Act and Regulation.

#### 135.02 Base Safety Program

**135.02.01** Notwithstanding the limitation relating to the requirement for initiating and maintaining an occupational



health and safety program set out in the Regulation, the Contractor will initiate and at all times maintain at the Site, and if the Contractor has agreed to be the Designated Prime Contractor, at the Specified Area, the Base Safety Program which will be designed to prevent injuries and occupational diseases within the contemplation of the Workers Compensation Act and the Regulation and, without limiting the generality of the foregoing, will describe how the Contractor will ensure that:

- a) where applicable, the Base Safety Program complies with the requirements of the program entitled the "Prequalification Procedures for Bridge Construction and Painting Program" instituted by the British Columbia Ministry of Transportation.
- b) the requirements of an occupational health and safety program stipulated in the Regulation will be satisfied, including the establishment and maintenance of a Joint Committee.
- c) the activities of all Employers, Workers and Other Persons at the Site and, if applicable, at the Specified Area, relating to occupational health and safety will be coordinated.
- d) reasonably practicable measures are taken to establish and maintain a system or process to ensure compliance with the Workers Compensation Act and the Regulation in respect of the Site, and if applicable, the Specified Area.
- e) all Workers, Employers, and Other Persons are made aware of all known or reasonably foreseeable health and safety hazards to which they may be exposed on the Site, and if applicable, the Specified Area, and are instructed in the terms of the Workers Compensation Act and the Regulation.
- f) complete and accurate reports, records and documents relating to occupational health and safety activities at the Site and, if applicable, at the Specified Area, or related to the Work, will be established, maintained, reviewed and assessed on an ongoing basis.
- g) safety equipment and apparel are properly used and worn by Workers and Other Persons, as required pursuant to the Regulation and the Base Safety Program.
- h) a first aid program in compliance with the Regulation is established, implemented and maintained at all times on the Site and, if applicable, on the Specified Area.

**135.02.02** The Contractor will determine and control the manner in which the Base Safety Program is established, initiated, and maintained and the manner in which the instructions, directions, rules, policies and procedures contained therein are carried out.

### **135.03 Prime Contractor - The Site**

**135.03.01** The Contractor, by entering into the Agreement, agrees to be the Prime Contractor in connection with the Site for the purposes of the Workers Compensation Act and the Regulation.

**135.03.02** The Contractor will, prior to commencement of the Work, deliver to the Ministry Representative, in writing:

- a) the name of each of the Qualified Coordinator and the Qualified Person in connection with the Site.
- b) a copy of the Notice of Project.
- c) confirmation that the Base Safety Program has been initiated and is readily available on the Site.

**135.03.03** The Contractor will, in connection with the Work and the Site:

- a) observe, abide by and comply with the Workers Compensation Act and the Regulation.
- b) deliver the Notice of Project to the Workers' Compensation Board in accordance with the Workers Compensation Act and the Regulation.
- c) prominently post and at all times maintain on the Site the Notice of Project in accordance with the Workers Compensation Act and the Regulation.
- d) ensure that the person or persons to be appointed as the Qualified Coordinator and Qualified Person meet the qualifications of a "qualified coordinator" and "qualified person" as described in the Workers Compensation Act and the Regulation.
- e) appoint and at all times maintain a Qualified Coordinator to perform the functions of the "qualified coordinator" on the Site as described in the Workers Compensation Act and the Regulation, and as set out in this Section, and designate and at all times maintain not less than one Qualified Person to be responsible for health and safety activities of the Contractor in connection with the Work, including, without limiting the generality of the foregoing, administering the Base Safety Program.



**f)** deliver written notice to the Ministry Representative of any change in the appointed Qualified Coordinator or the Qualified Person referenced in Subsection [135.03.03 \(e\)](#).

**g)** establish and at all times maintain one or more Joint Committees.

**h)** where conditions or activities affect the Workers of more than one Employer, or where there are overlapping or adjoining work activities of 2 (two) or more Employers at the Site, ensure:

**i)** that the Qualified Coordinator coordinates the occupational health and safety activities at the Site.

**ii)** that:

- Employers, Workers, Suppliers and Subcontractors of the Contractor, and Other Persons.
- the work activities of Workers, Employers, Suppliers and Subcontractors of the Contractor and Other Persons.
- the conditions of the Site.

comply with the Workers Compensation Act and the Regulation;

**i)** make the Base Safety Program and a copy of the Workers Compensation Act and the Regulation readily available at the Site.

**j)** provide and maintain the Site in a manner that ensures the health and safety of persons at or near the Site.

**k)** ensure that every Employer at the Site is given the information known to the Contractor that is necessary to identify and eliminate or control hazards to the health or safety of Workers and Other Persons at the Site.

**l)** ensure that Workers, Employers and Other Persons are made aware of all known or reasonably foreseeable health and safety hazards to which they are likely to be exposed by the Work on the Site.

**m)** do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with the Workers Compensation Act and the Regulation with respect to the Site.

**n)** immediately notify Employers, Workers, Suppliers and Subcontractors of the Contractor, and Other Persons of any hazard created by virtue of overlapping

or adjoining work activities of 2 (two) or more Employers and ensure that the hazards are addressed throughout the duration of such activities.

**o)** at the sole cost of the Contractor, provide, post and maintain 2 (two) signs, in accordance with the specifications, which contain the informational messaging stipulated in Drawing [SP135-01](#) of this Section, at locations satisfactory to the Ministry Representative.

**p)** immediately give written notice to the Ministry Representative of any event which is reportable or is subject to notification requirements under the Workers Compensation Act or the Regulation.

**q)** where the execution of the Work involves overlapping or adjoining work activities of 2 (two) or more Employers that create a hazard to Workers, cause the Qualified Coordinator to:

**i)** coordinate health and safety activities of all Employers at the Site in accordance with the Regulation.

**ii)** publish and post at the Site and otherwise make readily available on the Site, information relating to health and safety activities at the Site, including without limiting the generality of the foregoing:

- the name of the Qualified Coordinator.
- a drawing of the Site showing the project layout, first aid locations, emergency transportation provisions and the evacuation marshalling station.
- a set of construction procedures designed to protect the health and safety of Workers at the Site.

all in compliance with the requirements of the Workers Compensation Act and the Regulation.

#### **135.04 Designated Prime Contractor - The Specified Area**

**135.04.01** The Province may, in its sole discretion, designate in writing the Specified Area, and

**a)** appoint in writing the Contractor to be the Designated Prime Contractor in connection with the Specified Area, and upon notification of such appointment the Contractor will deliver written confirmation to the Province of its agreement to be the Designated Prime Contractor, or

**b)** appoint in writing a contractor other than the Contractor as the Designated Prime Contractor in



connection with the Specified Area, and will notify the Contractor in writing of the designation.

**135.04.02** The Designated Prime Contractor, in connection with the Specified Area, will:

- a) deliver written confirmation to the Workers' Compensation Board, with a copy to the Ministry Representative, of its agreement to be the Designated Prime Contractor for the Specified Area.
- b) appoint a Designated Qualified Coordinator to perform the functions of the "qualified coordinator" as described in the Workers Compensation Act and the Regulation, and as set out in this Section for the Specified Area.
- c) where conditions or activities affect the Workers of more than one Employer, or where there are overlapping or adjoining work activities at the Specified Area, ensure that:
  - i) the Employers, Workers, Suppliers and Subcontractors of the Designated Prime Contractor, and Other Persons,
  - ii) the work activities of all Employers, Workers, Suppliers and Subcontractors of the Designated Prime Contractor and Other Persons,
  - iii) the conditions of the Specified Area,
 comply with the Workers Compensation Act and the Regulation;
- d) provide and maintain the Specified Area in a manner that ensures the health and safety of persons at or near the Specified Area.
- e) ensure that every Employer at the Specified Area is given the information known to the Designated Prime Contractor that is necessary to identify and eliminate or control hazards to the health or safety of Workers and Other Persons at the Specified Area.
- f) make a copy of the Workers Compensation Act and the Regulation readily available at the Specified Area.
- g) cause the Designated Qualified Coordinator to:
  - i) coordinate health and safety activities of all Employers on the Specified Area in accordance with the Workers Compensation Act and the Regulation.

ii) publish and post on the Specified Area and otherwise make information relating to overlapping or adjacent health and safety activities on the Specified Area readily available, including without limiting the generality of the foregoing:

- the name of the Designated Qualified Coordinator,
- a drawing of the Specified Area showing the project layout, first aid locations, emergency transportation provisions and the evacuation marshalling station,
- a set of construction procedures designed to protect the health and safety of Workers in the case of overlapping or adjacent work activities on the Specified Area,

all in compliance with the requirements of the Workers Compensation Act and the Regulation.

### 135.05 Site and Specified Area Notice Process

**135.05.01** If the Prime Contractor, in connection with the Site, or the Designated Prime Contractor, in connection with the Specified Area determines, in its reasonable discretion, that:

- a) any Employer or its Workers has failed to comply with the Workers Compensation Act or the Regulation, or to act in accordance with the requirements of the Base Safety Program for coordinating health and safety activities,
- b) the failure creates or may create an unsafe or harmful condition on the Site or Specified Area that poses a danger of injury or death to Workers,

the Prime Contractor, or the Designated Prime Contractor, as applicable, may issue a Notice of Unsafe or Harmful Condition or Act to the applicable Employer, stipulating in reasonable detail the basis for the issuance of the Notice of Unsafe or Harmful Condition or Act, and the Contractor, or the Designated Prime Contractor, as applicable, will deliver a copy of the Notice of Unsafe or Harmful Condition or Act to the Ministry Representative.

**135.05.02** The terms "Employer" and "Workers" referenced in Subsection 135.05, do not include the Prime Contractor's or the Designated Prime Contractor's Subcontractors or Suppliers, or their respective employees, workers, servants, agents or invitees.

**135.05.03** Upon receipt of the Notice of Unsafe or Harmful Condition or Act, the Ministry Representative will issue to the applicable Employer an Order to Suspend Work at the location on the Site, or on the Specified Area, as applicable, that is specified in the Notice of Unsafe or



Harmful Condition or Act.

**135.05.04** The Province will be deemed to have relied on the terms of and reasons for the issuance of the Notice of Unsafe or Harmful Condition or Act, notwithstanding any subsequent investigation or inquiry of the matter by the Province, which the Province may but will not be obligated to undertake.

**135.05.05** If the Prime Contractor, or the Designated Prime Contractor, as applicable, and the Employer referenced in Subsection 135.05.01 fail to agree on the reasons for the issuance of the Notice of Unsafe or Harmful Condition or Act, then within one day of the issuance of the Notice of Unsafe or Harmful Condition or Act, the directive of the Prime Contractor, or the Designated Prime Contractor, to rectify the failure to comply with the Regulation or to act in accordance with the Base Safety Program, as the case may be, will be immediately implemented.

**135.05.06** When the failure to comply with the Workers Compensation Act or the Regulation in accordance with the Base Safety Program stipulated in the Notice of Unsafe or Harmful Condition or Act has been rectified by the Employer to whom it was given to the reasonable satisfaction of the Prime Contractor, or the Designated Prime Contractor, as applicable, the Prime Contractor, or the Designated Prime Contractor, as applicable, will immediately:

- a) withdraw the Notice of Unsafe or Harmful Condition or Act by endorsing on a copy thereof confirmation that the failure to comply with the Workers Compensation Act or the Regulation in accordance with the Base Safety Program has been rectified.
- b) deliver the endorsed copy of the Notice of Unsafe or Harmful Condition or Act confirming the cancellation thereof to the applicable Employer and to the Ministry Representative.

**135.05.07** The Ministry Representative will issue an Order to Resume Work on receipt of the endorsed copy cancelling the Notice of Unsafe or Harmful Condition or Act.

**135.05.08** If the Prime Contractor or the Designated Prime Contractor, as applicable, is delayed in performing the Work as a result of being required to issue the Notice of Unsafe or Harmful Condition or Act and the Work is stopped pursuant to an Order to Suspend Work under this Article, then the Completion Date will be extended by the number of days equal to the delay, as determined in the sole discretion of the Ministry Representative, and the

Prime Contractor or the Designated Prime Contractor, as applicable, will not be entitled to any compensation, in damages or otherwise, including without limiting the generality of the foregoing, any claim for lost profits or other consequential loss, including business loss, as a result of or in connection with the issuance and operation of any Notice of Unsafe or Harmful Condition or Act or the issuance and operation of any Order to Suspend Work pursuant to this Section.

#### **135.06 Contractor Obligations to Coordinate with the Designated Prime Contractor - The Specified Area**

**135.06.01** Notwithstanding the Contractor's agreement to be the Designated Prime Contractor for the Specified Area pursuant to Subsection 135.04.01, the Contractor will continue to undertake and perform the obligations of a Prime Contractor at the Site at all times in accordance with the Workers Compensation Act, the Regulation and this Section.

**135.06.02** If another contractor is appointed as the Designated Prime Contractor in connection with the Specified Area pursuant to Subsection 135.04.01, the Contractor will:

- a) continue to undertake and perform the obligations of a Prime Contractor at the Site at all times in accordance with the terms of the Workers Compensation Act, the Regulation and this Section.
- b) schedule and perform the Work and, in good faith, co-operate with the Designated Prime Contractor so as to comply with any directives that may be issued by the Designated Prime Contractor to coordinate the health and safety activities on the Specified Area.
- c) ensure that at all times all Employers, Workers, Subcontractors and Suppliers of the Contractor, and Other Persons comply with the Designated Prime Contractor's directions on coordinating occupational health and safety activities on the Specified Area.
- d) upon the request of the Designated Prime Contractor, deliver occupational health and safety records and documentation to the Designated Prime Contractor as necessary for the Designated Prime Contractor to meet its obligations under the Regulation and under this Section.
- e) advise the Designated Prime Contractor in writing and in advance of any work activities to be undertaken in the Specified Area that are likely to create a hazard for Workers of another Employer, and of the work activities.



**f)** on receipt of notification from the Designated Prime Contractor of any unsafe or harmful condition or act by its Workers, Subcontractors, or Suppliers, or the Workers of its Subcontractors or Suppliers, investigate the reported situation and take immediate action to correct the condition or act, and report back to the Designated Prime Contractor, as may be required by the Designated Prime Contractor.

**g)** upon receipt of a Notice of Unsafe or Harmful Condition or Act from the Designated Prime Contractor and of an Order to Suspend Work from the Ministry Representative, take all steps to rectify, or cause to be rectified, the failure to comply with the Workers Compensation Act and the Regulation or to act in accordance with the Base Safety Program to the satisfaction of the Designated Prime Contractor.

**h)** if the Contractor and the Designated Prime Contractor fail to agree on the reasons for the issuance of the Notice of Unsafe or Harmful Condition or Act within 1 (one) day of the issuance of the Notice of Unsafe or Harmful Condition or Act, immediately implement the directive of the Designated Prime Contractor to rectify the failure to comply with the Regulation or to act in accordance with the Base Safety Program, as the case may be.

**i)** advise the Designated Prime Contractor in writing of the name of the Qualified Person, and of any change in the Qualified Person, designated to be responsible for the Contractor's health and safety activities on or in connection with the Site, including the Specified Area.

**135.06.03** The Province will be deemed to have relied on the terms of and reasons for the issuance of the Notice of Unsafe or Harmful Condition or Act notwithstanding any subsequent investigation or inquiry of the matter by the Province, which the Province may but will not be obligated to undertake.

**135.06.04** Notwithstanding any other term of this Section or of the Agreement, the Province may withhold payment of any progress payment due to the Contractor under the Agreement. If the Designated Prime Contractor has issued, in connection with the Site or the Specified Area, as applicable, a Notice of Unsafe or Harmful Condition or Act in accordance with this Section, and the Province may continue to withhold payment of such progress payment or payments, as the case may be, until such time as the Notice of Unsafe or Harmful Condition or Act has been cancelled and the Order to Resume Work has been issued.

### **135.07 Contractor's Health and Safety Records**

**135.07.01** The Contractor will:

**a)** establish and maintain at a location on the Site, or at a location off the Site that is satisfactory to the Province, accurate records, including supporting documents, relating to the implementation, operation, and maintenance of the Base Safety Program, and to any other occupational health and safety matters relating to the Work.

**b)** notify the Province of the location referred to in Subsection [135.07.01 \(a\)](#) not later than 5 (five) days after the Commencement Date.

**c)** permit the Province, its servants, employees and agents, at any time or times during normal business hours, to copy or audit, or both, any or all of the records, including supporting documents, referred to Subsection [135.07.01 \(a\)](#).

**135.07.02** The records and documentation referred to in Subsection [135.07.01 \(a\)](#) include, but are not limited to the following in relation to the Work, the Site and the Specified Area:

**a)** the Base Safety Program.

**b)** any and all notices, directives and inspection reports which have been delivered to the Workers' Compensation Board by the Contractor or which the Contractor has received from the Workers' Compensation Board.

**c)** any and all written summaries of the particulars of any and all remedial actions taken by the Contractor to prevent the development or continuance of any risks, unsafe or harmful conditions or acts or hazards and to prevent the recurrence of such events.

**d)** minutes of and other documentation prepared in connection with or relating to safety meetings held between the Contractor and its Workers demonstrating that all Workers have and are receiving ongoing and adequate direction and instruction in the performance of their duties and the Work is being performed safely and without undue risk, and demonstrating the performance of regular inspections in accordance with and for the purposes stipulated in the Workers Compensation Act and the Regulation.

**135.07.03** The delivery of progress payments by the Province to the Contractor under the Agreement is conditional on the prior submission to the Ministry Representative by the Contractor, on a monthly basis, of a written summary of the documents recorded and collected under Subsection [135.07.02](#) and, if the Contractor is designated to act as the Designated Prime Contractor, a written summary of the actions taken by the Contractor to



coordinate the occupational health and safety activities of the Employers, the Workers, and the Other Persons within the Specified Area.

**135.07.04** The Contractor will cause the Qualified Coordinator to obtain and will ensure that the Qualified Coordinator:

- a) obtains the records prepared with respect to the Joint Committee meetings held in connection with the Site.
- b) distributes such records to the qualified persons, appointed in accordance with the Workers Compensation Act and the Regulation, of other Employers on the Site, and as may be otherwise required by the Workers Compensation Act and the Regulation.

**135.07.05** At all times during the Term, the Contractor will deliver to the Ministry Representative a copy of any accident or incident reports prepared by the Contractor in compliance with the Workers Compensation Act and the Regulation to the Ministry Representative when such reports have been completed.

**135.07.06** The Contractor will provide the Ministry

Representative with a statistical summary of all health and safety records applicable to the Site during the Term which summary entitled "Contractor's Accident Statistics Summary Report" attached as in [Appendix B](#) to this Section, will provide particulars of the following information:

- a) the total number of hours worked by the Workers of the Contractor and the Workers of Subcontractors of the Contractor.
- b) the total number of occurrences or events which occurred on the Site that were reportable to or subject to the notification requirements of the Workers Compensation Act or the Regulation.
- c) the total number person-days lost due to accidents, injuries or incidents.
- d) the total actual cost of damage to equipment and materials due to accidents, injuries, or incidents.

**135.07.07** Receipt and retention by the Province of the information and documentation listed above in this Section in no way constitutes approval of or authorization of the form, content or adequacy of such information and documentation on the part of the Province.



## APPENDIX "A"

**PRIME CONTRACTOR'S NOTICE OF UNSAFE OR HARMFUL  
CONDITION OR ACT (the "Notice")**

---

This Notice has been issued by the Prime Contractor to:

Name of Contractor: \_\_\_\_\_

Address: \_\_\_\_\_

The following unsafe or harmful condition or act was observed at the following location and time:

Description of unsafe or harmful condition or act: \_\_\_\_\_

Location: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_ AM/PM

---

The Contractor named in this Notice is required to correct the above referenced unsafe or harmful condition or act prior to performing any more work activity at the location identified above.

Prime Contractor: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_ AM/PM

Receipt acknowledged by the Contractor:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_ AM/PM

---

The Ministry Representative received a copy of this Notice on: Date: \_\_\_\_\_ Time: \_\_\_\_\_ AM/PM

On the basis of this Notice, the Ministry Representative will issue an "Order to Suspend Work" in connection with the unsafe or harmful condition or act as identified on this Notice.

---

The Prime Contractor will, if satisfied that the unsafe or harmful condition or act has been rectified cancel and withdraw this Notice.

Date of cancellation/withdrawal: \_\_\_\_\_ Time: \_\_\_\_\_ AM/PM

Prime Contractor - Signature: \_\_\_\_\_

---

The Ministry Representative will issue an "Order to Resume Work" when in receipt from the Prime Contractor of this Notice endorsed to indicate that the unsafe or harmful condition or act has been rectified.

**DISTRIBUTION:**

Original: Contractor

Copy: Ministry Representative

File Copy: Prime Contractor



## APPENDIX "B"


**BRITISH  
COLUMBIA**

 Ministry of  
Transportation

**CONTRACTOR'S ACCIDENT  
STATISTICS SUMMARY REPORT**

Project Number \_\_\_\_\_

Date (yyyy/mm/dd) \_\_\_\_\_

Description \_\_\_\_\_

Award Date (yyyy/mm/dd) \_\_\_\_\_

Completion Date (yyyy/mm/dd) \_\_\_\_\_

Name of Contractor \_\_\_\_\_

Month	Total Number of All Hours Worked by All Contractor's & Sub-contractor's Workers	Number of Reportable Accidents & Incidents	Number of Days Lost Due to Lost Time Accidents	Total Cost for Damage to Equipment or Material
Jan				
Feb				
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sep				
Oct				
Nov				
Dec				
<b>Totals</b>				

Contractor's designated authority - Signature \_\_\_\_\_

Print name of Contractor's designated authority \_\_\_\_\_

Attach additional copies of this form as necessary and submit to Ministry Representative upon contract completion.



**NOTE:**

CONTRACTOR PROVIDES COMPANY NAME AND PHONE NUMBER  
OF THE APPROPRIATE CONTACT PERSON.

**SPECIFICATIONS**

SIGN SIZE	(MINIMUM) 2440 mm x 610 mm (8'-0" x 2'-0") (MINIMUM) 2440 mm x 305 mm (8'-0" x 1'-0")
MATERIAL	10 mm PLYWOOD OR .081" SHEET ALUMINUM
COLOUR	BLACK MESSAGE ON WHITE REFLECTORIZED BACKGROUND
TEXT SIZE	100 mm AND CENTERED HORIZONTALLY

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 145

### GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

**145.01 General Requirements** - This Section covers the general Work requirements for highway, bridge, and marine construction.

The standards and materials specifications contained in the Standard Specifications for Highway Construction govern the specific requirements for the Work. Special Provisions provide additional specific requirements for the Work and supersede the Standard Specifications where there is conflict.

Specifications, standards, regulations and codes of other authorities named in full or by acknowledged abbreviations in the Glossary of Terms of the Standard Specifications or the Contract Document Package shall be adopted by reference.

Such reference in whole or in part by the necessary alphanumerical designation from the latest edition or revision is intended to fully detail the requirements of the Work.

**145.02 Reference Information** - Reference information for the Work identified in the Agreement is made available for the Contractor to use for its own purpose. The Contractor shall be solely responsible for any interpretation placed thereon and for all impacts resulting from such interpretation.

**145.03 Value Engineering Proposals** - The Ministry wishes to encourage the development of value engineering proposals (VEP's) during the Term of the Contract. The Ministry will provide a process, as outlined in Section 125 to encourage the introduction, consideration, and possible implementation of VEP's. The Contractor may submit any number of VEP's during the Term.

The Ministry will be the sole judge of the acceptability of a VEP and of the cost savings, which will be realized by the Ministry due to the implementation of the VEP. The decision of the Ministry will be final.

The Ministry will not be liable to the Contractor for the Ministry's failure to accept or implement a VEP submitted by the Contractor nor for any delays to the Work that may be attributable to the VEP. A VEP or Summary VEP cannot, under any circumstances, be the basis for a claim by the Contractor.

**145.04 Scope of Work** - The scope of Work is described in the Special Provisions. No warranty is given or implied that any or all of this Work will be required or supplied.

**145.05 Quantities and Dimensions** - Quantities,

dimensions, lines and elevations as shown on the plans and Drawings are designed neat lines. Approximate quantities entered in Schedule 7 - Approximate Quantities and Unit Prices are quantities approximated using the lines and dimensions shown in the Contract Document Package and other relevant factors, and may vary from quantities derived from the Drawings. Actual payment quantities will be measured, calculated, or otherwise determined in accordance with the Agreement.

**145.06 Unit Prices** - Unit Prices in the Schedule of Approximate Quantities and Unit Prices shall be complete and contain all the elements of cost involved, provision of all things, superintendence and profits. The price shall stand independent of any other Unit Price Item on the Schedule of Approximate Quantities and Unit Prices.

**145.07 Pre-construction Meeting** - The Ministry Representative will determine the pre-construction meeting's location and time and notify the Contractor.

**145.08 Mobilization** - Mobilization consists of the necessary Work and operations including, but not limited to, the movement of personnel, equipment, supplies, and incidentals to the Site, the establishment of offices, camps, and other facilities necessary to undertake the Work and all other Work Items and operations which must be initiated and finished as part of completion of the Work.

**145.08.01 Payment for Mobilization** - Where the Contract includes a payment Item for mobilization, the Lump Sum Price for mobilization includes any or all of the related expenses incurred for mobilization, demobilization and any re-mobilization not covered under the Work Items which must be initiated and finished as part of the Work. The Lump Sum Price for mobilization will be paid in increments as the Work progresses.

If the Contract does not contain a payment Item for "Mobilization", all costs associated with mobilization, demobilization and re-mobilization will be included in payment for Items having such costs.

Payment for mobilization, if applicable, will be made at the tendered Lump Sum Price as follows:

- a) The Contractor will be paid any portion of the mobilization Lump Sum Price exceeding five percent (5%) of the Tender Price within sixty (60) days after the Actual Completion Date or on the final progress estimate (whichever occurs first).
- b) That portion of the mobilization Lump Sum Price not exceeding five percent (5%) of the total Tender Price,



## SECTION 145

will be paid to the Contractor according to the following breakdown:

i) Seventy-five percent (75%) when the Contractor has submitted, in an acceptable form, to the Ministry Representative each of the following that is required under the Contract

- Construction Schedule,
- Cash Flow Projection Schedule,
- Traffic Management Plan,
- Quality Control Plan,
- Sediment and Drainage Management Plan,

and the value of the Work completed on bid Items other than mobilization exceeds two percent (2%) of the Tender Price.

ii) The remaining twenty-five percent (25%) of this portion of the mobilization Lump Sum Price will be paid prorated on a monthly basis for the percentage of Work completed as determined by the Ministry Representative when the Ministry Representative receives acceptable construction schedule updates, all quality control reports have been submitted by the Contractor as required by the Ministry, all equipment has been removed from the Site, and the Site has been cleaned up to the satisfaction of the Ministry Representative.

The payments from the Lump Sum Price, as set out above, will be full compensation for mobilization, demobilization and re-mobilization, regardless of the number of times the Contractor mobilizes.

**145.09 Authority of the Ministry Representative** - The Ministry Representative has the authority to accept or reject the Contractor's Work in accordance with the conditions set out in the Agreement. Until the Work meets the requirements of the Agreement and has been accepted by the Ministry Representative, the Ministry is not obligated to make payment for Work done by the Contractor. The Ministry Representative shall take all necessary measurements and calculations to determine the final quantities for final payment.

**145.10 Power, Telegraph, Telephone Lines and Other Utilities** - Moving of existing power, telegraph and telephone lines, poles and other utilities from their current to their final design locations, unless specified as being part of the Work, shall be performed by third parties at the Ministry's expense.

If the Contractor's operations require the temporary removal or relocation of lines or poles, such removal or relocation shall be entirely the responsibility of the Contractor and costs of any interim utility relocations shall be to the

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

Contractor's account. Utility owner(s) must be contacted prior to doing any utility work.

The Contractor shall be responsible for any damage to poles, lines or utilities caused by the Contractor's construction operations, and shall repair and make good the same or bear the expense of making good and repairing the same.

The Contractor shall take the necessary precautions to protect existing utility services during the performance of the Work and shall be responsible for any losses or damages caused by the Contractor.

Locations of the utilities shown on the Drawings are approximate and may not be complete. The Contractor shall be responsible to ensure the locations of the utilities are complete and shall notify the Ministry Representative of any discrepancies between the Drawings and the Contractor's findings.

**145.11 Permits** - The Contractor shall give all requisite notices in connection with the Work to the proper authorities and shall procure at the Contractor's expense all permits, licences, etc., of every description necessary for the construction and completion of the Work.

The Contractor shall deliver or make available all original certificates to the Ministry Representative for all or any part of the Work for which such certificates may be required in connection with performing the Work.

**145.12 Inspection of Work** - All materials and each part or detail of the Work shall be subject to inspection by the Ministry Representative.

The Contractor shall be held strictly to the true intent of the Agreement in regard to quality of materials, work practice and the diligent execution of the Contract.

The Ministry Representative shall be given access to all or any part of the Work, and to the preparation, fabrication or manufacture of the materials to be used. The Contractor shall furnish all information and assistance as is required to make a complete, true and detailed inspection.

The Ministry Representative may reject any part or parts of the Work which do not comply with the requirements of the Agreement. The Ministry Representative's decision will be accepted as final.

Inspection may extend to all or any part of the Work and to the preparation, fabrication or manufacture of the materials to be used. The Ministry Representative may station others on the Site to report on the progress of the Work and the manner in which it is being performed.



The Ministry Representative will report to the Contractor on materials furnished or Work performed that fails to fulfill the requirements of the Contract.

Inspection or its lack shall not relieve the Contractor from any obligations to furnish acceptable materials or to provide completed construction Work that complies with the Agreement.

The Contractor shall furnish for the approval of the Ministry Representative, at proper times, all shop and installation drawings as requested by the Agreement or which the Ministry Representative may deem necessary.

In accepting Plans submitted by the Contractor, the Ministry Representative will assume no responsibility as to the correctness of such Plans and the Ministry Representative's examination is only to ensure general compliance with the Agreement.

### **145.13 "Ministry Representative's Instruction" and "Contractor's Declaration"**

**145.13.01 "Ministry Representative's Instruction" -** "Ministry Representative's Instruction" form (H0202) will be issued by the Ministry Representative to the Contractor in order to:

- a) describe a portion of the Work which may not be covered specifically in the Contract.
- b) confirm instructions which may affect the method of carrying out the Work or payment.
- c) confirm verbal agreements made with the Contractor's representative.
- d) respond to the Contractor's representation on "Contractor's Declaration" form (H0203).

**145.13.02 "Contractor's Declaration" -** The Contractor is to issue the "Contractor's Declaration" form (H0203) to the Ministry Representative in order to:

- a) make a declaration of acceptance or objection to contents of the "Ministry Representative's Instruction".
- b) formally present the Contractor's opinions, problems or requirements for clarification.

**145.14 Protection and Restoration of the Work -** The Contractor shall protect all Work and surrounding infrastructure from injury or damage until the issuance of the Completion Certificate.

If the Contractor fails to prevent any injury or damage to the

Work, the Contractor shall rebuild, repair, and restore at its expense any portion of the Work so injured or damaged.

The Ministry may reimburse the Contractor for any injury or damage caused by an event not foreseen and not reasonably foreseeable by the Contractor and beyond the control and not resulting from any fault or negligence of the Contractor including but not restricted to acts of God, acts of a Public Enemy, acts of the Province, extraordinary action of the elements and unavoidable slides.

**145.15 Materials Supplied by the Contractor -** The Contractor shall provide all materials necessary for the orderly completion of the Work with the exception of the materials supplied by the Ministry as listed in the Special Provisions.

Material supplied by the Contractor shall not have been previously used and shall be in new condition.

All materials incorporated into the Work shall conform to the requirements of the Agreement unless previously approved otherwise by the Ministry Representative.

Materials supplied by the Contractor must be approved prior to incorporation in the work.

**145.15.01 Inspection of Materials -** The Contractor must provide manufacturer certification or milling slips for the Ministry's use, and allow 2 weeks for the Ministry Representative to test the materials. Such certificates or mill slips must demonstrate the material properties of the specific batch of materials provided to the Project and must demonstrate that the material complies with the requirements of the Agreement.

The Ministry may also perform random inspection of the materials.

The Contractor shall notify the Ministry Representative of the sources of materials supplied by the Contractor, and such notification shall be given sufficiently far in advance of delivery to enable the Ministry Representative to make inspection of the material at the source. Insufficient notice will be cause for the Ministry to reject the materials without compensation.

The Contractor will be charged for all travel time, board and lodging costs incurred by the Ministry or its designate, required to inspect materials components if the source of the material is outside the Province and incorporated into the Work.

The Ministry will offset any costs for inspecting the materials from any payments made to the Contractor.

**145.15.02 Samples and Testing -** The Contractor shall, as



## SECTION 145

required, submit to the Ministry Representative, for approval, samples of the materials proposed for use in the work. The approval or acceptance of samples of material shall not preclude the rejection of any material upon discovery of defects or weaknesses previous to acceptance of the complete work.

Any testing done on samples of materials provided to the Ministry Representative will be performed at the Ministry's expense, except where such testing establishes that the material does not comply with the Agreement. In such cases, the Ministry may offset the cost of testing from any payments due the Contractor.

**145.15.03 Alternative Materials** - Brands, species and manufacturer's names specified are approved for use in the performance of the Work. No alternative materials will be considered unless approved in advance by the Ministry Representative in writing.

Savings as a result of using alternate materials will be evaluated using Section 125 Value Engineering.

**145.16 Materials Supplied by the Ministry** - Ministry supplied materials will be arranged by purchase orders for delivery by the Purchasing Commission on instructions from the Contractor notifying the Ministry Representative.

Separate purchase orders will be issued for each class of material.

Materials ordered for a specific Site shall not be transferred to any other Site without the written consent of the Ministry Representative.

Ministry supplied and owned materials will be used only for Ministry Work. Further requirements for asphalt materials supplied by the Ministry are contained in Sections 501 and 951.

**145.16.01 Delivery Points** - Each purchase order will specify points of delivery. The Contractor shall be responsible for all costs that may arise such as unloading from truck or rail car, hauling to the Site, stockpiling, dunnage, and reloading.

The costs to transport all materials to the Site will be incurred by the Contractor at its own cost and will be considered incidental and no separate payment will be made for this portion of the Works.

Should the Contractor request delivery be made to an alternative point other than the nearest specified point of delivery or in any manner of delivery other than specified by the Purchasing Commission, the additional cost for this delivery shall be charged to the Contractor's account.

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

**145.16.02 Delivery of Materials** – When the Ministry Representative advises the Contractor of the name of the supplier(s), the Contractor shall be responsible for:

- a) determining requirements and ordering far enough in advance that work is not delayed.
- b) acceptance of all materials; careful unloading and handling; hauling and delivery from delivery point to job site; storage and security; prompt turn around of tank or shipping cars, trucks or delivery containers.
- c) prompt payment of all demurrage or rental charges on cars, (except as provided in Section 501) freight, handling, delivery, storage or any other charges arising after the initial receipt of material at the delivery point.
- d) ensuring that proper accounting is kept of all materials received.

The Contractor will obtain approval from the Ministry Representative prior to removing any materials from a Ministry storage site.

The Contractor shall not during normal working hours unload or take delivery of any material unless the Ministry Representative is present.

Where the Contractor takes delivery of materials during non-working hours, the Contractor shall immediately notify the Ministry Representative at the beginning of the next shift and allow sufficient time for the Ministry Representative to check quantity and quality before any materials are used.

After taking delivery of any materials supplied to the Contractor by the Ministry under the Contract, the Contractor shall be solely responsible for same and shall make good at the Contractor's expense any loss of or damage to such materials.

The Contractor will provide a secure yard or storage area for materials supplied by the Ministry. The Contractor will replace at its own cost any material, which cannot be accounted for in the storage yard inventory.

If asphalt materials are hauled directly from the delivery point for immediate application to the roadway, the material will be measured by mass or volumetrically by the Ministry Representative at the time of delivery. The Contractor shall ensure that an acceptable means of measurement is available.

**145.16.03 Distribution of Materials** - To control distribution of Ministry supplied materials (except asphalt materials as provided in Sections 501 and 951) and to facilitate accounting:



a) the Contractor shall arrange for delivery of the materials only after applying for and receiving authority to do so on "Authority to Arrange for Delivery of Construction Materials" form (H0313). The requirements of the Contractor shall be indicated on Part "A" of the form. Approval from the Ministry Representative shall be indicated on Part "B" of the form. The Contractor may then arrange for delivery from the supplier. As delivery will be made only on receipt of the purchase order number and the serial number of the "Authority" form, the Contractor shall arrange with the Ministry Representative to immediately distribute appropriate copies of the "Authority" form.

Material suppliers will be required to notify both the Ministry Representative and the Contractor when materials are shipped, giving sufficient information to identify each and every shipment against an appropriate "Authority" form serial number and purchase order number.

b) The use of "Authority" form shall not in any way relieve the Contractor of any responsibility imposed under Subsection 145.16.02.

c) If the Ministry Representative refuses to authorize the delivery of materials to the job, the Ministry Representative will send the refusal, with reasons in writing, to the Contractor.

d) The Ministry may, at the completion of the Work, if materials are delivered in excess of job requirements through conditions beyond the control of the Contractor, take over the surplus material or grant the Contractor the option of purchasing the material on Site. The transaction will be completed only after the Contractor obtains for the Ministry Representative, a supplier's credit note for the total cost to the Ministry of the excess material purchased f.o.b. at the delivery point.

Upon completion of the Work, the Contractor will deliver all unused materials, which have been purchased by the Ministry, to a location as specified by the Ministry Representative. No payment will be made for this portion of the Work.

**145.17 Operation of Pavement Brooms on Highway** - No mechanical pavement broom shall be operated on any highway without a rotating amber flashing light in operation. The light shall be mounted on self-propelled brooms and upon the towing vehicle of trailer type brooms.

Traffic Control is to be in accordance with the Traffic Control Manual for Work on Roadways. In addition, on extremely winding narrow roads an additional shadow vehicle shall be used ahead of the broom with a C-37 on the

front of the vehicle and a flashing arrow in bar mode.

#### **145.18 Supply and Maintain Facilities**

**145.18.01 Working Office** - When required under Special Provisions, the Contractor shall provide a suitable working office with lock-up for the sole use of the Ministry. The office shall meet the requirements of Appendix A and be weatherproof, reasonably soundproof, and have ample window area and ventilation. Location of the office shall be determined by the Ministry Representative.

The Contractor shall regularly collect refuse and keep the office clean and properly maintained with heat and light.

The office and contents shall be for the use of the Ministry for the duration of the Work and may if necessary be used concurrently with the other inspection agencies.

The Contractor shall supply a private telephone line for the sole use of the Ministry Representative. Ministry's long distance calls will be paid for by the Ministry.

Payment for the Ministry's Site Office (when requested) will be made at the Lump Sum price in the Agreement.

Payment will include the provision of the office, furnishings, maintenance through out the Term, and removal in its entirety.

Payment of 50% of the Lump Sum will be made when the office is ready for occupancy and the remaining 50% after the office has been removed and the Site cleaned up to the satisfaction of the Ministry Representative.

**145.18.02 Testing Facility** - When required by the Special Provisions, the Contractor shall provide the Ministry with a material testing facility with a minimum of 12 m<sup>2</sup> floor space either in the form of a small trailer or the portion of a large trailer. The testing facility shall include power, light, heat, ventilation, plus basic furniture to permit testing and preparation of test records. The facility shall be stable, reasonably quiet and lockable.

Payment for the Ministry's Material Testing facility (when required) will be made at the Lump Sum price in the Agreement.

Payment will include the provision of the facility, furnishings, maintenance through out the Term, and removal in its entirety.

Payment of 50% of the Lump Sum will be made when the facility is ready for occupancy and the remaining 50% after it has been removed and the Site cleaned up to the satisfaction of the Ministry Representative.



## SECTION 145

**145.18.03 Service for Ministry Facilities** – Where the Ministry provides its own facilities on Site, the Contractor shall, for the duration of the Contract, provide light and heat and any other services requested by the Ministry Representative for same, and the Contractor will be compensated on a Force Account Basis.

**145.18.04 Weigh Scale** - The Contractor shall provide a truck weigh scale wherever measurement of materials by mass is required.

The weigh scale shall be an approved electronic weigh scale or platform type with remote balancing beam. The scale shall be of sufficient size and capacity to weigh, at a single pass, the largest, rigid-framed haulage vehicle to be used on the job and in any case shall be of not less than 13 t (tonne) capacity. The scale shall be capable of weighing all loads to within 20 kg of the true mass.

At the start of the Work, and as frequently as the Ministry Representative may deem necessary in order to ensure the accuracy, the scale shall be calibrated and checked at the Contractor's expense by an Inspector of Weights and Measures.

The remote balancing beam shall be enclosed in a sound, watertight, dust-free scale house, properly ventilated and insulated. Adequate heating must be provided when the shade temperature is below 16°C.

The scale house shall be provided with full length windows facing the scale platform, and windows shall also be provided at either end, so that both the Contractor's scaleperson and the Ministry Representative's scale checker can at all times see vehicles to be weighed, not only on the scale but also approaching and leaving.

The front window shall be sufficiently large and low that the whole scale platform is readily visible to the Ministry Representative's checker. Immediately behind the balancing beam, a bench or table of sufficient length shall be provided to permit both scaleperson and checker to sit abreast in a position in which they can both write on the table and view the electronic scale or weigh beam and scale platform. Drawing [SP145-01](#) shows these requirements.

The Contractor shall supply and maintain, at no additional expense to the Ministry, portable washroom facilities at the weigh scale site.

Payment for the weigh scale and ancillary facilities shall be incidental to the Unit Prices of the materials being weighed.

**145.19 Weighing Materials** - The Contractor shall supply, at no additional expense to the Ministry, a qualified scaleperson to carry out the necessary weighing which will

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

be monitored by the Ministry Representative's scaleperson.

A weighing certificate prepared in triplicate, certified by the Ministry Representative's scaleperson, will be issued for each load. The required certificate will be supplied by the Ministry. The Contractor will be paid only for such material as has been acknowledged by the Ministry Representative's checker as having been received at the point of delivery designated by the Ministry Representative.

The delivery receipts will bear the signature, initials or other approved marking of the issuing Ministry Representative's scaleperson and receiving checker.

If the Contractor has an automated scale and the following conditions are being met, the Contractor shall not be required to supply a scaleperson:

- a) All weighed material is being delivered to a single Ministry job site. If the Contractor is delivering to two or more Ministry job sites at the same time, the Contractor shall supply a scaleperson as detailed in the first paragraph.
- b) Truck operators do not require instruction.
- c) There are no overloads, tarp covering, spillage difficulties, or any safety problems.
- d) The scale platform is maintained by the Contractor to be clean and free from loose material at all times.

Should any of the above four conditions not be met, the Contractor shall provide a qualified scaleperson upon the instruction of the Ministry Representative.

In the event the Ministry Representative determines a scaleperson is not required, all weighed vehicles must be tared by both the Ministry Representative and the Contractor together once a day. In the event that any of the above conditions are not being met, at any time during the Term, in the opinion of the Ministry Representative, then the Contractor shall supply a scaleperson as detailed in the first paragraph.

**145.20 Weather** - No work shall be undertaken by the Contractor when, in the opinion of the Ministry Representative, the weather is unsuitable or unfavourable for that particular class of work. Time lost by the Contractor due to stoppage on account of adverse weather, when such stoppage is requested by the Ministry Representative and where the circumstances meet the requirements of the Construction Agreement, may be granted to the Contractor as an Extension of Time. The Contractor shall not be entitled to make any claim for damages due to such delay.



**145.21 Layout of Work and Calculation of Quantities-** A number of key reference points of control line (primary) for the establishment of the design control line will be provided by the Ministry to enable the Contractor to lay out the Work. The Contractor shall assume full responsibility for the alignment, dimensions and elevations of each and every part of the work and their mutual agreement.

**145.21.01 Ministry Responsibilities** - The Ministry will survey the original ground line, and any subsequent material horizons, for determination of appropriate pay item quantities.

Where the Ministry has a pre-existing survey of the Site, the Ministry may use that survey as the original ground. If the Ministry elects to use such a survey, the Ministry Representative will notify the Contractor of such intent and give the Contractor an opportunity to view the cross-sections, contours, or Digital Terrain Model. Any areas of the survey or model that do not adequately reflect the Site at the start of construction will be identified by the Contractor or the Ministry and will be resurveyed by the Ministry prior to the Contractor starting work in any affected area of the Site.

Unless otherwise specified in the Agreement, calculation of quantities will be on a neat line basis, as calculated from the design lines shown on the Plans, adjusted to incorporate design changes and field-fits authorized by the Ministry Representative. Any material placed or excavated beyond the design lines is considered Unauthorized Work.

For items such as Type D excavation where the upper boundary of a cut cannot be determined until the completion of stripping, the design line will be revised to reflect the actual bottom of stripping line as determined by the Ministry's survey.

Quantities calculated from digital terrain models will be done using average-end-areas based on cross-sections extracted from the model or, at the Ministry Representatives option, by using prismatic volumes between surfaces in the model.

Where agreeable with the Contractor, alternate methods of determining payment quantities may be employed.

The Contractor may be required to adjust its construction activities from time to time to allow the Ministry's measurement work to proceed unencumbered. The Contractor shall not proceed with the next stage of any construction until the Ministry has completed measurements of the previous work.

Quality Assurance and checking of layout may be performed by the Ministry Representative.

**145.21.02 Contractor's Responsibilities** - The Contractor shall perform all layout of the work and all other survey work required to execute the Contract and construct the works in accordance with the Agreement.

The Contractor shall be responsible for establishing all secondary control points and/or lines, all slope stakes, the establishment of line and grades for subgrade and the various granular aggregate layers, layout by line and grade of all structures, culverts, and underground utilities, and shall perform all other layout and measurement necessary for the proper execution of the Contract.

The staking of all works shall be of a sufficient accuracy and frequency for the Ministry to carry out its quantity measurements and quality assurance program.

On request of the Ministry Representative, the Contractor shall submit documentation to verify the accuracy of the layout work.

The Contractor shall be satisfied, before commencing any Work, as to the meaning, intent and accuracy of any control points, control lines and benchmarks established by the Ministry.

Should the Contractor discover or suspect any errors in any control points, control lines, benchmarks, and data provided by the Ministry, the Contractor shall at once discontinue the affected work until such errors are investigated by the Ministry Representative and, if necessary, rectified.

No separate payment will be made for layout work and the cost thereof will be considered incidental to the various items of work to be performed in the Contract.

The Work shall be so laid out and constructed that the location of substructure elements and anchor bolt groups shall not differ from the true positions by more than the following amounts:

- a) Substructure elements - 12 mm
- b) Anchor bolt groups - 6 mm.
- c) The elevation of bridge seats shall not differ from true elevations by more than 3 mm.

Any deviation beyond the above mentioned tolerances shall be satisfactorily corrected by the Contractor at the Contractor's expense.

The Contractor shall furnish the Ministry Representative or any of the Ministry Representative's assistants with any reasonable help which the Ministry Representative or assistants may require at any time in driving stakes or in



## SECTION 145

setting out the Work.

**145.22 Access to Site** - The Contractor shall provide access to the Site as may be necessary. No separate payment will be made for the provision of any access roads or incidental works in connection therewith.

The Contractor shall make arrangements with the property owners adjacent to and around the terminal site for the use of access and for the use of any storage areas the Contractor may require. The Contractor shall acquire such access and storage rights at the Contractor's expense.

In the event of roads being temporarily closed to the travelling public, the Contractor shall, at the Contractor's expense, provide, erect and maintain all requisite barriers, fences or other proper protection and must provide, keep and maintain such patrollers, lights and danger signals as may be necessary, or as may be required by the Ministry Representative to ensure safety to the public and to the workers.

The Contractor, during the Contractor's operations, must also provide and maintain reasonable road access and egress to property fronting along or in the vicinity of the work under contract, unless other means of road access exists. The Ministry Representative will be the sole judge as to what may be deemed reasonable road access.

**145.23 Accommodation of Traffic** - The Contractor shall cause as little inconvenience as possible to the travelling public during the Contractor's operations and shall erect and maintain proper and adequate barricades, traffic signs, lights and other traffic control devices as may be considered necessary, in the opinion of the Ministry Representative, for the safety of both workers and public traffic.

All barricades, traffic signs, lights and other control devices shall be provided at the Contractor's expense, and shall be erected in accordance with, and otherwise conform to the standards as set out in the Ministry's "Traffic Control Manual for Work on Roadways", Special Provisions and Standard Specifications.

**145.23.01 Maintenance of Traffic** - The Contractor shall comply with the requirements of the Highways Act and amendments thereto and such other Acts, By-Laws or Regulations as are in force for the governing and regulating of traffic or use of any road upon or over which it is necessary to do work or transport materials. The Contractor must arrange to keep roads open to traffic at all times and must cause as little inconvenience as possible to the travelling public.

**145.23.02 Road Closure Notification** - Road closures shall not be permitted until the Contractor requests and receives

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

written permission from the appropriate authority in the Ministry of Transportation. This request shall be submitted in writing not less than seven days in advance of the closure.

Upon receiving written permission for closure, the Contractor shall notify the local police, fire, ambulance, municipality, school board, and public transit at least 72 hours in advance of the closure.

The Contractor shall notify the public by local radio and newspaper at least 24 hours in advance of the closure.

All costs related to the above shall be for the Contractor's account.

**145.24 Alterations to Drawings and Plans** - It shall be understood that the Drawings and Plans represent the nature and general layout of the work to be executed and not necessarily the works exactly as they will be carried out. The Ministry Representative will, without invalidating the Contract, be at liberty to make any reasonable alteration or to furnish any additional or amended Drawings which do not radically change the type of construction.

Payment for any such altered Work will be at the rates set forth in the Schedule 7 Approximate Quantities and Unit Prices.

**145.24.01 Adherence to Drawings** - The various parts of the Work shall be built in strict accordance with the furnished Drawings and with any supplementary Drawings which may be furnished during the progress of the Work as occasion requires.

Special Provisions, special specifications, Standard Specifications and the Drawings/Plans are to be considered as explanatory of each other, but should anything appear in one that is not described in the other, or should any discrepancy appear, no advantage shall be taken of such omission or discrepancy and the decision of the Ministry Representative as to the true intent and meaning of the Special Provisions, special specifications, Standard Specifications and the Drawings in such instances shall be final and binding, it being clearly understood that the Contractor is to execute all the works requisite for the perfect completion of each and all of the several parts of the Work according to the true intent and meaning of Agreement.

On all Drawings, in case of any discrepancy between the figured dimensions and the scaled dimensions, the figured dimensions shall govern.

**145.25 Use of Explosives** - In using explosives the Contractor shall exercise the utmost care so as not to endanger life or property and, whenever directed, the



number and size of the charges shall be reduced. Before doing any blasting the Contractor shall ascertain if there are in the neighbourhood any railway, power or other lines, water or other pipes, etc., which are likely to be in danger of being damaged. The Contractor shall give to the owner of such lines, pipes or other works timely notice of the intention to blast.

Whenever possible electric batteries shall be employed for simultaneous blasting.

The storage of explosives shall be in accordance with the regulations of the Canada Explosives Act and with any requirements of the Representative of the Explosives Regulatory Division within the Mineral Technology Branch of the Minerals and Metals Sector of the Federal Department of the Natural Resources Canada.

**145.26 Work in Ministry Pits or Quarries** - When operating in a Ministry pit or quarry where the Ministry retains the role of Pit Manager, the Contractor shall comply with all provisions of the Mines Act, the Health, Safety and Reclamation Code for Mines in British Columbia, and/or the WCB Occupational Health & Safety Regulation, as applicable to the work undertaken.

The Contractor shall appoint a properly certified supervisor or shift boss in any Ministry pit or quarry where work is undertaken, in compliance with Section 26 of the Mines Act, and ensure that the supervisor or shift boss is duly certified in accordance with Section 1.13 of the Health, Safety and Reclamation Code for Mines in British Columbia.

When the Contractor is operating in a Ministry pit or quarry, the Contractor shall utilize the pit or quarry in accordance with the Ministry Pit Development Plan or obtain written approval from the Ministry Project Manager prior to deviating from the plan.

When investigating private aggregate sources, the Contractor shall ensure that all permits are in place allowing the Contractor to purchase and remove the aggregate from the property of the Owner.

Availability and use of the listed reserves or any other private aggregate source must be arranged by the Contractor. Prior to the removal of any aggregate material from an aggregate source, the Contractor shall provide a written notice from the owner authorizing the Contractor to remove aggregate material for use in the work.

Ministry of Transportation pits or quarries may be used without charge, provided they are utilized, worked and maintained in accordance with the Standard Specifications and the Ministry's development plans. Prior to the removal of any aggregate material, the Contractor shall obtain written

approval from the local District Highways Manager. No warranty is given or implied that the source of aggregate material from the Ministry pits or quarries will meet requirements or requisite quantities.

The Contractor shall contact the Road and Bridge Maintenance Contractor a minimum of two (2) weeks before the date the Contractor anticipates the use of any Ministry pits or quarries.

The Contractor and the Road and Bridge Maintenance Contractor shall co-ordinate their activities and schedule usage of the pit among themselves and any other affected parties.

The following listed Variances to the Health, Safety and Reclamation code for Mines in British Columbia will apply only to pits and quarry operations which fall under the Ministry of Transportation ownership.

The Chief Inspector of Mines has provided the following clarifications to the Ministry in a letter dated August 9, 1999:

**Application for Continuation of Variance to Mine Code  
Section 1.5.1 - Hours of Employment**

*"Pursuant to section 13 of the Mines Act, R.S.B.C. 1996, c293, the assigned Ministry of Transportation (MoT) Pit Manager may permit the employment of persons in a sand and gravel pit or quarry (Mine) for up to 12 hours in a 24 hour period.*

*This variance applies only to pits managed by the MoT (Ministry of Transportation).*

*The Pit Manager shall communicate this variance to all affected workers, whether employees of the Ministry of Transportation, its contractors or sub-contractors.*

*This variance is subject to review within five years as provided by section 13(4) of the Mines Act.*

*A copy of this variance is available to any MoT regional or district Occupational Health and Safety Committees which may be involved in sand and gravel pit or quarry operations."*

**Section 4.9.1 – Health, Safety and Reclamation Code for  
Mines in British Columbia (Code)**

*"Due to the short period of time that some haul trucks spend at your various pits and quarries, i.e. for loading purposes only, I am hereby enabling a Health and Safety Inspector of the Mines Branch to vary the requirement for automatic back-up alarms on transient haul trucks at the discretion of the Inspector. If, in the opinion of the Inspector, the time spent by the truck at the pit or quarry*



## SECTION 145

*is of short duration, and the required routing of the truck for loading purposes is such that no hazards are created by such a routing, then an automatic back-up alarm need not be required and the use of any audio warning device will be accepted while in reverse."*

*"You are reminded that the above refers only to transient haul trucks and not to trucks used for production purposes; neither does it apply to any other vehicle in excess of 7,000 kg gross vehicle weight."*

### **Section 4.9.5 - Health, Safety and Reclamation Code for Mines in British Columbia (Code)**

*As a haul truck driver's visibility of the area surrounding the truck tends to improve as the size of the truck decreases, I am prepared to allow a variance to the above section of the Code as follows:*

*"Provided that any haul truck used for production purposes at a gravel pit or quarry does not exceed 45 tonnes gross vehicle weight, there will be no requirement for the attachment of a whip antenna fitted with a flag and lamp, or a flashing light mounted on the cab of non-production vehicles."*

**145.26.01 Available Ministry Sources** - The Contractor, by entering an available source, will be deemed to have accepted all obligations, risks and costs for the production of aggregate meeting the contract requirements, just as if the pit or quarry was private. No warranty is given that the source will meet the quality and quantity requirements. The Contractor, without any additional compensation, shall provide whatever selection, screening, crushing, mixing, blending or other processing of any kind may be required to produce aggregate meeting all requirements for its intended use, including but not limited to:

- specified aggregate gradation,
- fracture count,
- aggregate quality requirements such as but not limited to those set out in Subsection 202.04.02 and Table 501-D of Section 501 as applicable, and
- the specified properties of any products into which the aggregate is to be incorporated.

The Contractor shall comply with the Ministry pit development plan and the Ministry Representative's directions regarding the location of material extraction within the pit by the Contractor.

The Contractor's use of Ministry pits is limited to the extraction of previously unexcavated material from the bank, for the supply of materials for use on this Contract.

The Ministry's Road and Bridge Maintenance Contractor has certain rights and obligations with respect to some Ministry pits, and the Contractor shall coordinate its

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

activities with those of that contractor, where applicable, and with any other users, to the satisfaction of the Ministry Representative and the Ministry's District Highways Manager.

Except where specifically stated otherwise in the Special Provisions, no separate payment will be made for clearing, grubbing, disposal or relocation of stockpiles, debris or contaminated materials, or for any other costs of site preparation, pit development, or access, or for any delay or other cost arising from the use of Ministry pits by others, and all costs thereof shall be covered in the prices for the Items under which payment is provided for the applicable materials.

**145.27 Highway Right-of-Way** - The Contractor shall confine its operations to the highway right-of-way and Licences to Construct as shown on the Drawings. Any land, property or water lot outside these boundaries required for construction yards, access roads, disposal or storage areas, or other operations of the Contractor, shall be acquired by the Contractor at no additional expense to the Ministry. The Contractor shall make arrangements for the use and compensation of such land with the titled land owner.

Work within the Site shall be confined to that necessary to construct the Project to the lines and grades specified. Excavation outside the design lines and grades to extract aggregates or for other purposes is prohibited unless authorized in advance by the Ministry Representative.

**145.27.02 Disposal Site Outside the Right-of-Way** - Waste, or other materials specified or designated by the Ministry's Representative to be disposed of, such as, but not limited to clearing and grubbing materials, fences, old culverts, old concrete and asphalt, etc., shall be removed from the Site to a disposal site provided by the Contractor. All disposal sites shall be the responsibility of the Contractor.

The Contractor shall ensure that the disposal site complies with all Federal, Provincial, Municipal and Regional by-laws and regulations prior to disposing of the material. Any fees incurred shall be paid by the Contractor. The Contractor must provide documented proof to the Ministry Representative for the use of the selected disposal site.

In addition, the Contractor shall ensure that the disposal site complies with all municipal and regional government by-laws and regulations and, when relying upon any exemption permitted under section 2(d) of the *Agricultural Land Reserve Permit Regulation*, shall provide a written confirmation from the Regional District of their agreement that no permit is required.

**145.27.03 Access Roads to Private and Public Lands** - The Contractor shall not block or impede the use of any



private access roads or driveways during the Work of this Contract without the consent of the Ministry Representative.

The Contractor shall schedule any anticipated closure of an access with the property owner to minimize impact on the owner.

**145.27.04 Private Land Reserves** - Excavated or construction material shall not be deposited on land outside the right-of-way. Borrow material shall not be obtained from land outside the right-of-way, without prior approval from the titled land owner. In addition, lands located within an Agriculture Land Reserve require the approval from the B.C. Agricultural Land Commission and issuance of a valid permit under the Soil Conservation Act.

**145.28 Protection of Land Subdivision Monuments, Roads and Property**

**145.28.01 Protection of Subdivision Monuments** - The Contractor shall protect, preserve, and keep uncovered all land subdivision monuments or property marks during its construction activities which may cause disturbance to them. At points where construction activities will cover or destroy any land subdivision monuments or property marks, the Contractor shall be responsible for their protection from disturbance until their positions have been referenced. The Contractor shall not remove them until so directed by the Ministry Representative.

**145.28.02 Protection of Survey Monuments** - The Contractor shall be responsible for the preservation during construction of all geodetic benchmarks, survey monuments and property markers on the right-of-way. The Contractor shall use, at no additional expense to the Ministry, a British Columbia Land Surveyor to replace any survey monuments destroyed or damaged as a result of the Contractor's negligence. At locations where construction work will cover or destroy such markers, the Contractor shall not move or remove them until written direction is received from the Ministry Representative.

**145.28.03 Protection of Roads** - The Contractor shall ensure all equipment working on or hauling material on to and from the Site does not damage or deposit material onto any part of an existing roadway. Materials spilled onto the public roadways or driveways opened to public traffic shall be cleaned up immediately. The Contractor has the full responsibility to repair any damage to existing highways, local roads and driveways caused by its construction equipment and/or operations.

**145.28.04 Protection of Railway Property** - The Contractor shall be wholly responsible for any damage to railway trackage or property on the railway company's right-of-way resulting from highway construction operations. It

shall be the Contractor's responsibility that all workers and persons employed by the Contractor or the Contractor's agents, or under the Contractor's control, shall use due care that no person or property is injured, and that no rights are infringed in performing the work. The Contractor shall compensate injured parties.

All costs for employment of traffic control persons or other personnel required for the protection of the railway trackage or property shall be the responsibility of the Contractor. Where it is found necessary to re-route any telegraph or telephone lines during the course of operations, or where it is found necessary to make repairs to such installations as a result of contract operations, such re-routing or repair work shall be the responsibility of the Contractor, and shall be for the Contractor's account.

Any costs borne directly by or billed directly to the Ministry which relate to the above responsibilities will be charged to the Contractor with a surcharge of 20%.

The Contractor shall restore and clean all slopes between the highway and the railway track together with any fences, ditches and drains disturbed by the work to the satisfaction of the Ministry Representative.

The Contractor shall give advance notice to the railway company prior to carrying out any work on the railway right-of-way and shall not proceed without specific coordination with the railway company and its schedule, and notice to the Ministry Representative.

**145.28.05 Construction Stakes, Monuments, Bench Marks and Tide Gauge** - The Contractor shall set, as the Ministry Representative may direct and as is necessary for the proper layout of the Work, monuments and bench marks of concrete or other material sufficiently permanent and rigid to remain intact during the duration of the Work. The Contractor shall particularly avoid destroying or disturbing such monuments or construction stakes and, should such destruction be unavoidable, shall notify the Ministry Representative in advance so that the points may be properly referenced and re-established.

**145.28.06 Protection and Restoration of Property and Environment** - The Contractor shall not enter upon private property for any purpose without first obtaining permission of the owner of that property and shall be responsible for the preservation of public property along and adjacent to the Work, and shall use every reasonable precaution necessary to prevent damage or injury thereto.

The Contractor shall be liable for all damages caused by fire started by the Contractor and shall, under no circumstances start fires without first securing the required permits and approval of authorities having jurisdiction even though it



## SECTION 145

may be ordered or required to do such burning.

The Contractor shall take special care when burning brush, stumps or rubbish not to damages any standing trees, shrubs or other property and to use when practicable smokeless burning methods.

**145.29 Haul Routes and Overloads** - The Contractor shall be responsible for ascertaining that the Contractor's haul routes are acceptable to the authority having jurisdiction for highway loading.

Overweight or oversize vehicles are not permitted to use existing highway as a haul road for the hauling of construction materials, notwithstanding Section 7.01 of the Commercial Transport Regulation 1980 Consolidation, as amended from time to time.

Off-highway equipment may be permitted to cross the existing highway only at specific locations as approved by the Ministry Representative.

Once the crushed granular base, surfacing or pavement work has commenced on any portion of the new, reconstructed or relocated highway, no overloads will be permitted on that portion unless written approval is given by the Ministry Representative.

### 145.30 Health and Safety

**145.30.01 Occupational Health and Safety Program** - The Contractor shall provide an Occupational Health and Safety Program at the time of the pre-construction meeting and have it in place prior to the commencement of any Work. The Contractor shall provide evidence that an Occupational Health and Safety Program is in place at the pre-construction meeting.

Any delays in commencement of the Work related to acceptance of the Contract and site specifics of the Contractor's Occupational Health and Safety Program or interruptions of the Work related to the implementation of the Occupational Health and Safety Program are not Reimbursable Delays unless otherwise agreed to in writing by the Ministry Representative.

**145.30.02 Worksite Hazards** - The Contractor has the responsibility to identify worksite hazards and shall develop operational occupational safety policies and procedures and plans which are specific to the Work to ensure the safety of all persons at the Site and the travelling public passing through the Site.

When requested by the Ministry Representative, the Contractor shall provide copies of any safety policies, procedures or plans verifying steps have been taken to make

## GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE CONSTRUCTION

all concerned fully aware of all hazards or unsafe conditions in accordance to Section 135 - Construction Site Safety.

The Contractor shall provide for the safety, protection and convenience of the general public and residents along the highway.

The Contractor shall erect and maintain signs, fences and barricades at the ends of the bridges before they are opened to traffic and at other dangerous areas of the Project, as necessary to prevent access of vehicles and pedestrians to the unfinished bridge and other dangerous areas.

**145.30.03 Equipment** - All trucks and other equipment used by the Contractor whether owned or rented for use on the Project shall meet manufacture's specifications for its purpose.

All trucks and other equipment rented by the Contractor for use on the Project shall when practicable be qualified local trucks obtained from local residents.

For the purposes of this Section, qualified local truck means a truck that meets all the following:

- a) a truck that has Motor Carrier approval.
- b) where the Contractor has a collective agreement with its employees the truck operator is a member of, or has the permission of the appropriate bargaining unit.
- c) the truck fulfils, in the opinion of the Ministry Representative, the specialized needs of the Contractor.
- d) a truck registered on the Ministry's Hired Equipment list for the geographic area encompassing the Site to in adjacent areas.

Hire of trucks and other equipment paid on a production rate basis constitutes a Subcontract.

**145.30.04 Audible Back Up Warning Device** - All haul vehicles shall be equipped with an automatic audible warning device which will activate whenever the vehicle is backing up. The warning device shall be clearly audible above the ambient noise level at a minimum distance of 6 m from the back of the vehicle

**145.31 Faulty Work** - If there is evidence of any fault, defect, or injury from any cause whatever, which may adversely affect the strength, durability, safety, maintenance, or appearance of any section of the work, the Contractor shall, at the Contractor's expense, satisfactorily correct such faults or, if required, shall replace as much of said section as the Ministry Representative may deem necessary, even to the extent of replacing the entire section. The fact that the



inspector in charge may have previously overlooked such defective work shall not constitute an acceptance of any part of it.

Upon failure of the Contractor to comply promptly with any order of the Ministry Representative made under the provisions of this Section, the Ministry Representative will have authority to cause defective work to be remedied or removed and replaced and to deduct the costs thereof from any monies due or to become due to the Contractor.

**145.32 Temporary Excavation** - Where temporary excavations are undertaken in the course of the Work, the Contractor shall be responsible for maintaining the stability of adjacent ground and all structures and other works thereon, and for the cost of any temporary works which it provides for this purpose for which payment is not expressly provided in the Contract

### **145.33 General Sign Requirements**

**145.33.01 Contractor Identification Signs** - The Contractor may supply and install contractor identification signs for the Term. The Contractor shall maintain and remove such signs and all costs of supply, installation, maintenance and removal shall be the responsibility of the Contractor.

The contractor identification sign shall display only the Contractor's company name and beneath it the word "Information" followed by a telephone number which directly connects any caller to the Contractor's personnel who are familiar with, and are currently active on the Project.

The sign will not be reflectorized, and the background colour will not be either red, yellow or orange. The sign dimensions will not exceed 2,400 mm horizontal and 1,200 mm vertical, and the text size (height) will not be less than 150 mm.

The contractor identification sign will be erected only in conjunction with the C-35 project identification sign, and

will not be in advance of or at the same location as the C-35 sign. Where there is no C-35 sign, no contractor identification sign will be permitted.

No contractor identification sign may be installed without prior approval of both the sign and the intended installation and location by the Ministry Representative who, in determining whether or not to grant such approval, will not necessarily be limited to the requirements set out above.

**145.33.02 Prime Contractor Sign** - When designated as the Prime Contractor, the Contractor shall provide "Prime Contractor" sign as specified in Section 135 Construction Site Safety.

**145.33.03 Traffic Control Signs** – The Contractor is required to use the appropriate encapsulating or prismatic lens sheeting on the following traffic control signs in the work zone:

- a) encapsulating lens sheeting (identified by the "honeycomb" pattern) on:
  - C-2 ..... Survey Crew/Speed Limit;
  - C-4 ..... Crew Working;
  - C-15 & C-16 .. Temporary Slow & Hazard Marker;
  - C-36 ..... Survey Crew; and
- b) prismatic lens sheeting (identified by the diamond shaped pattern) on:
  - C-27 ..... Stop/Slow Paddle.

All the above traffic control signs shall meet current Ministry specifications. The Ministry Specifications for Standard Highway Sign Materials, Fabrication and Supply are located on our Ministry web page at:

**[www.th.gov.bc.ca/publications/eng\\_publications/geomet/geometsigns.htm](http://www.th.gov.bc.ca/publications/eng_publications/geomet/geometsigns.htm)**

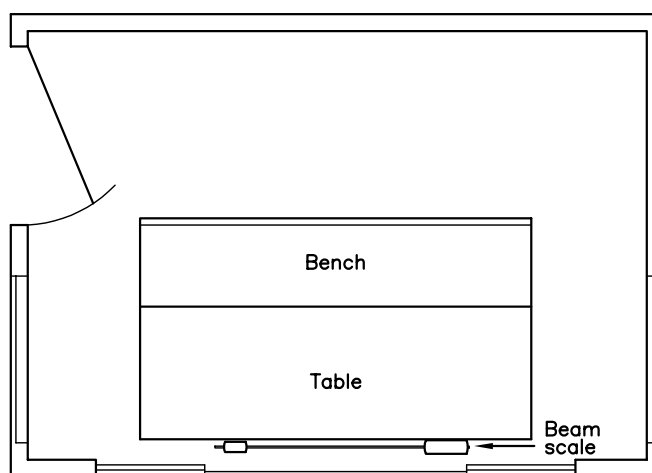
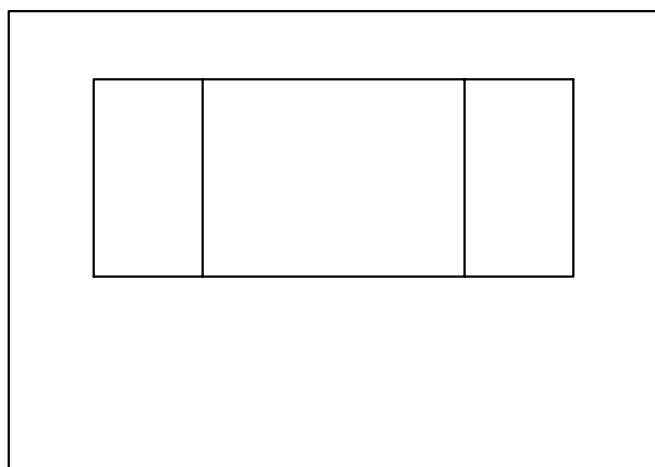
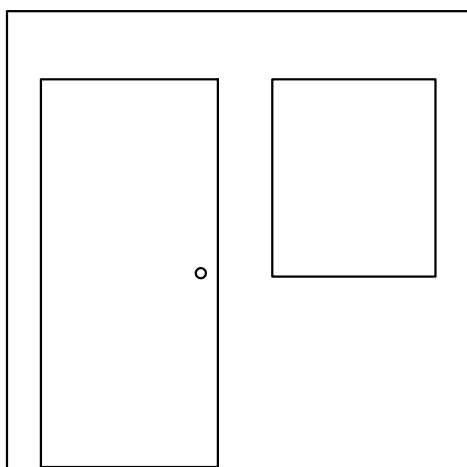
All costs to provide, replace and use the required control signs in the work zone will be included in related work items and no additional compensation will be made.



**APPENDIX A****Ministry Office Requirements**

<b>REQUIREMENTS FOR OFFICE TYPES</b>			
<b>Office Type</b>	<b>A</b>	<b>B</b>	<b>C</b>
Lockable desk/chair	1	2	3
Typist desk/chair	-	-	1
Drafting table 1.2 m x 2.4 m /stool	1	1	1
Reference table 1.2 m <sup>2</sup>	-	1	3
Conference table 1.2 m x 2.4 m	-	-	1
Additional chairs	2	2	9
Plan case or drawing storage unit	1	1	2
Filing cabinet (# drawers)	1 - 2 drawers	1 - 4 drawers	3 - 4 drawers
Shelving bookcase m <sup>2</sup>	2	5	20
Fire Extinguisher for Class A, B and C fires	1 - 5 kg	1 - 5 kg	2 - 5 kg
Supply Activated Telephones and Lines	One (1)	One (1)	Three (3) on two (2) lines with external bell and switch
Toilet	On site	On site	In washroom, hot and cold running potable water and wash basin
First Aid Kit	On site	#1 Unit Kit	#1 Unit Kit
<b>Floor Areas - m<sup>2</sup></b>			
a) Entrance	-	-	5
b) Ministry Representative's office	12	12	12
c) Additional Staff office	-	8	20
d) Wash room	-	-	As required
e) Store room	-	-	5



**NOTES:**

1. MINIMUM SIZE IS 2100 mm BY 3000 mm
2. INSULATED AND VENTILATED
3. ADEQUATELY HEATED WHEN SHADE TEMPERATURE IS BELOW 16°C

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 165

### PROTECTION OF THE ENVIRONMENT

**165.01 General** - This Section covers the general and specific provisions for the protection of the environment under the direction of the Ministry Representative, in cooperation with any Federal and/or Provincial Environment officers or an Environmental Monitor, as designated in the Special Provisions.

**165.01.01 Intent of Specifications** - These Specifications give the Ministry or its Agent the right to exercise control over environmental aspects of the work. The Contractor shall adhere to specific instructions if the work may result in an adverse impact on the environment.

The Ministry will determine the significance of environmental impacts in consultation with Environmental Agencies. The Ministry reserves the right of approval over the general methods employed by the Contractor in the performance of the work, but only insofar as they may affect relations with Environmental Agencies and the protection of aquatic and terrestrial resources, the health and safety of public, and protection of socio-community resources and features.

These specifications are for the protection of the environment, and shall be given such interpretation as will secure this intent.

**165.01.02 Definitions** - For the purposes of this Section, the following general terms are defined as follows:

“Compensation” refers to monetary payment or replacement in kind for environmental losses resulting from a development project, as well as the construction activities for the re-creation of lost or damaged habitat.

“Deleterious Substance or Material” is defined as a substance harmful to fish or fish habitat (Canada Fisheries Act, Section 34.1).

“Designated” shall mean designated in the Special Provisions or by the Ministry Representative.

“Environment” refers to the physical, biological, social, spiritual and cultural components that are interrelated and affect the growth and development of living organisms. The term “environment” in these specifications shall include socio-community issues and resources.

“Environmental Agencies” shall mean the appropriate regulating branches of the Federal and Provincial agencies responsible for the management and protection of the Environment and human resources. A partial listing of these agencies and their areas of concern is given in the joint publication “Land Development Guidelines for the

Protection of Aquatic Habitat”, Fisheries and Oceans Canada and Ministry of Environment, Lands and Parks (1992), hereafter referred to as the “Land Development Guidelines”.

The “Environmental Monitor” shall mean an agent hired by the Ministry to monitor the Contractor’s compliance with the environmental protection aspects of Standard Specifications, Special Provisions, permits and approvals, and to advise the Contractor and Ministry Representative on environmental problems. An Environmental Monitor will be used when and where required, and will report to the Ministry Representative.

“Environmental Approval” is defined as the written authority issued to a person or company by a government agency that allows the person or company to do something that otherwise may not be permitted by law or which is not defined in law. An environmental approval is a broad, generic term referring to informal or formal authorization for actions that may have an adverse effect on the environment, such as (i) undertaking an activity (e.g., authorization from fishery agencies to proceed with work within the wetted perimeter of a fish-bearing stream); or (ii) discharging some form of material (e.g., approval under the British Columbia Waste Management Act to introduce waste into the environment or the storage of special waste for a period of 12 months or less). The term “approval” can include related forms of authorization such as permits and licenses.

“Environmentally Sensitive Areas” shall mean areas requiring special management and attention to protect resources, habitat or species (which includes and is not limited to water quality, identified sensitive areas, fish and fish habitat, vegetation, rare and endangered flora/fauna, landscaping and visual aesthetics, soil conservation (including dust control), air quality and archaeological, heritage and cultural resources).

“Environmental Timing Window” shall mean any period suitable for environmentally sensitive construction work as designated by an Environmental Agency or other federal, provincial, municipal or local agency. This window represents the period that the natural or human environment is likely less susceptible to adverse impacts. A common example of an Environmental Timing Window on highway construction projects is a Fishery Timing Window. Timing windows may also be imposed for the protection of breeding birds, retention of significant recreational activities, maintenance of critical traffic patterns, etc.

“Fishery Timing Window” refers to the time period(s) of reduced risk for important commercial, sport, and resident



fish species, based on their life histories. The Fishery Timing Window is the time of year during which there are no fish eggs or alevins present in the substrates of local watercourses, and the period when fish migration (juvenile out-migration and adult spawning in-migration) is not occurring. This is generally the preferred period for (i) instream work or (ii) work adjacent to or over top of fish-bearing streams with the potential to create adverse impacts on fish or fish habitat.

"Habitats" are defined as those parts of the environment on which terrestrial and/or aquatic species depend, directly or indirectly, in order to carry out their life processes.

"Fisheries Sensitive Zone" is defined as the instream aquatic habitats, as well as out-of-stream supporting habitat features such as side channels, wetlands, and vegetated riparian areas adjacent to these features.

"Impact" is defined as an alteration, either positive or negative, to the environment brought about as a direct or indirect result of a highway project, including construction, operation and maintenance work (e.g., the consequence of a highway-related activity interacting with its surroundings).

"Mitigation" refers to a procedure or an action designed to avoid, reduce or control the severity, magnitude, duration and/or frequency of environmental impacts of a project through design alternatives, scheduling or other means.

"Permit" refers to a formal authorization, typically granted to proponents by an Environmental Agency, for discharging agreed upon quantities and types of regulated substances such as pollutants or waste. For example, under Section 8 of the British Columbia Waste Management Act, a permit may be issued to introduce waste into the environment or to store special waste subject to environmental protection requirements which are deemed advisable. The permit can specify the procedures or requirements respecting the handling, treatment, transportation, discharge or storage of waste that the holder of the permit must fulfill. The term "permit" can be defined by applicable legislation. The term "permit" is synonymous with the term "license", and the two terms are often used interchangeably.

"Riparian Area" is defined as the land adjacent to the normal high water level in a stream, river, lake or pond and extending to the portion of land that is directly influenced by the presence of adjacent ponded or channeled water, or a groundwater zone fed by surface water bodies (e.g., zone in which rooted vegetation is influenced). Riparian areas typically contain important vegetation resources which provide several critical functions for the survival of fish (e.g., protection from predators, shade for temperature regulation of the watercourse, and sources of food).

"Sedimentation" is defined as the deposition of material carried in water, usually as a result of a reduction in water velocity below the point at which material can be transported.

"Watercourses" shall apply to all bodies of water including streams, rivers, canals, ditches, lakes, ponds, and wetlands.

"Wetted Perimeter" is defined by Station number and/or as highlighted on the plan drawings.

**165.01.03 General Restraints for Watercourses and Groundwater** - The following general restraints in regard to the protection of any watercourse shall apply:

a) The Contractor shall place and/or dispose of all organic material, refuse, ash, petroleum products and other deleterious materials so as not to directly or indirectly pollute any watercourse or groundwater. The placement and disposal of all such products and materials shall be done in an environmentally acceptable manner.

b) Except as required by the Contract Documents, all inorganic material shall be placed and/or disposed of in a manner that does not obstruct or unduly disturb any permanent or seasonal watercourse. Any such obstruction or disturbance shall be restored to the original drainage pattern as reasonably required by the Ministry Representative. Any removal of inorganic material from a watercourse shall be done in a manner that minimizes adverse impacts and shall be carried out as directed by the Ministry Representative.

c) All activities within the wetted perimeter of any watercourse shall be kept to an absolute minimum. Machinery and equipment shall not be operated within the wetted perimeter of any watercourse other than under the authority of the Ministry Representative. An Environmental Monitor shall be present at the direction of the Ministry Representative during any work within the wetted perimeter of any watercourse on the Project.

The preceding requirements, a) through c), are considered incidental to the price bid for work under Contract and no other compensation will be made.

**165.01.04 Designated Streams and Designated Environmentally Sensitive Areas** - Any watercourse or environmentally sensitive area designated in the Special Provisions or by the Ministry Representative is subject to all of the restraints of this Section.

**165.02 Planning and Scheduling** - The Contractor shall carefully plan and schedule construction activities in a



manner that ensures the avoidance or absolute minimization of environmental damage. The Contractor shall be familiar with and be able to identify those areas and times which present environmental problems and shall prepare schedules and work methods accordingly. The Contractor shall forward a copy of each of the schedules to the Ministry Representative at least one week in advance of commencement of each of these operations, unless otherwise specified in the contract.

The Contractor, as directed by the Ministry Representative, shall provide an **Environmental Management Plan (EMP)** which describes in detail the approach to be taken in addressing environmental issues associated with the Project and the correlation of the EMP to the project schedule. The EMP will be structured according to the following format and will include, but not be limited to, the following:

- demonstrate understanding of the specific environmental issues involved with the Project,
- indicate an understanding of Ministry/Contractor responsibilities,
- include a sediment and drainage management plan,
- identify all the tasks required and clearly identify the duration and sequence of each task leading to the receipt of agency approvals, and
- indicate its linkage to the project schedule.

The EMP will clearly indicate how the Project will be undertaken to avoid negative impacts pertaining to, but not limited to, the following resources:

- water quality (including all surface and sub-surface sources),
- identified sensitive areas,
- fish and fish habitat,
- wildlife,
- vegetation (including riparian plant communities),
- rare and endangered flora/fauna,
- landscaping and visual aesthetics,
- soil conservation (including site stability, dust control),
- air quality, and
- archaeological, heritage, and cultural resources.

The Contractor, in consultation with the Ministry Representative, Environmental Monitor and the Environmental Agencies, shall be responsible for determining the conditions under which the work must be carried out in Environmentally Sensitive Areas, and for making all required on-site examinations and examinations of documents supplied and referenced by the Ministry in order to fully comprehend the environmental aspects of the work required.

#### **165.02.01 Environmental Legislation and Regulatory**

**Requirements** - The Contractor shall observe and comply with all federal, provincial, municipal and local laws and regulations which seek to ensure that construction work does not adversely affect the environment or social-community resources.

In the event of conflict between the requirements set out in these Specifications and quality control laws, statutes, regulations and ordinances of federal, provincial, municipal or local agencies, the more restrictive requirements or regulations shall apply. A violation of the environmental laws and regulations reported to the Ministry by the responsible agencies may result in the issuance of a non-conformance report. Should the situation warrant more stringent measures, it may also result in the issuance of an order to suspend work (e.g., a stop-work order) until the violation is corrected. The Contractor shall have no recourse for reimbursement due to delays or alterations to construction activities arising from such violations or the correction of such violations.

**165.02.02 Environmental Procedures** - The Ministry may require one or more detailed sets of environmental procedures for any work in and around Environmentally Sensitive Areas, such as critical fish habitat. When a set of environmental procedures is required, the Contractor shall prepare and submit the procedures for approval by the Ministry Representative and the Environmental Agencies prior to undertaking work in these areas. These detailed procedures shall supplement the EMP. The Contractor shall forward a copy of the approved set of procedures to the Ministry, prior to undertaking the work. The environmental procedures shall contain the following items:

- a) Existing environmental conditions. Identification of the environmental resources (e.g. fish species and habitat) in the area of the proposed work.
- b) Description of work proposed in the Environmentally Sensitive Area. Summary of the proposed work, equipment to be used, schedule of activities, and location.
- c) Environmental protection measures. Statement concerning the protective measures that will be used to protect environmental resources (e.g., species and habitat) from each anticipated adverse impact.
- d) Contingency plan. Description of alternative or backup plan in the event of an environmental emergency or failure of any of the protective measures.
- e) Environmental monitoring requirements. Indication of any specific or unique environmental monitoring requirements to ensure compliance with environmental



specifications and proper implementation of the environmental procedures.

The Contractor shall contact the Environmental Monitor and, if necessary, Fisheries and Oceans Canada (F&OC) and the Ministry of Water, Land and Air Protection for specific recommendations about the preparation of the environmental procedures. The environmental procedures must be approved by the Ministry Representative and the Environmental Agencies prior to commencement of work in Environmentally Sensitive Areas.

**165.02.03 Project Orientation** - The Contractor shall arrange regular meetings with the Ministry Representative, and, if employed, the Environmental Monitor. Other interested parties may be asked to attend (e.g., Agency Representatives), whose representation is necessary because of the specific type or location of work being undertaken. The purpose of such regular meetings will be to outline the schedule of upcoming construction and proposed activities, and to review the activities of the previous week. Such regular meetings do not relieve the Contractor from attending or arranging other types of meetings as required due to the nature or extent of the work being done.

The Contractor shall arrange and conduct such regular meetings during construction, subject to the following conditions:

- a) Meetings shall be held on a weekly basis when construction activities are to proceed during an Environmental Timing Window, during a period when work is to proceed in an Environmentally Sensitive Area, or during a period when the proposed construction activity elsewhere on a project is to proceed for a duration greater than two weeks and has the potential to cause adverse environmental impacts.
- b) During periods other than that specified above, regular environmental meetings shall be held every two weeks, or as otherwise agreed to by the Ministry Representative.
- c) In the event that the Environmental Monitor or the Ministry deem the Contractor's compliance regarding environmental requirements to be inadequate at any time during the Project, the frequency of the weekly or biweekly regular meetings shall be increased accordingly until the Environmental Monitor and the Ministry are satisfied with the Contractor's compliance rate.
- d) The Contractor's Environmental Representative will record highlights from the meetings (e.g., summary of major discussion items and key action items) and forward a copy to the Contractor, as well as include this

material in the Project Environmental Progress Reports.

- e) During the maintenance phase of the Project, the Contractor shall conduct regular environmental meetings with the Environmental Monitor on a quarterly basis, unless operations are to be conducted within Environmentally Sensitive Areas that pose potential environmental concerns. In the event that operations are to be conducted within such areas, the Contractor and Environmental Monitor shall conduct weekly environmental meetings for the duration of the maintenance work in such areas.

The Contractor is responsible for ensuring that the foreman, operators, and work crews (including any subcontractors) understand the specific environmental issues on the work site and their responsibilities under this Section. The Contractor's Environmental Representative will give all construction personnel a brief environmental orientation prior to such personnel commencing work in any Environmentally Sensitive Area on the Project. The Contractor's Environmental Representative will ensure that construction personnel are familiar with the environmental requirements and acceptable construction practices on the Project. The Contractor shall support the Contractor's Environmental Representative's role in this regard.

**165.02.04 Activity Within Designated Watercourses and Environmentally Sensitive Areas** - All activities that are conducted within the wetted perimeter of any designated watercourse or within other designated Environmentally Sensitive Areas must conform to the timing restrictions stated in the Special Provisions, and to the Environmental Timing Windows given in the approvals of the Environmental Agencies. Construction work must be scheduled so that all operations affecting the Fisheries Sensitive Zone or other designated Environmentally Sensitive Areas can be completed within these time periods. Prior to the commencement of any construction activities, all work in these areas must be approved by the Environmental Agencies and the Ministry Representative.

The Contractor must give at least 48 hours notice to the Ministry Representative in advance of any construction-related activity in designated areas. Construction activities within designated watercourses or other Environmentally Sensitive Areas shall not commence without the approval of the Environmental Monitor.

**165.02.05 Inclement Weather** - The Contractor shall cease operations, modify construction methods, or relocate to an alternative site within the project area during periods of inclement weather to avoid siltation of designated watercourses. If the Ministry Representative judges that the Contractor is not complying with the intent of this Section, the Ministry Representative may direct the Contractor as to



measures required without additional compensation for delays or alterations in the Contractor's work.

**165.02.06 Work Stoppage** - Prior to initiating work stoppages, the Contractor shall initiate and complete any mitigative and environmental protection measures required to safeguard the environment and the Project during work stoppages.

The Contractor shall give the Ministry Representative sufficient notice of impending shutdowns to enable the Ministry Representative, Contractor, and, if employed, the Environmental Monitor to examine the project. This notice shall be sufficient to permit the Contractor adequate time to install all necessary additional environmental mitigation measures as may be directed by the Ministry Representative.

The Contractor shall ensure the Environmental Monitor and construction personnel inspect Environmentally Sensitive Areas on the Project on a regular basis during any extended work stoppages (e.g., weekends, statutory holidays, Christmas vacation periods) to prevent environmental problems. If potential adverse environmental impacts are observed during work stoppage periods, the Contractor shall initiate and undertake any required environmental measures to avoid or minimize impacts.

### **165.03 Compliance, Enforcement and Payment**

**165.03.01 Temporary Pollution Control** - The Contractor shall be responsible for implementation of any temporary environmental protection measures, such as pollution control measures. If the Contractor fails to respond to this requirement or to the instructions in this regard from the Ministry Representative or the Environmental Monitor within directed time span, the Ministry Representative may take whatever action is necessary to provide the proper corrective measures. In the event the Contractor fails to take reasonable action to implement temporary environmental control measures, the Ministry's Representative shall determine the need for additional corrective action. The Ministry's Representative may deduct incurred costs from any money due or to become due to the Contractor for any corrective action taken in this regard.

**165.03.02 Responsibility for Damage to Environment** - The Contractor shall bear sole responsibility for any direct or indirect damage to the environment which occurs as a result of failure to comply with these Specifications, the directions of the Ministry Representative or recommendations of the Environmental Monitor.

**165.03.03 Stop Work Orders** - In the event that the Ministry Representative determines that some aspect of the construction is creating or will result in a substantial adverse

effect on environmental values or resources on or adjacent to the project site, the Ministry Representative may issue a "stop work order" (either an "Order to Suspend Work - form H8" or formal "Stop Work Order") on behalf of the Ministry. The Contractor shall subsequently be responsible for advising the Ministry Representative of the intended remedial action. The Ministry Representative may direct the Contractor to cease construction work on an unaffected portion of the site so that any necessary equipment can be immediately diverted to address the environmental emergency. In such an event the Contractor will not be entitled to any claim for compensation from the Ministry.

In the event that an Environmental Monitor is employed, and the Ministry Representative cannot be contacted, the Environmental Monitor will assume the Ministry Representative's role regarding Stop Work Orders, as detailed above, until such time as the Ministry Representative can be contacted. The Environmental Monitor will fully document all such instances. In such an event, the Contractor will not be entitled to any legal recourse or claim for compensation from the Ministry.

The Contractor shall be required to modify or halt any aspect of construction or maintenance that the Environmental Agencies determine poses or will pose an environmental concern. The Environmental Agencies may verbally direct the Contractor to modify or halt any such activity or submit formal written instructions to that effect. In either case, the Contractor's immediate compliance with their instructions will be mandatory. The Contractor shall document any such requests by the Environmental Agencies and forward a copy of this documentation to the Ministry within five working days of the initial notification by the Agencies.

**165.03.04 Compliance with Specifications** - The Contractor is responsible for ensuring that all subcontractors and employees are in compliance with these Specifications and all applicable environmental legislation and regulatory requirements at all times, and shall take immediate action to rectify problems in this regard. The Contractor shall initiate action to rectify environmental problems within the time period as specified by the Ministry Representative. The Contractor shall have available such additional safeguards, safety devices and protective equipment as are necessary to protect the environment. The Contractor shall be responsible for ensuring sufficient safety devices and protective equipment (e.g., pumps, silt fence, armoring, tarps, fuel spill cleanup kits, etc.) are readily available at all times during construction of the Project. The location and inventory of safety devices and protective equipment shall be documented and placed in a prominent location in the Contractor's field office. A copy of this information shall be updated as necessary and provided to the Ministry



Representative.

The Ministry Representative, and/or Environmental Monitor when employed, will inspect and monitor conditions at, and in the vicinity of, the project to ensure acceptable levels of pollution and disturbance are not exceeded, and to ensure compliance with the environmental specifications contained herein and in the Special Provisions.

The frequency of such inspection and monitoring efforts shall correspond to the sensitivity and location of construction activities, as well as to the environmental conditions (e.g., increased monitoring and inspection will be conducted during periods of inclement weather). In the event that the Ministry Representative is not satisfied with the frequency and duration of such inspection and monitoring, the Contractor and/or the Environmental Monitor will be required to increase their efforts in this regard to a level satisfactory to the Ministry.

**165.03.05 Payment** - All the requirements for compliance with these environmental specifications shall be considered incidental to the price bid for the Project under contract and no other compensation shall be made to the Contractor. However, the Contractor may be eligible for reimbursement for the installation of any additional environmental works (e.g., enhancement measures) where directed and approved in writing by the Ministry Representative and not covered in this Section or elsewhere in the Special Provisions or Schedule of Quantities and Unit Prices. Any eligible reimbursement will be paid for by an Order for Extra Work. The Ministry Representative, in consultation with the Ministry's Environmental Quality staff and the Environmental Agencies, will be responsible for determining the Contractor's eligibility in this regard and for identifying what environmental work is beyond the scope of the Contract and these specifications.

**165.04 Erosion, Sediment, and Drainage Control** - All works shall be undertaken in a manner that avoids or absolutely minimizes erosion problems and the discharge of siltation or other deleterious substances into any watercourse. The Contractor shall not disturb designated watercourses, unless the express written consent of the Environmental Agencies is obtained prior to initiating construction activities in such areas. No obstruction or debris shall be placed in any watercourse during any operations, unless specified in the Special Provisions or by the Ministry Representative, or for designated watercourses approved by the Environmental Agencies. Should any material be inadvertently placed within the normal high water wetted perimeter of a watercourse, the Ministry Representative shall be notified immediately and the Contractor shall remove the material immediately, using environmentally acceptable construction procedures and

under the direction of the Environmental Monitor.

**165.04.01 Sediment and Erosion Control** - The Contractor shall incorporate all permanent soil erosion control features into the project at the earliest practicable time, as outlined in the accepted work schedule, and shall be responsible for temporary erosion and sediment control measures, including daily inspection of the integrity of such measures during adverse weather conditions or when construction operations are proceeding in Environmentally Sensitive Areas. Control measures shall be capable of continuous operation during working and non-working hours, and are subject to approval by the Ministry Representative. Any deficiencies which are observed in erosion control measures shall be immediately corrected.

The Ministry Representative has the authority to define environmentally sensitive areas or conditions, such as areas of erodible soil, and to direct the Contractor to provide temporary erosion and sediment control measures. These measures may include, but may not be limited to:

- interceptor ditches or berms to direct runoff away from erodible areas;
- slope protection measures such as mulches, hydroseeding, erosion mats, geotextiles, filter fabric, polyethylene covers, or riprap;
- silt fences;
- ditch blocks to reduce flow velocities, and;
- sediment control measures, such as settling ponds.

The Contractor shall have sufficient materials, such as clean rock, granular material, and filter fabric available on-site for emergency protection measures when required.

The Contractor shall regularly maintain sediment and drainage control measures, such that they function as designed. Immediate action shall be taken by the Contractor to correct any deficiency observed in the operation of sediment and erosion control measures. In the event that a deficiency in any sediment or drainage control measures is directly or indirectly creating an adverse environmental impact, the Contractor shall initiate the necessary action to correct the problem within one hour of observing or being informed of the situation. In the event that a deficiency in any sediment or drainage control measures poses the potential to create an adverse environmental impact, the Contractor shall take action within two days of observing or being informed of the situation. In the event that environmental conditions or the status of the situation change in regards to a potential deficiency, the Contractor shall accelerate any proposed correction measure(s) by taking immediate action (i.e., within one hour). The judgment of the need and timing for corrective action in regard to sediment or drainage control measures shall be at the discretion of the Ministry Representative, Environmental



Monitor, and the Environmental Agencies.

Sediment and debris accumulations which compromise the functioning of the erosion and sediment control measures shall be removed by the Contractor and disposed of in an environmentally acceptable location and manner. At a minimum, silt fence structures shall be cleaned when sediment accumulation heights exceed 30 cm along any portion of the structure.

In the absence of site-specific requirements from the Fisheries and Oceans Canada or the British Columbia Ministry of Water, Land and Air Protection, the Contractor shall comply with criteria for suspended solids in runoff water from the site as agreed upon prior to construction by the Ministry Representative and Environmental Agencies.

Sediment and drainage control methods are detailed in the "Land Development Guidelines" and the MoT publication "Control of Erosion and Shallow Slope Movement". Compliance with the spirit and intent of these guidelines is mandatory. The determination of the Contractor's compliance with these guidelines shall be at the discretion of the Ministry Representative, Environmental Monitor and Environmental Agencies.

#### **165.04.02 Sediment and Drainage Management Plans -**

The Contractor, as directed by the Ministry Representative and in consultation with the Contractor's Environmental Representative, shall be responsible for the preparation and implementation of any Sediment and Drainage Management Plan(s) required for the Project. Such plans will form an essential component of the Contractor's environmental protection program, in terms of identifying environmentally acceptable construction practices for sediment and erosion controls at specific sites. The Sediment and Drainage Management Plan(s) will be subject to, but not limited to the following requirements:

- Prior to commencement of construction activities on the Project and thereafter when deemed necessary, the Contractor and the Environmental Monitor will identify areas and major construction activities for which the Contractor will be required to prepare one or more Sediment and Drainage Management Plans. Designation of these areas and activities will be done in consultation with the Environmental Agencies and the Ministry's Environmental Quality staff.
- In addition to activities within the Project area, a Sediment and Drainage Management Plan shall be submitted for activities related to the Contractor's work in areas away from the project that have the potential to create adverse environmental impacts, which will be determined by the Contractor in consultation with the Environmental Monitor, the Environmental Agencies and the Ministry. These

activities are not confined to the areas immediately adjacent to the right-of-way, but also in other locations in which the work or associated activities will be conducted, including but not limited to haul and access roads, temporary structures, borrow and granular excavations, staging/laydown areas, material storage sites and disposal sites.

- The Contractor shall not commence work in any area so identified until a Sediment and Drainage Management Plan has been submitted and accepted by the Ministry and involved Environmental Agencies.
- The acceptance and approval of the Contractor's Sediment and Drainage Management Plan or updated Plan shall be valid only so long as the conditions and anticipated conditions upon which the Plan and its acceptance were based continue to be applicable.
- The Contractor shall at all times be responsible for ensuring that work is carried out in accordance with a Sediment and Drainage Management Plan or updated Plan, which has been accepted by the Ministry and Environmental Agencies.
- The Ministry or the Environmental Agencies may request the Contractor to update and resubmit its plan(s) at any time, and may require the Contractor to cease work until the update(s) has been submitted and accepted. Whether or not the Ministry or the Environmental Agencies so request, the responsibility for carrying out the work in accordance with a validly accepted Plan lies entirely with the Contractor.
- The Ministry or the Environmental Agencies may order the Contractor to stop work or to take other precautionary or remedial measures whenever the Contractor is carrying out any work that is not in accordance with a Sediment and Drainage Management Plan or updated Plan which has been accepted by the Ministry or the Environmental Agencies, and for which that acceptance is still valid. All costs of any resulting delay shall be borne entirely by the Contractor.

At a minimum, a Sediment and Drainage Management Plan will include the following information and will be prepared in a format satisfactory to the Ministry Representative and the Ministry:

- a) A schedule for the proposed activities, as they pertain to the Sediment and Drainage Management Plan and construction staging, including anticipated duration of construction.
- b) A description of the construction procedures that will be used to limit the potential for erosion and sediment production, including estimates of work areas where applicable (e.g., volume of material in a proposed stockpile site), description of construction equipment to



be used, and staging of operations.

- c) A detailed description of the site-specific measures for runoff and drainage management.
- d) A detailed description of the site-specific mitigation measures and design information for erosion prevention and control (e.g., sizing of culverts, ditches or sediment/detention ponds, silt fence specifications, and description of ditching and berming).
- e) A schedule that identifies the various sloped areas by station and the dates in which they will be protected using temporary and permanent revegetation measures, such as hydroseeding.
- f) A detailed description of mitigative measures for ensuring acceptable water quality and quantity at points of discharge to watercourses, including sizes and specifications for any proposed water treatment facilities.
- g) A key plan and drawings, in suitable scale and detail, of the site and proposed mitigative measures and applicable construction procedures.
- h) A written commitment of on-site equipment (e.g., water pumps) and materials (e.g., silt fence, hay bales, rock armoring, and ditch breakers) for erosion, sediment and drainage control to deal with emergency situations that may arise.
- i) A written commitment of on-site equipment and staff to handle any fish salvage and transfer operations, if required.
- j) Contact names, positions and telephone numbers.

A description of the specific monitoring procedures prior to, during and after completion of construction activities at this site.

**165.04.03 Sediment Control Ponds** - The Contractor shall construct sediment control ponds where necessary to prevent the release of unavoidably entrained sediments in runoff from the construction site, and shall construct stormwater detention ponds for the temporary and/or permanent control and discharge of stormwater runoff. The Contractor shall provide designs for and construct sediment control ponds, as well as stormwater detention ponds, on a site-specific basis in a manner that conforms to the "Land Development Guidelines", other than for the following exception(s):

- Sediment control ponds and dry or wet stormwater detention ponds shall be designed and constructed to accommodate the 10-year return period storm under developed conditions with a minimum 0.60 metre

freeboard to the top of the berm.

The Contractor is referred to Section 3 of the "Land Development Guidelines" for other pond design criteria and Section 8 of that publication, for sample calculations for water flows and pond sizes.

If during construction the settlement pond is filled to capacity and is still required for sediment control, accumulated settled sediments shall be removed from sediment control ponds and stormwater detention ponds. Such sediments shall be disposed of in an environmentally acceptable location and manner.

**165.04.04 Maintenance of Drainage Patterns** - Except where interceptor ditches or berms are required to divert sediment laden runoff from the site to a sediment control pond, original drainage patterns shall be maintained throughout construction operations. Interceptor ditches or berms shall be constructed to divert water entering the site away from erosion prone areas. The Contractor will not rely on drainage courses or conduits being shown on the Plans, and will make whatever investigation is necessary. Where a natural watercourse traversing the construction site crosses this interceptor ditch or berm, an armoured or lined ditch or a culvert shall be installed in order to pass accumulated flows through or around the construction site in a manner that maintains the natural runoff pattern, unless otherwise directed by the Ministry Representative.

All ditches constructed for interception of clean water outside the work site(s) to divert it around the work site(s) and for collection of treated water from the work site(s) shall be designed and constructed to accommodate the 10-year return period storm with a 0.3 m freeboard under developed conditions. Temporary and/or permanent drainage ditches, including those constructed for sediment and erosion control, shall be designed to prevent high water velocities and erosion by including measures such as check dams, drop structures or erosion-resistant liners or armoring.

**165.04.05 Storm Drainage Systems** - In order to minimize siltation, the Contractor may be required to block storm drain inlets, or to activate inlets by means of sandbags, berms or swales, as circumstances require, or at the direction of the Ministry Representative. Berms shall be constructed of clean, non-erodible granular material. The Contractor shall maintain, on a regular basis, any inlets activated during the course of construction. Any deficiencies noted in these works shall be corrected immediately in the event that the inlet is plugged, and within the same day if the site is relatively dry.

The Contractor shall ensure adequate inspection and correction of any storm drainage system deficiencies for



sites within the influence of the Project. During periods of inclement weather, the Contractor shall ensure project staff inspect storm drainage systems throughout the day, and if necessary, make arrangements for inspection and maintenance during regular work stoppage periods, such as evenings or weekends. At a minimum, such inspections shall be carried out at the start of the regular workday, at mid-day in the workday, and one hour prior to end of the regular workday. Furthermore, in the event of flooding problems, the Contractor shall be responsible for any damages or compensation resulting from impacts on residences or businesses caused by a failure or deficiency in the Contractor's design and maintenance of the storm drainage system.

During concrete curb and gutter construction, road surface runoff shall be directed by berms or swales away from concrete which has been poured within the previous 48 hours.

### 165.05 Clearing and Grubbing

**165.05.01 Limits for Clearing and Grubbing** - Clearing and/or grubbing shall extend only to the designated limits, as defined in the Contract Drawings and marked on site. Prior to clearing or grubbing, marked limits will be inspected by the Ministry Representative, who may amend them. The Contractor may be required to use close-cut, no grub practices (i.e., cutting trees at ground level and not removing root system) or undertake hand clearing at environmentally sensitive sites, as designated in the Special Provisions or by the Ministry Representative.

The Contractor shall prepare a detailed clearing and grubbing plan in consultation with the Environmental Monitor and the Ministry Representative. The Contractor will obtain approval for this plan from the Ministry Representative and any necessary tree removal permits from the Ministry of Forests and/or municipal agencies prior to initiating any clearing and grubbing operations within 50 m of any designated watercourse or Environmentally Sensitive Area.

The Contractor shall minimize ground disturbance in the vicinity of any watercourse or Environmentally Sensitive Area, and shall not proceed with clearing and grubbing closer than 50 m from a designated watercourse or Environmentally Sensitive Area prior to marking the limits of the Fisheries Sensitive Zone or Environmentally Sensitive Area. The width of these zones, if not specified in the Special Provisions, will be determined by the Ministry Representative in consultation with the Environmental Agencies. The Contractor shall mark the limits of any Fisheries Sensitive Zone or Environmentally Sensitive Area, such as orange flagging tape or orange snow fence, at a

minimum height of 1.5 m.

All clearing and grubbing activities in this zone must be granted prior approval by the Environmental Agencies. The Contractor shall not conduct approved grubbing operations within this zone until ready to proceed with earthwork and stabilization.

In areas near designated watercourses or other Environmentally Sensitive Areas determined by the Ministry Representative to be of high erosion or siltation potential, the surface area of erodible soil exposed at one time may be limited by the Ministry Representative. This will supersede Subsection 200.03 and 200.04. The Ministry Representative may confine grubbing to an area where excavation and earthwork is to be actively conducted within approximately 30 days following the completion of grubbing operations. In the event that a highway project consists only of clearing and grubbing operations, the cleared ground shall be protected and able to withstand specified periods of inclement weather.

**165.05.02 Protection of Vegetation** - The Contractor shall protect all vegetation growing outside of the designated and marked areas for clearing and grubbing, as specified in Section 769 "Protection and Retention of Vegetation", with the exception of danger trees, which must be hand-felled and removed with minimum disturbance to retained vegetation.

**165.05.03 Clearing Activities** - Falling of timber into a watercourse is prohibited except in situations in which safety considerations dictate otherwise or unless approved by the Environmental Monitor. Any trees or large pieces of woody debris that accidentally fall into a watercourse and require removal, shall be removed in a manner that minimizes the disturbance of the watercourse and adjacent banks, and is approved by the Ministry Representative. Skidding of logs across watercourses will not be permitted. The Environmental Monitor must be present during removal of any large woody debris or trees from watercourses.

**165.05.04 Disposal of Combustible Materials** - The Contractor shall comply with the Forest Act and the Open Burning Smoke Control Regulation under the British Columbia Waste Management Act. For additional information regarding the regulation, the Contractor should contact regional Environmental Protection staff in the British Columbia Ministry of Water, Land and Air Protection office and the Fire Control staff in the British Columbia Ministry of Forests.

The Contractor shall prevent heat or smoke damage to all vegetation that has been designated for preservation. The use of waste oil and/or tires as fire accelerators shall not be permitted. The Contractor may be required to use a forced



air method of burning. Burning piles shall not be located within 50 m of any watercourse, wetland or other Environmentally Sensitive Area, or in areas where ditches are to be constructed without written approval of the Ministry Representative.

In situations in which the material generated as a result of clearing and/or grubbing may not be burned on site, the Contractor shall dispose of it in a manner approved by the Ministry Representative who may require approval of the British Columbia Ministry of Water, Land and Air Protection.

### 165.06 Stripping Operations

**165.06.01 Exposure of Erodible Earth** - In areas where erosion or siltation is anticipated, the duration of exposure of erodible earth material shall be minimized. In such cases the surface area of erodible earth material exposed at one time shall be determined and approved in writing by the Ministry Representative. (See Subsection 165.05.01 Limits for Clearing and Grubbing)

**165.06.02 Placement of Stripped Material** - The Contractor shall avoid placement of stripped materials in areas adjacent to watercourses or other Environmentally Sensitive Areas. Sediment and erosion control measures must be taken prior to and after placement of stockpiles of stripped material in areas where natural drainage or storm water could erode the stockpile and thereby transport pollutants to surface waters. The location of stockpiles and erosion control measures must be approved by the Ministry Representative prior to placement of stripped materials and may be specified in the Special Provisions. The Contractor shall ensure that all stockpiles are stable.

Polyethylene sheeting or other suitable tarp material shall be used to cover temporarily exposed steep surfaces or stockpiles of erodible materials, such as topsoil, sand, gravel or roadbase fill. The Contractor shall ensure such erodible materials are properly covered with sheeting or suitable tarp materials immediately after creation of any temporary stockpiles. Such sheeting or tarp materials shall be examined and maintained on a regular basis. The sheeting or tarp materials shall be sufficiently anchored to prevent displacement by winds.

**165.06.03 Slope Protection** - The Contractor shall employ suitable techniques to prevent the initiation of surface soil erosion and movement of sediments from slopes, particularly those exposed as a result of clearing, grubbing and stripping operations. Acceptable techniques and conditions of implementation of erosion and sediment control measures for slopes are outlined in Section 3 (i.e., entitled "Slope Protection and Surface Protection") of the

"Land Development Guidelines" and the MoT publication "Manual of Control of Erosion and Shallow Slope Movement". Compliance with the requirements specified in this Section, as well as any Authority/MoT manual(s) developed specifically for the Project, will be mandatory.

### 165.07 Earthwork Operations (Subgrade Construction)

**165.07.01 Excavation and Disposal of Waste or Surplus Material** - The creation and use of any site on Crown or private lands for the placement and disposal of waste or surplus material requires prior approval from the Ministry Representative and may require the approval of representatives of British Columbia Forests and the Environmental Agencies. Unless another time period is specified in the Special Provisions or by the Ministry Representative, not less than fifteen days prior to disposing of any waste or surplus material, the Contractor shall submit to the Ministry Representative for approval, a proposal delineating the locations and extent of the areas in which the Contractor intends to dispose of such material. The proposal shall describe the nature of the material and the methods to be employed in material placement, stabilizing and site revegetation. If a disposal site is required off the right-of-way, the proposal shall also indicate the procedures for any required land clearing activity. The proposal will be reviewed by the Ministry Representative who may consult with the Environmental Monitor, if employed, and the Environmental Agencies. No waste or surplus material shall be disposed of until the proposal has been approved. All work shall be done in accordance with the approved proposal.

All waste disposal sites shall be selected such that spoil is prevented from entering any watercourse. The excavated material shall be properly drained, spread and trimmed to a stable slope not exceeding 1.5 to 1, in a manner which minimizes disturbance of watercourses and vegetated areas. All waste sites shall be revegetated immediately after creation of the waste disposal site, or else suitable temporary erosion control measures, such as tarps, shall be used until revegetation is undertaken. The Contractor is responsible for ensuring that revegetation is successfully accomplished unless otherwise specified in the Special Provisions.

**165.07.02 Work in Areas of High Water Table** - Work in areas of high water table shall be scheduled to proceed during dry weather periods unless otherwise specified in the Special Provisions. The Contractor shall adopt all necessary mitigation measures to avoid or minimize adverse impacts in such areas.

**165.07.03 Drilling and Blasting** - Blasting operations shall be conducted in a manner that minimizes the disturbance of residences, businesses and public infrastructure (e.g.,



schools and churches) and to aquatic and terrestrial habitats and organisms due to shock waves, noise and vibration.

The Contractor shall not conduct blasting within 400 m of fish habitat without the approval of the blasting plan by the Fisheries and Oceans Canada; British Columbia Ministry of Water, Land and Air Protection, Fish and Wildlife offices and the Ministry Representative. The Ministry Representative may require the Contractor to undertake mitigative measures such as scheduling of works in Timing Windows given by the Environmental Agencies, smaller staggered blasts or use of blasting mats to minimize impacts. Vibrations and shock waves in fisheries habitat resulting from blasts shall comply with the Fisheries and Oceans Canada "Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters".

Blasting operations shall be controlled to minimize the entry of fly rock into watercourses or adjacent to the right-of-way, particularly in an urban setting. If required by the Environmental Agencies, the Contractor shall comply with the Agencies' directions in removal of fly rock from watercourses and Environmentally Sensitive Areas at no cost to the Ministry.

When blasting is to be conducted adjacent to or in a designated environmentally sensitive area, the Contractor shall provide at least 24 hours notice of each blast to the Ministry Representative. The Contractor shall provide at least 24 hours written notice to those individuals or groups potentially affected by shock waves, noise and vibration from blasting operations.

**165.08 Borrow and Sand / Gravel Pits** - All Borrow and Sand/Gravel pit locations, operations, reclamation and revegetation shall comply with the Ministry of Energy and Mines / MoT / Natural Resources Canada joint publication "Reclamation and Environmental Protection Guidelines for Sand, Gravel and Quarry Operations in British Columbia".

**165.08.01 Control of Drainage** - Prior to borrow excavations, or quarry, sand or gravel pit development, all surface water entering the site shall be controlled so that its entrance into the operating area is prevented. Drainage shall be controlled throughout borrow operations in order to prevent natural drainage and surface runoff from carrying sediment into adjacent watercourses. The Contractor shall prepare a Sediment and Drainage Management Plan (see Subsection 165.04.02) prior to the creation and/or operation of any borrow excavations or quarry, sand or gravel pit development sites. The Contractor shall also prepare a Reclamation Plan.

**165.08.02 Location and Development of Borrow and Sand/Gravel Pits** - Clearing for borrow and sand/gravel pits

shall comply with Subsection 165.05 - Clearing and Grubbing. All topsoil shall be stockpiled for future reclamation.

Borrow excavations shall not be located in the wetted perimeter of a watercourse or on a stream floodplain at a location likely to create a new channel to the stream at a time of flooding, without the approval of the Environmental Agencies. Borrow sources located within 100 metres of the wetted perimeter of a watercourse or at distances less than 100 m from any water-impounding dyke or dam embankment will require the design of a Professional Engineer or Professional Geologist. Final floor elevations shall be sufficiently high that they will not be subject to fluctuations in the groundwater table.

In erosion-prone areas, overburden removal shall be restricted to an area that will be excavated within one year. The open face(s) of the borrow pit should be no larger than necessary for efficient pit operation. Material should be exhausted at one location in a pit prior to the opening of a new face to remove a similar type and grade of material.

The Contractor shall be responsible for maintaining the functionality of erosion, sediment and drainage control measures within and around borrow and sand/gravel pits throughout all phases of overburden and material removal, as well as during periods of work stoppages. Borrow and/or sand/gravel pits shall be rehabilitated and decommissioned in an environmentally acceptable manner and to the satisfaction of the Ministry and the Environmental Agencies.

To minimize the spread of noxious weed seeds between construction sites and gravel pits/quarries, all crushing equipment and mining vehicles must be cleaned with a power/high pressure washer (manually cleaned in freezing temperatures), before entering any MoT pit or quarry. If the pit contains noxious weeds the crushing equipment and mining vehicles must also be cleaned with a power/high pressure washer (manually cleaned in freezing temperatures) before leaving the pit/quarry. Prior to the production of aggregates the pit floor, crusher/plant location, equipment-parking area, stockpile site(s), pit face(s) and area to be mined will be inspected by the contractor for the presence of noxious weeds. If noxious weeds are present they must be removed mechanically by the contractor. Noxious weeds are defined as non-native plants species designated on the provincial or regional district lists as defined by the Weed Control Act.

**165.08.03 Washing Operations** - In locations where siltation of a fish-bearing watercourse may occur, approval shall be obtained from the Environmental Agencies prior to the establishment of aggregate washing operations, and all wash water shall be subject to Subsection 165.04. Where



possible the Contractor may be directed by the Ministry Representative to use water from pit dewatering or clarified water from the sediment pond(s) in the wash plant.

Waste or surplus material shall be disposed of at a waste disposal site approved by the Ministry Representative. The Contractor shall create and designate, with appropriate signing, suitable sites and facilities for disposal of waste or surplus material. In particular, the disposal of deleterious materials, such as surplus concrete or concrete wash water in sites other than those approved by the Environmental Monitor and the Environmental Agencies will be prohibited. The Contractor and the Contractor's Environmental Representative shall be responsible for ensuring all construction personnel, including subcontractors, are made aware of this requirement. In the event that it is not feasible to install a suitable concrete waste disposal site immediately adjacent to the work site, such as during a concrete pour on a long bridge deck, then the Contractor shall take the necessary precautions to isolate the work site from any watercourse or other environmentally sensitive area and to temporarily collect the concrete waste or wash water and transport it to a nearby suitable disposal facility. The Contractor shall notify and seek approval from the Ministry and the Environmental Agencies for any changes in the location of waste disposal sites during construction operations.

#### **165.09 Detour, Access and Haul Roads**

**165.09.01 Design, Construction and Operation of Access Roads** - Any temporary access, detour and/or haul roads associated with the project shall be constructed to accommodate all required uses and maintained throughout the course of construction operations in a safe, environmentally sound manner.

The location, alignment, design and construction of all detour, access and haul roads shall be subject to the approval of the Ministry Representative, who may have to obtain the approval of the appropriate Environmental Agencies. Clearing shall extend no further than safe operation requires, or to the edge of cut or toe of fill. Root systems of cleared vegetation shall not be removed except in the area of cuts or actual road surface.

The Contractor shall employ suitable measures to maintain air quality, visibility, and safe conditions in the use of access, detour and/or haul roads associated with the Project.

**165.09.02 Drainage and Erosion Control** - Drainage structures shall be incorporated into and maintained for the duration of the project along all detour, access and haul roads to minimize erosion and maintain drainage patterns.

**165.09.03 Abandonment** - The Contractor shall winterize haul and access roads at the end of the construction season and shall ensure proper drainage control measures are in place. Culvert inlets and outlets shall be flagged. During periods of work stoppages, the Contractor shall ensure sufficient inspection and maintenance of the access, detour and/or haul roads such that adverse environmental impacts are avoided or minimized. In the event that potential or existing environmental problems are identified by the Contractor, its staff, the Ministry, the Environmental Agencies or the public, the Contractor will take immediate steps to rectify the problem and ensure corrective action is taken to prevent future recurrence of similar problems.

When no longer required by the Contractor or the Ministry, construction roads shall be properly decommissioned, including measures such as blocking such roads off from vehicular traffic, scarifying the compacted surfaces and generally revegetating the area. All drainage and crossing structures shall be removed, and sufficient cross ditches and ditch blocks constructed and stabilized to restore the original drainage patterns and prevent erosion. The Ministry Representative may require that windrows along the side of the road be removed, and the road surface sloped to drain in the direction of the surrounding contours. Fill may be required to be pulled back onto the road if it is judged to be unstable. Remaining cut slopes shall not exceed the natural angle of repose. Reclamation works required by the Ministry Representative may include, but may not be limited to decompaction of the road surface, revegetation of exposed soil surfaces, and reforestation.

**165.10 Instream Works** - In general the Contractor shall comply with the requirements specified in Section 5, "Guidelines for Construction Practices within the Fisheries Sensitive Zone", of the "Land Development Guidelines", as well as those requirements noted below. The Contractor, in consultation with the Environmental Monitor, shall prepare a detailed set of environmental procedures for any work within a Fisheries Sensitive Zone, within the wetted perimeter of any fish-bearing watercourse (or any watercourse that flows directly into a fish-bearing stream), or for any work with the potential to cause major adverse impacts on a fish-bearing watercourse (e.g., concrete pour for a bridge deck over a fish-bearing watercourse, hydroblasting of bridge substructures over a fish-bearing watercourse, etc.).

No clearing or equipment operation shall take place in a Fisheries Sensitive Zone prior to Ministry and environmental agency approvals. Waste material generated during instream works shall not be stored or dumped within the floodplain unless otherwise approved by the Ministry Representative.



Drainage of waterbodies, such as wetlands, swamps or beaver ponds, shall be subject to the approval of the Ministry Representative who will consult the Environmental Agencies, unless drainage of these areas is specifically required as part of the Contract and has been approved by Fisheries and Oceans Canada and British Columbia Water Management office.

**165.10.01 Provision of Fish Passage** - Unless the Contractor has written approval from the Ministry Representative and the Environmental Agencies, any instream works in fish bearing streams shall provide for fish passage. It is the Contractor's responsibility to contact the Environmental Agencies to determine fish passage requirements for the specific location.

The Contractor is required to give two week's notice to the Ministry Representative of any activities, which may result in stranding of fish, to allow for scheduling of fish retrieval and/or transfer operations.

**165.10.02 Management of Water Discharges** - During preparation of stream diversions, culvert installations and other operations involving dewatering where drainage could readily reach a designated watercourse, all effluent and silt-laden water shall be discharged to a sediment control pond or a vegetated area acceptable to the Ministry Representative and the Environmental Monitor for removal of silt prior to its release into that watercourse. This requirement also applies to the control of discharge resulting from curing areas of recent concrete pours for bridges or drainage structure headwalls. The direct discharge or discharge via seepage of untreated, silt-laden water or other deleterious substance into any watercourse is prohibited.

**165.10.03 Encroachment of Fill into Watercourses** - Embankments which encroach on fish-bearing watercourses shall either be isolated and dewatered, by means of a cofferdam, until surfaced with riprap, or constructed of clean granular material and riprap or shot rock which is free of fine-grained material or other potential contaminants. Riprap composition and placement may be further detailed in the Special Provisions. The method of placement of this material shall be such that disturbance and/or alteration of aquatic habitats is absolutely minimized. Fill material must be entirely contained within the proposed fill cross section.

**165.10.04 Temporary Stream Crossings** - Prior to construction, the Contractor shall provide the Ministry Representative with a plan for approval, describing the proposed locations and types of stream crossings, complete with construction procedures and timing of construction. The Contractor shall forward a copy of the approved plan to the Ministry. Temporary stream crossings shall be subject to the same environmental constraints as permanent

crossings, and shall be built to pass, at least, the 10 year return period flood for the time of year during which the structure will be in place. Wherever possible, vegetative cover shall be maintained in order to minimize erosion.

Temporary stream crossings that have been constructed during periods of low precipitation (i.e. summer and late winter) shall be completely removed prior to periods of increased precipitation (i.e. fall and spring freshet), unless otherwise approved by the Ministry Representative.

**165.10.05 Instream Equipment Operation or Crossings** - The entering or crossing of any designated watercourse by construction equipment, when not specified in the Special Provisions, shall require and comply with the written approval of the Ministry Representative who will consult the Environmental Agencies. The Contractor shall notify the Ministry Representative 48 hours prior to allowing equipment to cross or enter designated streams. The Environmental Monitor shall be present while equipment enters into and exits from any designated watercourse.

Upon completion, the banks shall be restored, stabilized and revegetated to prevent erosion. This work shall be completed to the satisfaction of the Ministry Representative.

**165.10.06 Culvert Installations** - Unless otherwise approved by the Ministry Representative, culvert installation in designated watercourses shall involve an appropriate method of isolating the work site from the stream, such as the diversion of the stream around the culvert site, and the placement of the culvert in the "dry".

Installation of riprap and other protective works shall be carried out at the earliest possible time following culvert installation in order to prevent erosion and siltation.

**165.10.07 Culvert Obstructions** - Unless the watercourse is dry, an obstructed culvert shall be cleared by mechanical means. Any variance to using mechanical means to clear wet obstructed culverts must have the prior approval of the Workers' Compensation Board.

**165.10.08 Channel Diversions** - Channel diversions shall be performed in accordance with the Special Provisions. If not specified in the Special Provisions, methods shall be approved by the Ministry Representative, and shall comply with the "Land Development Guidelines".

**165.10.09 Bridge Construction** - Bridge Endfills shall be constructed implementing fully the applicable subsections of Section 165, and Section 769, Protection and Retention of Vegetation. The Fisheries Sensitive Zone shall not be disturbed until construction of the endfill or crossing structure is ready to proceed. The Contractor may be



required to hand fall trees and leave the root systems in place.

**165.10.10 Watercourse Clean-up** - Final watercourse clean-up shall consist of, but not be restricted to, the removal of temporary haul roads and temporary crossings, the reshaping of the stream to its original configuration, width and depth, the protection of stream banks, revegetation, and the removal of all construction related material and debris, including any material and debris deposited upstream or downstream of the site as a result of operations, under the direction of the Ministry Representative. All abandoned temporary diversions shall be plugged and stabilized. In the event that erosion has occurred during the course of construction, the Contractor will be required to recontour, stabilize and revegetate the affected area.

**165.11 Ditch Maintenance** - To reduce the risk of damage to aquatic habitat and sensitive life stages of fish and other aquatic organisms, the Contractor shall ensure that the excavation and maintenance of ditches is conducted in an environmentally sound manner.

Excavation for ditch cleaning of any ditch that contains or directly drains into fish-bearing waters shall be performed only within Timing Windows as detailed in the "Guidelines for Land Development, Appendix III" or as specified in the Special Provisions.

The Contractor shall consult local Environmental Agencies for the locations of sensitive areas and local Timing Windows prior to commencement of ditch maintenance. Areas identified as Fisheries Sensitive Zones shall be revegetated by the Contractor prior to the close of the timing window.

**165.12 Bridge Maintenance** - In performing any bridge rehabilitation or maintenance, the Contractor shall follow the procedures specified in the document "Federal Fisheries Guidelines for the Protection of Fish and Fish Habitat During Bridge Maintenance Operations in British Columbia"

The Contractor shall take measures to ensure absolute minimal loss of paint and abrasive material into watercourses during bridge cleaning. Mitigation measures may include placement of ground covers, lined nets or tarpaulins to capture falling debris, blast enclosures to encase the section of the bridge to be abrasively blasted, use of vacuum-shrouded power tools, and use of floating booms and barges to trap floating debris. Similar measures shall also be employed to assist in mitigating paint spray drift.

### 165.13 Servicing and Operation of Equipment

**165.13.01 Transport of Materials** - The Contractor shall use equipment and containers that are capable of safely transporting petroleum products and/or hazardous materials in compliance with Section 7.33.1 of the Federal "Transport of Dangerous Goods Regulations" for bulk containers, and Sections 7.21 and 7.23 of the same regulations for materials in packages or small containers. These regulations shall apply to both on-road and on-site transport. In addition to compliance with the Federal Transport of Dangerous Goods Regulations, the transportation of fuel trailers, fuel tanks on skids, and non-commercial fuel trucks shall comply with all the requirements of the Motor Vehicle Act and the British Columbia Fire Code.

The Contractor shall take the necessary precautions to prevent the loss of materials during transport on public highways, roads, access roads, and haul routes. Trucks carrying loose materials shall be covered and restraints shall be used to prevent materials from blowing or falling from vehicles. The Contractor shall be responsible for collection and removal of any and all litter deposited by vehicles or equipment along access routes during construction-related activities, including removal of dirt and mud deposited from truck tires on municipal roadways.

**165.13.02 Location and Installation of Fuel Storage Facilities** - The siting and installation of all fuel storage facilities shall be the responsibility of the Contractor. Fuel storage shall not be located within 30 m of a watercourse, within a watercourses flood plain, or where there is a potential for any spilled fuel to enter a watercourse or groundwater. Fuel storage facilities shall be located on flat or gently sloping ground and shall be dyked to contain at least 125% of the total capacity of the storage containers. Dykes shall be constructed of impermeable material or lined to ensure that petroleum products cannot escape.

All large fuel storage tanks must be locked and secured when not in use. Automatic shut-off nozzles shall be installed on all dispensing units over 250 ℓ capacity. Fuel storage tanks must be drained within one week of completion of construction or within one month of a prolonged shutdown period.

All small fuel storage containers, such as 45 gallon (200 litre) drums, used as a fuel cache shall be installed on a stable storage rack, within an impermeable containment device capable of capturing at least 125% of the total capacity of the storage container(s). A cover, such as a tarp, must be placed over the top of the fuel cache to prevent accumulation of precipitation in the containment device. The small fuel storage container(s) shall contain a metal spigot with a padlock placed on the container when not in use.



In the transport, storage and/or dispensing of fuel and other petroleum-based products, the Contractor shall comply with the requirements outlined in the Ministry of Environment, Lands and Parks/Ministry of Forests publication: "Environmental Standards & Guidelines for Fuel Handling, Transportation and Storage" (December, 1995).

The Contractor shall be responsible for all costs associated with clean-up and disposal of any escaped toxic and hazardous substances.

**165.13.03 Servicing of Equipment** - The fueling, servicing or washing of machines or equipment within the wetted perimeter or riparian zone of watercourses is prohibited. On-site fueling and lubrication of equipment shall also be conducted as far as possible from detention and sediment control facilities. The Ministry Representative may require that servicing be conducted at designated sites that are properly protected and approved by Fisheries and Oceans Canada and British Columbia Ministry of Water, Land and Air Protection.

Refuse generated during the servicing of equipment (e.g., air and oil filters, hydraulic fluids, petroleum products) shall be collected and disposed of in an environmentally acceptable location and manner. Where possible, the Contractor is encouraged to recycle lubricants and other waste materials generated during the servicing of equipment and machinery, or alternatively dispose of such materials and refuse at nearby recycling depots. The dumping of oil or other deleterious materials on the ground or in any watercourse is strictly prohibited. The Contractor shall provide a means of catching and retaining drained oil or other deleterious materials and shall properly dispose of these materials in a location approved by the Ministry Representative.

**165.13.04 Equipment Operation in Environmentally Sensitive Areas** - Construction equipment shall be operated only within the designated construction site and access roads. Equipment operators shall not be allowed to damage or destroy vegetation or streambanks outside of this area.

The operation of equipment and machinery in a Fisheries Sensitive Zone must be:

- a) authorized by the Ministry Representative
- b) kept to an absolute minimum, and
- c) undertaken only during the period(s) specified in the Special Provisions.

When working in any designated watercourse, equipment shall use biodegradable hydraulic fluid and shall be steam cleaned of oil, grease and other contaminants deleterious to

aquatic species, prior to commencing work. When working in or near any watercourse, the Contractor shall ensure that all hydraulic systems, fuel systems and lubricating systems are in good repair. Equipment with fuel or fluid leaks shall not be permitted to enter the wetted perimeter of any watercourse. Equipment developing such leaks shall be removed immediately and repaired.

#### **165.14 Waste Disposal and Toxic/Hazardous Materials**

**165.14.01 General** - All non-toxic or non-hazardous wastes which are not designated as combustible waste to be burned on-site shall be either recycled or disposed of in an approved sanitary landfill or other specialized area as indicated in the Special Provisions or as directed by the Ministry Representative. Any waste material that is inadvertently dumped in or adjacent to watercourses or other designated environmentally sensitive areas shall be removed by the Contractor and disposed of in an approved manner at the Contractor's expense.

The Contractor shall be responsible for the regular collection and disposal of all waste material generated by employees and sub-contractors. The Contractor shall take the necessary precautions to prevent loss of these materials during transport on public highways and roads, and shall be responsible for cleanup of all of these materials and all litter deposited by employees and subcontractors along access routes during construction-related activities, at no expense to the Ministry. Construction debris shall not be allowed to accumulate on the construction site but shall be collected promptly and regularly removed from the site. The Contractor shall ensure that waste materials are placed and stored in suitable containers. Waste material shall be disposed of at an approved waste disposal site. The Contractor shall be responsible for providing and regularly servicing animal-proof refuse containers and for ensuring that all employees and subcontractors dispose of wastes to keep the Project clear of waste and garbage.

**165.14.02 Spill Clean-up Plans for Toxic/Hazardous Materials** - Contingency plans for the clean-up of toxic or hazardous spills shall be prepared prior to construction and submitted, together with a list of spill abatement equipment to be stored on the job site, to the Ministry Representative for review. The Ministry Representative may require the Contractor to have on site any additional equipment or materials deemed necessary to deal with a potential spill. For operations adjacent to a watercourse, the Ministry Representative may require a Ministry-approved spill kit to be present. The Contractor shall promptly replace any used spill abatement and clean-up materials and maintain a sufficient inventory of materials throughout construction operations. For operations being conducted adjacent to or within the wetted perimeter of a watercourse or other



Environmentally Sensitive Area, the Contractor shall have an approved spill kit ready for use nearby.

The Contractor shall immediately report any spill of any toxic or hazardous material verbally to the Ministry Representative and the Provincial Emergency Program (24 hour phone line: 1-800-663-3456). Written notification of the spill must follow within two weeks of this verbal report. The Contractor shall immediately take the necessary steps to abate the discharge and provide the necessary labour, equipment, materials and absorbents to contain and remove the spill, clean up the affected area, dispose of waste materials at an approved disposal site, and restore the area to the satisfaction of the Environmental Regulatory Agencies, at the Contractor's expense. Any soil contaminated by spills shall be removed and replaced by comparable substitutes at the expense of the Contractor. Contaminated soil and vegetation removed shall be disposed of in an approved waste disposal site. If the Contractor fails to respond to the Ministry Representative's requirements for cleanup, the Ministry reserves the right to take whatever action is necessary to clean up the spill and deduct incurred costs from any money due or to become due to the Contractor.

The Environmental Monitor and/or the Contractor's Environmental Representative shall document any spills observed in the vicinity of the Project that are not the result of Project-related activities, and notify the Environmental Agencies of such incidents.

**165.14.03 Contaminated Sites** - If an area within or adjacent to the project site has been identified as a possible source of contaminated or hazardous material and the defined contaminated or hazardous material has not been removed prior to the start of the project, the Contractor shall notify the Ministry Representative at least two weeks prior to the time work is scheduled in or adjacent to that area.

In the event that the Contractor locates material on the project site believed to be contaminated or hazardous, and which has not been previously identified, the Contractor shall immediately cease work in that area and notify the Ministry Representative. The Ministry Representative will seek investigation and disposal recommendations from regional staff of the British Columbia Ministry of Water, Land and Air Protection, Environmental Protection office. No work shall proceed in the identified or suspected area until such time as these materials have been removed to the satisfaction of the Ministry Representative, representatives of the British Columbia Ministry of Water, Land and Air Protection Environmental Protection office, and the British Columbia Workers' Compensation Board. Unless it is specified in the Special Provisions, or agreement is made with the Ministry Representative to carry out such work, the Contractor is not responsible for the removal of

contaminated or hazardous materials, which are not the result of the Contractor's actions.

**165.14.04 Concrete Wastes** - The Contractor shall isolate fresh concrete or cement from any designated watercourse for 48 hours after placement. Containers or trucks carrying cement or fresh concrete shall be washed at a site approved by the Ministry Representative. Concrete wastes, including wastewater from batching or cleaning, shall only be disposed of at approved and designated disposal sites (i.e., location designated with proper signing). All cement-contaminated wastewater from cleaning or mixing is to be considered toxic, and must be prevented from entering any designated watercourse for at least 48 hours to allow the water to reach neutral pH. Any cement or concrete-contaminated wastewater shall be tested prior to release into a designated watercourse. In the event that such wastewater pH levels are unacceptable in terms of water quality for fish and other aquatic species, the Contractor shall take the necessary measures to contain and treat such wastewater until acceptable pH levels are achieved (i.e., pH levels are the same as the receiving waters).

The Contractor shall securely store on-site and use suitable equipment and materials for the mitigation of concrete spills into or in areas adjacent to watercourses. For example, cylinders of gaseous carbon dioxide shall be kept on the Project site, which shall be used in the event of concrete or concrete leachate discharges into any watercourse. During any concrete pour within 15 m of, or in work areas above the wetted perimeter of any designated watercourse, the Contractor shall ensure that carbon dioxide cylinders and suitable application devices (e.g., weighted soaker hoses) are available on-site and ready for use in the carbonation of water columns to neutralize any concrete leachate that is inadvertently discharged into the watercourse. Where concrete leachate is allowed to enter settling ponds, such that pH levels become very high, bubbling with carbon dioxide may not be an effective buffering agent. In such cases, it may be necessary to use other methods, such as acid buffers. The Ministry Representative shall be responsible for assisting the Contractor in identifying appropriate mitigation options and monitoring effectiveness of procedures to mitigate unacceptable pH levels.

Aged, broken concrete shall only be used as riprap with the approval of the Ministry Representative and the Environmental Agencies. The Contractor shall remove broken concrete or concrete wastes that have been inadvertently placed in non-approved sites on the Project and dispose of them at an approved waste disposal site.

**165.14.05 Petroleum Wastes** - Refuse generated during the servicing of equipment shall be removed from the site and disposed of in a location and manner that has been approved



by the Ministry Representative. The dumping of oil or other deleterious materials (such as diesel used to wash out dump boxes) on the ground is prohibited. Where facilities are located within a reasonable distance, the Contractor shall dispose of wastes at recycling depots.

Solids, sludges and other pollutants generated as a result of construction or removed during the course of treatment or control of wastewaters shall be disposed of in a manner that prevents their direct or indirect discharge to any watercourse or groundwaters. Effluent generated by the water scrubber of an asphalt mixing plant must be given retention time in suitably sized, impermeable settling ponds prior to release into an adjacent watercourse. The required retention time will be determined by the Ministry Representative in consultation with representatives from British Columbia Water, Land and Air Protection.

Asphalt pavement shall be stockpiled for recycling in a specified location, or disposed of in a location approved by the British Columbia Environmental Protection branch, as directed by the Ministry Representative

**165.15 Pesticides** - The use of all pesticides is subject to pre-approval by the Ministry Representative. The use of herbicides for vegetation control, other than noxious weeds, is not permitted. The Contractor shall comply with all Federal, Provincial and local regulations relative to the storage, use, and proper disposal of pesticides. Relevant legislation includes the Federal Pest Control Products Act and the British Columbia Pesticide Control Act. All pesticide wastes, washwaters, solvents, and containers shall be disposed of in compliance with the British Columbia Waste Management Act, Special Waste Regulation.

#### **165.16 Air and Noise Pollution**

**165.16.01 Noise and Emissions** - All activities, equipment, processes and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with Federal, Provincial and local regulations governing noise levels and air emission standards. The Ministry Representative may require the Contractor to have maintenance performed on equipment or alter practices which are judged to produce excessive noise or emissions.

**165.16.02 Dust Control** - Application and handling of the any dust palliative, with the exception of water, shall be in compliance with the Ministry standards as given in "Maintenance Guidelines for Dust Palliatives and Gravel Road Stabilization".

Dust control techniques may also be required by the Ministry Representative during other construction operations, including but not limited to demolition, drilling,

sand blasting and concrete cutting.

#### **165.17 Use of Water**

**165.17.01 Authorization for Use** - For any source of water not specified in the Special Provisions, the Contractor is required to contact British Columbia Ministry of Sustainable Resource Management / Ministry of Water, Land and Air Protection Water Management office before any water is diverted, impounded, pumped or used for any purpose, including dust control, compaction, or operation of a work camp. Authorization in the form of an approval for short term use of water may be required from that agency. The Contractor should be aware that, if required, a water application approval may take at least six weeks to process.

Downstream water flow must be maintained at all times during water takings in fish-bearing waters.

Prior to commencing any work which may affect potable water supplies downstream of the construction area, the Contractor shall ensure that all owners of licensed water intakes have been notified.

Water sources must be approved by the Ministry Representative. In order to reduce the impact on local water supplies and watercourses, the Contractor may be required to use uncontaminated wastewater, such as that pumped from the surface of sedimentation basins.

**165.17.02 Screened Intake Requirements** - The intakes of all pumps or diversions used to withdraw water from fish-bearing watercourses shall be screened in accordance with the Fisheries and Oceans Canada "Freshwater Intake End-of-Pipe Fish Screen Guideline".

The Contractor shall provide and maintain stable access routes to all water withdrawal sites. The location of all such routes shall be subject to the approval of the Ministry Representative and the Environmental Agencies.

#### **165.18 Support Facilities**

**165.18.01 Location and Operation of Support Facilities** - The preservation of trees, shrubs, ground cover, fish and wildlife must be considered in site selection and construction of all temporary support facilities. During site preparation, vegetation shall be removed using selective hand clearing in preference to blanket clearing with heavy machinery, retaining vegetative cover wherever possible. The Contractor shall locate temporary field offices, storage, plant and other facilities on pre-existing cleared portions of the job-site or on areas to be cleared during the course of routine construction unless otherwise authorized by the Ministry Representative.



Where possible, for aesthetic purposes, work camps and parking areas shall be located behind a vegetative screen buffer. The Ministry Representative may require that work vehicles and heavy equipment shall be parked in designated locations only.

The Contractor shall abide by all pollution control practices, laws, ordinances and regulations applicable to the construction of work camps and support facilities. The Contractor shall obtain the approval of the British Columbia Ministry of Health, the British Columbia Water, Land and Air Protection Environmental Protection and Water Management offices, and any applicable local authority prior to the installation and/or operation of sewage disposal and potable water distribution systems.

Work camps, field office facilities and work sites shall be kept clear of litter and garbage. The Contractor shall be responsible for providing and regularly servicing animal-proof refuse containers and for instructing all employees to dispose of food wastes accordingly. Sanitary landfill operations shall be located well away from the main camp in order to minimize conflicts with wildlife.

Combustible solid wastes shall be incinerated on a regular basis, subject to all applicable emission guidelines. Solid waste containers shall be large enough to contain all of the wastes generated between collection periods. The containers shall be constructed such that spilled liquids are contained and access by insects and wildlife is prevented. Storage areas and containers shall be maintained in a sanitary condition and shall be covered to prevent spreading of wastes by water, wind or animals. Transportation of solid waste shall be performed in a manner which prevents littering during transit to the disposal site.

Sanitary landfill sites shall be located a minimum of 450 m from watercourses or campsites, and shall be situated such that contamination of any stream, lake or groundwater system is avoided. The location of all sanitary landfill sites must be approved by British Columbia Ministry of Water, Land and Air Protection, Municipal or local officials and the Ministry Representative. The bottom of the landfill site shall be located at least 2 m above the water table. Trees and other vegetation shall be removed progressively as the size of the landfill increases in order to minimize erosion by wind and water.

Sanitary wastes shall not be discharged into watercourses or on the soil surface. All temporary toilets shall be equipped with approved septic tanks having safe drainage or with closed holding tanks which are emptied only into approved treatment plants or sewage tanker trucks. All temporary toilets used on -site shall be placed in environmentally acceptable areas, and shall be secured to avoid or minimize

damage from vandalism.

**165.18.02 Abandonment of Sites** - Upon completion of construction, all temporary support facilities and camp infrastructure, including buildings, equipment, lumber, refuse, surplus materials, fencing and other such items shall be removed. The original drainage pattern shall be re-established, and all disturbed areas shall be revegetated.

The Contractor shall ensure that all project-related sites are left in an environmentally acceptable manner, subject to the approval of the Ministry Representative, the Ministry and the Environmental Agencies. Decommissioned construction areas, material sources and access roads shall be reclaimed by the Contractor such that as much of the original forest, wildlife, agricultural productivity, recreational use, etc. as possible is restored or enhanced.

### **165.19 Protection of Livestock and Wildlife**

**165.19.01 Protection of Livestock and Wildlife** - Harassment of livestock or wildlife in and adjacent to the project site is prohibited. The presence of livestock or wildlife in or adjacent to the project site, field office trailers or construction camp shall not be encouraged by feeding. The Contractor is required to inform work crews of the location of wildlife and livestock crossing sites situated within the boundaries of the construction area.

If it is necessary to arrange the removal or transfer of beavers, bears or other wildlife from the work-site or camp the Contractor shall contact a British Columbia Ministry of Water, Land and Air Protection Fish and Wildlife representative prior to taking action, and follow the course of action recommended.

**165.19.02 Disturbance of Fish and Wildlife** - Rules regarding hunting, fishing and the discharge of firearms by the Contractor, employees and sub-contractors, within the project area during the period of construction, shall be made in consultation with the Ministry Representative and the local British Columbia Ministry of Water, Land and Air Protection Fish and Wildlife office. The Contractor shall be responsible for ensuring compliance with these rules.

**165.20 Archaeological and Paleontological Discoveries** - In the event that any item of particular archaeological, heritage, historical, cultural or scientific interest is found on the project site, such item(s) shall remain the property of the Province and the Contractor shall, on making or being advised of such a find, immediately cease operations in the affected area, minimize activities which create ground disturbance in and adjacent to the affected area, and notify the Ministry Representative of the discovery. The Ministry Representative will notify the Archaeology Branch of the



British Columbia Ministry of Sustainable Resource Management. Work shall not resume within 30 m of the discovery site until an appropriate directive has been received from that agency.

To protect archaeological and paleontological sites that are situated within or adjacent to a project site, the Contractor may be required to use a variety of mitigative measures, including but not limited to drainage or erosion control, slope stabilization measures, or erecting fences or other suitable barriers to protect archaeological or paleontological sites that are situated within or adjacent to a project site. These measures, with any negotiated extensions of time for completion of the contract they require, will be determined and adopted at the discretion of the Ministry Representative. The costs associated with such mitigative measures will be borne by the Ministry, unless otherwise specified in the Special Provisions.

A buffer zone, in which no land alteration or other activity is

permitted, may be required to ensure adequate site protection. The width of this buffer zone shall be determined by the Ministry Representative in consultation with a representative of the Archaeology Branch of the British Columbia Ministry of Sustainable Resource Management.

The Contractor shall be responsible for the actions of employees and sub-contractors with respect to site vandalism and the unlicensed collection of artifacts from designated archaeological sites in and around the construction area.

**165.21 Resolution of Disputes** - In the event that a dispute arises between the Contractor and the Ministry, or the Environmental Monitor and the Ministry regarding environmental matters related to the project, the Ministry, or where appropriate, the Environmental Agencies, will have the final decision.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 194

### TRAFFIC MANAGEMENT FOR WORK ZONES

#### PART A – GENERAL

**194.01 General** - Traffic management requirements will be as specified herein and as specified in the Special Provisions or by the Ministry Representative.

The Contractor's Traffic Management Plan, Construction Schedule and its provisions for traffic control and safety will be based on providing safe passage through the Work Zone for all road users (i.e. cyclists, pedestrians and motorists). The Contractor will at all times make provisions for traffic through the Site to a sufficiently high standard to ensure the safety of the workers on the Project, the safety and the convenience of the travelling public, driver expectancy, and the protection of the Work Area. The Contractor will supply and maintain all traffic control devices and personnel necessary to provide all traffic control.

The Contractor's accommodation for pedestrian and vehicular traffic, and proposed traffic control procedures, for each work operation, will require approval by the Ministry Representative prior to the start of that operation.

Any one or more of the advance warning area, transition area, buffer zone and termination area of the traffic control (work) zone may be outside the Limits of Construction, but this will in no way diminish the Contractor's responsibility to meet the requirements of the Traffic Management Plan.

**194.02 Definitions** - For purposes of this Section, the following general terms are defined in the Traffic Management Guidelines for Work on Roadways:

- Traffic Management Plan
- Traffic Management Strategy
- Traffic Control Plan
- Incident Management Plan
- Public Information Plan
- Implementation Plan

In addition, the following terms are used in this Section and defined below:

“Work Area” refers to an area that contains the work activity and is closed to traffic and set aside for the exclusive occupation by workers, equipment and construction materials. Work areas may remain fixed in location or may move as work progresses.

“Work Zone” as defined in the Traffic Control Manual for Work on Roadways.

“Construction speed zone” as defined in the Traffic Control Manual for Work on Roadways.

**194.03 Standard Documents** – Traffic Management Plans shall be developed in accordance with standards defined in the latest version of the following documents:

- MoT Traffic Management Guidelines for Work on Roadways (TMG)
- MoT Traffic Control Manual for Work on Roadways (TCM)
- MoT Electrical and Traffic Engineering Manual and all current Technical Bulletins
- TAC Geometric Design Guide of Canadian Roads
- MoT Supplement to TAC Geometric Guide
- Workers' Compensation Board (WCB) Regulation

All Ministry Publications listed above can be purchased from:

GOVERNMENT PUBLICATION SERVICES  
MINISTRY OF MANAGEMENT SERVICES  
PO BOX 9452 STN PROV GOVT  
VICTORIA BC V8W 9V7

[www.publications.gov.bc.ca/queries/service.html](http://www.publications.gov.bc.ca/queries/service.html)

Email: [QPPublications@gems5.gov.bc.ca](mailto:QPPublications@gems5.gov.bc.ca)

PHONE: 1-800-663-6105

FAX: (250) 387-1120

**194.04 Traffic Control Supervisor** - The Contractor will designate a traffic control supervisor who has the Contractor's authority to respond to traffic control requirements and who will provide surveillance of traffic conditions through the Work Zone. This person or qualified designate will be available at all times, both when the Contractor is working and during weekends or other periods when the Contractor's forces are not active on the Project, to respond to calls from the police and from representatives of the Ministry concerning damage or deficiencies in the traffic control devices and the passage for traffic through the Work Zone.

The traffic control supervisor shall meet the requirements of the TMG and WCB Regulation and shall not be the Contractor's site superintendent.

**194.05 Compliance with Acts and Regulations** - The Contractor shall comply with the requirements of any legislation, Regulations and by-laws as are in force for the regulation of traffic or use of any road upon or over which it is necessary to carry out work or to haul materials or things.

#### PART B – PLANNING AND SCHEDULING

**194.11 Provide Traffic Management Plan** - The Contractor shall prepare a Traffic Management Plan (TMP)



in accordance with the Ministry definitions and guidelines specified in the Traffic Management Guidelines for Work on Roadways Manual.

The Special Provisions or the Ministry Representative will specify the Traffic Management Strategy and required documentation for the Traffic Management Plan.

The Traffic Management Plan will be fully integrated with the Contractor's plan and schedule for carrying out the work, comply with the requirements of the TCM, the Traffic Management Guidelines for Work on Roadways, the Traffic Management Strategies listed below, and with the provisions of the Agreement.

**194.12 Traffic Management Plan Review** – The Ministry Representative may review the Contractor's Traffic Management Plan for general conformance with the requirements of the Special Provisions and the Agreement for sufficiency of detail to provide a complete and unambiguous traffic control layout. No review or change requested by the Ministry Representative in any way relieves the Contractor of any of its responsibilities for ensuring safe and adequate traffic management. No work that effects traffic will be permitted until the Ministry Representative accepts the Traffic Management Plan.

Where the Traffic Control Manual shows a choice of traffic control layouts for a given specific situation, the Ministry Representative may request the Contractor to use an alternative layout which is acceptable.

The following time periods are required for plan review and acceptance unless otherwise specified in the Special Provisions or by the Ministry Representative:

- A Traffic Control Plan shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows. The following conditions shall apply:
  - Any plan modifications shall be submitted to the Ministry Representative for review at least ten (10) working days prior to any changes being made in the field.
  - A staged plan shall be submitted to the Ministry Representative for review at least ten (10) working days prior to implementation of a new stage.
- The Implementation Plan, if required, shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows.
- The Public Information Plan, if required, shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows.
- The Incident Management Plan, if required, shall be submitted to the Ministry Representative for review at

least fifteen (15) working days prior to the start of any Works effecting traffic flows.

## PART C – TRAFFIC MANGEMENT OPERATIONAL DETAILS

**194.21 Speed Zones** - . Reduction in speed limits may take several forms as defined in the TCM 1.4.6. Construction speed zones within the Project will be determined at the discretion of the Road Authority or as specified in the Special Provisions.

The Contractor's work plan, Construction Schedule and its provisions for traffic control and safety will include references to the reduced posted speeds referred to in Subsection 194.21.

The location and length of posted speed reduction zones shall be adjusted daily, or more frequently as appropriate to the Work, to provide the shortest reduced speed zone practical. For example, on a resurfacing project, the reduced speed limit would usually be invoked around active operations such as milling, priming, paving, and, if necessary, at access points to pits and the plant, but will not generally be acceptable for areas of the Site used only for haul.

## 194.22 Use of Channelling Devices and Taper Rates -

Traffic cones, temporary highway delineators, standard barricades or other marker devices such as wooden or metal saw horses, temporary marking tape, etc., shall be used in the following circumstances for channelling traffic:

- a) from one lane to another or for merging traffic where a reduction in the number of lanes must be effected
- b) around a hazard on the travelled way
- c) through an area of unfinished construction where the intended traffic lanes are not self-evident
- d) at any other location where, in the Ministry Representative's opinion, channelling will ensure the safe passage of public traffic.

Minimum taper rates and spacing between cones or delineators shall be as shown in TCM.

**194.23 Equipment on the Travelled Way** - When working on the travelled way equipment shall be placed in such a position as to present a minimum of interference and hazard to the travelling public. Equipment units shall be kept as close together as working conditions will permit and preferably on the same side of the travelled way. Equipment shall not be left overnight on the travelled way but shall be located so as to avoid the possibility of an accident.



**194.24 Roadway Configuration** - The Contractor shall arrange to keep interconnected lanes of the highway open to traffic at all times with the least amount of inconvenience to the travelling public unless otherwise authorized by the Ministry Representative.

**194.25 Roadway Condition** - The Contractor shall keep the travelled way well-graded, free of potholes and of sufficient width that the required number of lanes of traffic may pass. The subgrade shall be completed progressively in order that gravel surfacing may follow in an orderly manner. Prior to tearing up a portion of the existing travelled way the Contractor shall obtain Ministry Representative approval and shall also have available a sufficient supply of crushed gravel, or another approved product, to ensure a smooth riding surface during the work.

**194.26 Closures** – Road closures shall not be permitted until the Contractor requests and receives written permission from the appropriate authority in the Ministry of Transportation. This request shall be submitted in writing not less than fifteen (15) days in advance of the closure.

Upon receiving written permission for the closure, the Contractor must notify the local police, fire, ambulance, municipality, school board, and public transit at least seven (7) days in advance of the closure.

The Contractor shall notify the public by local radio and newspaper at least five (5) days in advance of the closure.

All costs related to the above shall be borne by the Contractor.

**194.27 Detours** —Where detours are required for the execution of the work or deemed necessary by the Ministry Representative, the Contractor shall provide well graded, gravelled detours or temporary roads to facilitate the passage of traffic around the restricted construction area. The Contractor shall be responsible for signs, maintenance of same and maintenance of the detour or temporary road. The Contractor shall consider the condition of the pavement used for detours and its impact on the safety and function of the detour. Milled surfaces upon which traffic is to run shall be clean and allow adequate drainage.

The minimum design requirements for any detours will be specified in the Special Provisions or by the Ministry Representative.

Where the anticipated detour extends beyond the existing road surface, the Contractor will submit an engineering design to the Ministry Representative for review, a minimum of fourteen (14) days in advance of building the detour. The engineering design will include the design

speed, the horizontal and vertical geometry, plus evidence that the design vehicle is accommodated for all movements and that all the requirements of this Agreement are satisfied.

Where the anticipated deviation is minor, the Contractor may apply to the Ministry representative, in writing, for approval to proceed without a formal design. Such approval does not relieve the Contractor of any of its responsibilities for provision of a safe site.

**194.28 Access to Property** - During operations the Contractor shall provide and maintain reasonable road access and egress to property fronting along or in the vicinity of the work unless other reasonable means of road access exists. The Ministry Representative will be the sole judge of what may be deemed reasonable road access.

**194.29 Winter Lay-Up** – In the event that the Work is stopped due to winter conditions, the Site is to be left in a condition as specified in the Special Provisions or as deemed acceptable by the Ministry Representative.

**194.30 Delays** – All major and minor delays to the travelling public will be determined by the Ministry Representative.

The Contractor will monitor the queue lengths created by any delay to the flow of traffic. Traffic must be cleared prior to starting another delay unless authorized by the Ministry Representative. If the Ministry Representative determines that the traffic delays are excessive, the Contractor shall immediately cease construction activities and make all the travel lanes available to traffic as quickly as possible. Resumption of roadway operations shall be permitted as traffic levels dictate and upon approval by the Ministry Representative.

## PART D – TRAFFIC CONTROL DEVICES

**194.41 Traffic Signals** - Short one-way sections, such as bridge and culvert construction detours, etc., may be controlled by traffic signals and it is acceptable where the restriction will be in effect for an extended period. The use of signals on long one-way zones is not recommended as delays to traffic may be of considerable length and might not be accepted by the motorist.

Where traffic signals are requested by the Contractor, the Contractor shall arrange to have a qualified Traffic Engineering consultant prepare a Traffic Engineering study for the signal. The study shall document the following:

- Site layout
- Anticipated volumes
- Requirements for advance warning signs
- Actuation



- Proposed traffic signal timing plans

The Contractor will submit the study to the Ministry Representative for review. The approval for the installation of the signals will be determined by the Ministry Representative.

If the proposed traffic signal installation is approved by the Ministry Representative, the Contractor shall:

- Prepare a traffic signal design, signed and sealed by an electrical engineer registered with the APEGBC
- Supply and install all traffic controller equipment
- Supply power
- Operate and maintain the signals

Changes to the signal timing plans shall only be prepared by a qualified professional traffic engineer experienced in traffic signal timings. Traffic controller technology used shall comply with industry standard practice and shall have a conflict monitoring mechanism that will ensure signal malfunctions/conflicts result in the signal going to a flashing red state. Signals shall be vehicle actuated unless otherwise approved by the Ministry Representative. Signal operations shall conform to TCM 2.2.8 and the *Electrical & Traffic Engineering Manual*.

Where the work activity impacts the operation of an existing signal, the Contractor must submit a written notification to the Ministry Representative a minimum of ten (10) days in advance of the disruption to the signal.

**194.42 Pilot Cars** – The use of pilot cars may be warranted where public traffic must use a particularly hazardous route, or where traffic is required to remain in one lane, or change periodically from one lane to another, or negotiate a section of construction at restricted speed. Pilot cars shall be operated in conjunction with flagpersons stationed at each end of the restricted section. When required, the Contractor shall provide sufficient pilot cars, as may be required from time to time, to keep a steady and controlled flow of traffic moving around or through the construction area.

Pilot cars shall be equipped with the following:

- a) A sign or signs with minimum 200 mm letters, designating the vehicle as a pilot car, and showing the message in both directions. Signs shall be illuminated during the hours when headlights must be used. Signs shall not be displayed when the vehicle is not being used for piloting.
- b) Amber flashing lights mounted on the roof at either side so as to be clearly visible from both directions. The flashing lights shall be in use for both day and night piloting.

**194.43 Use of Flagpersons** – It is generally expected that flagpersons will be required in the following situations:

- a) when public traffic is required to pass working vehicles or equipment which may block all or part of the travelled roadway.
- b) when it is necessary to institute a one-way traffic system through a construction area or other blockage where traffic volumes are heavy, approach speeds are high, and a traffic signal system is not in use.
- c) in high speed, high volume areas where temporary protection is required while other traffic control devices (barricades, cones, signs, etc.) are being erected or taken down.
- d) for emergency protection when other traffic control devices are not readily available.
- e) in all situations, where adequate protection for workers, working equipment and public traffic is not provided by other traffic control devices.

**194.44 Traffic Signs** – All standard signs, new and replacement, shall meet current Ministry specifications. The Ministry Specifications for Standard Highway Sign Materials, Fabrication and Supply are located on our Ministry web page at:

**[www.th.gov.bc.ca/publications/eng\\_publications/geomet/geometsigns.htm](http://www.th.gov.bc.ca/publications/eng_publications/geomet/geometsigns.htm)**

Prior to the commencement of work the Contractor shall supply all posts, hardware and equipment required for the proper installation and maintenance of the project (C-35) signs and the Contractor's own "Construction Ahead" (C-18) signs. The Contractor shall place the signs as indicated in the TCM or as directed by the Ministry Representative.

Upon completion of the project the Contractor shall remove the C-35 signs and the C-18 signs, posts and hardware when directed by the Ministry Representative. The removal of the signs shall also include the backfilling, compacting and dressing of the postholes to the satisfaction of the Ministry Representative.

The signs shall be erected in advance of all highway and bridge construction projects whether undertaken by contract or day labour. The signs may be omitted at the direction of the Ministry Representative if the project is not in public view.

The Contractor shall supply and maintain all necessary signs and traffic control devices required by this specification and the TCM or as ordered by the Ministry Representative. All



signs and devices used must conform to the standards detailed in this manual.

**194.45 Barricades, Lights, Delineators, Traffic Lines -**

The Contractor shall provide, erect and maintain all types of temporary marker devices including traffic line marking tape, barricades, fences, delineators, flare-pots, battery operated amber flashing lights and 110 volt steady burning or simultaneous flashing lights, in order to ensure safety to the workers and the general public. These devices shall be as required by the Special Provisions and the TCM, or as directed by the Ministry Representative.

Flashing amber lights, if deemed necessary by the Ministry Representative, are used for extra night time effectiveness and the batteries of the flashing lights shall be checked each day.

Battery operated flashing lights, if two-faced, and if used to mark the right hand edge of a travelled lane, must have one face covered so that the light is not visible to traffic travelling in the other direction. Flashing lights having two faces showing in opposite directions may be used only if it is necessary that the obstruction or lane edge being marked be seen from both directions of travel. They should not be used in a line of delineators through an area of incomplete construction except where traffic must be diverted and a specific hazard exists.

Temporary road construction lighting installations shall be positioned as shown in FIGURE 1: Positioning of Temporary Lighting Adjacent to a Highway to minimize glare and resulting impaired driver vision. Lights shall be aimed away from any approaching traffic and at an angle of less than 45 degrees above vertical. Where lights cannot be located as shown then temporary glare screens shall be used to shield the traffic from the light source. These glare screens shall be metal or an opaque plastic material designed to shield the lighting from the eyes of the driver.

The Contractor shall be responsible for the application and

removal of all temporary pavement marking and reflective devices. When traffic lanes have to be redefined for Long Duration Work, the Contractor shall eradicate all redundant temporary or pavement markings that are not required for the intended traffic patterns.

Class I and Class II standard barricades are illustrated in the TCM. Temporary delineator posts shall be as shown on Drawing SP194.02. In speed zones of 50 km/h or less, the minimum height of traffic cones shall be 450 mm. Where the maximum speed limit is over 50 km/h, the minimum height of cones shall be 700 mm.

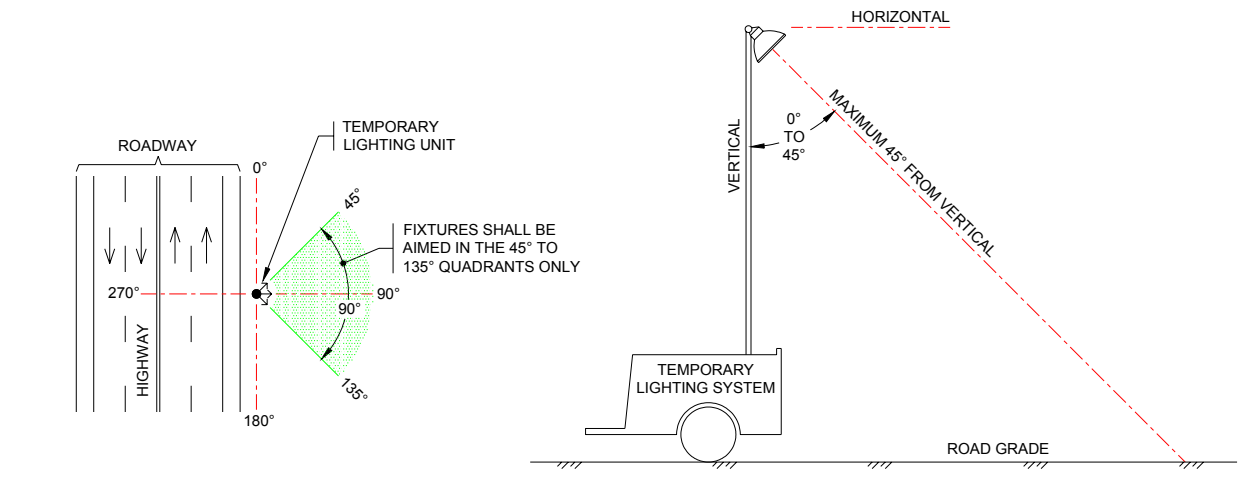
**194.46 Changeable Message Signs** –The use of changeable message signs (CMS) may be specified in the Special Provisions or by the Ministry Representative. Each sign must be portable. When in operation, the CMS shall be a minimum of two (2) metres from the bottom of the sign display to the road surface, and shall be level and capable of pivoting for sighting purposes. The specifications of the sign are as follows:

Sign unit:	Yellow/Orange LED display
Sign display:	3 lines with 8 characters per line
Character size:	450mm (18 inches)
Character matrix:	5 x 7
Remote dial-up access:	By cellular phone or equivalent

A full matrix sign may be used given that it has the display parameters noted above.

The Contractor is responsible for the CMS including but not limited to bringing the signs to the Project, moving and setting-up, providing storage as required including moving the signs into and out of storage, maintaining the signs in full operating condition, ensuring the correct message is being displayed, damage to or loss of the signs and returning the signs to the supplier. The Contractor shall provide to the Ministry Representative with a description of the messages displayed and the procedures of how the messages on the CMS will be changed when the Contractor is on and off site.





**FIGURE 1: Positioning of Temporary Lighting Adjacent to a Highway**

## PART E – GENERAL MAINTENANCE

**194.51 Maintenance** - The Contractor shall be responsible for the continuing maintenance of all traffic control devices in use as follows:

a) Signs, etc., not applying to existing conditions shall be removed or covered. If covered, such as after sundown or during periods when work is suspended, the covering shall be placed over the sign so as to totally obliterate the message thereon. Where operations are carried out in stages, only those devices or signs, which apply to the current stage, are to be left in place or uncovered.

b) Signs shall be checked daily for legibility, damage, suitability and location. Dirty, damaged, unsuitable or misplaced signs shall be cleaned, repaired or replaced. Signs and delineators with a reflective surface shall be cleaned as frequently as necessary to ensure full reflectivity. As considerable damage may be inflicted on signs and devices during a weekend, the Contractor shall conduct a check for replacement or repairs before the rush hour on Monday morning. Similarly, high traffic volume and recreational routes shall be checked during the weekend or at any other time that works is not in progress.

During hours when headlights are required, signs that have not been treated with a reflective coating shall be illuminated. After sundown all signs shall be checked

for visibility and those that cannot be seen clearly shall be adjusted or replaced.

## PART F – PAYMENT

**194.61 Payment** – The cost of all Traffic Management requirements, including the provision of pilot cars, all flagging and traffic control equipment, and personnel covered in this Section and the Contract Documents, or as ordered by the Ministry Representative, will be considered to be included in the unit prices bid for the applicable work of the Contract unless otherwise specified in the Special Provisions.

However, where pilot cars and flagpersons are included as bid items in the Contract Documents, a record of the days and hours that each pilot car and/or flagperson was employed shall be submitted daily by the Contractor for verification and approval of the Ministry Representative. In such event the overtime “hours worked” by flagpersons in accordance with the current union agreement shall be expressed in equivalent straight-time “hours earned” for payment at the rate bid. Pilot cars will be paid for at the all found rate bid in the Schedule for the actual number of hours operated as such..



## SECTION 200

### CLEARING AND GRUBBING

**200.01 Clearing** - Except for trees and shrubs to be preserved as indicated on the Plans or designated by the Ministry Representative, "Clearing" shall mean the complete removal and disposal of all standing and fallen trees, stumps, logs, upturned roots, rotten wood and all other vegetation growth, and accumulations of rubbish of whatsoever nature, and any other objectionable material from the area shown on the Plans, or as directed by the Ministry Representative. Protective measures for the protection and retention of vegetation are specified in Section 769.

It shall also include the removal of existing cribwork, guard rail, fences, siphon structures built of timber and/or metal, culvert pipes of all types and timber box culverts within the limits of the work; but shall not include the removal of concrete buildings or their foundations, concrete bridge piers or abutments and their footings, concrete siphon boxes or concrete box culverts. The above items, which are excluded from Clearing shall be classified as Solid Rock and will be paid for as such in accordance with the measurements established by the Ministry Representative, and at the unit price bid in the Schedule of Approximate Quantities, and Unit Prices for Solid Rock.

The area to be cleared shall include those areas required for the highway right-of-way, borrow pits, quarry sites, Ministry or Crown gravel pits and access roads thereto, if ordered by the Ministry Representative; off-take ditches or other drainage ditches and channels for stream diversions either within or without the right-of-way; clearing of debris in streams as indicated on the plans, or as directed by the Ministry Representative either within or without the right-of-way; foundations for structures and the right-of-way as shown on the Plans, or as directed by the Ministry Representative, for intersecting public and private road approaches or diversions of same outside the main highway right-of-way. All such areas are hereinafter referred to as the "Area."

**200.02 Disposal of Material** - All material, slash and debris resulting from clearing operations shall be disposed of by burning unless there are specific provisions for otherwise disposing of same. Unmerchantable timber, stumps, etc., shall not be disposed of by pushing outside the clearing and grubbing right-of-way. All trees shall be felled within the Area but, in the event of any trees falling outside the Area, such trees shall be cut up and together with all debris and slash therefrom, brought back to the Area and there burned. The Ministry Representative may designate certain trees or shrubbery to be left standing, in which case the Contractor shall take every precaution not to damage or injure such trees or shrubbery in felling adjacent timber, burning or any other clearing operations as specified in Section 769.

Such trees or shrubbery are to be limbed or thinned to such height and extent as may be directed by the Ministry Representative. No deduction will be made in the total quantity of clearing for any trees or shrubbery ordered to be left standing; no additional payment will be made for any limbing or thinning of such trees or shrubbery as may be directed by the Ministry Representative.

Except as hereinafter provided, all slash and debris shall be piled and burned at points located centrally in the Area. The number of fires to be started at any one time shall be limited to the capacity of the Contractor's equipment and organization to provide adequate protection against the spreading of the fires to adjacent timber or property.

All burning shall be carried out subject to the Provisions of the Forest Act and regulations thereto. In the event of Forestry regulations prohibiting burning, the slash, debris, etc., may be piled along the sides of the Area until such time as the regulations are rescinded.

Clearing must be carried on and completed at least 1 km ahead of grading operations.

**200.03 Grubbing** - Grubbing means the entire removal and disposal by burning as described in Subsections 200.01 "Clearing" and 200.02 "Disposal of Material" of all stumps, roots and embedded logs to a depth of 0.6 m below the ground line.



Grubbing shall be carried out over the entire Area as defined in Subsection 200.01 "Clearing." Grubbing shall be fully completed at least 300 m in advance of grading operations.

**200.04 Danger Trees** - This item shall consist of removing, on written order of the Ministry Representative, any leaning or dangerous trees or snag outside the clearing Area.

Such trees shall be felled and disposed of as provided for in Subsection 200.01 "Clearing" and Subsection 200.02 "Disposal of Material."

The Contractor will not be required to grub the stumps of any danger trees.

**200.05 Payment for Danger Trees** - Danger trees will be measured in three sizes according to the diameter of the tree trunk measured at a point 1.25 m above the ground line at the base of the tree. These sizes shall be as follows:

- a) Under 0.75 m in diameter
- b) Between 0.75 m and 1.5 m in diameter
- c) Over 1.5 m in diameter.

Compensation for removal of danger trees as provided herein shall be made at the following unit prices which shall be accepted as full payment for everything furnished and done to remove danger trees as specified:

- a) Under 0.75 m in diameter - \$25.00 per tree
- b) Between 0.75 m and 1.5 m in diameter - \$60.00 per tree
- c) Over 1.5 m in diameter - \$100.00 per tree.

**200.06 Mail Boxes** - Where it becomes necessary to remove or otherwise disturb existing mail boxes within the limits of any project, the Contractor will be required to install the boxes temporarily in such a position that their usefulness will not be impaired. After construction work has been completed, the boxes shall be re-installed at positions designated by the Ministry Representative. No new posts or materials will be required, except that any damage caused by the Contractor to either boxes or supports, due to the Contractor's negligence, shall be repaired by the Contractor at the Contractor's expense.

All costs in connection with the removal and replacement of the mail boxes, as specified above, shall be considered as incidental to the construction of any improvement and shall be included in the unit prices for the various pay items of work involved in the contract. No additional compensation will be made.

**200.07 Removal of Existing Signs and Symbols** - When construction operations are started, the Contractor shall remove all existing Signs and Symbols of the British Columbia Ministry of Transportation not needed for the safe and orderly direction of traffic, and any other authorized signs within the limits of the right-of-way, and shall deliver them to such point as directed by the Ministry Representative.

Payment for this work shall be included in the unit prices for the various pay items of work involved in the contract. No additional compensation will be paid.

**200.08 Quantities and Payment** - Clearing will be paid for at the unit price bid per hectare of clearing and will, unless otherwise specified, comprise the full length and breadth of the right-of-way as shown on the Plans or as directed by the Ministry Representative. Grubbing will be paid for at the unit price bid per hectare of grubbing and will, unless otherwise specified, comprise the full length and breadth of the right-of-way as shown on the Plans or as directed by the Ministry Representative.

These prices shall be accepted as full compensation for everything furnished and done in connection therewith, regardless of the nature or condition of the Area.



## SECTION 201

### ROADWAY AND DRAINAGE EXCAVATION

#### DESCRIPTION

**201.01 General** - Roadway and Drainage Excavation shall include all excavation and the construction of all embankments required for the formation of the roadbed, parking areas and look-outs; excavation for any drainage ditch, off-take ditch or channel for stream diversion within or outside the right-of-way; removal of surcharge material, topsoil and organic waste material from the roadway, and of topsoil and unsuitable overburden from any borrow pit or any Ministry or Crown gravel pit, and disposal of same, as may be directed by the Ministry Representative; excavation of materials below grade; excavation of borrow pits; the grading necessary to construct any frontage road, gravel pit access road, borrow pit access road or any other access road, public or private, either within or outside the right-of-way, as may be ordered by the Ministry Representative; the grading of connections to intersecting roads, public or private, either within or outside the right-of-way; the hauling and disposal of all excavated material, and the trimming and shaping of all excavations and embankments.

**201.02 Extent of Work** - The dimensions of the excavations and embankments shall be as shown on the Contract Drawing but the Ministry Representative may increase or decrease the width of the roadbed or the ratio of the slopes as conditions and circumstances may necessitate.

Construction Grade is defined as the grade upon which the Asphaltic Pavement is laid.

Subgrade is defined as the grade upon which the first layer of select granular sub-base or base material is laid.

#### MATERIALS

**201.11 Description of Material Types** - Excavation shall be classified, as approved by the Ministry Representative, under the following material types:

- a) Type A
- b) Type B
- c) Type C
- d) Type D

The material encountered in any highway excavation shall be classified as one of the four types listed above.

In no case shall a material be classified using percentages of two or more types.

It is possible that material may change at some level in the excavation. Where such a change occurs, in order to obtain approval for a change in classification, the Contractor shall immediately notify the Ministry Representative. If a

classification change is approved, sufficient field measurements will be taken to establish the boundary between the two types of material.

**201.11.01 Type A - Solid Rock** - Type A shall include all forms of "solid rock in place" occurring in masses, ledges, seams or layers of sufficient hardness to require breaking by continuous drilling and blasting before excavation and removal.

It shall also include detached masses of rock or boulders individually containing a volume of 1.5 m<sup>3</sup> or more.

**201.11.02 Type B - Materials Containing More Than 50% Loose or Broken Rock** - Type B Material shall mean loose or broken rock, boulder gravel, or any other material containing at least 50% boulders or broken rock, having a size greater than 0.03 m<sup>3</sup> but less than 1.5 m<sup>3</sup> and in a state not requiring loosening, or drilling and blasting for removal.

Any excavation or portion thereof, containing the 50% boulders or broken rock of the size described above, shall be classified as this type of material and will be paid in its entirety under this category.

Any excavation, not containing 50% boulders or broken rock of the size described above, shall be classified in its entirety as Type D Material, and in that event no allowance will be made for the smaller percentage of boulders or broken rock in the material.

**201.11.03 Type C - Materials Requiring Ripping** - Type C shall include those materials of such density or so firmly cemented together that a force of at least 360 kN per linear metre of ripper shank or ripping equipment embedded in the material is required to loosen the material. If the material can be loosened with a lesser force, then the material will be classified as Type D.

If a means other than ripping equipment is used to loosen materials, the force generated must be equivalent to that specified above.

Where deemed necessary by the Ministry Representative, a ripping test will be conducted using a bulldozer or other appropriate equipment, under suitable weather conditions, that will develop sufficient traction and effectively deliver a force of 360 kN per lineal metre of ripper shank embedded into the alleged Type C. The material will only be classified as Type C if it cannot be loosened under such an applied load.

The test will be conducted at the Contractor's expense unless the test indicates, to the satisfaction of the Ministry



Representative, that the material is Type C. In that case, the cost of the equipment (including mobilization if the equipment is brought in solely for the purpose of the test) and the operator will be paid as Extra Work.

**201.11.04 Type D - All Other Materials** - Type D shall include all other materials of a nature not included in the foregoing definitions of Type A, Type B, or Type C; regardless of the nature or condition of the material or the method used to excavate or remove.

Type D shall also include any unsuitable materials of an organic nature, unless such materials have been specifically set apart in the Special Provisions of the contract.

**201.12 Unsuitable Material** - Unless otherwise shown, specified or directed, all topsoil and organic material shall be stripped from the highway cut and fill areas, and placed in the area between the highway and the right-of-way boundary, or on any other area designated by the Ministry Representative.

Where additional material is found above or below subgrade in an excavation or in the foundation of an embankment, which in the opinion of the Ministry Representative is unsuitable, such material shall be removed and paid for as excavation, as classified by the Ministry Representative. Soft clays and peats are examples of normally unsuitable materials.

Backfilling, where required, shall be carried out with approved materials, as ordered by the Ministry Representative. Payment for such backfilling and haul will be made at the unit prices bid for "Roadway and Drainage Excavation" and "Overhaul" in the Schedule of Approximate Quantities and Unit Prices.

Material that is unsuitable for the construction of embankments shall be disposed of as ordered. Any such material subsequently placed in an embankment, without the approval of the Ministry Representative, shall be removed and disposed of, as directed by the Ministry Representative, and no payment will be made for the removal or haul of such unsuitable material from the embankment.

Upon completion of the road grade, all topsoil and organic material suitable for growth of ground cover shall be spread on the cleared right-of-way and up the fill slopes to generally blend in with the cross-section. Care shall be taken that proper drainage is maintained. This topsoil shall be trimmed to a neat appearance preparatory to seeding by others. No additional payment will be made for replacing and trimming topsoil except that haul in excess of 300 m will be paid in accordance with Subsections 201.45, 201.83 and 201.93.

## CONSTRUCTION

**201.31 Rock Cuts**- See Section 204

**201.32 Dangerous, Loose and Overhanging Rock** - The Contractor shall be required to remove dangerous, loose and overhanging rock within or outside the limits of the highway right-of-way, when and where ordered by the Ministry Representative. Such work within the cut slopes will be paid for under the heading of "Roadway and Drainage Excavation." Such work beyond the cut slopes will be paid for at a negotiated rate or by Order for Extra Work.

**201.33 Overbreak in Solid Rock** - Overbreak in solid rock excavation encountered in this contract is that portion of any such material which is excavated, displaced or loosened outside and beyond the slopes or grades as staked or re-established (with the exception of slides as described in Subsection 201.42) regardless of whether any such overbreak is due to the inherent character of any formation encountered or to any other cause.

All overbreak, as so defined, shall be removed by the Contractor at the Contractor's expense, and shall be disposed of by the Contractor, in the same manner as provided for "Surplus Material", but at the Contractor's expense without any allowance for overhaul, except as hereinafter stated.

**201.33.01 Allowable Overbreak** - If, and only where directed by the Ministry Representative, use is made of the overbreak to replace material, which would otherwise have to be borrowed for the construction of the roadway, then such overbreak will be classed as allowable overbreak.

**201.33.02 Contractor's Negligence** - Overbreak resulting from fault or negligence of the Contractor shall be removed and disposed of, as directed by the Ministry Representative, at no cost to the Ministry.

Definition of negligence will be deemed to mean lack of cut-off drill holes on the back slope, excessive spacing of drill holes and overloading of same.

**201.34 Surplus Material** - All excavation shall, if required, be taken or hauled into the nearest embankment and out to the extreme distance required by the Ministry Representative. The surplus beyond what is necessary to form the nearest embankment shall be disposed of in widening this embankment uniformly along one or both sides of the same, or shall be hauled to form or widen any embankment on the road to be constructed, as the Ministry Representative may direct. No material shall be wasted and in no case shall material be deposited above the grade of the adjacent roadbed, unless directed in writing by the Ministry Representative.



**201.35 Enlargement of Excavation** - In cases where the quantity of material taken from a regular excavation will not be sufficient to form the requisite embankment, the deficiency shall be supplied by taking material from excavation within or outside the right-of-way, at such places as the Ministry Representative may direct, or from enlargement of the regular excavations made uniformly on one or both sides. The sides of the excavation in all cases shall be dressed to such slopes as the Ministry Representative may require, provided that if the Contractor shall have sloped or scaled such excavation by direction of the Ministry Representative before widening the same, payment for sloping or scaling the second time will be made by Order for Extra Work.

**201.36 Rock Embankments** - This section applies to embankments constructed from material containing more than 15% by volume of rock larger than 150 mm.

Embankments shall be constructed in layers equal in thickness to the largest size of the material but not exceeding 0.7 m. Greater lift thicknesses will be permitted by the Ministry Representative under special conditions provided the Contractor can spread the larger material satisfactorily.

The material shall be deposited and spread so that the larger rocks are well distributed and the intervening spaces are filled with smaller sizes as may be available to form a stable embankment. The finer portion of excavated rock shall be retained for the top transition layer. Each layer shall be compacted by routing the loading construction equipment over the entire width.

When a rock embankment is overlain by an earth embankment or by sub-base or base course materials, the top 0.5 m of the rock fill shall be sealed with smaller rock particles and suitable soil materials, if necessary, to prevent the uppermost layers penetrating into voids in this rock embankment.

Where permitted by the Ministry Representative, and where the width is too narrow to accommodate equipment, material for the toe of the side hill rock fills may be placed by end dumping until sufficient width of the embankment has been formed to carry equipment, after which the remainder shall be placed in layers and compacted as specified. Any loose material left on the slopes by end dumping shall be incorporated in the fill and compacted.

When embankments are made on hillsides or where a new fill is to be applied upon an existing embankment, the slopes of the embankment or original ground (except rock) shall be terraced in a continuous series of steps a minimum of 1.5 m wide as the embankment rises.

The material from step excavation shall be spread and compacted into the adjoining embankment. No additional payment will be made for excavation or for placing step material in the adjoining fill.

**201.37 Earth Embankments** - This section applies to embankments constructed from material containing less than 15% by volume of rock larger than 150 mm. Embankments shall be constructed in such a manner that they shall be completely stable with reference to designated traffic loading.

The natural surface shall be excavated to remove organic soils or other unsuitable material, as directed by the Ministry Representative, and the removal of such material will be paid at the unit prices for the class of excavation involved.

The earth embankment shall then be constructed in successive horizontal layers not exceeding 200 mm in loose thickness except that the top 500 mm shall be constructed in layers not exceeding 100 mm in loose thickness. Each layer shall be compacted to minimum 95% of the laboratory density obtained by the current ASTM test method D 698, except in the top 300 mm of the embankment, which shall be compacted to minimum 100% of the laboratory density.

No organic soils shall be placed in the embankment. Soils that cannot be compacted to the required density because of a high moisture content shall not be employed without prior aeration and drying.

When embankments are made on hillsides or where a new fill is to be applied upon an existing embankment, the slopes of the embankment or original ground (except rock) shall be terraced in a continuous series of steps a minimum of 1.5 m wide as the embankment rises.

The material from step excavation shall be spread and compacted into the adjoining embankment. No additional payment will be made for excavation or for placing step material in the adjoining fill.

The Contractor shall be responsible for selecting equipment and methods of attaining the specified degree of compaction. In general the roller mass shall be sufficient to compress the soil vertically after each pass but not sufficient to unduly rut or shear the soil.

Water shall be added and incorporated into the soil using suitable equipment such as rotary mixers, cultivators, etc., to increase the natural moisture content to the optimum moisture percentage as determined by the current ASTM test method D 698. In the event that the natural moisture content is greater than the optimum, the soil shall be aerated and dried employing suitable mixing equipment.



**201.38 Frozen Material** - The use of frozen material in embankments will not be permitted; the only exception is broken rock containing less than 15% passing a 4.75 mm sieve. Frozen excavated material which will be suitable when dry shall be stored and allowed to thaw and dry, and then placed in the embankment, as directed by the Ministry Representative. No compensation will be allowed for the storing and rehandling of this material.

**201.39 Snow Removal** - Snow overlying the surface of a cut, or the site or surface of an embankment shall be removed and deposited beyond the slope stakes at the Contractor's own expense.

**201.40 Bridge End Fill** – Material for bridge end fill shall be in accordance with Subsection 202.07. Construction of bridge end fill shall be in accordance with Subsection 202.31.

**201.41 Transition Sections** - Subgrade, other than solid rock, shall be subcut 1 m deep at the line of transition from cut to embankment. The subcut shall taper to zero depth 8 m within the cut. The embankment construction shall be carried back over the subcut only after the embankment has reached the level of the bottom of the subcut, as measured by the Ministry Representative. Payment for the subcut will be made as "Roadway and Drainage Excavation."

**201.42 Slopes and Slides** - The slopes of all excavations and embankments shall be trimmed neatly and evenly to the line and slope indicated on the Plans or as directed by the Ministry Representative.

No undercutting of slopes in excavation by power shovels or other excavation equipment will be permitted.

In case slopes, finished to the lines as shown on the Plans, slide into the roadway or out of embankments before final acceptance of the work, such slide material shall be removed by the Contractor from the roadway or replaced by the Contractor in the embankment, as the case may be, at the unit price for the class of excavation involved. The classification of material in slips and slides shall be in accordance with its condition at the time of removal regardless of its prior condition. The slopes shall be refinished by the Contractor, as directed by the Ministry Representative. Such refishing will be paid for by Order for Extra Work. Materials to replace embankment slides shall be obtained from sources designated by the Ministry Representative.

Slopes undercut at the base or destroyed in any manner by act of the Contractor shall be resloped by the Contractor at the Contractor's expense to the slope, as directed by the Ministry Representative. All materials resulting from such

resloping shall be removed and deposited, as directed by the Ministry Representative. No payment will be made to the Contractor for the removal of such material.

**201.43 Ditches** - Ditches which may be considered necessary for the proper drainage of the work shall be constructed at such points and to such cross-section, alignment and grade as the Ministry Representative may direct. This shall include inlets and outlets to culverts and ditching of all kinds. Ditching quantities will be considered as ordinary excavation quantities and will be measured, classified and paid for as such.

**201.44 Borrow** - Borrow shall consist of the excavation and disposal, as directed by the Ministry Representative, of suitable and satisfactory material obtained from borrow pits, approved and measured by the Ministry Representative, for the construction of embankments, subgrade or shoulders. The widening of roadway cuts and ditches will not be considered as borrow.

Borrow pits may only be opened at sites approved by the Ministry Representative. The Ministry will formally arrange for securing the sites and the right-of-way thereto and will pay the cost of compensation, royalties and fencing, where required, and all other expenses in connection therewith except the cost of maintenance of access roads. This, however, shall not be interpreted as relieving the Contractor of any responsibility for damage to person and property.

Borrow pits shall be so excavated that they will drain to the nearest natural outlet, or to an outlet designated by the Ministry Representative. Side slopes of borrow pits in all cases shall be dressed to such slopes as the Ministry Representative may direct.

**201.45 Haul and Overhaul** - Excavated material shall be hauled to any distance that the Ministry Representative may direct. Whenever the material is hauled to a distance greater than 300 m, the Contractor will receive additional compensation for overhaul as allowed for in Subsections 201.83 and 201.93.

**201.46 Watering** - Water for compacting embankments, constructing subgrades and surfacing, and for laying dust caused by grading operations and traffic, shall be applied in the amounts and at the places designated by the Ministry Representative. Water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable control apparatus. When directed by the Ministry Representative, sprinkling shall be done at night or in the early morning hours when evaporation loss is at a minimum.

The Contractor shall make all necessary arrangements for obtaining water at the Contractor's expense.



**201.47 Finishing of Roadway** - Before acceptance and final payment is made, the entire roadway, including the roadbed, shoulders and ditches shall be neatly finished and trimmed to the lines, grades and cross-sections shown on the plans, or as directed by the Ministry Representative, to reproduce smooth surfaces, slopes and a uniform cross-section. Subgrade shall be finished within a tolerance of  $\pm 15$  mm except for rock cut fills where the tolerance shall be  $\pm 50$  mm.

All drainage ditches, waterways and culverts shall be opened up and cleaned out to restore them to their full effectiveness.

All loose rock and boulders within the right-of-way resulting from grading and grubbing operations shall be gathered up and buried, or otherwise disposed of as the Ministry Representative may direct.

The Contractor shall grade all portions of the right-of-way outside the Excavation and Embankment areas to conform to the general ground line. This work will be considered as subsidiary work pertaining to the Item of "Roadway and Drainage Excavation," and no extra payment will be made.

**201.48 Surcharge Pre-consolidation** - Pre-consolidation by surcharging shall be carried out where indicated on drawings and/or Special Provisions, or as directed by the Ministry Representative. Embankments on these areas shall be placed directly on the natural ground without removal of the organic materials, unless otherwise directed by the Ministry Representative, and shall be constructed to a surcharged height above construction grade as shown or specified.

The Contractor shall be allowed to place the initial lift of embankment to a minimum depth required to carry the Contractor's hauling equipment. The remainder of the embankments shall be constructed in accordance with procedures set forth in this Section; except that compaction will not be required on the surcharge material above construction grade.

To avoid shear failures, the rate of construction shall be rigidly controlled by instrumentation installed by the Ministry.

The surcharge shall remain on the embankments a minimum of three months, or additional time as directed by the Ministry Representative, and as may be indicated by the instrumentation.

Should any of the instrumentation become damaged or rendered unusable by the construction operations, same will be replaced by the Ministry at the Contractor's expense.

**201.49 Back Slope Stabilization** - Drainholes, rock bolts, mesh and/or shotcrete may be required where rock is being excavated.

The backslope stabilization requirements will be assessed by the Ministry Representative during construction and the amount and location of the drainholes, rockbolts, mesh and shotcrete may be changed or deleted according to the condition of the rock encountered in the field.

No adjustments in prices for changes in quantities or compensation for eliminated items will be made.

## MEASUREMENT

**201.81 Borrow** - Borrow pits will be contour surveyed before the Contractor begins work therein and no payment will be made to the Contractor for any material excavated from borrow pits prior to this being done.

**201.82 Excavation** - All "Roadway and Drainage Excavation" will be measured in excavation by cross-section from the ground line as it exists after Clearing and Grubbing operations have been completed, as specified in Subsections [200.01](#) through [200.03](#).

Pay quantities will be computed in CUBIC METRE to the neat lines staked. Computation of end areas under  $20 \text{ m}^2$  will be by calculation and end areas over  $20 \text{ m}^2$  will be determined by use of planimeter; or the electronic computer may be used to determine all volumes. In computing volumes, the method of average end areas will be used. Adjustments for curvature will be made in any cut where deemed equitable by the Ministry Representative.

**201.83 Overhaul** - Overhaul of excavations and embankments will be measured on the completion of the project by the 1000 STATION METRES where a station metre (Sta. m) is  $1 \text{ m}^3$  of excavated material hauled a distance of one station (100 m). No allowance will be made for shrinkage or swell.

After allowances have been made for specific hauls which have been designated by the Ministry Representative, this information will be used to prepare a final volume overhaul diagram which will form the basis for payment of all other overhaul on "Roadway and Drainage Excavation."

**201.84 Watering** - Water will be measured by the KILOLITRE in tanks or tank trucks of known capacity or by means of metres of a type approved by the Ministry Representative, which shall be furnished and installed by the Contractor at the Contractor's expense.

**201.85 Compaction** - Compaction will be measured by the



SQUARE METRE. In determining the area compacted, the width shall be the mean width of the top and bottom of each 300 mm layer so compacted.

### PAYMENT

**201.91 Borrow** - Payment for BORROW materials will be at the Contract Unit Price per cubic metre of "Roadway and Drainage Excavation" classified as provided for in Subsection 201.11. All subsections in this specification relating to excavation shall apply to borrow.

**201.92 Excavation** - Payment for EXCAVATION will be at the Contract Unit Price per cubic metre for the various types of materials excavated. The Contract Unit Price for such excavation will include hauling the materials to any point within 300 m from the point of excavation and shall be accepted as full compensation for everything furnished and done in connection therewith.

Compensation for hauling excavation to distances greater than the free haul limit of 300 m will be paid as prescribed in Subsection 201.93.

**201.93 Overhaul** - Payment for OVERHAUL will be at the Contract Unit Price per 1000 station metres (Sta. m).

**201.94 Watering** - Payment for WATERING will be at the Contract Unit Price per kilolitre. The Contract Unit Price shall be full compensation for furnishing all labour, materials, tools, equipment and doing all work incidental to furnishing, hauling and applying water as specified in Subsection 201.46.

**201.95 Allowable Overbreak** - Allowable overbreak will be paid at 75% of the Contract Unit Price for TYPE A MATERIAL. The quantity at the Contract Unit Price for overbreak in any one cut shall not exceed 10% of the original theoretical cut, as shown on the Plans or as directed by the Ministry Representative. Material in excess of the above 10%, if used in lieu of borrow and only on the advice of the Ministry Representative, will be paid at the Contract Unit Price for TYPE D MATERIAL.

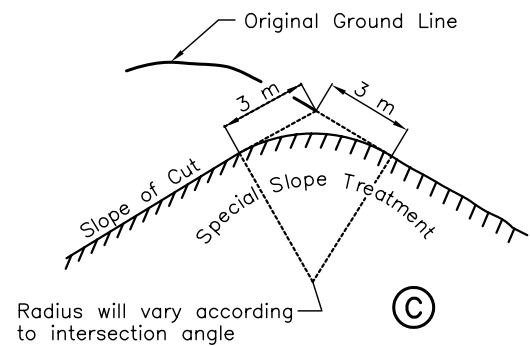
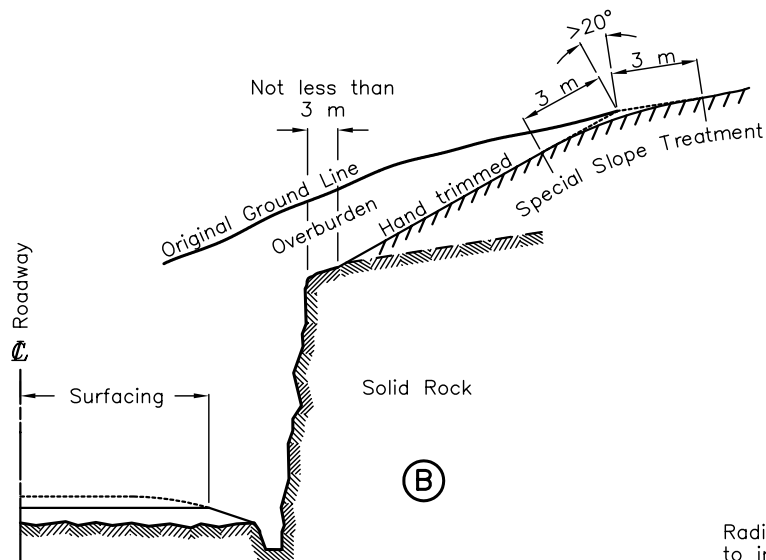
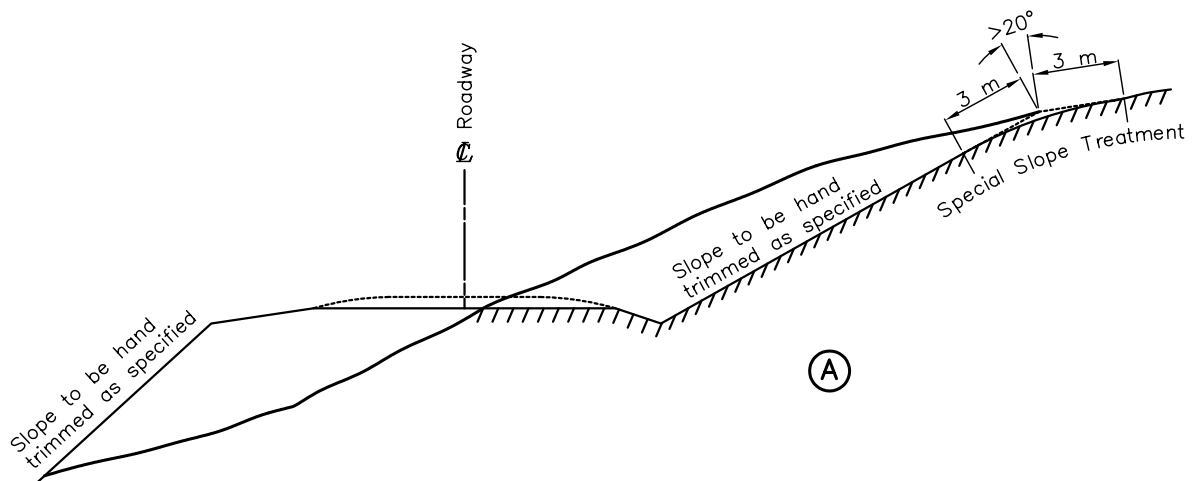
**201.96 Embankment** - Except where otherwise distinctly provided herein, the work described under the heading of "Embankment" will not be paid for directly as a pay item, but shall be considered as incidental work pertaining to the placement of the several classes of Excavation or Borrow and, therefore, no additional compensation will be made for the construction of embankments.

**201.97 Compaction** - The top 300 mm below subgrade which is compacted to minimum 100% of the laboratory density, as described in Subsection 201.37 and any additional compaction to 100% density ordered by the Ministry Representative, will be paid for directly as a pay item at the Contract Unit Price for COMPACTION.

All other compaction described in Subsection 201.37 shall be considered as incidental work pertaining to the several classes of Excavation or Borrow and, therefore, no additional compensation will be made.

**201.98 Surcharge Removal** - Payment for surcharge removal will be at the Contract Unit Prices for EXCAVATION and OVERHAUL.





## NOTES:

1. SPECIAL SLOPE TREATMENT REFERS TO THE ROUNDING OFF AT THE INTERSECTION OF CUT SLOPES WITH THE EXISTING GROUND LINE. IT SHALL BE APPLICABLE WHERE THE MATERIAL IS OTHER THAN SOLID ROCK, AND WHEN THE DIFFERENCE IN THE INTERSECTION ANGLE BETWEEN THE BACKSLOPE AND THE ORIGINAL GROUND EXCEEDS 20 DEGREES.
2. MATERIAL REMOVED IN SPECIAL SLOPE TREATMENT SHALL BE DISPOSED OF IN THE EMBANKMENTS, OR AS OTHERWISE DIRECTED BY THE MINISTRY REPRESENTATIVE.
3. PAYMENT FOR SPECIAL SLOPE TREATMENT SHALL BE MADE AT THE RATE BID PER LINEAR METRE OF SPECIAL SLOPE TREATMENT. THIS PRICE SHALL BE ACCEPTED AS FULL COMPENSATION FOR EVERYTHING FURNISHED AND DONE IN CONNECTION HERewith.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 202

### GRANULAR SURFACING, BASE AND SUB-BASES

#### PART A - SCOPE OF SPECIFICATION

**202.01 Preliminary and General** - This specification describes the classification, the materials and the professional standards required for the production of granular aggregates and the construction of granular surfacing, granular base and select granular sub-base.

Designated Pits and Quarries shall include:

- a) Ministry owned pits and quarries
- b) Pits or quarries leased by the Ministry
- c) Pits or quarries attained through Special Agreement by the Ministry

#### PART B - MATERIALS

**202.02 General Classification of Aggregate** - Aggregates used in highway construction for granular surfacing, base and sub-base are classified as follows:

##### 202.02.01 Crushed Surfacing Aggregates

- i) **High Fines Granular Surfacing Aggregate:** This aggregate is used for surfacing of gravel roads and when paving is not scheduled for a few years. Cohesion for this aggregate is achieved by plastic fines.

##### 202.02.02 Crushed Base Course Aggregates

- i) **Well Graded Base Course Aggregate:** This material is a well graded aggregate with 0 to 5% finer than 0.075 mm.
- ii) **Intermediate Graded Base Course Aggregate:** This aggregate is intermediate in gradation and permeability between well graded aggregate and open graded aggregate. Its gradation is characterized by 0 to 5% finer than 0.075 mm and greater than 10% passing 2.36 mm.
- iii) **Open Graded Base Course Aggregate:** Open graded aggregate is a highly permeable, uniformly graded aggregate with 0 to 5% finer than 0.075 mm and less than 10% passing 2.36 mm.

##### 202.02.03 Sub-base Aggregate

- i) **Select Granular Sub-base Aggregate:** Select Granular Sub-base is an aggregate gradation which may vary from densely graded to open graded but in all gradations contains less than 5% passing 0.075 mm.

**202.03 General Description of Work** - The aggregates for granular surfacing, base and sub-base may be supplied either by the Contractor or produced from a Designated Pit or Quarry.

Production of granular surfacing and granular base requires crushing and placing in stockpile. Production of select granular sub-base may be by crushing, screening or direct excavation.

Granular aggregate shall be loaded from the stockpile, crushing and screening plant, or pit face, as may be applicable; weighed, hauled out to the highway, placed accurately without segregation and thoroughly compacted to established line and grade.

The Contractor shall maintain the prepared surface of the base course aggregate until it has been paved or until



completion of the contract, whichever is applicable.

#### 202.04 Aggregate Quality

**202.04.01 General** - Granular aggregate shall be composed of inert, clean, tough, durable particles of crushed rock, gravel, sand and fines capable of withstanding the deleterious effects of exposure to water, freeze-thaw, handling, spreading and compacting. The aggregate particles shall be uniform in quality and free from an excess of flat or elongated pieces.

Aggregates for surfacing, base and sub-base will be tested in accordance with the standard British Columbia Ministry of Transportation (Geotechnical and Materials Engineering Branch) Manual of Test Procedures Soils and Mineral Aggregates (see Table 202-A).

**202.04.02 Quality Tests** - All aggregates for surfacing, base and sub-base shall meet the following requirements:

i) The sand equivalent value (BCH I-8) shall not be less than:

- 40 for 25 mm and 50 mm base course aggregates
- 30 for 75 mm base course aggregate
- 20 for sub-base aggregate and surfacing aggregate

ii) The degradation factor (BCH I-9) shall not be less than 35.

iii) The soundness (BCH I-5) shall be considered unsatisfactory if the loss after 5 cycles exceeds:

- 20% for coarse aggregate
- 25% for fine aggregate

iv) If aggregate fails any of tests i), ii) or iii) it shall be examined using the Ministry petrographic test (BCH I-17). The cause of failure shall be ascertained. On the basis of this test, the Ministry Representative will decide on rejection or else the need for beneficiation of the aggregate by chemical or physical means.

v) The plasticity index (BCH I-12) of high fines surfacing aggregate shall not be greater than 6.

**TABLE 202-A AGGREGATE TESTS FOR SURFACING, BASE AND SUB-BASE**

TEST DESIGNATION		
BCH	BASED ON ASTM	TITLE OF TEST
I-1	C-136	Sieve Analysis of Aggregates
I-2	C-117	Wash Test of Aggregates
I-5	C-88	Soundness of Aggregates by Use of Magnesium Sulphate
I-8	D2419	Sand Equivalent
I-9	---	Degradation Test
I-12	D-4318	Plastic Limit Determination
I-13	---	Fracture Count on Coarse Aggregate
I-17	---	Petrographic Test

#### 202.05 Aggregate Gradation

**202.05.01** Aggregate, when tested in accordance with Test BCH I-1 and I-2, shall have a gradation that defines a curve (% passing versus log sieve size) with a slope between adjacent sieves, equal or intermediate to the corresponding slopes of the boundary curves defined by the specification. Gradations shall fall within the limits shown in Table 202-B through 202-E.

**202.05.02** Once one of the above classifications has been specified, field and/or laboratory tests will be performed to select a gradation curve within that specification.

An aggregate gradation having been accepted, the maximum permissible variation of the mean of any 4 consecutive tests from the accepted gradation curve shall be within the limits specified in Table 202-F.



**TABLE 202-B HIGH FINES GRANULAR SURFACING AGGREGATE**

SIEVE SIZE (mm)	% PASSING FOR NOMINAL MAXIMUM SIZE - HIGH FINES
25	100
19	85 – 100
9.5	60 - 85
4.75	40 - 70
2.36	---
1.18	20 - 50
0.300	10 - 30
0.075	5 – 15

**TABLE 202-C WELL GRADED BASE COURSE AGGREGATE**

SIEVE SIZE (mm)	% PASSING FOR NOMINAL MAXIMUM SIZE		
	25 mm	50 mm	75 mm
75	---	---	100
50	---	100	---
37.5	---	80 - 100	60 - 100
25	100	---	---
19	80 - 100	50 - 100	35 - 80
9.5	50 - 100	35 - 75	25 - 60
4.75	35 - 70	25 - 55	20 - 40
2.36	25 - 50	20 - 40	15 - 30
1.18	15 - 35	15 - 30	10 - 20
0.300	5 - 20	5 - 15	3 - 10
0.075	0 - 5	0 - 5	0 - 5

**TABLE 202-D INTERMEDIATE GRADED BASE COURSE AGGREGATE**

SIEVE SIZE (mm)	% PASSING FOR NOMINAL MAXIMUM SIZE		
	25 mm	50 mm	75 mm
75	---	---	100
50	---	100	55 – 100
37.5	---	60 - 100	40 - 80
25	100	40 - 75	---
19	65 - 100	---	17 - 40
12.5	---	15 - 40	---
9.5	30 - 70	---	---
4.75	15 - 40	---	---
2.36	10 - 30	10 - 25	10 - 25
0.300	5 - 15	5 - 15	4 – 15
0.075	0 - 5	0 - 5	0 - 5

**TABLE 202-E OPEN GRADED BASE COURSE AGGREGATE**

SIEVE SIZE (mm)	% PASSING FOR NOMINAL MAXIMUM SIZE		
	25 mm	50 mm	75 mm
75	---	---	100
50	---	100	70 - 100
37.5	---	75 - 100	50 - 85
25	100	---	---
19	75 - 100	35 - 65	15 - 55
9.5	30 - 65	5 - 35	---
6.3	---	---	0 - 20
4.75	5 - 30	0 - 15	---
2.36	0 - 10	0 - 10	0 - 10
0.300	0 - 8	0 - 8	0 - 8
0.075	0 - 5	0 - 5	0 - 5

These tolerances do not waive the requirement that the running average of four consecutive tests must be maintained at all times within the limits specified in Subsection [202.05.01](#).

Should there be a substantial change in the type of



aggregate exposed as the work proceeds, the Ministry Representative may authorize a change in the mean gradation.

**202.05.03** When tested according to BCH I-13, Method A, the fracture count shall be at least 50%. If this requirement cannot be met for a specified crushed aggregate type, then the Contractor shall, at no additional charge, crush aggregate to the next smaller size or such intermediate size, as the Ministry Representative may direct, in order that the crushed granular aggregate shall meet the requirement.

**202.06 Select Granular Sub-base** - Sub-base may be crushed and shall be screened or be a pit run aggregate which shall meet the following gradation requirements when tested according to Test BCH I-2 (See Table 202-G).

Any gradation supplied by the Contractor within the above limits will be accepted, provided it will not rut when subjected to the loading exerted by the rear axle of a fully loaded tandem truck.

**202.07 Bridge End Fill** – Bridge end fill material shall meet the gradation requirements specified in Table 202-H

**202.08 - 202.09 Not Used**

### PART C - USE OF DESIGNATED PITS OR QUARRIES

**202.10 Source of Supply** - The Contract documents may designate one or more pits or quarries.

The Ministry will normally provide the gravel pits or quarries and the right-of-way to pit or quarry sites and will pay the cost of royalties, access road construction and fencing. The cost of maintaining access roads shall be considered as part of the cost of

producing the construction aggregates and shall be payable by the Contractor. The Ministry will exercise its best judgement in the selection of the pit or quarry sites; however, the failure of the pit or quarry to yield materials of uniform quality shall not constitute grounds for a claim by the Contractor against the Ministry.

The Contractor shall be satisfied as to the gradation and other characteristics of the raw material in the designated pit or quarry and as to the nature and amount of work required to produce materials which will meet all gradation requirements, and the Contractor shall, at the Contractor's expense, remove any objectionable materials from the aggregate.

**202.11 Development of Pit or Quarry** - Before any material for aggregate is excavated from the pit or quarry, the site shall be cleared and grubbed, and all debris disposed of as ordered by the

**TABLE 202-F AGGREGATE GRADATION VARIATION LIMITS**

SIEVE SIZE	VARIATION LIMITS % PASSING
4.75 mm and larger	± 5
1.18 mm to 4.75 mm	± 3.5
0.300 mm to 1.18 mm	± 2
0.075 mm to 0.300 mm	± 1

**TABLE 202-G GRADATION REQUIREMENTS FOR SELECT GRANULAR SUB-BASE**

SIEVE SIZE (mm)	% PASSING FOR NOMINAL MAXIMUM SIZE
75	100
19	15 - 100
9.5	0 - 100
0.600	0 - 100
0.300	0 - 15
0.075	0 - 5

**TABLE 202-H GRADATION REQUIREMENTS FOR EMBANKMENT MATERIAL**

SIEVE SIZE (mm)	PERCENTAGE PASSING
75	100
37.5	30 - 100
19	20 - 100
4.75	10 - 60
1.18	6 - 32
0.300	4 - 15
0.075	0 - 5



Ministry Representative. If topsoil or undesirable overburden exist, these materials shall be stripped and placed in separate stockpiles as directed by the Ministry Representative for future use in pit or quarry reclamation.

Adequate precautions and actions shall be taken to prevent pollution of the air, watercourses and adjoining land by the stockpiled material. If erosion prevention is deemed necessary, the Ministry may arrange to have the stockpiles grass seeded.

Watercourses located within or immediately adjacent to the gravel pit or quarry operations are to be protected against pollution. Where it is necessary to divert watercourses, application must be made to Comptroller of Water Rights, Water Resources Services, Ministry of Environment, Victoria, prior to such diversion being undertaken. Upon termination of operations, the watercourses shall be restored to as close to their original condition as is practicable.

The Contractor shall not operate the pit or quarry in a manner which will contaminate remaining granular material nor leave the pit or quarry in a condition which will limit its future use.

**202.12 Use of All Materials** - All designated pits or quarries, once entered and developed, shall be used to their full potential. Normally, the Contractor shall produce select granular sub-base by selection or screening, provided that oversize reject aggregate is removed and properly placed in a stockpile for later crushing and use. However, if excessive oversize occurs, the Ministry Representative may order that pit run aggregate be crushed to produce 75 mm crushed granular base for use in place of select granular sub-base.

For the production of crushed surfacing and crushed base aggregates, the Contractor shall provide crushing equipment such that all aggregate which will pass through 375 mm x 450 mm slotted openings shall be used for the production of crushed aggregate; rocks which will not pass through these openings shall be stockpiled or disposed of as and where directed by the Ministry Representative. Crushing and screening equipment shall be provided with adequate facilities and capacity to bleed off reject aggregate in usable condition, or otherwise remove any excess of fine aggregate, dust or objectionable aggregate coatings that may be present in or on the aggregate, so as to make it generally acceptable for use. No portion of the products of crushers or screening plants that can be used shall be wasted, but shall be stockpiled or used as directed by the Ministry Representative.

**202.13 Unsuitable Materials** - The rejection or addition of any particular size material necessary to produce gravel conforming to specification requirements shall be the responsibility of the Contractor, and no additional compensation will be paid therefore.

**202.14 - 202.15 Not Used**

**202.16 Change of Designated Pit or Quarry** - No payment will be made to the Contractor for moving plant from one designated pit or quarry to another designated pit or quarry.

If, in the opinion of the Ministry Representative, a saving in haul can be accomplished, or designated pits or quarries are inadequate or unsuitable, additional sources of aggregate will be acquired and developed at the Ministry's expense.

If the Ministry Representative requires a move to a newly designated pit or quarry the Contractor will be given notice in writing. On completion of the move, the Contractor will be paid a lump sum of \$2,500 for moving a unitized crusher (i.e., crusher that has screening and crushing components on one unit) and its supporting trapping, stockpiling and power units, or other basic crushing set-up which does not include an additional breaker or screening unit. A further \$800 per unit will be paid for each of such additional crushing and screening units. The payment will be deemed to be full compensation for all costs and expenses of the move and set-up of the crusher. If the Contractor moves the crushing plant without first securing a written order to do so from the Ministry Representative it will be considered sufficient proof that the move was unnecessary, and no allowance or



compensation will be made to cover such a move.

**202.17 Pit Cleanup** - When the Contractor discontinues operations in any pit or quarry, the Contractor shall trim the sides of pit excavations, waste piles and stockpiles to a 1.5 to 1 slope, or such other slope as the Ministry Representative may direct, open up such drains or ditches as may be required to prevent water standing therein, and leave the site in a neat condition, all to the satisfaction of the Ministry Representative. The trimming, sloping, ditching and draining of the pit or quarry, as well as maintenance of the access roads, shall be considered part of the cost of producing the granular aggregate and no additional payment will be allowed.

If a pit has been fully depleted and is to be abandoned, the Contractor shall reshape the sides to a slope not steeper than 2 to 1 using the stockpiled overburden if necessary, and cover same with any topsoil previously removed and stockpiled, all as directed by the Ministry Representative. In such cases, the replacing of stockpiled overburden and topsoil will be paid for in accordance with Subsection 202.41.

**202.18 Work in Ministry Pits or Quarries** – All work in a Ministry pit or quarry will be in accordance with Subsection 145.26.

**202.19 Not Used**

## **PART D - CONTRACTOR SUPPLIED AGGREGATES**

**202.20 Preliminary and General** - Aggregates, when supplied from private pits or quarries, shall meet the requirements of Part B of this section.

When optional use of a Ministry pit or quarry is provided under the Contract, the Contractor, by entering the pit or quarry, will be deemed to have accepted all obligations, risks and costs for the production of aggregate meeting the requirements of Part B of this section, just as if such pit or quarry were private. The Ministry gives no warranty that its pit or quarry will meet the quality and quantity requirement.

**202.21 Development and Clean Up of Private Pits or Quarries** - Pit or quarry development and cleanup shall be in accordance with local and Provincial Regulations.

**202.22 Development of Ministry Pits or Quarries for Optional Use** - Subsections 202.11, 202.12, 202.13 and 202.17 will apply when the Contractor chooses to use an available Ministry Pit or Quarry.

**202.23 Contractor to Pay All Costs** - The Contractor shall bear and pay all costs including applicable royalties for provision of granular aggregates described in Subsections 202.20, 202.21 and 202.22. The Contractor shall also pay all costs for any move of the equipment that may be ordered or required because a pit or quarry of the Contractor's choosing proves unsuitable for production of the contracted quantity of granular aggregates meeting the requirements of Part B of this section.

**202.24 Surplus Aggregate** - Where a stockpile is constructed outside of Ministry property, the Contractor shall provide a written agreement with the owner of the property that only the Ministry will have, at no additional cost to it, access to and use of the surplus aggregate for a period of five (5) years after the completion of the Work.

## **PART E - PRODUCTION OF CRUSHED AGGREGATE**

**202.25 Equipment and Plant** - The Contractor shall provide and maintain in good operating condition, all plant and equipment necessary to comply with the requirements of this specification. Such plant and equipment shall be of a type and capacity to ensure proper construction and maintenance of access roads, development of the pit or quarry, maximum use of the pit or quarry, production of granular aggregates to the standard of uniformity required, and adherence to the construction schedule.



Adequate sampling facilities shall be installed by the Contractor at the discharge end of the production conveyor. The Contractor shall ensure that the plant and equipment meet the requirements of the current Pollution Control Act and Workers' Compensation Board Regulations.

**202.26 Working of Pit** - A pit shall be worked in such a manner as to ensure that granular material excavated and fed to the crushers, screening plants or loaders shall be as uniform as possible. This may require the use of equipment capable of deep excavating through horizontal gravel layers or carrying out selective digging or cross blending over a large area of the pit. Before commencing production, the Contractor shall discuss the proposed method of production with the Ministry Representative and obtain the Ministry Representative's general approval.

**202.27 Crushing Operations** - The Contractor shall adjust the crushers and/or screening plants and provide such screens as may be necessary to produce and maintain acceptable gradations of granular aggregates. The Ministry Representative will arrange for regular sieve analysis of granular aggregate during production, and the Contractor will be warned if it appears that aggregate gradation is moving out of specification. If the Contractor fails to remedy these defects as soon as possible, crushing and/or screening shall cease at the end of the shift and shall not recommence until the crusher has been repaired or readjusted to the satisfaction of the Ministry Representative.

## **202.28 Stockpiling**

**202.28.01** Unless it is specified in the Special Provisions or ordered otherwise in writing by the Ministry Representative, all crushed aggregates shall be stockpiled prior to use on the Highway. Stockpiling of select granular sub-base is not normally required, but if the Contractor elects to do so, conditions of this subsection shall be applicable.

Adjustment of bid prices for changes in stockpiling requirements, which are ordered by the Ministry Representative in writing, will be made as in Subsection [202.50](#).

**202.28.02** The Ministry Representative will select stockpile sites within 1 km freehaul of the crusher. Stockpile sites shall be cleared of all vegetation, trees, brush, rocks or other debris and a uniform gravel surface prepared before the stockpile material is deposited on the stockpile site.

**202.28.03** Stockpiles shall be constructed on the previously prepared site in accordance with stakes set by the Ministry Representative, and when completed shall be neat and regular in shape, occupying as small an area as is practicable. Spilling of material over the edges of the piles will not be permitted.

**202.28.04** Stockpiles shall be built up in layers not to exceed 1 m in thickness.

**202.28.05** Plank or protected runways shall be provided for operating trucks on stockpiles when the Ministry Representative deems them necessary to prevent dirt being tracked onto the crushed aggregate.

**202.28.06** The Ministry Representative may, on receipt of a written request from the Contractor, permit the Contractor to build the final stockpile by bulldozing the aggregate from a feed pile at the end of a production belt provided that the following are maintained:

- i) The bulldozer(s) to be used shall be equipped with U-shaped pushing blades.
- ii) The aggregate does not become contaminated with oversize material, mud or other objectionable material picked up from the pit floor or general working areas.
- iii) The crushed granular aggregate is distributed evenly over the final stockpile area in lifts not greater than 150 mm in depth.



- iv) The cone of the feeder pile at the end of the production belt shall not, without express permission, be allowed to build up to a greater height than 2 m.
- v) No appreciable segregation shall occur in the main stockpile as a result of using this method.

**202.29 Not Used****PART F - CONSTRUCTION METHOD****202.30 Weather and Job Conditions**

**202.30.01** No construction shall be undertaken during snow, heavy rain, freezing or other unsuitable conditions. Aggregate shall not be placed upon a frozen, wet, muddy or rutted sub-grade, sub-base, base or surface unless otherwise directed.

**202.30.02** When the sub-grade is soft due to excessive moisture, the placing of granular sub-base shall be stopped until rutting or displacement of the lower layers can be prevented by reduced loading or by other means approved by the Ministry Representative.

**202.31 Bridge End Fill** - Construction of the bridge end fill shall not commence until the Ministry Representative has assessed the pertinent foundation conditions that may affect the future stability of both the bridge and embankments and has authorized continuation of construction. Unless the procedure for construction is stated in the Special Provisions, the Contractor's proposed method must be submitted to the Ministry Representative for approval before commencing work.

The bridge end fill shall be laid out by extending back from the bridge abutment station, as shown on the Plans; a distance of 8.0 m along centerline at finished grade and thence to a 1.5:1 backslope. The front slope, as shown on the Plans, shall start at the bridge abutment station.

The bridge end fill shall be constructed to the subgrade elevation.

The material shall consist of mineral soil with the gradation in accordance with Subsection 202.07. The aggregate particles shall be uniform in quality and free from an excess of flat or elongated pieces.

The bridge end fill shall be constructed in successive horizontal layers not exceeding 150 mm in loose thickness.

Each layer shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698.

The determination of field density will follow a method approved by the Ministry Representative.

Payment for bridge end fill shall include supply, haul placement and compaction.

**202.32 Thickness of Granular Courses** - Crushed surfacing course, crushed base courses and select granular sub-base course shall be constructed to the specified thickness and dimensions as shown on the Contract Drawings or as described in the Special Provisions, unless otherwise directed by the Ministry Representative.

Normally, on new construction, crushed bases shall be constructed to a compacted thickness of 150 mm. The remaining requirement for granular base course shall be composed of select granular sub-base of such thickness as may be considered necessary to provide supporting strength for the flexible pavement structure.

**202.33 Construction of Crushed Base or Select Granular Sub-base**



**202.33.01** Aggregates for select granular sub-base or crushed base shall be delivered to the roadbed as uniform mixtures and shall be spread in layers without segregation, preferably through an approved aggregate spreader. Granular aggregate shall not be end dumped from trucks in piles on the grade. The Ministry Representative may permit spreading from the tailgate of trucks or from centre dump units, provided the Ministry Representative is satisfied that the work will be well controlled and segregation will not occur.

When the sub-grade for granular aggregate sub-bases consists of cohesionless sand, and written permission is granted by the Ministry Representative, a portion of the granular aggregate sub-base or base may be dumped in piles upon the sub-grade and spread ahead in sufficient quantity to stabilize the sub-grade. Segregation of aggregates shall be avoided and the material as spread shall be free from pockets or large or fine material. Segregated materials shall be remixed until uniform.

Where the required thickness is 150 mm or less, the granular base or sub-base may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate shall be spread and compacted in two or more layers of approximately equal thickness; the maximum compacted thickness of any one layer shall not exceed 150 mm. Each layer shall be spread and compacted in a similar manner. At locations where the granular base or sub-base is to be placed over areas inaccessible to the spreading equipment, the granular sub-base or base may be spread by any means to obtain the specified results.

**202.33.02** Immediately following spreading, the material shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698.

If, because of the nature of the granular aggregate, the Ministry Representative considers that the results from the above test will be unreliable or the use of the test for density measurements is impractical, then the Ministry Representative may order that each lift or course of aggregate shall be continuously and thoroughly rolled. For well graded aggregate this may consist of not less than five passes using either a grid roller or three wheel steel roller and in addition by not less than five passes using an approved vibratory roller or heavy pneumatic tired roller for each lift of well graded aggregate placed on the roadbed. For purposes of this requirement, the rollers specified above shall meet the following minimum requirements:

- i) The three wheel steel roller shall have a gross mass of not less than 12 tonnes with a compression at the rear wheels of not less than 60 kg per lineal centimetre of wheel width.
- ii) The grid roller shall have two rolls side by side each of a minimum width of 750 mm and a minimum diameter of 1.5 m. The minimum gross mass shall be 15 tonnes.
- iii) The vibrating roller shall have a minimum steel drum diameter of 1.15 m, a minimum drum width of 1.5 m, and shall be capable of being loaded so as to have a gross mass of 20 kg per lineal centimetre of drum width.
- iv) The pneumatic tired roller shall be equipped with wheels which carry 13.00 x 24 pneumatic tires capable of being inflated to a minimum pressure of 830 kPa. The roller shall have a gross mass such that each and every wheel shall carry a minimum proportional load of 3200 kg.

However, so that development of new compaction equipment will not be inhibited, the Ministry Representative may give written permission for the substitution of new alternative compaction equipment if the Ministry Representative is satisfied that such equipment will provide equal or superior compaction performance.

**202.33.03** Subject to the concurrence of the Ministry Representative, the Contractor may water the base material as required to aid in attaining the specified density.

**202.33.04** The completed surface of the granular course shall conform to the required line, grade and cross section



as shown on the Plans to an accuracy  $\pm 15$  mm.

#### **202.34 Construction of 25 mm Crushed Base Course**

**202.34.01** Crushed 25 mm base course aggregate shall be placed on a properly prepared surface to such depth or at such rates as may be specified. If the Ministry Representative is of the opinion that the finished surface of the granular base does not meet the requirements of Subsection 202.33.04 but has been thoroughly and densely compacted and should not be disturbed, the Ministry Representative may order that the surface of the granular base be corrected to the true cross section, line and grade, and within the tolerances specified by use of a levelling course of crushed 25 mm base course aggregate. In such event, the crushed 25 mm base course aggregate so used will be paid for only at the rates bid for 50 or 75 mm crushed base, provided the same Contractor is responsible for the construction of both the crushed base, or select granular sub-base and the 25 mm crushed base course.

The 25 mm crushed base course shall be constructed in such a manner that the aggregate is neither segregated, contaminated nor degraded. End dumping will not be permitted. The thickness of the 25 mm crushed base course shall be substantially uniform and the minimum thickness shall not be less than the nominal thickness shown on the drawings or ordered by the Ministry Representative. If the Contractor is unable to provide adequate manually operated equipment or workers of sufficient skill to lay the 25 mm crushed base course aggregate within the tolerances specified, the Ministry Representative may require that the Contractor lay the aggregate through an approved electronically controlled spreading machine. In such an event the Ministry Representative will assist the Contractor in setting out the necessary reference line required to guide the electronic control equipment and the spreading machine.

**202.34.02 Compaction** - Immediately following spreading, the 25 mm crushed base course aggregate shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698).

The method of compaction to be employed may be selected by the Contractor, but shall be subject to review or alteration by the Ministry Representative. If the Contractor is unable to obtain the specified density, the 25 mm base course aggregate shall be compacted in lifts less than 75 mm in thickness until the specified density is obtained.

**202.34.03 Watering** - If required, water shall be applied to attain the specified density.

**202.34.04** The completed surface of the granular course shall conform to the required line, grade and cross section as shown on the Plans to an accuracy  $\pm 10$  mm.

**202.35 Equipment for Watering** - Water shall be applied from a distributor of the pressure type, equipped with a spray bar mounting nozzles similar to those used on asphalt distributors and capable of applying the water accurately and uniformly. Splash plate type distributors or those equipped with spray bars that eject fine streams of water will not be permitted. The distributor must be provided with a satisfactory means for accurately measuring the quantity of water sprayed. If the Ministry Representative so requires, measuring equipment shall be calibrated under the Ministry Representative's inspection. The Contractor shall make all necessary arrangements for obtaining water at the Contractor's expense.

**202.36 Proof Rolling** - Before acceptance, each compacted course of well graded base course aggregate shall receive one complete coverage by the tires of a truck having a 9 tonne axle load with a tire pressure of 600 kPa. Any areas where rutting or displacement occurs shall be either excavated and replaced or stabilized by the addition of suitable blending material incorporated uniformly into the base as directed by the Ministry Representative.

**202.37 Benkelman Beam Testing** - At any time during the course of the work, when considered necessary by the Ministry Representative, Benkelman Beam testing may be undertaken.



202.38 - 202.39 Not Used

**PART G - MEASUREMENT AND PAYMENT**

**202.40 Water Applied to the Highway** - Water for compaction shall be measured and will be paid for at the unit price bid per 1,000 ℓ for the actual quantity applied to the highway and shall be full compensation for everything furnished and done to supply, haul and apply water to the highway.

**202.41 Development and Cleanup of Designated Pits and Quarries**

**202.41.01** Authorized clearing and grubbing of designated pits and quarries, and construction of the access road will normally be paid for at the unit prices bid in the "Schedule of Approximate Quantities and Unit Prices." Payment for removal and stockpiling of overburden and topsoil in the development of the proposed work areas, and payment for spreading overburden to reshape the sides of a pit and spreading topsoil over a depleted pit or quarry will be at the unit prices bid for "Roadway and Drainage Excavation."

**202.41.02** Pit and quarry development work, restoration work, and construction of access road will be paid for by Order for Extra Work in the following cases:

- i) No appropriate unit prices appear in the Schedule.
- ii) The gravel pits or quarries are designated subsequent to tendering.
- iii) Development and restoration work is substantially different from that bid at the time of tendering.
- iv) Restoration work is required outside the current work area.
- v) Where unit measurement is impracticable.

**202.42 Stockpile Reject Aggregate**

**202.42.01** Aggregate from screening or crushing operations in a designated pit or quarry, whether:

- i) Oversize under Subsection 202.06 or 202.12, or
- ii) Rejected at the crusher in order that the product meets the requirements of Subsection 202.05, shall be stockpiled separately according to size in accordance with Subsections 202.28.02 and 202.28.03, except that the freehaul distance will be 300 m. Stockpiles of reject aggregate shall not be contaminated by organic or other deleterious materials.

**202.42.02** The volume of each stockpile of reject aggregate will be determined by cross-sectioning and average end area computation. The Ministry Representative will authorize payment for reject aggregate in stockpile at the rate of \$0.40 per cubic metre.

**202.42.03** If the Ministry Representative directs that a stockpile of reject aggregate be situated at a distance greater than 300 m, Overhaul rates shall apply. If there is no bid price for Overhaul in the Schedule of Approximate Quantities and Unit Prices, a price will be negotiated.

**202.43 Blending Materials for Stabilizing Aggregates on the Highway** - Blending materials, supplied, loaded, hauled, placed and mixed into the granular aggregate on the highway to correct deficiencies in aggregate stability, will be paid for at the same rate as the granular aggregate which has to be stabilized. Normally, no additional payment will be made to cover the costs of work required to correct stability failure in the aggregate unless the



Ministry Representative is satisfied that such instability is inherent in the type of aggregate available to the Contractor from a designated pit or quarry, and that the lack of stability has not risen because of unsatisfactory production methods or improper construction practices. In these circumstances, the Ministry Representative will issue an Order for Extra Work to the Contractor to cover the additional cost of mixing blending material into the granular aggregate to correct the stability deficiency. Blending may be performed at the pit or quarry or on the highway in whichever manner the Ministry Representative may direct.

**202.44 Crushed Aggregate in Stockpile** - Crushed aggregates, placed in stockpile only, will be paid for at the unit price bid either:

- a) per tonne weighed into the stockpile, or
- b) per cubic metre, measured in stockpile by cross sectioning and computed by average end areas.

Payment at the bid price shall be accepted as full compensation for everything furnished and done to supply (where applicable), produce and stockpile the crushed aggregate.

**202.45 Advance Payment - Crushed Surfacing and Crushed Base** - An advanced payment of 70% of the demonstrated production costs or 30% of the extended amount for the item will be made for crushed base aggregates in stockpile. The quantities shall be determined by cross-sectioning the completed stockpile, calculating volume in cubic metres, deducting 10% for stockpile loss and converting to tonnes using a factor of 2.0.

Recovery of the advance payment will be made as the respective aggregate is subsequently withdrawn from the stockpile, placed and compacted on the roadway.

**202.46 Crushed Surfacing and Base Supplied by the Contractor and Constructed in Place** - Crushed surfacing and crushed base aggregates supplied and constructed in place will be paid for at the applicable unit price bid per tonne for the actual quantity of crushed aggregate incorporated in the surface or base. Payment shall be full compensation for everything furnished and done, including costs for acquisition and development of private pits or quarries, payment of royalties or purchase price of aggregate, crushing, stockpiling, loading, hauling, spreading and compaction in place as specified, excluding watering which will be paid as provided in Subsection 202.40.

**202.47 Crushed Surfacing and Base Produced from Designated Pits and Quarries and Constructed in Place** - Crushed aggregate for surfacing or base, produced in a designated Ministry's pit or quarry and constructed in place, will be paid for at the unit price bid per tonne for the actual quantity of crushed aggregate incorporated in the surface or base. Payment shall be full compensation for everything furnished and done, including access road maintenance, aggregate production, stockpiling, loading, spreading and compaction in place as specified, excluding watering which will be paid as provided in Subsection 202.40, and haul which will be paid as provided in Subsection 202.51.

**202.48 Select Granular Sub-base Supplied by the Contractor and Constructed in Place**

**202.48.01** Select granular sub-base supplied and constructed in place will be paid at the unit price bid per tonne for the quantity of select granular aggregate actually incorporated in the sub-base.

**202.48.02** If the Schedule of Approximate Quantities and Unit Prices does not contain an item for Select Granular Sub-base Supplied and Constructed in Place, then the select granular sub-base will be paid at a rate of \$0.35 per tonne lower than the bid price per tonne for 50 mm Crushed Well Graded Base Supplied and Constructed in Place.

Payment at either rate shall be accepted as full compensation for everything furnished and done, including costs for acquisition and development of private pits or quarries, payment of royalties or purchase price of aggregate, loading, hauling, spreading and compaction in place as specified, excluding water which will be paid as provided in



Subsection [202.40](#).

**202.49 Select Granular Sub-base Produced from Designated Pits and Constructed in Place**

**202.49.01** Select granular sub-base, screened in a designated Ministry's pit and constructed in place, will be paid at the unit price bid per tonne for the quantity of select granular aggregate actually incorporated in the sub-base.

**202.49.02** In the event pit run (unscreened) material meets the gradation specification in Subsection [202.06](#), and the Contractor is given permission or instructed by the Ministry Representative to use pit run material as select granular sub-base, then this material will be paid at a rate of \$0.15 per tonne lower than the unit price bid per tonne for Select Granular Sub-base Produced and Constructed in Place.

**202.49.03** In the event the Contractor is given permission or is instructed by the Ministry Representative to use pit run material as select granular sub-base and the Contractor is further given permission to use mass haul equipment to place the material directly on the highway without weighing, the volume of the material will be measured in the borrow or gravel pit. The cubic metres will be converted into tonnes by multiplying by a factor of 2.0 and the Contractor will be paid at a rate of \$0.15 per tonne lower than the price bid per tonne for Select Granular Sub-base Produced and Constructed in Place.

**202.49.04** If the Schedule of Approximate Quantities and Unit Prices does not contain an item for Select Granular Sub-base Produced and Constructed in Place, screened material will be paid for at a rate of \$0.35 per tonne lower than the bid price per tonne for 50 mm Crushed Well Graded Base Produced and Constructed in Place. Pit run material will be paid at a rate \$0.50 per tonne lower than the bid price for 50 mm crushed well graded base.

Payment at any of the above rates shall be accepted as full compensation for everything furnished and done, including access road maintenance, aggregate production, loading, spreading and compaction in place as specified, excluding watering which will be paid as provided in Subsection [202.40](#) and haul which will be paid for as provided in Subsection [202.51](#).

**202.50 Adjustment for Stockpiling**

**202.50.01** If the Ministry Representative instructs the Contractor, in writing, to stockpile select granular sub-base before it is incorporated in a sub-base course, the Ministry will pay the Contractor \$0.15 additional for each tonne of stockpiled material which has actually been incorporated in the sub-base course.

**202.50.02** If the Ministry Representative instructs the Contractor, in writing, to omit the stockpiling of granular materials as required by Subsection [202.28](#) or the Special Provisions, a deduction of \$0.15 per tonne will be made from the tender price.

**202.51 Haul on Crushed Surfacing, Base and Sub-base Aggregate** - Granular aggregate for surfacing, base or sub-base produced from a designated pit or quarry shall be hauled to any distance that the Ministry Representative may direct. Haul on material which is stockpiled prior to installation in a course on the highway will be measured from the original point of production via the stockpile to the delivery point.

Haul on material which is placed directly on the highway will be measured from the point of production to the delivery point.

Haul on material produced for stockpiling only will be measured from a point 1 km freehaul distance from the point of production to the stockpile. Payment for haul beyond 1 km freehaul, in this instance will be made at a rate of \$0.07 per tonne kilometre.

Payment for haul in the first kilometre for surfacing, base or sub-base aggregates, applied to the roadway, shall be



at the price bid for the first kilometre of haul, which shall include a basic loading rate. Payment for haul beyond the first kilometre will be at the prices bid which shall be based on an incremental rate per tonne which is equal and additional for each succeeding kilometre of haul. In the case where there are kilometre haul gaps on the Schedule, the incremental rate will still be added for each of the missing kilometres to arrive at the price for the next haul distance shown.

Where the deadhaul exceeds 1 km, the basic loading rate shall be bid into the least kilometre of haul shown on the Schedule and the same basis as above used to bid each succeeding kilometre of haul.

In the event haul occurs beyond or short of those kilometres shown in the Schedule, the rates for such haul will be established by extending the incremental rate bid per tonne per kilometre, or by subtracting the same rate from the price bid for the least kilometre haul.

Should the Contractor err in following the above procedure, the haul rates will be adjusted accordingly, using an incremental rate established as the difference between the first and second kilometre of haul, or the difference between the least kilometre of haul shown on the Schedule and the next subsequent kilometre of haul.



## SECTION 204

### ROCK CUTS

#### DESCRIPTION

**204.01 Scope** - This Section describes the controlled blasting techniques required to produce rock cut slopes at the locations shown on the plans or as authorized by the Ministry Representative. Rock shall be excavated to subgrade elevation as shown on the plans. The work shall be conducted, whether by blasting or other methods, in a manner that minimizes blast damage to the excavation backslope and minimizes the requirement for stabilization. The responsibility for the results of every blast lies with the Contractor. Nothing within this specification shall be interpreted to mean the Ministry accepts responsibility for the results of any blast.

#### 204.02 Definitions

**204.02.01 Backline Holes** - A line of holes detonated or intermittently detonated along the specified excavation backslope.

**204.02.02 Bench** – A near-horizontal or shallow slope surface at the top of a near-vertical rock face where blastholes are collared.

**204.02.03 Bench Width** – The horizontal distance on the bench between the excavation backslope and the crest of the existing rock face. Generally this dimension defines the width of the rock to be removed and is perpendicular to the highway alignment.

**204.02.04 Blast Crater** - A local depression in rock formed by blasting.

**204.02.05 Buffer Holes** - The line of production holes located closest to and parallel to the backline holes.

**204.02.06 Burden** - The distance between the blasthole and the nearest free face.

**204.02.07 Charge** - A specific quantity of explosive such as a cartridge.

**204.02.08 Controlled Blasting** - Controlled blasting is the controlled use of explosives and accessories in carefully spaced and aligned production and backline drill holes to produce the specified excavation backslope within the specified excavation limits. The purpose of controlled blasting is to minimize damage to the rock backslope, to help ensure long-term stability and to minimize flyrock.

**204.02.09 Controlled Delay Sequence** - The delay sequence required for controlled blasting.

**204.02.10 Cushion Blasting** - A blasting method whereby the production holes are detonated before the backline holes.

**204.02.11 Delay** - A blast initiator with a specific delay time period before detonation.

**204.02.12 Excavation Backslope or Smooth Wall** - This is the location of the free surface or shear plane in the rock produced by blasting along the backline holes.

**204.02.13 Excavation Limits** - This is the boundary within which rock is removed.

**204.02.14 Explosive Decoupling** - The separation of an explosive charge from the wall of the blast hole.

**204.02.15 Flyrock** - The throw of fragmented material during blasting.

**204.02.16 Free Face** - The rock face that provides relief for a blast.

**204.02.17 Guide Holes** - Those holes along the backline that are not loaded with explosive and are not stemmed.

**204.02.18 Hole Deviation** – Borehole misalignment distance measured in two directions, within and perpendicular to the excavation backslope. Within the plane of the excavation backslope, hole deviation is borehole misalignment as measured by the horizontal offset distance between any point in the design hole location and the point at a corresponding depth in the actual hole. Perpendicular to the plane of the excavation backslope, hole deviation is the horizontal offset distance between the plane of the design excavation backslope and the centreline of the borehole being measured.

**204.02.19 Lift** - The vertical distance between the top and bottom of an area to be blasted.

**204.02.20 Overbreak in Rock** - Overbreak in rock is any rock outside of the specified excavation limits (except slide material described in Subsection 201.42) that is excavated, displaced or loose due to the inherent character of any formation encountered or due to any other cause.

**204.02.21 Overburden** - This is Type B, C and/or D material (as described in Subsection 201.11) overlying rock.

**204.02.22 Presplit (or Pre-Shear) Blasting** - A blasting method whereby backline holes are detonated before production holes are detonated.

**204.02.23 Production Blasting** - Blasting of production



holes detonated in a controlled delay sequence.

**204.02.24 Production Holes** - All holes within the specified excavation limits that are not backline holes. Production holes are often more widely spaced than backline holes.

**204.02.25 Rock Excavation** - Rock excavation includes drilling holes, loading holes with explosives, detonation by controlled blasting, mucking to subgrade and ditch level, and removal of material to a designated area. Rock excavation also includes secondary breakage of oversize rock.

**204.02.26 Rock** - Rock is Type A material as defined in Subsection [201.11.01](#).

**204.02.27 Scaling** - The removal of all loose material using scaling bars, portable hydraulic jacks, other hand tools, wire rope cables, compressed air blow pipes, blasting without the need for drilled holes and other methods authorized by the Ministry Representative.

**204.02.28 Setback Distance** - The setback distance is the horizontal distance between the top of the excavation backslope and the toe of the overburden material. Setback is created by removing overburden.

**204.02.29 Spacing** - The distance between blastholes perpendicular to the burden.

**204.02.30 Stemming** - Material placed on top of the explosive to provide confinement of the explosive gases.

**204.02.31 Subdrill** - The distance drilled below subgrade level.

**204.02.32 Trimming** - The removal by drilling and controlled blasting of potentially unstable rock remaining at the exposed excavation backslope. Trimming may not require backline holes.

### 204.03 Quality Control

**204.03.01 General** - Quality control shall be conducted for all blasting operations.

**204.03.02 Blasting Consultant** - The Contractor shall retain a blasting consultant, acceptable to the Ministry Representative, to provide quality control. The consultant shall not be an employee of the Contractor, explosives manufacturer or explosives distributor.

**204.03.03 Vibration Specialist** - The Contractor shall retain a vibration specialist to provide blast vibration

monitoring if required. The specialist shall not be an employee of the Contractor, explosives manufacturer or explosives distributor.

### 204.03.04 Quality Control Activities For Blasting Operations

Quality control for blasting operations shall be performed for test sections, full scale blasting operations and trimming. The Contractor shall provide to the Ministry Representative a copy of the field report generated by the Consultant within one day of each site visit by the Consultant. Quality control for blasting includes, but is not limited to the following activities by the blasting consultant:

- Viewing the proposed blast area at least one (1) week before drilling operations commence.
- Preparing and submitting blast designs for production and backline holes.
- Intermittently viewing the site during drilling for each blast area.
- Intermittently observing the loading of holes with explosives and tying in to the delay system.
- Observing the blasts and reviewing the excavated areas.
- Attending on site to view the excavation backslope after each lift and reviewing excavation backslope for quality control purposes.
- Viewing the site while reviewing proposed changes to the blast design and preparing new designs.
- Attending on site at other times as are appropriate to assist the Contractor in the setting up, assessment and adjustment of the various procedures to be employed for blasting.
- Preparing a field report for each site visit, including details of the progress of blasting operations, a statement whether the blast design is being complied with, any changes to the blast design, any recommendations made to the Contractor and any problems encountered by the Contractor.

### 204.04 Submittals

**204.04.01 General** - Review of submittals by the Ministry shall not relieve responsibility from the Contractor for the accuracy and adequacy of the submittals. Submittals are for quality assurance and record keeping purposes. Inadequate or incorrect submittals will be returned for revisions prior to acceptance. The Contractor shall submit to the Ministry Representative the following documentation for review.

**204.04.02 Qualifications and Experience of Contractor** - Prior to the pre-construction meeting, the Contractor shall provide a statement of the qualifications, experience and work function of all personnel assigned to drilling and blasting duties. A statement of previous work experience on similar projects shall also be provided. This statement shall include the project name, location, volume of rock, year



constructed and the owner/client contact name. The company, the driller and the blaster shall each have a minimum of 5 consecutive years demonstrated experience in drilling and controlled blasting work on at least 3 projects involving rock cuts over 8 m height along transportation corridors.

**204.04.03 Qualifications and Experience of Proposed Blasting Consultant** - By the pre-construction meeting, the Contractor shall provide the name of the consulting firm, and the name and qualifications of the blasting consultant's on-site representative who will be providing the quality control for rock excavation. The blasting consultant shall have a minimum of 5 consecutive years demonstrated experience in preparing successful blast designs along transportation corridors for at least 3 projects. The following information shall be included in the qualifications submitted:

- Project name, location and experience.
- Name and phone number of owner/client contact who can verify the experience of the blasting consultant's site representative.

**204.04.04 Qualifications and Experience of Proposed Vibration Specialist** - By the pre-construction meeting, the Contractor shall provide the name and qualifications of the vibration specialist who will be providing the quality control for rock excavation. The vibration specialist shall have a minimum of 5 consecutive years demonstrated experience in the field of vibration monitoring for at least 3 projects. The following information shall be included in the qualifications submitted:

- Project name, location and experience.
- Name and phone number of owner/client contact who can verify the experience of the vibration specialist.

**204.04.05 Proposed General Construction Plan** - By the pre-construction meeting, the Contractor shall submit a general construction plan showing proposed blasting sequence numbers defining the order of blasts for the contract. The plan shall also show the following information for each blast:

- Blast sequence number.
- The location of the blast in relation to the remaining rock on the site.
- Approximate dimension of the rock to be removed.
- Estimated volume of rock to be removed.
- Location of the disposal site.

**204.04.06 Sequence of Operations** – The Contractor shall adopt a logical, systematic sequence of operations to ensure blasting is conducted safely and effectively. The following general sequence of blasting operations outlines minimum requirements of the Contractor to maximize the stability of

the excavation backslope and does not limit or supercede any other requirements in this specification:

- Retain a blasting consultant to perform quality control.
- Submit blast designs for review and authorization by the Ministry.
- Accurately survey locations of proposed blastholes.
- Drill holes, load explosives, detonate blast and remove muck pile.
- Check the excavation backslope to determine hole offsets, hole angles, hole alignment and compliance with allowable tolerances.
- Review blast results and make changes to blasting operations as necessary.
- Perform backslope stabilization to the satisfaction of the Ministry Representative before subsequent lifts are detonated.

**204.04.07 Blast Design** - The Contractor shall provide and follow a blast design, approved and signed by the blasting consultant, not less than one week prior to commencing drilling and blasting operations and a minimum of one day before the Contractor proposes to implement any changes to the previously utilized drilling or blasting methods. The design may be prepared by the blaster, but shall be reviewed by the Contractor and forwarded to the blasting consultant for signing. The design shall contain full details of the drilling and blasting patterns and controls that the Contractor proposes to use for controlled blasting. The blast design shall contain the following minimum information:

- Date the design was prepared and proposed date of blast.
- Station limits of proposed blast.
- Plan and section views of proposed drill pattern including free face, burden, blasthole spacing, blasthole diameters, blasthole angles, lift height, hole depth, and subdrill depth.
- The location of production (including buffer) and backline holes.
- Loading diagram showing type and amount of explosives, primers, initiators, and location and depth of stemming.
- Initiation sequence of blastholes including delay times and delay system.
- Manufacturer's data sheets for all explosives, primers, delays, and initiators to be used.
- Blasting consultant's signature, printed name, and company name.
- Blaster's signature, printed name, company name, and blaster's certificate number.

**204.04.08 Preblast Survey** - The Contractor shall conduct a preblast survey a minimum of one day before blasting operations commence. The preblast survey shall include a



complete description of the existing condition of any nearby buildings, structures, wells and utilities that potentially may be damaged by blasting operations. The survey method used shall be acceptable to the Contractor's insurance company.

**204.04.09 As-Built Blast Design** - Within one day after each blast, the Contractor shall submit, unless otherwise authorized by the Ministry Representative, an as-built blast design showing all actual blast details in a format that permits direct comparison with the proposed blast design.

**204.04.10 Blasting Consultant's Field Report** - The Contractor shall provide the blasting consultant's field report within one day after each visit by the blasting consultant.

**204.04.11 Vibration Control Records** - As required, the Contractor shall provide all seismograph records of vibration monitoring and interpretation of results within one day after each blast.

**204.04.12 Peak Overpressure Records** - As required, the Contractor shall provide a permanent signed and dated record of the peak overpressure measurements within one day after each blast.

## MATERIALS

### 204.11 Explosives and Related Products

**204.11.01 Manufacturer** - All products and materials used for any blasting operations shall be products of a company regularly engaged in the manufacture of explosives and related products.

**204.11.02 Expired Explosives** - Explosives with an expired shelf life shall not be used.

**204.11.03 Water Resistance** - Water resistant explosives may be required for the work.

## CONSTRUCTION

**204.31 Permits and Regulations** - The Contractor shall obtain all necessary permits for and shall comply fully with the laws, rules and regulations of Municipal, Provincial and Federal agencies in connection with the use, transportation, storage and safe handling of all explosives, including those regulations contained in the Industrial Health and Safety Regulations (IHSR) published by the Worker's Compensation Board (WCB) of British Columbia.

**204.32 Supervision** - The Contractor shall provide at least one person thoroughly trained and experienced in the use of

explosives who shall be present at all times during the execution of all blasting operations and who shall direct such work.

**204.33 Personnel** - The Contractor shall ensure that all persons conducting blasting operations have a valid blaster's certificate issued by the WCB or is under the direct supervision of a certificate holder.

**204.34 Safety** - The Contractor shall meet all WCB regulations. All work shall be performed in a manner that prevents injury or harm to any personnel employed in the rock excavation area. Warning signs shall be posted and readily recognizable audible warning signals shall be used. The perimeter of the area affected by blasting operations shall be patrolled and controlled by direct voice communication. The Ministry Representative may stop work if the safety of the public is being jeopardized by the Contractor's blasting operations.

**204.35 Flyrock Control** - Before the detonation of any blast in areas where flying rock or other debris may result in personal injury or damage to property, the area within the excavation limits shall be covered with suitable blasting mats, soil or other equally serviceable material to prevent flyrock.

**204.36 Other Damage** - The Contractor shall be responsible for any damage resulting from blasting. Occupants of local buildings shall be notified by the Contractor, prior to the commencement of the blasting, as to the timing, size of blasts, types of warning and other signals.

### 204.37 Subgrade and Ditch Areas

**204.37.01 General** - The subgrade shall be constructed to  $\pm 50$  mm of the specified line and grade before the placement of Select Granular Sub-Base Material. Any pinnacles of intact rock protruding above the design subgrade elevation shall be removed.

**204.37.02 Supporting Rock** - The Contractor shall exercise care and use appropriate methods to prevent breaking, loosening or otherwise damaging supporting rock below subgrade level and ditch bottom. The Contractor shall be responsible for the methods used and for any damage to the rock structure resulting from the operations.

**204.37.03 Drainage** - Unless otherwise authorized by the Ministry Representative, excavated rock areas shall be free draining. If craters formed in rock by blasting below subgrade elevation are not free draining, then the Contractor shall provide drainage by trenching to a free outlet. These blast craters and drainage trenches shall be backfilled to subgrade elevation.



**204.37.04 Shatter Zone for Drainage** - Unless otherwise authorized by the Ministry Representative, drainage shall also be provided by shattering the upper portion of rock below subgrade and ditches within the entire excavation limits. The shatter zone shall be 300 mm thick. A shatter zone thickness of 900 mm may be required near cut to fill transition zones for 10 m beyond the transition, or as requested by the Ministry Representative.

**204.37.05 Backfill Material** - Backfill shall be free draining material such as clean broken rock or coarse clean granular material from a source authorized by the Ministry Representative. All backfill shall be placed and compacted as specified.

**204.37.06 Ditches** - The ditches shall be formed and cleaned before any base material is placed on the subgrade.

#### **204.38 Blasting Test Section(s)**

**204.38.01 General** - Unless otherwise authorized by the Ministry Representative, all requirements for full scale blasting shall also apply to test sections. Prior to commencing full-scale blasting operations, the Ministry Representative may require the Contractor to demonstrate the adequacy of the proposed blast design by drilling, blasting, and excavating short test sections, up to 30 m in length, to determine which combination of method, hole spacing, timing, and charge yields acceptable results. The length of the blast test section shall be as specified in the blast design.

**204.38.02 Reduced Section Length** - Where requested by the Ministry Representative, the Contractor shall use test section lengths of less than 30 m.

**204.38.03 Backline Hole Spacing** - Unless otherwise specified in the blast design, the Contractor shall begin the tests by drilling backline holes 750 mm apart along the specified excavation backslope, then adjust if needed, until the Ministry Representative authorizes the spacing to be used for full-scale blasting operations.

**204.38.04 Review of Test Section Results** - The Contractor shall not drill beyond the test section until it has been excavated and the results reviewed by the blasting consultant and continuation is authorized by the Ministry Representative.

**204.38.05 Revision of Methods** - If either the blasting consultant or the Ministry Representative determines that the results of the test section are unsatisfactory, then notwithstanding the Ministry Representative's prior review of such methods, the Contractor shall adopt such revised methods as are necessary to achieve the required results.

**204.38.06 Additional Test Sections** - If at any time during the progress of the work the methods of drilling and blasting do not produce the required excavation backslope geometry within the tolerances specified for backline holes, then the Contractor will be required to drill, blast and excavate short sections, not exceeding 30 m in length, until a technique is achieved that will produce the desired results.

**204.39 Overburden Removal and Setback** - The setback distance shall be 3.0 m. Unless otherwise authorized by the Ministry Representative, the Contractor shall, before drilling the backline holes, remove all overburden within the excavation limits or 10 m beyond the limits of the production holes in a direction parallel to the backline. The overburden surface shall be sloped at 1.5:1 unless otherwise authorized by the Ministry Representative.

#### **204.40 Backline and Production Holes**

**204.40.01 Stemming** - The upper portion of all holes between the topmost charge and the hole collar shall be stemmed. Stemming materials shall be sand or other inert angular granular material with similar specific gravity passing a 9.5 mm sieve.

**204.40.02 Hole Obstructions** - Before placing charges, the Contractor shall determine that the hole is free of obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charges will not cause spalling of material from the walls of the holes.

**204.40.03 General Orientation** - All holes shall be drilled downward unless otherwise specified in the blast design and authorized by the Ministry Representative. In general, slash holes (horizontal, near horizontal or fanned out holes) shall not be drilled along the excavation backslope or on pioneering routes excavated to provide access for backline hole drilling, unless authorized by the Ministry Representative.

**204.40.04 Insertion of Explosive** - Explosive materials shall not be inserted into the holes until the blast design has been reviewed by the Ministry Representative.

#### **204.41 Backline Holes**

**204.41.01 General** - The Contractor shall control the hole layout and drilling operations using proper equipment and techniques to ensure that backline holes are located and oriented correctly. The proposed location of each backline hole shall be accurately surveyed and staked.

**204.41.02 Hole Location** - For each blast, the line of backline holes shall extend 10 to 20 m beyond the limits of the production holes to be detonated or to the end of the



specified excavation backslope, as applicable.

**204.41.03 Hole Location Tolerance** - Backline holes shall be drilled within 75 mm of the staked collar location.

**204.41.04 Hole Deviation** - Backline holes shall not deviate from the plane of the specified excavation backslope by more than 150 mm as measured perpendicular to the slope. Backline holes shall not deviate more than 150 mm as measured within the plane of the excavation backslope

**204.41.05 Hole Diameter** - The backline holes shall be 50 to 75 mm in diameter, or as recommended by the blasting consultant and authorized by the Ministry Representative. Trim blast holes may be as small as 25 mm diameter.

**204.41.06 Hole Length** - The length of backline holes for any individual lift shall not exceed 8 m unless the Contractor can demonstrate to the Ministry Representative that the Contractor can stay within the tolerances and produce the required excavation backslope geometry.

**204.41.07 Guide Holes** - Guide Holes shall be of the same diameter and drilled in the same plane and to the same tolerance as the remaining backline holes.

**204.41.08 Hole Length Increase** - Upon satisfactory demonstration, the length of holes may be increased to a maximum of 12 m with written authorization of the Ministry Representative. If more than 5% of the backline holes are misaligned in any one lift, then the Contractor shall reduce the height of the lifts until the 150 mm alignment tolerance is met.

**204.41.09 Control of Drilling Orientation** - All drilling equipment used to drill the backline holes shall have mechanical devices attached to that equipment to accurately determine the orientation of the drill steel entering the rock. Backline hole drilling will not be permitted if these devices are either missing or inoperative.

**204.41.10 Offset Between Lifts** - When the cut height requires more than one lift, a maximum 0.5 m offset between lifts is permitted to allow for drill equipment clearances. The Contractor shall begin the backline hole drilling at a point on the top lift which will allow for necessary offsets and shall adjust at the start of lower lifts to compensate for any drift which may have occurred in the upper lifts.

**204.41.11 Length for Toe Berm Removal** - Drilling 0.5 m below ditch bottom is permitted to facilitate removal of the toe berm.

## 204.42 Presplit Blasting

**204.42.01 General** - As conditions permit, unless otherwise specified in the blast design and authorized by the Ministry Representative, presplit blasting shall be conducted for all blasting to the excavation backslope. In general, cushion blasting may proceed when the bench width is less than three times the lift height.

**204.42.02 Explosive Type and Accessories** - Drill hole conditions may vary from dry to filled with water. The Contractor shall use explosives and blasting accessories appropriate for the drill hole conditions encountered to accomplish the specified results. Only standard explosives manufactured for presplit blasting shall be used in backline holes, unless otherwise specified in the blast design and authorized by the Ministry Representative. Bulk ammonium nitrate and fuel oil (ANFO) shall not be loaded into the backline holes.

**204.42.03 Explosive Decoupling** - Explosives shall be evenly distributed and decoupled to the maximum extent possible.

**204.42.04 Explosive Charges** - The bottom charge of backline holes may be larger than the remaining charges but shall not be large enough to cause overbreak. The top charge of backline holes shall be placed far enough below the collar and be sufficiently small to avoid overbreak and heaving of rock beyond the excavation backslope.

**204.42.05 Modified Blasting Sequence** - The Contractor may detonate the backline holes before drilling production holes, provided satisfactory excavation backslopes are obtained.

**204.42.06 Backline Hole Delays** - If required to reduce ground vibrations or noise, backline holes may be delayed, provided the effective hole-to-hole delay time is not more than 25 ms.

**204.42.07 Excavation Backslope Geometry** - The excavation backslope shall not deviate more than 150 mm from a plane passing through adjacent drill holes except where the character of the rock is such that, as determined by the Ministry Representative, irregularities are unavoidable. The 150 mm tolerance shall be measured perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the ditch.

## 204.43 Cushion Blasting

**204.43.01 General** - Where the horizontal distance from the specified excavation backslope to the existing free face is less than 5 m, the Contractor may use cushion blasting instead of presplit blasting.



**204.43.02 Delay Time** - The difference in delay time between the backline holes detonated after the buffer holes shall be between 25 and 75 ms. With the exception of these criteria, requirements for presplit blasting shall also apply to cushion blasting.

#### **204.44 Production Blasting**

**204.44.01 Hole Diameter** - Production holes shall not exceed 150 mm in diameter, unless otherwise specified in the blast design and authorized by the Ministry Representative.

**204.44.02 Hole Location** - Production blast holes (not including buffer holes) shall not be drilled closer than 2.0 m to the backline holes, unless otherwise specified in the blast design and authorized by the Ministry Representative. The bottom of the production holes (including buffer holes) shall not be lower than the bottom of the backline holes.

**204.44.03 Delay Sequence** - All sequences shall be delayed in such a manner that successive delays promote the movement of rock in the direction of a free face at all times.

**204.44.04 Damage to Backslope** - It is the Contractor's responsibility to take all necessary precautions during production blasting to minimize blast damage to the excavation backslope.

**204.44.05 Buffer Holes** - A line of buffer holes shall be drilled along a plane parallel to the backline holes. Buffer hole diameters shall be between 50 and 75 mm unless otherwise specified in the blast design. Unless otherwise specified in the blast design, the line of buffer holes shall be drilled approximately 1 m away from the backline holes and spaced 1.0 to 1.5 m centre to centre.

**204.44.06 Buffer Hole Charge and Detonation** - The explosive charge in buffer holes shall not exceed 50% of the full explosive load that could be placed in a 75 mm diameter production hole. Detonation of the buffer holes shall be on a delay sequence toward a free face. Ammonium nitrate and fuel oil shall not be used for buffer holes unless otherwise specified in the blast design and authorized by the Ministry Representative.

#### **204.45 Vibration Control and Monitoring**

**204.45.01 Vibration Control** - The Contractor shall use blasting methods designed to limit the intensity of ground vibrations originating within the excavation limits. When blasting near buildings, structures, wells, utilities or other works that may be subject to damage from blast induced ground vibrations, the ground vibrations shall be controlled using properly designed delay sequences and allowable

charge weights per delay.

**204.45.02 Charge Weight Per Delay** - Allowable charge weights per delay shall be based on vibration levels that will not cause damage. The Ministry Representative may monitor vibration levels at the blast site by requesting trial blasts to determine actual vibration levels reached during blasting.

**204.45.03 Monitoring** - Monitoring shall meet ISRM standards. Whenever vibration damage to adjacent structures is possible, the Contractor shall monitor each blast with approved seismograph(s) located between the blast area and the closest structure(s) subject to potential blast damage. The geophone shall be placed as close as possible to the structure(s) but not directly above the structure(s). The seismograph(s) shall be set to record particle velocity, accelerations, and frequency in the range generally found with controlled blasting. The peak particle velocity shall be calculated as the maximum vector sum of three mutually perpendicular components of vibration. All components and peak particle velocity shall be recorded.

**204.45.03 Vibration Limits** - Peak particle velocity, accelerations and frequency shall not be allowed to exceed the safe limits of the nearest structure subject to potential vibration damage. The Contractor shall employ a qualified vibration specialist to establish the safe vibration limits.

**204.45.04 Interpretation** - The vibration specialist shall interpret the seismograph records to ensure that the seismograph data is effectively used in the control of the blasting operations with respect to the existing structures.

#### **204.46 Air Concussion and Noise Control**

**204.46.01 General** - When requested by the Ministry Representative, an air concussion monitoring system shall be installed in a representative location between the blasting area and the nearest structure subject to potential blast damage or annoyance. The equipment used to make the air concussion measurements shall be the type specifically manufactured for that purpose.

**204.46.02 Monitoring** - The air concussion monitoring system shall be set to record air overpressure on the linear setting. When requested by the Ministry Representative, human annoyance (A weight setting) and human ear response (C weight setting) shall also be recorded.

**204.46.03 Overpressure** - Peak overpressure shall be controlled using appropriate blasthole patterns, detonation systems and stemming to prevent venting of blasts, and to minimize air concussion and noise levels produced by the blasting operations. The contractor shall use a qualified



vibration specialist to establish safe overpressure limits.

#### **204.47 Excavation Backslope Stabilization**

**204.47.01 Stabilization** - The excavation backslope shall be stabilized as recommended by the Ministry's geotechnical engineer and to the Ministry Representative's satisfaction, during or upon completion of the excavation of each lift. Unless otherwise authorized by the Ministry Representative, drilling of the next lift shall not proceed until stabilization has been completed. Drilling of the next lift shall not proceed until all concerns about stability raised by the Ministry's geotechnical engineer and the Ministry Representative are addressed by the stabilization work. Stabilization shall be completed before any base material is placed upon the subgrade.

**204.47.02 Stabilization Methods** - Stabilization methods include scaling, trimming, the application of rock bolts, shotcrete, slope mesh, drains or other stabilization techniques recommended by the Ministry's geotechnical engineer and authorized by the Ministry Representative.

**204.48 Special Use of Excavated Rock** - Excavated rock of suitable quality required for walls, riprap, paving, or other special use shall be sorted and deposited in stockpiles if so requested by the Ministry Representative.

### **MEASUREMENT**

**204.81 Type A Excavation** - Type A excavation will be measured by the CUBIC METRE.

**204.82 Excavation Backslope (Smooth Wall)** - The excavation backslope will be measured by the SQUARE METRE where the height of the cut exceeds 2 m. Measurement will apply to the condition of the slope prior to scaling. Measurement for payment, including measurement of smooth wall surface area, hole deviation and slope deviation, will be conducted by the Ministry.

### **PAYMENT**

**204.91 Type A Excavation** - Payment for TYPE A

EXCAVATION will be at the Contract Unit Price per cubic metre and will be authorized by the Ministry Representative after submittal of all documentation required in this Section. The Unit Price will be considered full compensation for the requirements of this Section.

Design slope lines including approved offsets, subgrade and ditch lines shall represent the pay lines of Type A excavation.

If so determined by the Ministry Representative, stabilization necessitated by improper blasting operations shall be at the Contractor's expense.

Trimming will be paid at the Contract Unit Price per cubic metre for TYPE A EXCAVATION.

All costs associated with blasting test sections and any revised methods necessary to produce acceptable results shall be incidental to Type A excavation.

Additional drilling, blasting and excavation required to construct subgrade to the required tolerances and excavating, loading, hauling, placing and compacting backfill material for blast craters and drainage trenches to subgrade level shall be incidental to Type A excavation.

All costs associated with vibration control, air concussion and noise control, and all monitoring shall be considered incidental to Type A excavation.

**204.92 Excavation Backslope (Smooth Wall)** - Payment for EXCAVATION BACKSLOPE will be at the Contract Unit Price per square metre for only that part of the exposed cut face meeting the geometric tolerances for excavation backslope in this Section. Geometric tolerances to be met include hole location tolerance, hole deviation, offset between lifts and deviation of excavation backslope geometry.

Scaling of loose material disturbed by blasting including removal and disposal of overbreak shall be considered incidental to payment for excavation backslope.



## PROPOSED BLAST DESIGN

PROJECT NO. \_\_\_\_\_

File #: \_\_\_\_\_

(TO BE SUBMITTED NOT LESS THAN 1 DAY BEFORE DRILLING)

**GENERAL:**

CONTRACTOR'S NAME \_\_\_\_\_  
 BLASTER'S NAME \_\_\_\_\_  
 BLASTER'S CERTIFICATE NUMBER \_\_\_\_\_

DATE PREPARED \_\_\_\_\_  
 PROPOSED BLAST DATE \_\_\_\_\_  
 BLAST # \_\_\_\_\_

HIGHWAY# \_\_\_\_\_  
 BLAST LOCATION AT: \_\_\_\_\_

UTILITY PROTECTION OR STANDBY REQUIRED: (CIRCLE) YES NO

**SITE DETAILS:**

HEIGHT ABOVE HWY \_\_\_\_\_ (m) SLOPE ANGLE \_\_\_\_\_ (°) SLOPE LENGTH \_\_\_\_\_ (m)  
 ROCK TYPE \_\_\_\_\_  
 DISTANCE TO NEAREST STRUCTURE (UTILITY) \_\_\_\_\_ (m)

**ANTICIPATED DRILLING DETAILS:**

PROPOSED NO. OF BACKLINE HOLES \_\_\_\_\_ PROPOSED APPROX. NO. OF HOLES \_\_\_\_\_  
 PROPOSED AVG. DEPTH \_\_\_\_\_ (m) HOLE DIA. \_\_\_\_\_ (mm)  
 PROPOSED NO. OF ROWS \_\_\_\_\_ APPROX. HOLE SPACING \_\_\_\_\_ (m) BURDEN \_\_\_\_\_ (m)  
 PROPOSED MAXIMUM DEPTH \_\_\_\_\_ (m) PROPOSED HOLE INCL.: (CIRCLE) VERTICAL HORIZ. VARIABLE  
 PROPOSED TOTAL DEPTH \_\_\_\_\_ (m)

**PROPOSED BLAST DETAILS:**

EXPLOSIVE TYPE \_\_\_\_\_ EXPLOSIVE SIZE \_\_\_\_\_ mm by \_\_\_\_\_ mm  
 APPROX. NUMBER OF CARTRIDGES \_\_\_\_\_ APPROX. TOTAL WEIGHT \_\_\_\_\_ (kg)  
 PROPOSED NUMBER OF DELAYS \_\_\_\_\_ DELAY TYPE AND LENGTH \_\_\_\_\_ (ms)

INITIATION DEVICE: (CIRCLE) E.B. CAPS SAFETY FUSE OTHER (SPECIFY) \_\_\_\_\_  
 BLASTING MACHINE: TYPE \_\_\_\_\_ CAPACITY \_\_\_\_\_

APPROX. VOLUME OF ROCK TO BE BLASTED \_\_\_\_\_ (m<sup>3</sup>)**PROPOSED BLAST SKETCH:****SHOW THE FOLLOWING:**

SCALE  
 PLAN VIEW  
 CROSS-SECTION  
 ROCK GEOMETRY  
 APPROX. HOLE LOCATIONS  
 APPROX. HOLE DEPTH  
 PROPOSED TIE-IN PATTERN  
 ROW BY ROW DELAYS  
 DETONATION DIRECTION  
 HIGHWAY LOCATION  
 UTILITY LOCATION  
 NORTH ARROW

PLAN VIEW:

CROSS-SECTION VIEW:

BLASTING CONSULTANT NAME \_\_\_\_\_ SIGNATURE \_\_\_\_\_ COMPANY \_\_\_\_\_

BLASTER'S SIGNATURE \_\_\_\_\_ COMPANY \_\_\_\_\_

RECEIVED BY MINISTRY REPRESENTATIVE (SIGNATURE) \_\_\_\_\_

(Use Additional Sheets if Necessary)



## AS-BUILT BLASTING RECORD

File #: \_\_\_\_\_

PROJECT NO. \_\_\_\_\_

(TO BE SUBMITTED NOT MORE THAN 1 DAY AFTER EACH BLAST)

**GENERAL:**

CONTRACTOR'S NAME \_\_\_\_\_  
 BLASTER'S NAME \_\_\_\_\_  
 BLASTER'S CERTIFICATE NUMBER \_\_\_\_\_

DATE PREPARED \_\_\_\_\_  
 ACTUAL BLAST DATE \_\_\_\_\_  
 BLAST # \_\_\_\_\_

HIGHWAY# \_\_\_\_\_  
 BLAST LOCATION AT: \_\_\_\_\_

UTILITY PROTECTION OR STANDBY USED: (CIRCLE) YES NO TYPE OF UTILITY PROTECTION \_\_\_\_\_

**SITE DETAILS:**

HEIGHT ABOVE HWY \_\_\_\_\_ (m) SLOPE ANGLE \_\_\_\_\_ (°) SLOPE LENGTH \_\_\_\_\_ (m)  
 ROCK TYPE \_\_\_\_\_  
 DISTANCE TO NEAREST STRUCTURE (UTILITY) \_\_\_\_\_ (m)

**DRILLING DETAILS:**

NUMBER OF BACKLINE HOLES \_\_\_\_\_  
 AVERAGE DEPTH \_\_\_\_\_ (m)  
 NUMBER OF ROWS \_\_\_\_\_  
 MAXIMUM DEPTH \_\_\_\_\_ (m)  
 TOTAL DEPTH \_\_\_\_\_ (m)

TOTAL NUMBER OF HOLES \_\_\_\_\_  
 HOLE DIAMETER \_\_\_\_\_ (mm)  
 HOLE SPACING \_\_\_\_\_ (m) BURDEN \_\_\_\_\_ (m)  
 HOLE INCLINATION: (CIRCLE) VERTICAL HORIZ. VARIABLE

**BLAST DETAILS:**

EXPLOSIVE TYPE \_\_\_\_\_  
 TOTAL NUMBER OF CARTRIDGES \_\_\_\_\_  
 TOTAL NUMBER OF DELAYS \_\_\_\_\_

EXPLOSIVE SIZE \_\_\_\_\_ mm by \_\_\_\_\_ mm  
 TOTAL WEIGHT \_\_\_\_\_ (kg)  
 DELAY TYPE AND LENGTH \_\_\_\_\_ (ms)

INITIATION DEVICE: (CIRCLE) E.B. CAPS SAFETY FUSE OTHER (SPECIFY) \_\_\_\_\_  
 BLASTING MACHINE: TYPE \_\_\_\_\_ CAPACITY \_\_\_\_\_

VOLUME OF ROCK BLASTED \_\_\_\_\_ (m<sup>3</sup>)

**BLAST SKETCH:****SHOW THE FOLLOWING:**

SCALE  
 PLAN VIEW  
 CROSS-SECTION  
 ROCK GEOMETRY  
 HOLE LOCATIONS  
 HOLE DEPTH  
 TIE-IN PATTERN  
 ROW BY ROW DELAYS  
 DETONATION DIRECTION  
 HIGHWAY LOCATION  
 UTILITY LOCATION  
 NORTH ARROW

PLAN VIEW:

CROSS-SECTION VIEW:

BLASTER'S SIGNATURE \_\_\_\_\_ COMPANY \_\_\_\_\_

RECEIVED BY MINISTRY REPRESENTATIVE (SIGNATURE) \_\_\_\_\_

(Use Additional Sheets if Necessary)



## SECTION 205

### RIPRAP

**205.01 General** - This Section covers the protection by riprap of embankments and channels at the locations and of the type and class shown on the Drawings or required by the Ministry Representative.

Work within any watercourse shall generally be carried out in conformity with the environmental protection provisions to the satisfaction of the Ministry Representative.

**205.02 Material** - Rock shall be hard durable angular quarry rock of a quality that will not disintegrate on exposure to water or the atmosphere. The gradation of rock sizes (mass in kg) in each class of riprap, as specified or directed, shall conform to Table 205-A.

Rocks generally shall be evenly graded, approximately the stipulated sizes, and individual rocks shall have a thickness greater than one-third their length and none shall have a mass greater than five times that of the specified class mass.

For visual comprehension only, Table 205-B indicates the approximate average dimension of an angular rock for each specified rock class mass.

**205.03 Preparation** - Areas to receive riprap shall be trimmed to a uniform surface and to the slope(s) indicated on the Drawings or as directed by the Ministry Representative.

Before rock placement commences, loose material shall be removed and minor pot-holes and hollows filled with selected materials well tamped-in to the approval of the Ministry Representative.

**205.04 Foundations** - To provide a stable foundation and protection against any undercutting, the riprap shall be thickened at the toe, laid horizontally to form an apron and/or keyed into the bed of the watercourse, all as indicated on the Drawings or as directed by the Ministry Representative.

**205.05 Filter Blankets** - Filter blanket material and placement, where required, shall be as specified in the Special Provisions or as directed by the Ministry Representative.

**205.06 Loose Riprap** - The controlled placement of rock of the class specified shall produce a rock mass of the nominal or required thickness over the area indicated. The rock shall be manipulated as necessary to provide mass stability and a regular surface with a minimum of voids.

**TABLE 205-A GRADATION OF ROCK SIZES IN EACH CLASS OF RIPRAP**

CLASS OF RIPRAP (kg)	*NOMINAL THICKNESS OF RIPRAP (mm)	ROCK GRADATION: PERCENTAGE LARGER THAN GIVEN ROCK MASS (kg)		
		85%	50%	15%
10	350	1	10	30
25	450	2.5	25	75
50	550	5	50	150
100	700	10	100	300
250	1000	25	250	750
500	1200	50	500	1500
1000	1500	100	1000	3000
2000	2000	200	2000	6000
4000	2500	400	4000	12000

\* The thickness of riprap, measured at right angles to the slope, for the class specified, shall be the nominal thickness stated, unless otherwise shown on the Drawings or required by the Ministry Representative.

**TABLE 205-B APPROXIMATE AVERAGE DIMENSION OF AN ANGULAR ROCK FOR EACH SPECIFIED ROCK CLASS MASS**

kg	10	25	50	100	250	500	1000	2000	4000
mm	200	300	350	450	600	800	1000	1200	1500



**205.07 Hand-Laid Riprap** - Hand-laid riprap, normally Class 10 or 25, shall conform to the size, gradation and requirements set out in Subsection [205.02](#). Individual rocks too large to handle shall be manipulated for satisfactory setting and spacing.

At the toe of sloped riprap, a sufficient number of the larger rocks shall be placed to form a firm foundation approximately 50% thicker than the required nominal riprap thickness. The remaining larger rocks shall be regularly spaced, at least one to every 2.5 m<sup>2</sup>, when placing the general rock mass to the nominal or required thickness over the area indicated. Smaller rocks or spalls shall be well hammered in to fill the interstices and to form a closely massed regular surface.

Where riprap is required in two layers, the rocks shall be laid up and generally lap jointed between the regularly spaced larger rocks placed as through headers.

**205.08 Grouted Riprap** - Where grouted riprap is shown or required, the surfaces of the rocks shall be cleaned and wetted and the interstices filled with cement mortar, well rodded and pounded in for a minimum mortar depth of 300 mm or as otherwise detailed or required by the Ministry Representative. The mortar shall consist of one part Portland cement to three parts well-graded clean fine aggregate mixed to a proper consistency.

**205.09 Measurement and Payment** - Measurement shall be made by multiplying the facial area by the average thickness dimensions as shown on the Drawings or as directed by the Ministry Representative. No allowance will be made for the quantity of rock placed in excess of these dimensions.

Payment shall be on the basis of the price bid per cubic metre for the type and class of riprap specified or required. The price bid shall be accepted as full compensation for everything completely furnished and done in connection therewith, but shall not include the excavation for foundation, which shall be paid for under "Foundation Excavation", nor for excavation of rock for riprap which shall be paid for under "Roadway and Drainage Excavation", nor for haul which shall be paid for under "Overhaul" in accordance with Subsection [201.93](#).



## SECTION 206

### ROCK BOLTS

#### DESCRIPTION

**206.01 Scope** - This Section covers the installation, by appropriate rock bolting methods, of anchored steel bars tensioned and locked off against faceplates in the areas designated by the Ministry Representative. Unless otherwise stated below, all rock bolts shall be installed and tensioned to the rock bolt manufacturer's specifications.

#### 206.02 Codes And Standards

CAN/CSA G164.....Hot Dip Galvanizing of  
Irregularly Shaped Articles.  
CAN/CSA G30.18.....Billet Steel Bars for  
Concrete Reinforcement  
CAN/CSA G40.21.....Structural Quality Steels  
CAN/CSA A23.2-9C.....Compressive Strength of  
Cylindrical Concrete  
Specimens.

**206.03 Quality Control** - The Contractor shall provide quality control for rock bolt operations.

**206.04 Submittals** - The Contractor shall supply the following to the Ministry Representative:

**206.04.01 Proposed Rock Bolt System** - Provide documentation as follows for the proposed rock bolt system for review at least 5 working days before commencing rock bolt installation.

- a) Rock Bolts** - Type, dimensions and manufacturer of the bar, face plate, washer (where applicable), and nut.
- b) Resin** - Published specifications showing name of material, manufacturer, graph of unconfined compressive strength development versus time, gel time, viscosity, shelf life, storage and handling requirements.
- c) Grout** - Published specifications showing name of material, manufacturer, 7 and 28 day unconfined compressive strength, composition, shelf life, storage and handling requirements.
- d) Data Sheets** - Upon request, supply the manufacturer's product data sheets.
- e) Properties of Steel** - Upon request, supply the physical and chemical properties for each lot or heat number of the steel.
- f) Test Results** - Upon request, submit a certified statement from an independent testing laboratory of the physical dimensions and mechanical properties of the

rock bolt bar proposed for use. This statement shall include:

- Minimum cross-sectional area of the threaded portion of the bar.
- Minimum cross-sectional area of the unthreaded portion of the bar.
- Yield strength of the bar.
- Ultimate tensile strength of the bar.
- Percent elongation of the bar at yield and ultimate strength.

**g) Quick Setting Mortar** - Name of material, manufacturer, 7 and 28 day unconfined compressive strength, and composition.

**206.04.02 Calibration Certificates** - Provide tensioning jack calibration certificates 5 working days before commencing rock bolt installation. Calibration of jacks shall have been performed by an authorized testing agency not more than 30 days prior to rock bolt testing. The certificate shall show the relationship between gauge pressure and applied load. Pumps and jacks shall be paired for calibration.

**206.04.03 Contractor's Rock Bolt Records** - Provide daily rock bolt tensioning records within one day of each day's rock bolt operations. Records shall include contractor name, date of tensioning, weather, temperature, test jack identification number, pump identification number, name of person who tested the rock bolt, rock bolt location, rock bolt number, rock bolt length, resin or grout details, test start time, test end time, gauge reading for each minute of the creep test, and lock off load. For resin systems, records shall also include the start and end times of spinning the bar through the resin in the hole.

#### MATERIALS

**206.11 Materials** - Steel materials shall be hot-dip galvanized to CSA G164. All resin, grout and steel materials shall be the products of established manufacturers regularly engaged in the manufacture of rock bolt materials for at least five years. Materials shall meet the following additional requirements:

#### a) Rock Bolt Bars

- Steel hot-rolled Grade 400 meeting CAN/CSA G30.18.
- Nominal bar diameter 22 mm unless otherwise specified.
- Threadlike surface deformations for full length of bar and suitable for mechanical coupling.



- Cut-thread reinforcing bar not permitted.

#### b) Miscellaneous Hardware

- Steel hardware to be compatible in size and strength with rock bolt bars.
- Face plates to CAN/CSA G40.21 Grade 300W.
- Faceplate dimensions 10 mm by 150 mm by 150 mm unless otherwise specified.
- Faceplates date stamped after galvanizing on the side visible when installed with the current year (in the format YYYY) in numbers 10 mm high.
- Face plates slotted for grout tube if grout is used.

#### c) Resin

- Fast-set and slow-set resin in cartridge form.
- A minimum unconfined compressive strength *when* fully mixed and cured of 90 MPa, tested in accordance with CAN/CSA A23.2-9C.
- Encased in a plastic film that provides optimum resistance to moisture, and is easily ruptured to enable complete mixing during installation.
- Suitable thixotropic and viscous properties to permit adequate mixing of the resin components by rotation of the rock bolt bar and to contain the resin within the drill hole.
- Easily identifiable gel time and as recommended by the resin manufacturer.
- Reach 80% of its ultimate strength within a time interval equal to five times the gel time.
- Non-shrink after the gel time.
- Unaffected by mild acids or mild alkalis.
- Cartridge boxes labelled with the resin expiry date.

#### d) Grout

- Pre-mixed, unsanded, non-metallic, and non-shrink cementitious grout containing silica fume.
- Can be mixed to a flowable consistency.
- Minimum 7 day compressive strength of 30 MPa and a minimum 28 day compressive strength of 40 MPa, tested in accordance with CAN/CSA A23.2-9C.
- Admixtures to be used according to the manufacturer's specifications.
- Calcium chloride accelerator is not permitted.

#### e) Mortar Pads

- Portland cement based.
- Quick setting.

## CONSTRUCTION

### 206.31 Execution

**206.31.01 General** - The entire rock bolt system shall be stored under cover away from deleterious materials. All grease and other deleterious material shall be removed from the steel prior to rock bolt installation.

**206.31.02 Site Preparation** - Where rock bolts may be adversely impacted, rock removal above and around proposed rock bolt locations shall be completed before installation of rock bolts commences. Any minor rock scaling performed in conjunction with rock bolting shall be considered incidental to rock bolting.

### 206.31.03 Drill Holes

**a) Location, Orientation and Depth** - The location, direction, angle and depth of the holes will be dependent on field conditions encountered and will be detailed by the Ministry Representative.

**b) Hole Diameter** - The diameter of the holes shall be suitable for the rock bolt system chosen. Where grout is used, the hole size shall be according to the rock bolt manufacturer's recommendations. Where only resin is used, the hole size shall be according to the resin manufacturer's recommendations.

**206.31.04 Cleaning** - All water, grease, oil, cuttings and other deleterious materials shall be removed from finished holes by a water and/or air jet as required.

### 206.31.05 Installation

**a) General** - Rock bolts shall be inserted (or rotated) into the drill holes and fully encapsulated in resin or grout to the drill hole collar. When resin is used, the bolt shall be advanced and rotated at a rate recommended by the resin manufacturer.

**b) Anchorage Length** - The anchorage length shall be the last 1000 mm of the inserted end of the bar, unless otherwise specified.

**c) Centralizers** - If grout is used, centralizers on 3.0 m centres shall centralize the rock bolt in the drill hole before grout is placed. Centralizers shall be suitable for holes in rock.

**d) Resin** - Resin cartridges shall be installed as follows or as specified by the resin manufacturer:

- **Fast-Set Resin** - A sufficient number of fast-



setting cartridges shall be placed at the bottom of the hole for the anchorage.

- **Slow -Set Resin** - A sufficient number of slow-setting cartridges shall be placed between the anchorage and the collar of the hole.

**e) Grout** - Grout shall be prepared and placed as follows unless otherwise specified by the grout manufacturer:

- **Mixing** - Grout shall be mixed in a colloidal or high shear grout mixer according to the grout manufacturer's published instructions. Mixing paddles shall be slotted and perforated. Mixing time shall be not less than two minutes.
- **Batching** - All ingredients for the grout mix shall be batched by mass. Water shall be added to the drum first and dry ingredients afterwards. Grout shall not be re-tempered after initial mixing. Grout shall be placed immediately after mixing.
- **Grout Placement** - Grout shall be pumped using a grout tube extending to the bottom of the hole. The inserted end of the tube shall remain below the level of the grout in the hole to effect a continuous air free column as the grout level rises. Grout shall be placed quickly and continuously to avoid overworking, segregation, bleeding and disturbance of initial set. Grout that has stiffened due to delay in placing shall not be used in the work and shall be disposed of at an authorized location.

**f) Rock Face Preparation** - The bearing surface shall be prepared to allow the faceplate to be oriented within the limits recommended by the anchor manufacturer. If necessary, rock shall be chipped from around the face plate contact area.

**g) Mortar Pad Construction** - Mortar pads shall be constructed as required to ensure the bar is within 20° of a line perpendicular to the faceplate. The pad shall not crack or deform when loaded. Sufficient time shall be provided to allow pads to achieve sufficient bearing capacity prior to test-tensioning.

**h) End Hardware Installation**

- Nuts shall bear uniformly against the faceplate.
- The bolt extension beyond the nut shall be 100 mm ± 10 mm.

**206.31.06 Tensioning** - All rock bolts shall be test-

tensioned and locked off following set-up (or curing) of the anchorage. Prior to testing, the grout and resin shall meet the strength specified by the anchor manufacturer. The following procedure applies to 22 mm diameter bars. An alternative procedure may be specified for different bar sizes.

**a) Equipment** - Equipment required for tensioning shall be supplied by the Contractor and shall be of a size adequate to provide the required tension. A torque wrench shall not be used for tensioning.

**b) Test-Tensioning and Creep Test** - Rock bolts shall be test-tensioned to 139 kN (31,000 lb). This load shall be held for 10 minutes for the creep test.

**c) Lock-Off Tension** - Rock bolts shall be locked-off to a tension of 111 kN (25,000 lb) after testing.

**d) Acceptance Criteria** - During the creep test a load loss of greater than 10% of the load applied shall be indicative of anchorage failure. Creep movement at the anchor head shall not exceed 2 mm during the creep test. A replacement rock bolt shall be installed at the Contractor's expense where these criteria are not met.

**206.31.07 Rock Bolt Evaluation** - The Ministry Representative will implement a program of evaluation of rock bolts installed. After locking off the anchor, the load shall be re-applied to determine the lift-off load. The lift-off load shall be the tension level at which the anchor nut can be loosened by hand. Lift-off tests shall be performed on rock bolts chosen by the Ministry Representative to a minimum of 5% of the total number of rock bolts. One additional lift-off test on a different bolt shall be performed for each bolt whose lift-off load is not within 10% of the specified lock-off load. Following lift-off testing, all bolts shall be locked off as specified.

## MEASUREMENT

**206.81 Rock Bolts** - Rock bolts will be measured by the METRE installed. The measurement length shall be the length of bar in the rock.

## PAYMENT

**206.91 Rock Bolts** - Payment for ROCK BOLTS will be at the Contract Unit Price per metre. Payment for rock bolts will be authorized after installation to the contract specifications and after submittal of the completed Contractor's Daily Rock Bolt Testing and Tensioning Record. The Unit Price will be considered full compensation for all work and materials supplied according to the requirements of this Section.



# CONTRACTOR'S DAILY ROCK BOLT TESTING AND TENSIONING RECORD

**File #** \_\_\_\_\_

**PROJECT NO.** \_\_\_\_\_

(TO BE SUBMITTED WITHIN 1 DAY AFTER EACH DAY'S ROCK BOLTING OPERATION)

Contractor Name \_\_\_\_\_  
 Bolt Type \_\_\_\_\_ Size \_\_\_\_\_  
 Resin/Grout Type \_\_\_\_\_ Anchorage Length \_\_\_\_\_ m  
 Test Jack Number(s) \_\_\_\_\_

[illegible]

**Certified Correct:** \_\_\_\_\_  
**(Contractor's Superintendent)**



## SECTION 207

### SLOPE MESH FOR ROCK CUTS

#### DESCRIPTION

**207.01 Scope** - This Section applies to slope mesh structures which are installed to provide rockfall protection.

**207.01.01** Rock slope scaling and tree removal, performed in conjunction with slope mesh installation, shall be considered incidental to slope meshing. Rock slope scaling and tree removal shall be completed before the mesh support system is installed unless otherwise authorized by the Ministry Representative. Trees to be removed will be detailed by the Ministry Representative.

**207.01.02** Discarded mesh components, scaled rock, trees and debris generated by the slope meshing work shall be removed from the ditches and disposed of by the Contractor. Temporary storage of felled trees in ditches will not be permitted.

**207.01.03** The contractor shall layout in the field all anchor and suspension cable locations for each section. Each section will be reviewed by the Ministry Representative prior to installation.

**207.01.04** Field conditions may require final anchor, cable and mesh configurations to vary from the Ministry's drawings. All variations must be authorized by the Ministry Representative.

**207.01.05** The area to be provided with slope mesh protection shall be divided into sections with a maximum width of 24 m. Each section shall have a separate suspension cable, end main anchors and end anchors. End main anchors of adjacent sections shall be positioned 200 mm apart. The gap between sections shall be closed with mesh.

**207.01.06** The maximum mesh length shall be 80 m.

**207.01.07** The maximum rock impact energies shall be as follows:

- 3 kJ above cut crest
- 30 kJ below cut crest

**207.01.08** Overburden thickness may range from zero to over 1.5 m.

#### MATERIALS

**207.11 Slope Meshing Materials** - Unless otherwise specified, preparation and installation of materials shall be according to manufacturer's recommendations.

All components shall be hot-dip galvanized conforming to ASTM A 123 or ASTM A 153 or CSA G164 where appropriate. Damaged galvanizing shall be re-galvanized at the contractor's expense.

**207.11.01 Mesh** - Mesh shall be 11 gauge (2.95 mm dia.) hexagonal triple twist gabion type mesh. Mesh wire shall meet federal specification QQ-W-461g, possess soft tensile strength with a finish 5 class 3 zinc coating of not less than 260 g/m<sup>2</sup>. The weight of zinc coating shall be determined by ASTM A 90. The coating shall withstand four one minute dips by the preece test, ASTM A 239. Mesh opening shall be hexagonal in shape and uniform in size measuring 80 mm by 100 mm.

**207.11.02 Threadbar** - Threadbar shall conform to CSA G30.18, grade 400 steel, manufactured by Dywidag Systems Int. (DSI) or authorized equivalent.

**207.11.03 Eye nuts** - Eye nuts shall be cast or manufactured eye nuts by DSI or authorized equivalent.

**207.11.04 Cables** - All cables shall be fibre core conforming to CSA G4. Cables shall be unsplined.

**207.11.05 Thimbles** - Thimbles shall meet FF-T-276B Type III (extra heavy G-414).

**207.11.06 Clips** - Clips shall meet FF-C-450 Type 1, Class 1 (G450 Crosby clip or authorized equivalent).

#### 207.12 Grout

**207.12.01** Grout for main anchors shall be Celtite Anchortite. Grout for auxiliary anchors shall be Celtite Lokset cartridges, cement grout or authorized equivalent.

**207.12.02** Cement grout shall be Target 1118 or Ocean Microsil anchor grout or equivalent with W/C=0.35. Grout minimum 3 day and 28 day compressive strengths shall be 20 MPa and 40 MPa respectively, tested in accordance with CSA A23.2-1B.

**207.13 Conformance Documents** - Prior to installation the contractor shall supply documents of conformance to project specifications of all materials upon request.

#### CONSTRUCTION

##### 207.31 Anchor Installation

**207.31.01** Overburden shall be excavated to rock at anchor locations unless specified otherwise. The Contractor shall minimize disturbance of surrounding soil



and rock when excavating. Cables shall not contact ground surface.

**207.31.02** Anchor holes shall be a minimum of 1.5 times anchor diameter and in strong, competent rock. Anchors shall be centered in the hole and grouted. Anchors shall not be loaded within 3 days of grouting.

**207.31.03** Main anchors shall be located at local high points where practicable to maximize clearance between suspension cable and ground surface. Main anchors shall be vertical and centered in the hole unless otherwise authorized by the Ministry Representative. Main anchor height above ground surface may be reduced where authorized by the Ministry Representative for field conditions.

**207.31.04** Auxiliary anchors shall be located to minimize potential for main anchor bending.

**207.31.05** Main anchors may be substituted, where authorized by the Ministry Representative, with a limited number of guy cables directly connected to the suspension cable where no suitable main anchor locations can be found. Guy cable anchors shall be located to maximize suspension cable elevation. See Section Y-Y, on Drawing [SP207-02](#) and Detail B on Drawing [SP207-03](#).

**207.31.06** Auxiliary or guy anchor embedded length may require extension if weak rock conditions are encountered.

**207.32 Soil Anchors** - Soil anchors shall be used where required or as ordered by the Ministry Representative. For soil anchor details see Drawings [SP207-04](#) and [SP207-05](#).

Concrete requirements for soil anchors:

- minimum compressive strength at 28 days = 30 MPa
- maximum nominal size of aggregate = 28 mm
- air content =  $5 \pm 1\%$

- slump =  $55 \pm 20$  mm
- maximum w/c ratio by mass = 0.45

Upon request by the Ministry Representative, the contractor shall load test one overburden soil anchor to 10 kN to verify capacity.

**207.33 Cable and Mesh Installation** - Suspension, auxiliary, end, and guy cables shall be installed to nominal tension to remove slack before and after installing mesh.

A maximum of two horizontal mesh seams (200 mm overlap) shall be permitted along the entire mesh height. The upper mesh portion shall be between the slope and lower mesh at the overlap. The horizontal seam connections shall be similar to the vertical seams.

The mesh shall terminate 1500 mm above the highway edge of pavement elevation. The bottom of the mesh shall be evenly trimmed parallel with the highway elevation. The bottom of the mesh shall be bent to remove the curl.

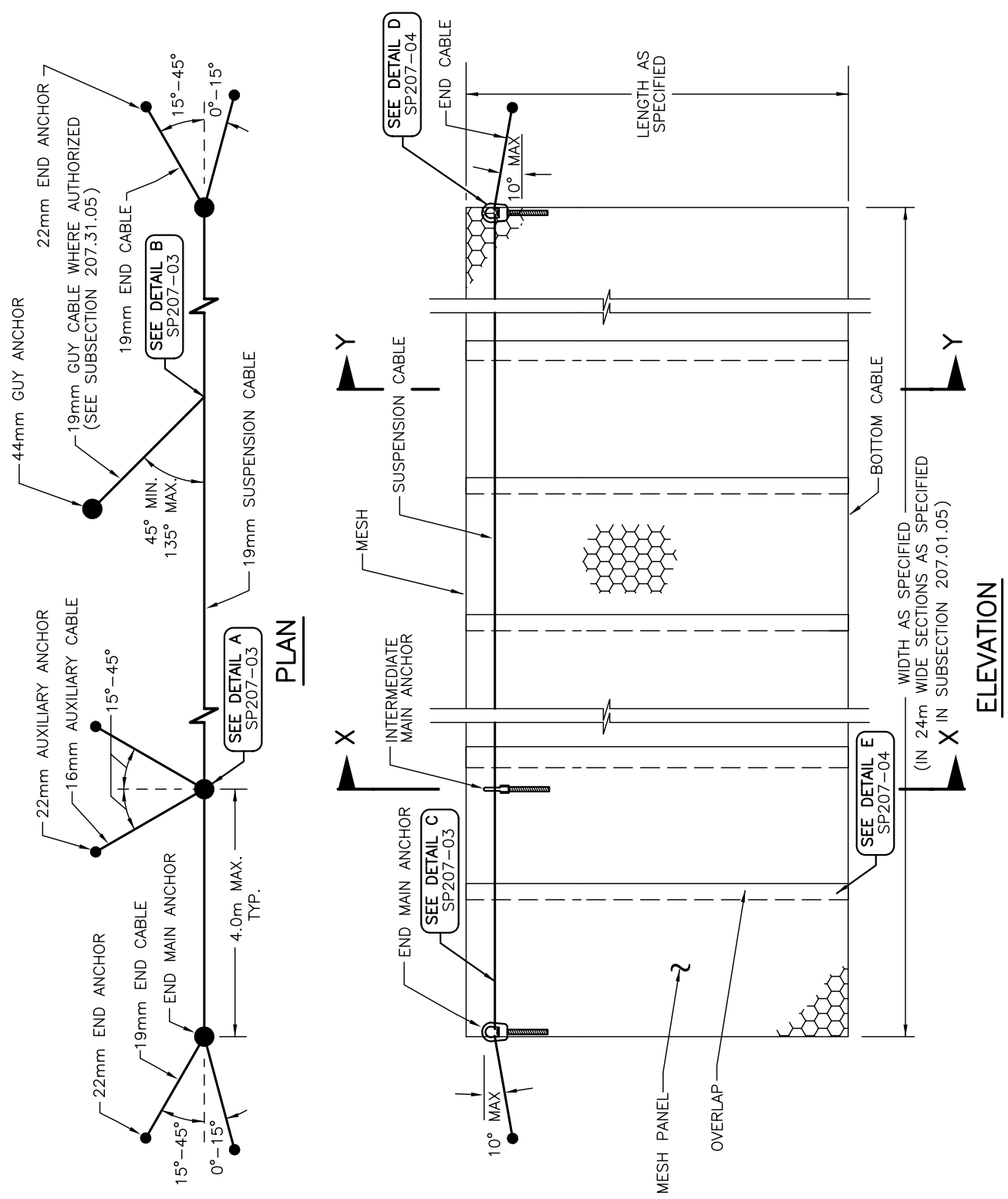
## MEASUREMENT

**207.81 Slope Mesh** - Slope mesh shall be measured by the SQUARE METRE of slope meshed area.

## PAYMENT

**207.91 Slope Mesh** - Payment for SLOPE MESH will be at the Contract Unit Price per square metre. The Unit Price will be full compensation for all requirements in this specification. Partial payment may be authorized where all components have been installed in a portion of the designated slope meshing area. No separate payment will be made for mesh overlap.

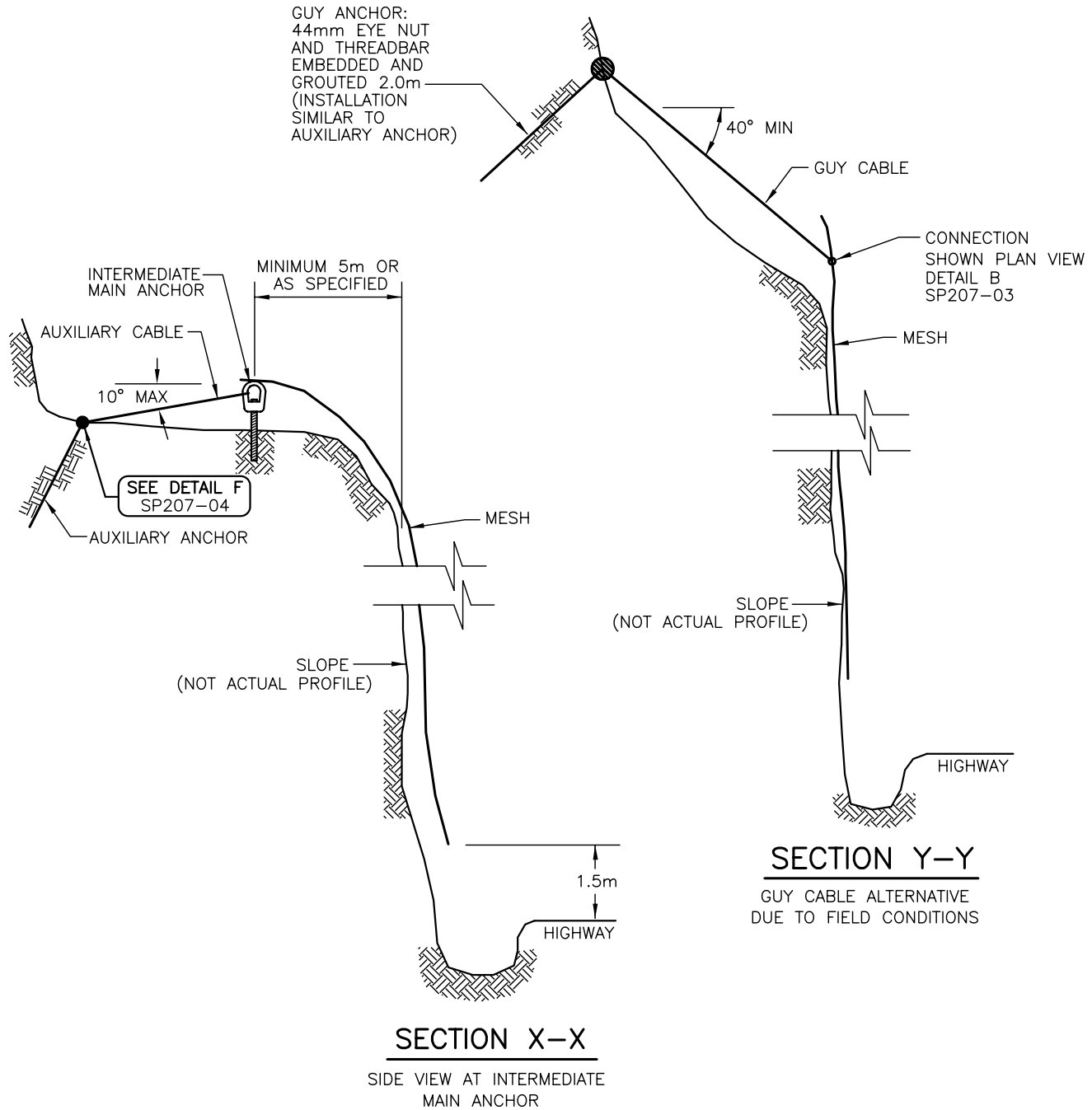




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



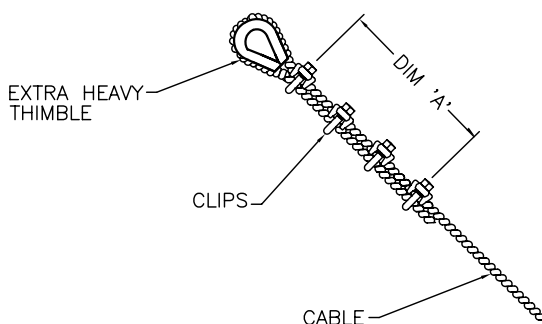
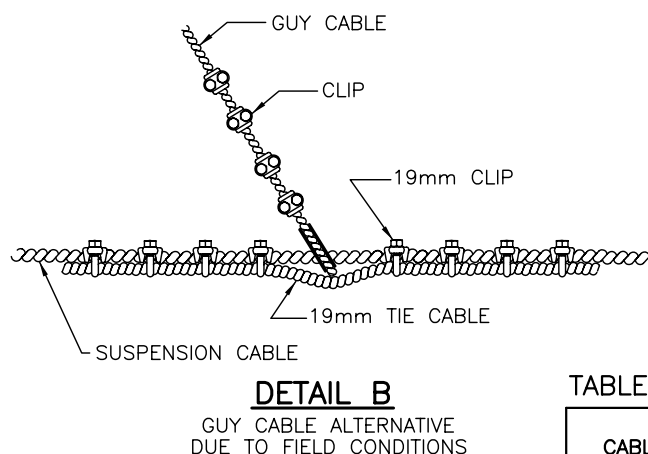
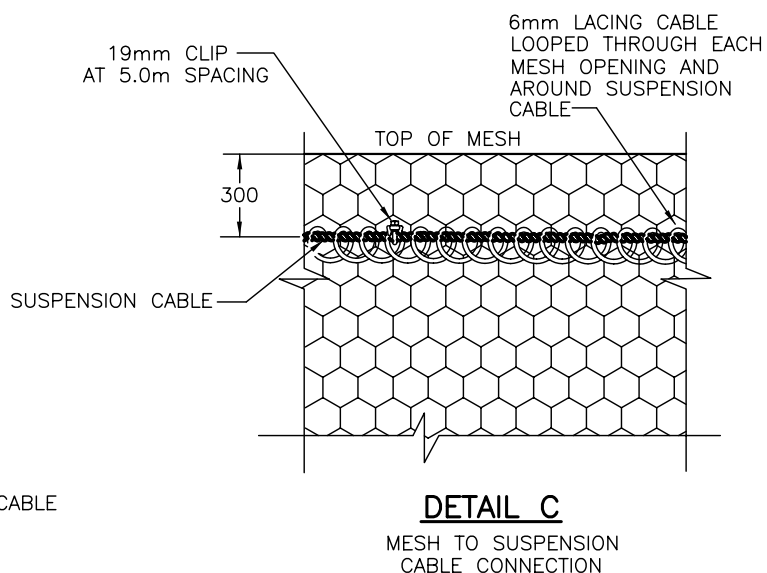
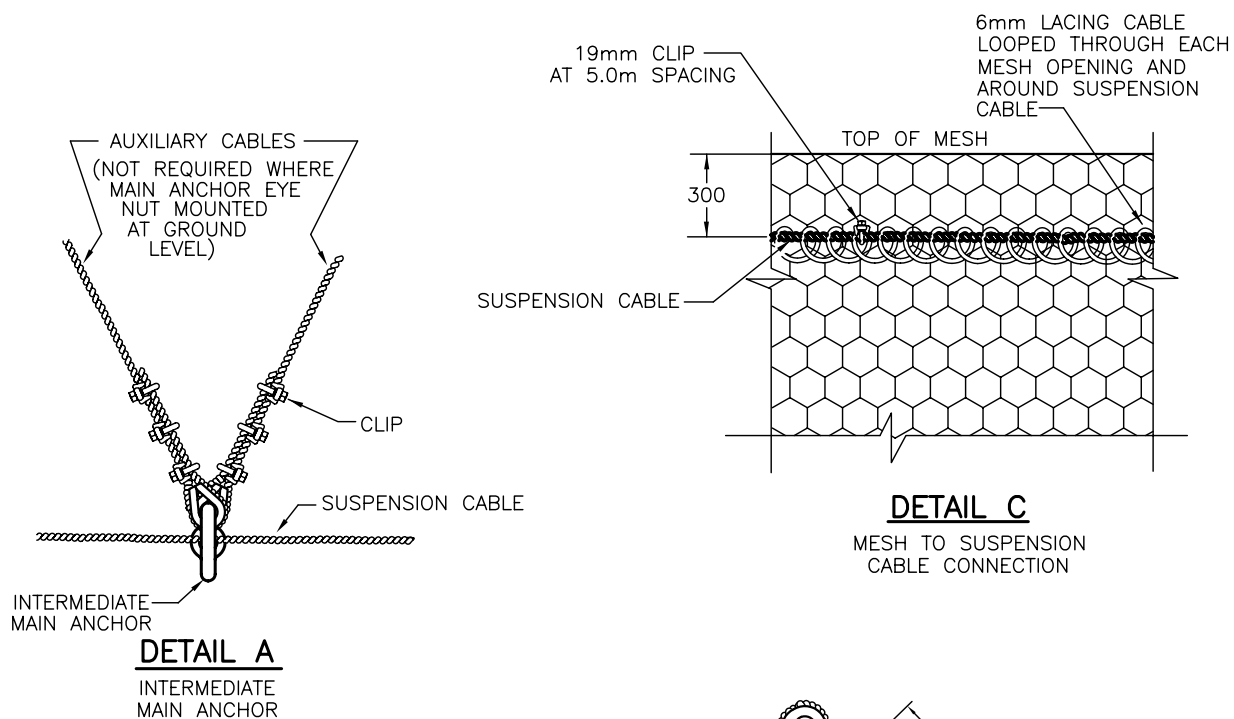
**NOTES:**

1. FOR LOCATION OF SECTIONS SEE DWG. SP207-01.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**CABLE LOOP DETAIL**

FOR SUSPENSION, END, GUY AND AUXILIARY CABLES  
(SEE TABLE 1)

TABLE 1: CLIPS

CABLE TYPE	CABLE SIZE (mm)	CLIP SIZE (mm)	Nº. OF CLIPS FOR LOOP	DIMENSION 'A' (mm)	TORQUE Nm (ft. lbs)
Suspension, End, Guy	19	19	4	460	175 (130)
Auxiliary	16	16	3	300	113 (95)
Lacing	10	19	(varies)	N/A	54 (45)

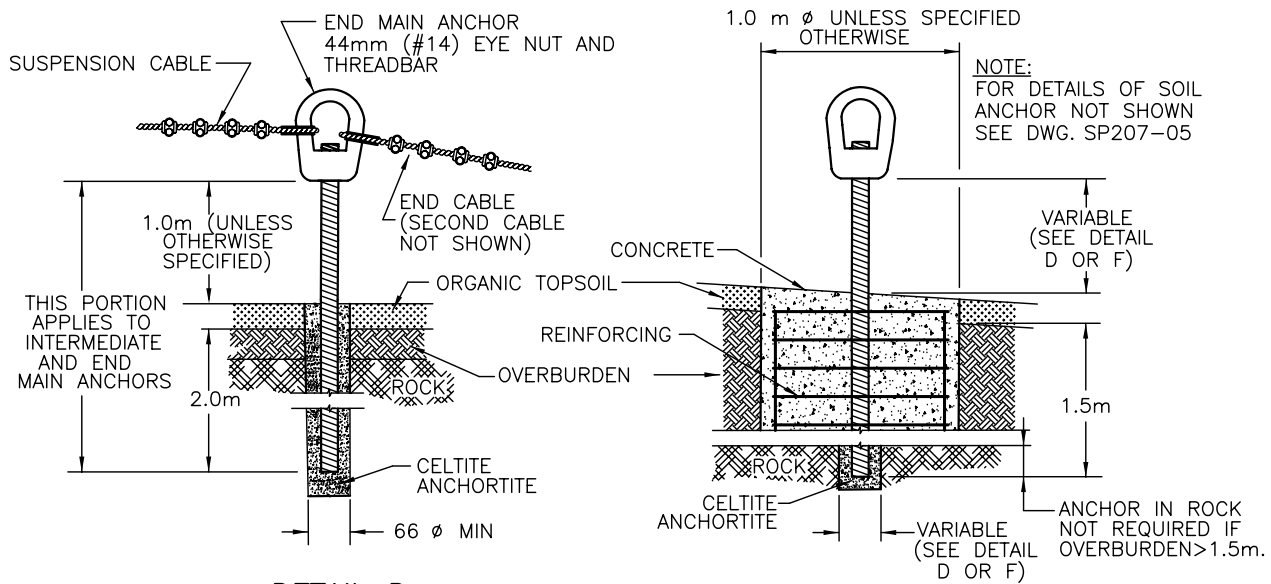
**NOTES:**

1. FOR LOCATION OF DETAILS SEE DWG. SP207–01.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



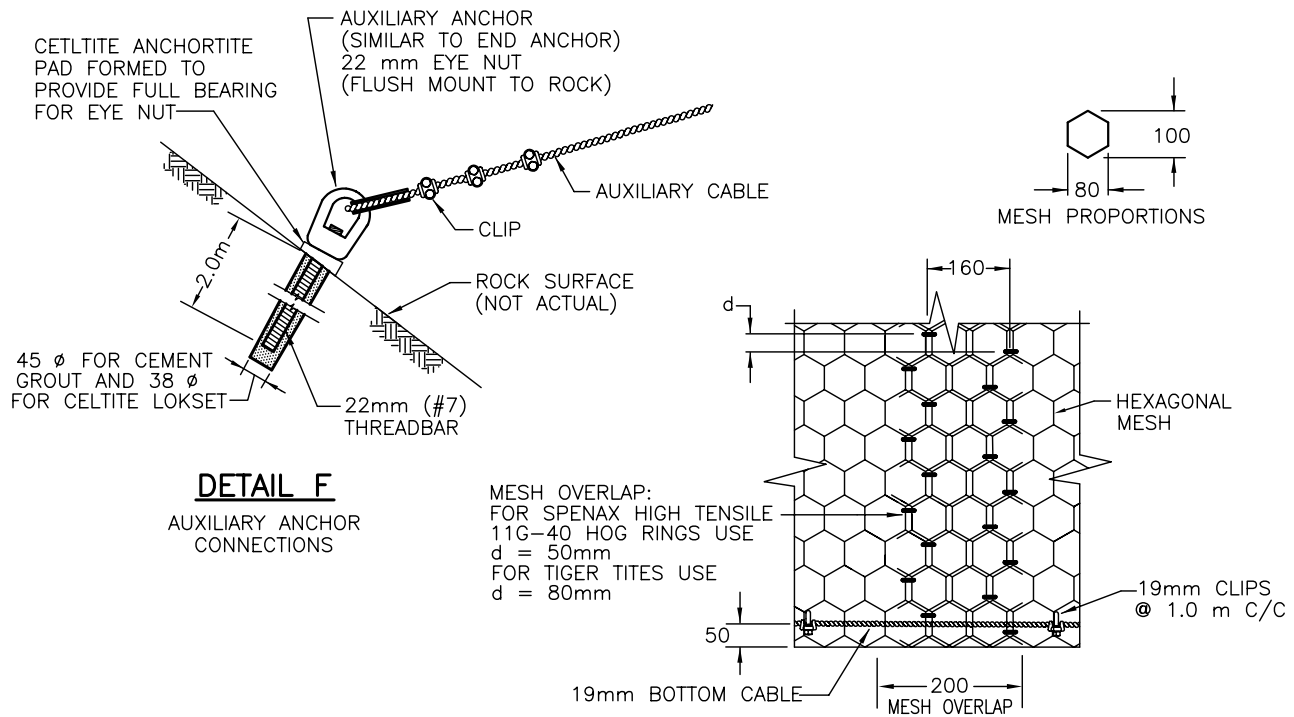


**DETAIL D**

END MAIN ANCHOR CONNECTIONS  
(MESH OMITTED FOR CLARITY)

**SOIL ANCHOR DETAIL**

ALTERNATE ANCHOR DETAIL IN OVERBURDEN.  
FOR OVERBURDEN THICKNESS GREATER  
THAN 0.6m (SEE SUBSECTION 207.01.08)



**DETAIL F**

AUXILIARY ANCHOR  
CONNECTIONS

**DETAIL E**

MESH SEAM CONNECTIONS AND BOTTOM CABLE

**NOTES:**

1. FOR LOCATION OF DETAILS SEE DWGS. SP207-01 & 02.

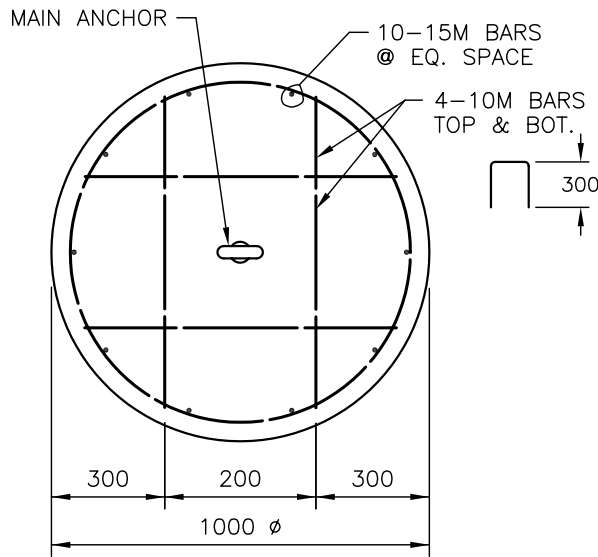
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

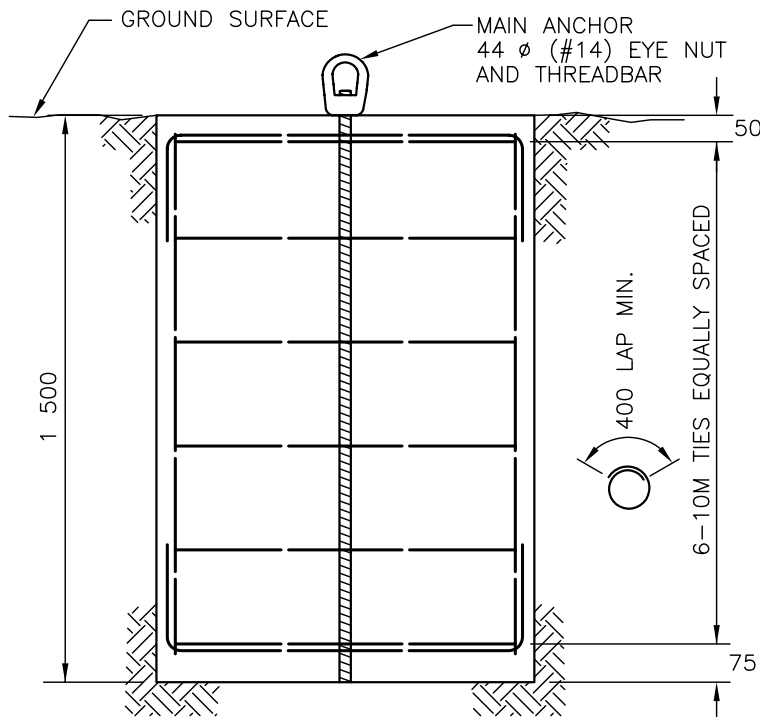


## NOTES:

1. INSTALL 300, 600 OR 1000mm  $\phi$  SOIL ANCHOR AS SPECIFIED.
2. REDUCE SOIL ANCHOR DEPTH WHERE ROCK IS ENCOUNTERED, AND INSTALL MAIN ANCHOR INTO ROCK TO PROVIDE TOTAL 1.5m EMBEDDED LENGTH.
3. CONCRETE REQUIREMENTS SHOWN ON SLOPE MESH DRAWING.
4. ALL REINFORCING STEEL TO MEET C.S.A. SPECIFICATION G30.18-M, GRADE 400R.
5. ALL REINFORCING STEEL TO HAVE 50mm COVER UNLESS SPECIFIED OTHERWISE.
6. PLACE REINFORCING BARS IN ACCORDANCE WITH RECOMMENDED PRACTISES OF THE CONCRETE REINFORCING STEEL INSTITUTE (C.R.S.I.)
7. CONCRETE AND REINFORCING STEEL TO MEET STANDARD SPECIFICATION SECTIONS 412 AND 218 UNLESS SPECIFIED OTHERWISE.

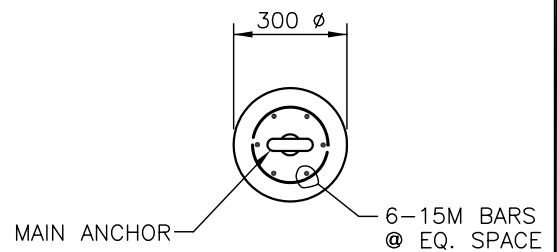


**PLAN**



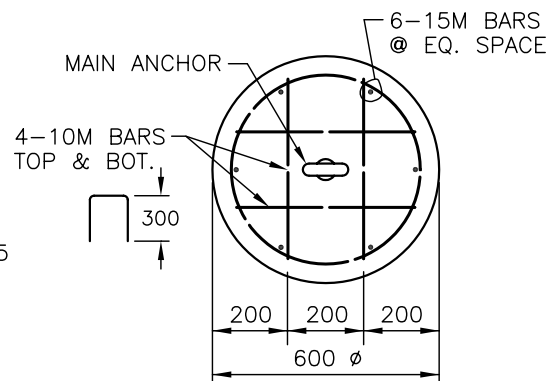
**ELEVATION**

**1000  $\phi$  SOIL ANCHOR**



**300  $\phi$  SOIL ANCHOR**

(ALL NOT SHOWN SIMILAR TO 1000  $\phi$  SOIL ANCHOR)



**600  $\phi$  SOIL ANCHOR**

(ALL NOT SHOWN SIMILAR TO 1000  $\phi$  SOIL ANCHOR)

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 208

### DRAINS FOR ROCK CUTS

#### DESCRIPTION

**208.01 Scope** - This Section covers the installation of lined drains in the designated areas to the specified depth. The exact locations of drain holes will be dependent on field conditions and will be detailed by the Ministry Representative

#### MATERIALS

**208.11 PVC Pipe Materials** - Drain hole lining shall consist of Schedule 40 slotted PVC pipe. The outside diameter of the pipe shall not be less than 67% of the borehole diameter, and the internal diameter of the pipe shall be a minimum of 19 mm. The slots shall be along the entire length of the pipe in one row. Unless otherwise specified, the slots shall be 0.5 mm wide, spaced 6 mm apart and have a minimum length of 30% of the outside circumference of the pipe.

#### CONSTRUCTION

**208.31 Drilling** - Advancement of drilling for drain holes shall be in an upslope direction. The dip angle for drain holes shall be 5°, or as specified by the Ministry

Representative. Finished holes shall be flushed with air to remove deleterious materials.

**208.32 PVC Pipe Installation:** PVC pipes shall be installed into the finished holes immediately after flushing. Pipes shall be coupled according to the manufacturer's specifications. The pipe shall be installed along the entire length of the holes and shall protrude 0.30 m out of the rock face. The slots shall be on top when the pipe is installed. The pipe shall be secured in the hole, using plastic or wooden wedges driven into the hole collar if necessary, so that the pipe cannot be pulled out by hand.

#### MEASUREMENT

**208.81 Lined Drains** - Lined drains will be measured by the METRE of drain hole drilled.

#### PAYMENT

**208.91 Lined Drains** - Payment for LINED DRAINS will be at the Contract Unit Price per metre. Payment for lined drains will be authorized after installation to the contract specifications. The Unit Price will be considered full compensation for all work and materials necessary to complete the installation prescribed in this Section.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 209

### SHOTCRETE FOR ROCK CUTS

#### DESCRIPTION

**209.01 General** - Unless otherwise specified, the shotcrete standards of ACI 506.2 and the standards of good practice in ACI 506R shall apply. Section 211, Portland Cement Concrete, shall also apply for shotcrete, unless otherwise specified.

Shotcrete operations shall include, but not be limited to pre-construction and construction work including preparation of the mix design(s), quality control, surface preparation; installation of wick drains, weep holes and pipes; supply and installation of the shotcrete; preconstruction and construction testing, curing; the supply, transportation and testing of shotcrete panels; any core extraction of the in-place shotcrete, and any other testing to determine curing or protection requirements.

#### 209.02 Quality Control

**209.02.01 General** - The Contractor shall engage at its own expense, a specialist firm (the Contractor's Consultant) to provide on-site quality control for shotcrete operations. The Contractor's Consultant shall not be an employee of the Contractor.

**209.02.02 Qualifications** - The Contractor's Consultant shall have designed shotcrete for 3 projects over the last 5 years. The Contractor's Consultant's representative conducting onsite shotcrete tests shall be an ACI or CSA certified concrete technician.

**209.02.03 Specific Requirements** - For wet and dry process shotcrete, quality control shall include, but not be limited to the following:

- Observation of surface preparation before shotcrete application.
- Observation and testing during shotcrete application.
- Observation of curing operations.

**209.02.04 Other Requirements** - The Contractor's Consultant shall be present at other times as are appropriate to assist the Contractor in the preparation, assessment and adjustment of the various procedures to be used for shotcrete operations.

**209.02.05 Field Report** - The Contractor shall ensure that the Contractor's Consultant prepares a field report for each site visit, signed by the Contractor's Consultant. The report shall include details of the progress of shotcrete operations, any recommendations made to the Contractor and any problems encountered by the Contractor.

#### 209.03 Submittals

**209.03.01** The Contractor shall submit for review the following documentation by the pre-construction meeting:

**a) Qualifications and Experience of the Contractor** - Provide a statement of the qualifications, experience and work function of all personnel assigned to shotcrete duties. A statement of previous work experience on similar projects shall also be provided. This statement shall include the project name, location, type of shotcrete, volume of shotcrete, year constructed and the owner contact name. The company, the nozzle operator and the predampener/pot operator shall each have a minimum of 5 years demonstrated experience on shotcrete work.

**b) Qualifications and Experience of the Contractor's Consultant** - The qualifications shall include the name of the consulting firm, and the name and qualifications of the Consultant's on-site representative who will be providing the quality control. The following information shall be included in the qualifications submitted:

- Project name, location and experience.
- Name and phone number of the owner contact who can verify the experience of the Contractor's Consultant's site representative.

**c) Proposed Laboratory Testing Agency** - Provide a statement of the testing agency's experience in performing laboratory tests on shotcrete. The agency shall be an independent, qualified laboratory with a proven record of performing tests on shotcrete on at least 5 previous projects. The testing agency shall be certified to CSA A283.

**d) Certification of the Concrete Technician** - Provide evidence of ACI or CSA Certification for the concrete technician who will be providing on site shotcrete tests.

**209.03.02** The Contractor shall submit for review the following documentation at least 10 days prior to commencing shotcrete operations:

**a) Materials Records** - Provide records showing source and proof of conformance to project specifications of the following materials:

- Portland Cement (provide mill certificates)
- Silica Fume (provide mill certificates)
- Mix Water
- Aggregates
- Admixtures (provide supplier data sheets)
- Fibre Reinforcement (if specified), include



load/deflection curves to ASTM C 1018 for the proposed mix design

- Mesh Reinforcement (if specified, provide mill certificates)

**b) Previous Performance Data** - Provide previous performance data for the proposed shotcrete mix design, if available.

**c) Proposed Shotcrete Mix Design (Proportions)** - Provide documentation for the proposed shotcrete mix design. Include such back-up data as requested. The proposed mix design submittal shall include:

- Mix design number.
- Batch quantities in kg/m<sup>3</sup> based on aggregates in an SSD (Saturated Surface Dry) moisture state for wet process shotcrete and ready mix supplied dry process shotcrete. Batch quantities for dry bagged supply shall be based on mass of aggregates in a dry state.
- A total cementitious content of not less than 20% by mass of the total ingredients.
- Aggregate source, bulk density, absorption, combined gradation data and a grain size distribution graph scaled between 0.075 mm and 75 mm showing the percent passing curve for the combined aggregate.

**d) Proposed Shotcrete Imprint** - Provide a drawing of the proposed shotcrete imprint including content, imprinting method and materials that will be used to produce the imprint.

**209.03.03** The Contractor shall submit for review the following documentation within 1 day following each day of shotcrete application:

**a) Field Report** - Provide original field reports signed by the Contractor's Consultant.

**b) Daily Records** - Provide daily shotcrete records with the following information (certified by the Contractor's Consultant in the case of wet process shotcrete):

- Contractor Name
- Nozzleman Name
- Helper Name
- Contractor's Consultant's Name (for wet process shotcrete)
- Contractor's Consultant's Representatives Name (for wet process shotcrete)
- Date
- Weather
- Contractor's start and end time
- Shotcrete equipment type

- Temperature
- Type of shotcrete (wet or dry process)
- When is slump measured, before or after admixture and fibres

Submit the following information for each batch of shotcrete:

- Batch number
- Location of shotcrete
- Mix design number
- Batch time at plant (wet process)
- Batch arrival time on site
- Truck departure time (wet process)
- Placement start time
- Placement end time
- Quantity used
- Water/cementitious materials ratio (wet process)
- As-shot air content (wet process)
- Slump (wet process) - indicate when measurement is made (e.g.: after air entrainment is added, before superplasticizer is added and before fibre reinforcement is added)
- Percent rebound (visual estimate)
- Average thickness of shotcrete
- Test panel number
- Shotcrete delivery tickets from batch plant (wet process)
- Comments on the quality of the shotcrete and any problems that arise
- Proposed revised mix design

**209.03.04** The Contractor shall submit the laboratory test results within 2 working days after testing. These test results shall compare the shotcrete performance with the requirements given in Table 209-A. Records shall include all reporting requirements outlined for construction testing. Records shall also include an original summary report of all test results, showing the sample number, sample origin, panel number, panel origin, date the panel was sprayed, panel shipping date, date panel received at the laboratory, photos of prepared test samples, test date, sample age at testing, test results for each sample, average test results of the three samples for each test at a given age, and acceptability of the results.

**209.04 Definitions** - The following definitions refer to words and terms used in this specification. For definitions not covered in this document, refer to ACI 506R and ACI 506.2.

**209.04.01 Blow pipe** - Air / water jet operated by nozzle operator's helper during shotcrete placement to assist in keeping rebound and overspray out of the work.

**209.04.02 Dry Process Shotcrete** - A process where most



of the water added to the shotcrete mixture is added at the nozzle.

**209.04.03 Overspray** - Shotcrete material deposited away from the intended receiving surface.

**209.04.04 Pot (Sometimes called Gun)** - Machine used to meter the shotcrete into the hose.

**209.04.05 Predampener** - Device used to mix a portion of the mixing water with the shotcrete. Can also be used to mix accelerator with shotcrete.

**209.04.06 Saturated Surface Dry** - The state of a material in which it will neither add nor subtract moisture from other material placed in contact with it.

**209.04.07 Slake** - A process of deterioration of freshly exposed rock due to exposure to the atmosphere and/or water.

**209.04.08 Sloughing (also called sagging)** - Subsidence of shotcrete, due generally to excessive water in the mix or placing too great a thickness of shotcrete in a single pass.

**209.04.09 Weep Pipes** - Plastic pipes inserted in water bearing fissures to relieve water pressure from behind the shotcrete.

**209.04.10 Wet Process Shotcrete** - Shotcrete in which all of the ingredients are mixed before introduction into the delivery hose. Compressed air is introduced to the material flow at the nozzle. If an accelerator is used, it is normally added at the nozzle.

## MATERIALS

### 209.11 Materials

**209.11.01 Cement** - Cement shall be Type 10 or 30.

**209.11.02 Silica Fume** - Silica fume shall meet the requirements of CAN/CSA-A23.5-M, Supplementary Cementing Materials, Type U Silica Fume, with the following additional requirements:

- Minimum SiO<sub>2</sub> content - 90 percent by mass
- Maximum carbon content: 5 percent by mass

**209.11.03 Pozzolan** - Pozzolan shall be Type F flyash.

**209.11.04 Water** - Surface or ground water may be used for cleaning the slope and curing provided it is free of deleterious substances. Verification that the water intended for use is acceptable is at the discretion of the Ministry Representative and at the expense of the Contractor.

**209.11.05 Aggregates** - Aggregate shall be normal density. The combined aggregate gradation limits shall meet the limits shown in Table 209-B.

### 209.11.06 Admixtures

**a) General** - Chemical admixtures shall include air-entraining, water reducing and set retarding admixtures where appropriate.

**b) Superplasticizers** - Superplasticizers shall meet the requirements of CAN3-A266.6-M.

**c) Accelerating Admixtures in General** - Accelerating

**TABLE 209-A SHOTCRETE PERFORMANCE REQUIREMENTS**

TEST DESCRIPTION	TEST METHOD	AGE (DAYS)	SPECIFIED REQUIREMENT
*Maximum Water / Cementitious Materials Ratio		-	0.45
*Air Content - As Shot, %	CAN/CSA A23.2-4C	-	4 ± 1½
*Slump at discharge into shotcrete pump, mm	CAN/CSA A23.2-5C	-	80 ± 30
Minimum Compressive Strength, MPa	CAN/CSA A23.2-14C	7 28	30 40
Minimum Flexural Strength, MPa	ASTM C 1018	7	4
Minimum Toughness Performance Level (TPL)	ASTM C 1018 and this specification	7	III
Maximum Boiled Absorption, % Maximum Volume of Permeable Voids, %	ASTM C 642	7 7	8 17

Notes: \* Properties apply to wet process shotcrete only.



admixtures shall only be used with the written consent of the Ministry Representative.

**d) Accelerating Admixture Requirements -**  
Accelerating admixtures:

- i) shall be non-chloride based accelerating admixtures meeting the requirements of CAN/CSA A23.1M Clause 15.1.7.1;
- ii) shall be compatible with the cement being used when tested in accordance with ASTM C 1117;
- iii) shall have a demonstrated ability, when used at the required proportions, to produce accelerated shotcrete meeting the performance criteria specified in Table 209-A;
- iv) for wet process shotcrete shall be liquid, dispensed at the nozzle in closely controlled quantities;
- v) for dry process shotcrete shall be liquid, dispensed at the nozzle in closely controlled quantities; or be powdered and either:
  - integrally mixed in the case of dry bagged material or;
  - mechanically proportioned through the predampener in the case of ready mix supply; metering of accelerators directly into the pot will not be permitted.

**209.11.07 Fibre Reinforcement** - Unless otherwise specified, shotcrete reinforcement shall consist of steel or polyolefin fibres. The fibres shall be capable of meeting the performance criteria specified in Table 209-A and the

following requirements:

- a) **Steel Fibres** - These fibres shall meet the requirements of ASTM C 1116 Type I.
- b) **Polyolefin Fibres** - These fibres shall only be used in wet process shotcrete and shall meet the requirements of ASTM C 1116 Type III.

**209.11.08 Mesh Reinforcement** - Where specified instead of or in addition to fibre reinforcement, shotcrete shall be reinforced with mesh anchored to the surface before shotcrete application. For fibre reinforced shotcrete, additional reinforcement may be required by placing mesh panels up to 0.60 m by 0.60 m without anchors between successive shotcrete lifts where final shotcrete thicknesses are expected to exceed 300 mm in local areas.

a) **Mesh Materials** - Mesh shall consist of welded wire fabric 102 mm by 102 mm opening (4 by 4 inch) by MW13.3 / MW13.3 (8 gauge) wire meeting CSA G30.5 and hot dip galvanized meeting ASTM A 123.

b) **Mesh Anchor Materials** - Anchors shall consist of ASTM A 615 Grade 400 steel, minimum 19 mm nominal diameter. Anchorage may be resin or grout. Grout anchorage may be Ocean "Microsil Anchor Grout" or Target "Unsanded Silica Fume Grout". Resin anchorage may be Celtite Lokset or Ground Control cartridges. Face plates shall be 150 mm by 150 mm by 6 mm. Face plates, nuts and washers shall be capable of developing full anchor pullout capacity.

c) **Mesh Coverage and Overlap** - Mesh shall be installed over the entire area to be shotcreted, unless otherwise specified. Mesh joints shall be lapped 1.5 mesh openings in each direction (horizontally and vertically) and tied at minimum 100 mm intervals with 16 gauge tie wire to achieve full contact between mesh layers.

d) **Mesh Anchor Spacing** - Mesh shall be anchored on minimum 1.2 m centres in each direction or closer where required to form the mesh to within 50 mm of the slope surface. The mesh shall be in full contact with the surface where practicable. The mesh may also be anchored to any previously installed rock bolts provided the spacing is consistent with the spacing required for the above anchors.

e) **Anchor Installation** - Anchors shall be installed as recommended by the anchor manufacturer. The minimum anchor embedment length shall be 1.0 m. Resin or grout shall be applied to full anchor embedment.

**TABLE 209-B COMBINED GRADATION LIMITS FOR SHOTCRETE AGGREGATE**

U.S. STD SQUARE MESH	METRIC SIEVE SIZE	TOTAL PASSING EACH SIEVE SIZE, % BY MASS
3/4	20 mm	
1/2	14 mm	100
3/8	10 mm	90-100
#4	5 mm	70-85
#8	2.5 mm	50-70
#16	1.25 mm	35-55
#30	0.630 mm	20-35
#50	0.315 mm	8-20
#100	0.160 mm	2-10



**f) Mesh Anchor Testing** - A total of 5% of the anchors shall be load tested to 20 kN. This load shall be held for 10 minutes. A load loss of greater than 10% of the applied load shall be indicative of anchorage failure. Any failed anchors shall be replaced at the Contractor's expense.

**209.11.09 Anchor Reinforcement** - Where specified, additional anchor reinforcement shall be installed. Anchor materials, installation and testing shall meet the requirements for mesh anchors unless otherwise specified. Face plates for these anchors shall be "Spider Plates". These anchors and plates shall be fully embedded in the shotcrete.

#### 209.11.10 Materials Handling and Storage

**a) General** - All materials shall be stored and handled in a manner that will prevent damage, deterioration or contamination.

**b) Hot Weather Storage** - During hot weather prebagged material shall be stored in a manner that will allow maximum cooling of the material.

**c) Cold Weather Storage** - During cold weather prebagged material shall be stored in a manner that will provide maximum heat retention of the material.

#### 209.12 Performance Requirements

**209.12.01 General** - Shotcrete shall meet the performance requirements in Table 209-A.

**209.12.02 Air Content** - The air content shall be determined on wet process shotcrete sprayed into a CAN/CSA-A23.2-4C air pressure meter base or freshly applied material removed from in-place and consolidated into the air meter base by rodding.

### CONSTRUCTION

#### 209.31 Batching, Mixing and Conveyance

**209.31.01 General** - Shotcrete shall be batched, mixed and supplied using (one of) the following system(s):

- a)** dry bagged pre mix supply to ASTM C 928 or:
- b)** ready mix supply

**209.31.02 Mixing** - Shotcrete supplied shall be uniformly mixed with no evidence of segregation or improper mixing.

**209.31.03 Batching and Conveyance** - Ready mix

supplied shotcrete shall be batched and conveyed at a rate that allows a consistent application of shotcrete. Irregularities of conveyance that result in delays or a surplus of aged material on site shall be avoided. Shotcrete that has stiffened excessively or is more than 90 minutes old from the time of batching will not be accepted.

#### 209.32 Preconstruction Testing

**209.32.01 General** - The Contractor shall perform preconstruction shotcrete tests (prior to full-scale shotcrete operations), at a shotcrete test site chosen by the Ministry Representative, to demonstrate the competence of the crew, the adequacy of the equipment and the adequacy of the shotcrete mix design. The requirement for preconstruction testing may be waived by the Ministry Representative if sufficient documentation of previous satisfactory performance on similar work is provided.

**209.32.02 Previous Performance** - Documentation for previous satisfactory performance shall meet the following requirements:

- a) Company** - The company shall have applied more than 100 m<sup>3</sup> of shotcrete on a minimum of 3 projects in the last 5 years.
- b) Nozzle Operator** - The nozzle operator shall have applied more than 100 m<sup>3</sup> of shotcrete on a minimum of 3 projects in the last 5 years.
- c) Predampener/Pot Operator** - The predampener/pot operator shall have mixed more than 100 m<sup>3</sup> of shotcrete on a minimum of 3 projects in the last 5 years.
- d) Contacts** - The contact name and number for each project above shall be supplied upon request.

**209.32.03 Application** - Shotcrete applied at the shotcrete test site shall be applied in accordance with the general shotcrete provisions in these specifications.

**209.32.04 Test Panel** - One test panel shall be gunned and tested for the preconstruction shotcrete testing as described for construction testing.

**209.32.05 Test Results** - The Contractor shall not apply shotcrete outside of the shotcrete test site area until the preconstruction shotcrete test results have been evaluated by the Ministry Representative and authorization is given to proceed with the work.

**209.32.06 Revised Methods** - If the results of the shotcrete tests are unsatisfactory in the opinion of the Ministry Representative, then, notwithstanding the Ministry



Representative's prior review of the Contractor's preconstruction submittals, the Contractor shall adopt such revised methods as are necessary to achieve the required results.

**209.32.07 Additional Tests** - The Contractor shall perform, at any time during the progress of the work, additional shotcrete tests at designated test sites if the shotcrete applied in the areas specified in this Contract is unsatisfactory in the opinion of the Ministry Representative.

### **209.33 Weather Conditions**

**209.33.01 Heavy Rain or High Wind** - During periods of heavy rain or high wind, the Contractor shall ensure that the quality of the finished shotcrete product is not compromised. Shotcrete shall not be applied during such weather unless protective measures can be practicably taken.

**209.33.02 Hot Weather** - During periods of hot weather, when ambient temperatures are expected to rise over 30°C, the following requirements shall be met:

- a) Curing** - The Contractor shall implement curing immediately after the shotcrete has been placed.
- b) Temperature at Placement** - The Contractor shall take any steps necessary to ensure that the temperature of the shotcrete supplied to the site is less than 25°C at the time of placement.

**209.33.03 Cold Weather** - During periods of cold weather, where the minimum ambient air temperature falls below 5°C, the following requirements shall be met:

- a) Temperature at Placement** - The Contractor shall take whatever steps are necessary to ensure that the in-place shotcrete temperature is between 10 and 25°C at the time of placement.
- b) Initial Curing Temperature** - The Contractor shall ensure that, during the initial curing period (4 days), the in-place shotcrete temperature will not fall below 5°C. Shotcrete shall not be placed unless measures can be practicably taken to ensure these requirements are met.
- c) Temperature at the Pot** - The Contractor shall not allow the temperature of the dampened dry process shotcrete at the pot to exceed 30°C.
- d) Ice, Snow or Frozen Surfaces** - Shotcrete shall not be applied to frozen surfaces, or surfaces covered with frost, ice or snow.

**209.34 Surface Preparation** - Surfaces to which shotcrete

is applied shall be cleaned of loose rock, dirt and debris which if left in place could impair the bond of shotcrete to rock, concrete or existing shotcrete. Water or air and water jets shall be used to clean rock surfaces. Compressed air only shall be used to clean rock surfaces that have a tendency to slake from contact with water.

**209.35 Drainage** - Unless otherwise controlled, water seepage from slopes shall be controlled by installing weep holes, weep pipes, and wick drains. Surface runoff shall be controlled using suitable water diversion systems.

**209.35.01 Weep Holes** - Weep holes (and weep pipes as required) shall be installed before shotcrete is applied. These weep holes shall be on 1 to 1.5 m centres in the areas to be shotcreted in joints, fractures and faults, or at a closer spacing where required by the Ministry Representative. Holes and pipes shall be inclined to permit free drainage.

**209.35.02 Weep Pipes** - To prevent blockage of weep holes due to entry of shotcrete or rebound materials, weep pipes shall be secured in weep holes and temporarily plugged at the outer end of the pipe. The plugs shall be removed when shotcreting is completed. Weep pipes shall consist of 25 mm minimum outside diameter Schedule 40 plastic pipe.

**209.35.03 Active Seepage Areas** - Where active seepage occurs, weep holes shall be drilled approximately 150 mm or more to intercept fractures or openings wherever practicable and weep pipes shall be installed prior to the application of shotcrete. Where drilling is not practicable, the weep pipes shall be secured in the fractures by other appropriate means.

**209.35.04 No Active Seepage Areas** - Where no active seepage occurs, weep holes shall be installed in joints, fractures and faults by one of the following methods:

- a)** by securing the weep pipes by appropriate means before shotcreting;
- b)** by marking locations using sticks or other appropriate means before or during shotcreting and drilling at the marked locations after shotcreting. Weep holes shall be 25 mm diameter and shall be drilled to intersect the joints, fractures and faults under the shotcrete at the marked locations. Weep pipes are not required for such holes.

**209.35.05 Weep Pipe Removal or Cutting** - Weep pipes shall be removed or cut level with the shotcrete surface after the shotcrete has reached initial set, within one day after application.

**209.35.06 Additional Weep Holes** - Additional weep



holes shall be drilled after shotcreting where there are visible signs of water pressure, such as seepage and damp spots in the hardened shotcrete.

**209.35.07 Wick Drains** - In areas of active seepage, wick drains shall be installed before shotcreting in addition to weep holes if requested by the Ministry Representative. Wick drains shall consist of a flexible polypropylene core drain wrapped with a proven durable geotextile filter fabric. Wick drains shall be 3 mm by 100 mm size (variable length), with #120 sieve filter, 0.17 mm/s filter permeability, and 0.8 kN core grab tensile strength. They shall be able to withstand all handling, abrasion and distortion that occur during installation. Wick drains shall be secured to the surface on maximum 0.5 m centres with pneumatically driven nails, or authorized substitute fasteners. Fastener spacing shall be reduced where required to ensure wick drains are in full contact with the surface. Wick drains shall be installed and covered with shotcrete in a manner that allows gravity drainage to the toe of the slope.

**209.35.08 Surface Runoff** - Where the bond of shotcrete to rock may be impaired by surface water runoff, this water shall be controlled and directed away from the area to be shotcreted.

**209.36 Existing Rock Bolts** - Within or near areas designated for shotcrete where rock bolts were installed (not for the sole purpose of securing mesh) prior to shotcrete application, the rock bolts shall be protected or extended through the shotcrete as follows:

**209.36.01 Extension of Rock Bolts** - Unless otherwise specified, where rock is fractured within 0.5 m of the existing rock bolts, the face plates and nuts shall be removed before shotcrete is applied. The bar shall be extended, where necessary, using a short piece of bar and a coupler. The shotcrete shall be applied up to and against the existing bar. The face plates and nuts shall then be reinstalled over the shotcrete after the shotcrete has cured. Each face plate shall be replaced to the same bar from which it was removed. The exposed bar length shall be 100 mm following reinstallation of the face plate. The bar shall be nominally tensioned (using a wrench to the nut).

**209.36.02 Protection of Rock Bolts** - All other rock bolts shall be protected from overspray. Where overspray was not anticipated, the affected rock bolts shall be cleaned off by appropriate means.

## **209.37 Application**

**209.37.01 General** - Prior to application of any shotcrete, the Contractor shall obtain authorization to proceed after the areas prepared for shotcrete have been reviewed by the

Ministry Representative. Review by the Ministry Representative shall not relieve the Contractor from the responsibility for ensuring that the shotcrete operations are conducted in a satisfactory manner in accordance with these specifications.

**209.37.02 Wetted Surface** - Not more than one hour prior to application of shotcrete, all surfaces (except slaking ground) to be shotcreted shall be sprayed with water. Wetted surfaces shall be allowed to dry back to a saturated-surface-dry condition prior to application of shotcrete. If necessary, a blow-pipe shall be used to facilitate removal of surface water. Compressed air used in the blow pipe shall be oil-free.

**209.37.03 Shotcrete Layers** - Wherever possible, shotcrete shall be applied to the full thickness in a single layer, provided it does not slough or become delaminated. If multiple lifts are required, the previous shotcrete lifts shall be scraped or broomed prior to the time of set to remove any loose material, rebound, overspray, laitance or any other material that may impair bond of subsequent layers. Previous lifts shall be prevented from drying out by moist curing. Construction joints shall be to a 45° edge.

**209.37.04 Rebound and Overspray** - A blow pipe shall be used during the course of the work to remove accumulations of rebound and overspray from areas to be shotcreted. Rebound and overspray shall not be incorporated in the completed work.

**209.37.05 Thickness and Area Covered** - In general, an average thickness of 100 mm of shotcrete shall be applied over fractures, joints and faults in the areas designated for shotcrete, unless otherwise specified by the Ministry Representative. In general, shotcrete shall cover laterally to a maximum of 0.50 m beyond fractures, joints and faults over solid rock or concrete areas.

**209.37.06 Access** - Suitable devices shall be employed to allow access to the work for shotcreting. Access shall be such that fresh shotcrete is not damaged by hoses, equipment or personnel.

**209.37.07 Surface Finish** - The shotcrete surface shall be left in a natural gun state unless otherwise specified.

**209.37.08 Embedments** - A cover of 50 mm of shotcrete shall be applied over any reinforcing steel or other embedments. If greater total thicknesses of shotcrete are applied to encapsulate the embedments this work shall be performed at no cost to the Ministry.

**209.37.09 Imprint** - The plastic shotcrete surface shall be neatly imprinted with capitalized lettering 75 mm high with



the following information:

- MoT
- (the shotcrete completion date, in the format MMM, YYYY)
- (the name of the Contractor)

The imprint shall be located in a small area in the bottom right corner of each continuous shotcrete area, unless otherwise authorized by the Ministry Representative. Where practicable, the information shall be readable unaided from highway level following shotcrete curing. Imprints produced by scraping letters into the plastic shotcrete will not be acceptable.

### **209.38 Curing and Protection**

**209.38.01 Curing Compounds** - Membrane curing compounds shall not be used unless specifically authorized in writing by the Ministry Representative.

**209.38.02 Moist Curing** - The surface of the shotcrete shall be maintained in a moist condition for a minimum period of 4 days following shotcrete application or until an in-place compressive strength of 20 MPa has been reached. Wet burlap and polyethylene sheet or water sprays shall be used to provide moist curing.

**209.38.03 Protection from Freezing** - The shotcrete shall be protected from freezing for a minimum period of 7 days after placing or until an in-place compressive strength of 20 MPa has been reached, whichever occurs first.

**209.38.04 Sampling and Testing** - If compressive strength samples are used to determine curing or protection requirements, the cost for obtaining the samples, shipping the samples and performing the tests shall be the responsibility of the Contractor. Extraction of cores shall be in accordance with CAN/CSA A23.2-14C. Compressive strength testing shall be performed according to requirements for construction testing.

### **209.39 Construction Testing**

**209.39.01 On-Site Tests** - For wet process shotcrete, the following on-site tests shall be conducted for each truck:

- As-placed air content.
- Slump at discharge into pump.

**209.39.02 Thickness Monitoring** - The Contractor shall monitor the thickness of shotcrete applied using depth gauges or probes. Thickness shall be measured on 1.0 m centres or closer as required to provide thickness control.

**209.39.03 Test Panels in General** - The Contractor shall

produce test panels in accordance with the requirements of ASTM C 1140, but panels shall have minimum base dimensions of 500 mm x 500 mm and a minimum depth of 125 mm. The form base shall be made from 19 mm thick sealed plywood, and side pieces shall be made from two by six timbers. The test panel molds shall have 45° sloped sides to permit escape of rebound.

**209.39.04 Test Panel Frequency** - One construction test panel shall be cast on each day of shotcrete placement or for every 50 m<sup>3</sup> of shotcrete being placed, whichever results in more panels. The time of gunning the panels may be chosen by the Ministry Representative.

**209.39.05 Test Panel Gunning and Marking** - Test panels shall be gunned using the same nozzle and length of hose as the production shotcrete. The Ministry may request test panels to be gunned at the location of the in-situ shotcrete. Construction test panels shall contain no reinforcement or embedments (other than fibre reinforcement). For each test panel the Contractor shall provide a record of the test panel number, date cast, date shipped and date received by the laboratory.

**209.39.06 Test Panel Curing and Transportation** - Test panels shall be field cured, in the forms, in the same manner as the specified shotcrete work, for a minimum period of 48 hours, prior to transport to the test laboratory. Panels shall be covered with wet burlap and plastic sheet to prevent drying. In cold weather, panels shall be protected from temperatures below 5°C by covering with thermal insulation blankets or by placing panels in a suitably heated enclosure. Test panels shall be transported in their forms and kept moist, with care being taken not to crack or damage the shotcrete.

**209.39.07 Test Panels in Laboratory** - The test panels shall be placed in a moist room in the laboratory, maintained at a temperature of 23 ± 2°C and relative humidity of 98 ± 2%. After age 3 days the test panels shall be removed from the forms and returned to the moist room until the time of testing.

**209.39.08 Test Specimen Extraction and Storing** - At specified test ages, test specimens shall be extracted from the panels using either diamond sawing or coring. Test specimens shall be maintained in a moist state in the moist room in the laboratory or in a lime-saturated water bath maintained at 23 ± 2°C until the time of testing.

**209.39.09 Compressive Strength Test Specimens** - Compressive strength test specimens shall preferably be 75 mm diameter cores. Length/diameter ratios shall not exceed 2:1 and shall not be less than 1:1.



**209.39.10 Compressive Strength Testing** - For each panel, three specimens shall be tested for compressive strength at each specified age. Compressive strength tests shall be conducted in accordance with CSA/CAN-A23.2-14C. Measured compressive strengths shall be corrected to equivalent 2:1 length:diameter cores, using the core correction factors given in CSA/CAN-A23.2-14C (Table 1). Reporting of results shall be according to Section 5 (Reporting) in CSA/CAN-A23.2-14C.

**209.39.11 Flexural Strength and Toughness Test Specimens** - Flexural strength test specimens shall have dimensions of 100 mm x 100 mm x 350 mm. Reporting of results shall be according to "11. Report" in ASTM C 1018 and shall include all load - deflection graphs.

**209.39.12 Flexural Strength and Toughness Testing** - For each panel, three specimens shall be tested for flexural strength and toughness at the specified age. Flexural strength and toughness tests shall be conducted in accordance with ASTM C 1018 with the following additional requirements:

**a) Measuring System** - A "Japanese Yoke" or other measuring system that precludes any extraneous deflection measurements shall be used. An automatic data acquisition system or equivalent shall also be used during the tests.

**b) Accuracy of Measurement** - The accuracy of the first crack deflection shall be verified by comparing the measured value with the theoretically calculated value by using the formula:

$$\delta = \frac{23 PL^3}{1296 EI} \times \left[ 1 + \frac{216 H^2 (1 + \mu)}{115 L^2} \right]$$

Where:

- $\delta$  = mid-span deflection in mm
- $P$  = load at first crack in kN
- $L$  = load span in mm
- $E$  = modulus of elasticity (for convenience usually based on an estimated compression modulus of elasticity) in GPa
- $I$  = moment of inertia in mm<sup>4</sup>
- $H$  = height of specimen in mm
- $\mu$  = Poisson's Ratio (for convenience usually based on an assumed compression Poisson's Ratio of 0.2)

For a 100x100x350 mm beam tested on a 300 mm span the first crack deflection for typical fibre reinforced shotcrete will have first crack deflection in the range of about 0.03 to 0.05 mm. Extraneous deflections have been eliminated if first crack deflections are within this

range.

**c) Recording of Deflections** - An LVDT connected to an x-y plotter or digital recording shall be used to capture load vs. deflection response. Dial gauges shall not be used for recording deflections. Bending Load shall be plotted against Net Midspan Deflection.

**d) Testing Machine** - A deflection-control testing machine shall be used, but shall not be of the closed-loop or soft testing type.

**e) Total Deflection** - Deflection measurements shall continue until a total deflection of 2 mm is reached.

**209.39.13 Toughness Performance Level Data Analysis** - Toughness Performance Level of flexural strength specimens shall be obtained by the following analysis:

**a) Template** - A template shall be created using the percent of design flexural strength shown in Table 209-C, but expressed in load equivalent units. The following formula shall be used:

$$P_d = \frac{\sigma \times B \times H^2}{L} \times \frac{1}{1000}$$

to determine load equivalent units, where:

- $P_d$  = design flexural load in kN
- $\sigma$  = design flexural strength in MPa
- $B$  = beam width in mm
- $H$  = beam depth in mm
- $L$  = load span in mm

**b) Master Template** - A master template shall be produced to the same scale as the load vs. deflection data recorded from the toughness test. The master template shall be superimposed over the actual load deflection curves and compared with the recorded data.

**c) Acceptability Criterion** - To conform to a given Toughness Performance Level the recorded data shall meet the specified flexural strength and fall above the line representing the given Toughness Performance

**TABLE 209-C TOUGHNESS PERFORMANCE LEVEL**

TOUGHNESS PERFORMANCE LEVEL	RESIDUAL FLEXURAL STRENGTH BY % OF DESIGN FLEXURAL STRENGTH	
	1/600 Span (0.5 mm)	1/150 Span (2.0 mm)
III	50%	30%



Level at both the 0.5 mm and 2 mm net midspan deflection.

**209.39.14 Boiled Absorption and Permeable Voids Test Specimens** - Specimens for boiled absorption and permeable voids testing shall be 75 mm cubes cut from the broken ends of flexural test prisms, or extracted 75 mm diameter cores at least 100 mm long.

**209.39.15 Boiled Absorption and Permeable Voids Testing** - For each panel, three specimens shall be tested for boiled absorption and permeable voids at the specified age. Boiled absorption and permeable voids tests shall be conducted in accordance with ASTM C 642. The report of results shall include all information recorded for 6.1 Calculation in ASTM C 642.

**209.39.16 Laboratory Test Results** - For each type of test, test results shall be considered acceptable if the average of three (3) specimens tested at a given age meets or exceeds the criteria specified in Table 209-A. The test results for an individual specimen shall not be less than 80% of the criteria specified for compressive strength, and not more than 120% of the criteria specified for boiled absorption and permeable voids.

#### 209.40 Shotcrete Deficiencies and Repair

**209.40.01 General** - The Contractor shall, whenever possible, correct deficiencies while the shotcrete is still plastic. For any proposed changes to the initial mix design, a solid volume calculation shall be performed and submitted upon request. The calculation shall include the mass, density and volume of each constituent material, the total yield, and a comparison between measured (ASTM C 138) and the calculated plastic density.

**209.40.02 Deficiency Types** - Shotcrete deficiencies other than failure to meet the performance requirements include, but are not limited to, the following:

- a) Improper consolidation of the shotcrete because of incorrect spraying angles or improper distance of the nozzle from the receiving surface.
- b) Improper control and removal of overspray and rebound material.
- c) Excessive shotcrete or fibre rebound.
- d) Any evidence of excessive plastic or drying

shrinkage cracking.

e) Segregation, incorporation of sand lenses, excessive voids, tears, sags, sloughs or delaminations in the work.

f) Inadequate thickness.

**209.40.03 Shotcrete Repair** - At the discretion of the Ministry, shotcrete with deficiencies as defined above shall be removed and replaced to these specifications.

**209.41 Shotcrete Evaluation** - The Ministry Representative will implement a program of evaluation of the in-place shotcrete.

**209.41.01 Core Extraction** - Cores shall be extracted from the in-place shotcrete in accordance with CAN/CSA A23.2-14C, at locations detailed by the Ministry Representative, and tested for compliance to the project specifications. Generally up to 6 cores shall be extracted from every 200 m<sup>2</sup> of shotcreted surface.

**209.41.02 Non-Destructive Testing** - The shotcrete will be checked for delaminations, voids or other deficiencies using appropriate non-destructive testing procedures.

#### MEASUREMENT

**209.81 Shotcrete** - Shotcrete will be measured by the CUBIC METRE supplied and installed in-place on the slope in the designated areas.

#### PAYMENT

**209.91 Shotcrete** - Payment for SHOTCRETE will be at the Contract Unit Price per cubic metre. Payment for up to 75% of the shotcrete installed will be authorized after the Ministry Representative has received 7 day test results for this shotcrete. Payment for the remaining 25% will be authorized after 28 day test results and complete documentation have been received. The Ministry may consider reduced payment for defective or deficient shotcrete based on test results on test panels and/or in-situ shotcrete. The Contract Unit Price for shotcrete shall be considered full compensation for all requirements in this specification.



# DAILY SHOTCRETE RECORD

File #: \_\_\_\_\_

PROJECT NAME \_\_\_\_\_

PROJECT NO. \_\_\_\_\_

(TO BE SUBMITTED WITHIN 1 DAY AFTER EACH DAY'S OPERATION)

Contractor Name \_\_\_\_\_ Date \_\_\_\_\_

Nozzleman Name \_\_\_\_\_ Weather \_\_\_\_\_


Helper Name \_\_\_\_\_ Temperature \_\_\_\_\_ °C

Contractor's Consultant's Name \_\_\_\_\_ Contractor's Start \_\_\_\_\_ End \_\_\_\_\_ Time \_\_\_\_\_

Contractor's Consultant's Representative \_\_\_\_\_ Shotcrete Equipment Type\_\_\_\_\_

Shotcrete Type: (circle)    WET    DRY    Process

For wet process, when is slump measured (circle) BEFORE AFTER Air entrainment added

BEFORE	AFTER	Superplasticizer added
		

BEFORE      AFTER      Fibre Reinforcement added

### On-Site Details and Tests for Shotcrete:

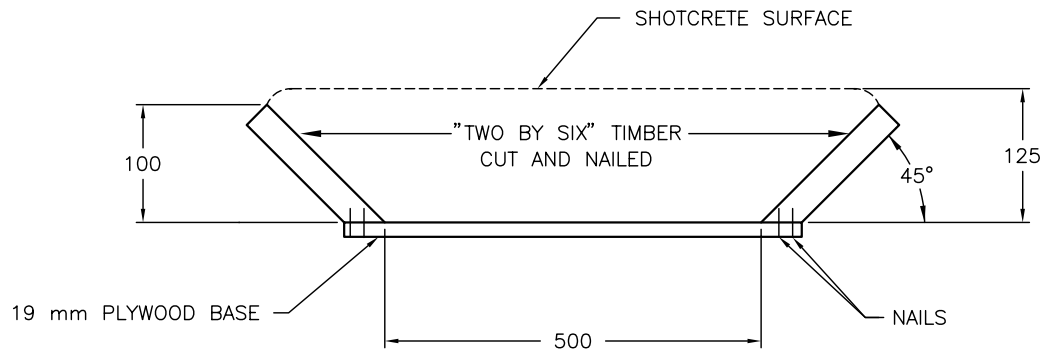
[illegible]

Comments: \_\_\_\_\_  
\_\_\_\_\_

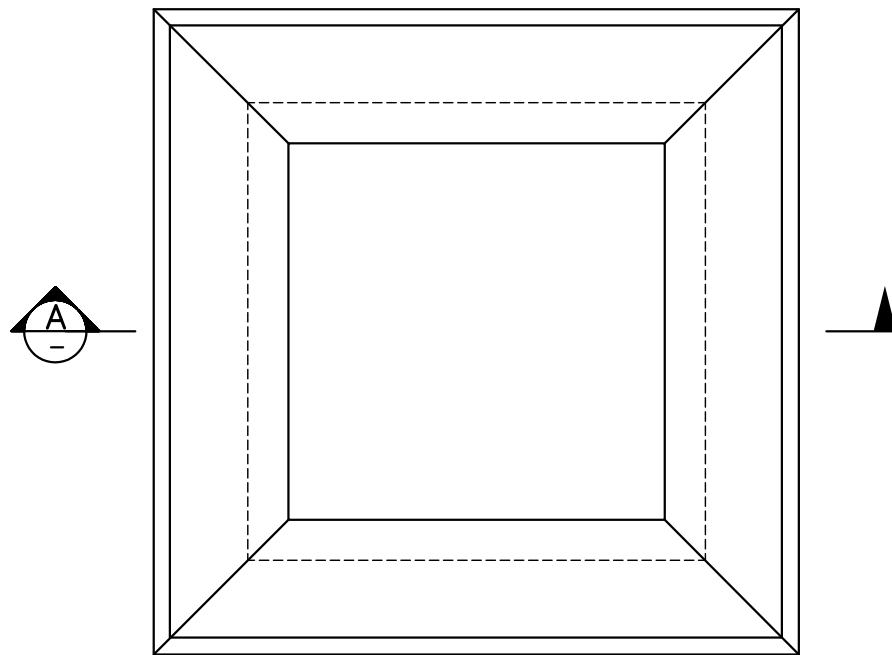
Certified Correct: \_\_\_\_\_ (Contractor's Consultant's Representative) \_\_\_\_\_ (Title)

(Use Additional Sheets if Necessary)





SECTION A

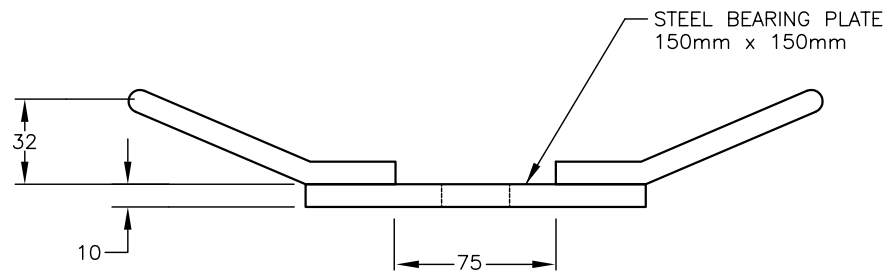


PLAN VIEW

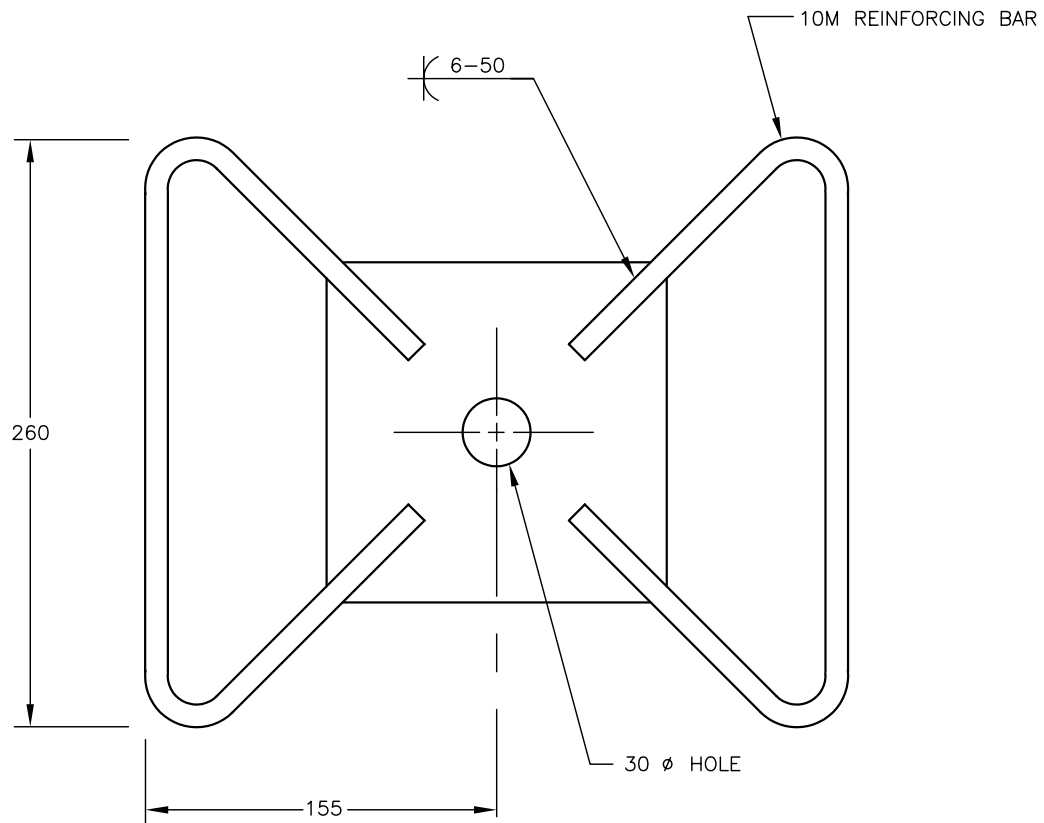
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





ELEVATION VIEW



PLAN VIEW

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 211

### PORTLAND CEMENT CONCRETE

**211.01 General** - This Section of the Province of British Columbia "Standard Specifications for Highway Construction" describes the quality requirements for Portland cement concrete and its constituent materials.

The standards listed in Table 211-A shall apply except as specified otherwise herein or in the Special Provisions.

**TABLE 211-A APPLICABLE STANDARDS**

CAN/CSA - A23.1	Concrete Materials and Methods of Concrete Construction
CAN/CSA - A23.2	Methods of Test for Concrete

The standards listed in Table 211-B are referred to in this Specification.

**TABLE 211-B STANDARDS REFERRED TO IN THIS SPECIFICATION**

CAN/CSA - A5	Portland Cement
Standard Specifications Section 314	Admixtures for Portland Cement Concrete
ASTM C 566	Standard Test Method for Total Moisture Content of Aggregate by Drying
ASTM C 881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

The publications listed in Table 211-C are Standards of Good Practice for Concrete Production and Construction.

References to standards shall be to the current editions at time of tendering.

**211.02 Inspection** - Necessary facilities shall be provided by the Contractor to enable the Ministry's authorized representative to examine the materials designated for supply to the construction job site and to take samples; such samples shall be for the purpose of testing and evaluating their suitability for use.

All materials, equipment and tools necessary for performing all parts of the work shall be subject to inspection before shipment to the construction site, at the construction site or both, for compliance with the specified requirements.

Rejected material and any work incorporating such rejected

material shall be removed from the job site and replaced at the Contractor's expense.

**NOTE:** The acceptance of any material shall not preclude its future rejection if it is subsequently found to differ from samples initially approved.

**TABLE 211-C STANDARDS OF GOOD PRACTICE FOR CONCRETE PRODUCTION AND CONSTRUCTION**

CAN/CSA S269.3	Formwork
AC1 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
AC1 305R	Hot Weather Concreting
AC1 306R	Cold Weather Concreting
AC1 308	Standard Practice for Curing Concrete
AC1 309	Standard Practice for Consolidation of Concrete
National Ready Mixed Concrete Association	Concrete Plant Standards
	Truck Mixer and Agitator Standards

#### 211.03 Materials

**211.03.01 Portland Cement** - Portland cement shall meet the requirements of CSA Standard CAN3-A5-M.

**NOTE:** Unless otherwise specified, Type 10 Normal Portland cement shall be used.

A 1 kg sample of cement will be taken by the Ministry Representative from cement used in the first batch of concrete on each job. Thereafter, a 1 kg sample will be taken from each new shipment of cement to be used in the work. These samples will be held by the Ministry Representative until satisfactory 28 day tests of all of the represented concrete have been obtained.

**211.03.02 Water** - Water for use in concrete and for curing shall be free from injurious amounts of oil, acid, alkali, organic matter, sediment or any other deleterious substance.

**211.03.03 Admixtures** - Admixtures shall not be added to the concrete without the approval of the Ministry Representative. Calcium chloride or admixtures containing chlorides shall not be used. If pozzolans are used in concrete they shall be evaluated as described in Section 933.



**211.03.04 Aggregate** - Aggregate means a natural, processed or manufactured granular material having physical, chemical and mineralogical characteristics suitable for use in mortar or concrete. Normal density coarse and fine aggregate shall conform to the test methods listed in Table 211-D

**i) Coarse Aggregate** - Coarse aggregate shall conform to the following requirements:

- Sampling shall be according to CSA Test Method A23.2-1A
- Gradation shall be determined in accordance with CSA Test Method A23.2-2A

**NOTE:** The gradation of coarse aggregates used shall be such that the percentage passing any one sieve does not vary more than 5% from the initially approved coarse aggregates used in the mix design.

Grading shall be within the limits shown in Table 211-E for the nominal maximum size aggregate specified.

If the nominal maximum size of coarse aggregate is not specified, it shall be deemed to be no larger than:

- 20% of the narrowest dimension between sides of forms
  - 75% of the minimum clear spacing between reinforcing steel or between the reinforcing steel and forms
  - 33% of slab thickness
- OR
- 33% or 50 mm, whichever is smaller, of smallest internal diameter of the concrete pump hose or pipe

Deleterious Material Content:

- free of coatings, roots, wood and bark chips
- flat and elongated particles: maximum 15% by mass
- other deleterious materials conforming to the limits specified in Table 211-F.

**ii) Fine Aggregate** - Fine aggregate shall conform to the following requirements:

**TABLE 211-D TEST METHODS FOR NORMAL DENSITY COARSE AND FINE AGGREGATE**

CSA A23.2 - 1A	Sampling Aggregates for Use in Concrete
CSA A23.2 - 2A	Sieve Analysis of Fine and Coarse Aggregate
CSA A23.2 - 3A	Clay Lumps in Natural Aggregate
CSA A23.2 - 4A	Low Density Material in Aggregate
CSA A23.2 - 5A	Amount of Granular Material Finer than .08 mm in Aggregate
CSA A23.2 - 6A	Relative Density and Absorption of Fine Aggregate
CSA A23.2 - 7A	Test for Organic Impurities in Fine Aggregates for Concrete
CSA A23.2 - 8A	Measuring Mortar-Strength Properties of Fine Aggregate
CSA A23.2 - 9A	Soundness of Aggregate by Use of Magnesium Sulphate
CSA A23.2 - 10A	Density of Aggregate
CSA A23.2 - 11A	Surface Moisture in Fine Aggregate
CSA A23.2 - 12A	Relative Density and Absorption of Coarse Aggregate
CSA A23.2 - 13A	Flat and Elongated Particles in Coarse Aggregate
CSA A23.2 - 14A	Potential Expansivity of Cement-Aggregate Combinations (Concrete Prism Expansion Method)
CSA A23.2 - 16A	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
CSA A23.2 - 17A	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
BCH Test I - 17	Petrographic Analysis



- Sampling shall be according to CSA Test Method A23.2-1A.
- Grading shall be within the limits given in Table 211-G when tested in accordance with CSA Test Method A23.2-2A.
- Fineness modulus shall be between 2.2 and 3.1.
- Fineness modulus tolerance shall be  $\pm 0.2$  (except that the above sentence shall apply) from the fineness modulus of the initially approved fine aggregate used in the design mix.
- Organic impurity content, from testing in accordance with CSA Test Method A23.2-7A, producing a colour darker than the standard light straw will not be permitted.
- A maximum 45% shall be retained between any two consecutive sieves.
- Deleterious substance content shall not exceed the limits specified in Table 211-F.

**211.04 Storage and Handling of Materials** - All materials shall be stored and handled to prevent contamination or deterioration, otherwise they shall be rejected. Where applicable, materials shall be identified by MSD sheets.

**211.04.01 Cement** - Cement shall be stored in a manner that will prevent hydration and contamination.

**NOTE:** Cement having a temperature greater than 50°C shall not be used.

**211.04.02 Tanks** - Tanks used for storing and/or hauling concrete mixing water shall be free of oil, organic matter, sediment or any other deleterious substance.

**211.04.03 Admixtures** - Admixtures shall be stored and handled according to manufacturer's recommendations and instructions.

**211.04.04 Other Materials** - Other materials, such as curing compounds, shall be stored and handled according to manufacturer's recommendations and instructions.

**211.04.05 Aggregates** - Aggregates shall be stockpiled, stored and handled to prevent segregation or the inclusion of foreign materials and the intermixing of fine and coarse aggregates. A minimum of 10 m<sup>3</sup> of each aggregate size, in excess of the requirements of the daily concrete operations, shall be maintained in stockpiles at the batching plants in order to ensure proper continuity of the work with approved aggregates.

**NOTE:** Stockpiled aggregate which has segregated or become contaminated shall be rejected. Separate batch plant storage bins shall be provided for each size of aggregate to be batched.

Precautions shall be taken when moving, handling and transferring aggregates to prevent contamination or segregation, as necessary, and in accordance with the following recommendations:

- Aggregate blanket 150 mm thick should be left on the ground as stockpiles are depleted.
- Aggregate transfer over stockpiles or storage bins of other sized aggregates should be avoided.
- Storage bins should be filled only to 150 mm from the top unless a suitable extension rim is provided to prevent contamination.
- Front end loader buckets should be filled by raising them vertically up the face of the stockpile, not by thrusting into the stockpile in one place.
- Depositing aggregates into the batch plant storage bins should be made directly over the bins' outlet.
- Storage bins should be kept as full as possible during batching to minimize segregation as the aggregates are withdrawn from the bins.

**TABLE 211-E GRADING REQUIREMENTS FOR COARSE AGGREGATE**

NOMINAL SIZE OF AGGREGATE (mm)	TOTAL PASSING EACH SIEVE, PERCENT BY MASS OF TOTAL SAMPLE (mm)								
	56	40	28	20	14	10	5	2.5	1.25
40 - 5	100	95 - 100	---	35 - 70	---	10 - 30	0 - 5	---	---
28 - 5	---	100	95 - 100	---	30 - 65	---	0 - 10	0 - 5	---
20 - 5	---	---	100	90 - 100	---	25 - 60	0 - 10	0 - 5	---
14 - 5	---	---	---	100	90 - 100	45 - 75	0 - 15	0 - 5	---
10 - 2.5	---	---	---	---	85 - 100	85 - 100	10 - 30	0 - 10	0 - 5



**TABLE 211-F LIMITS FOR DELETERIOUS SUBSTANCES IN AND PHYSICAL PROPERTIES OF AGGREGATES**

CSA TEST METHOD	SUBSTANCE OR PROPERTY	MAXIMUM PERCENTAGE BY MASS OF TOTAL SAMPLE	
		COARSE AGGREGATE	FINE AGGREGATE
A23.2 - 3A	Clay Lumps	0.25	1.0
A23.2 - 4A	Low-Density Granular Materials	0.5	0.5
A23.2 - 5A	Material Finer than 0.08 mm for Concrete Subject to Significant Wear	1.0	3.0
	Material Finer than 0.08 mm for Other Concrete	1.0	5.0
A23.2 - 9A	Magnesium Sulphate Soundness Loss	12	16
A23.2 - 16A, 17A	Los Angeles Abrasion Loss for Concrete Subject to Significant Wear	35	N/A
	Los Angeles Abrasion Loss for Other Concrete	50	N/A

Acceptable and uniform aggregate moisture content shall be obtained and maintained by necessary means to include the following:

- Washed or wetted aggregates should remain in stockpiles for a minimum of 12 hours to permit a uniform moisture content throughout the stockpile to be reached before aggregate transfer to batch plant storage bins.
- After each day's concreting during wet weather, fine aggregate bins should be either emptied or covered with a suitable waterproof covering.

### 211.05 Proportioning of Mixes

**211.05.01 Concrete Mixes** - Proportioning of concrete mixes shall be the responsibility of either the Contractor (subject to review by the Ministry Representative) or the Ministry Representative.

When the Contractor is to proportion the concrete mixes, the Contractor shall produce concrete to the Ministry's specification and assume all responsibility for the quality thereof. The Contractor shall submit copies of the design mixes (including such back-up data as requested) to the Ministry Representative for review before the concrete is produced.

When the Ministry Representative is to proportion the concrete mixes, the Ministry will assume responsibility for the properties of the concrete when produced by the Contractor in accordance with these Specifications, the Special Provisions, the Ministry Representative's instructions and all applicable standards of good practice. In

this case, the Contractor shall notify the Ministry Representative of the sources of concrete and constituent materials at least six weeks before concrete is to be placed. The Ministry Representative will sample and test all materials, design the concrete mixes, and inspect equipment and the manufacture of concrete. The Contractor shall ensure that materials and production methods used to produce concrete fully meet the specified requirements.

For Ministry-designed concrete, the mix proportions are valid only for materials previously approved by the Ministry Representative. Changes to mix proportions may be required at any time during the course of the work to improve the quality of the concrete.

**TABLE 211-G GRADING LIMITS FOR FINE AGGREGATE**

SIEVE SIZE (mm)	TOTAL PASSING SIEVE PERCENTAGE BY MASS OF TOTAL SAMPLE
10	100
5	95 - 100
2.5	80 - 100
1.25	50 - 90
0.630	25 - 65
0.315	10 - 35
0.160	2 - 10



Whether for Ministry-designed or Contractor-designed concrete, the Ministry Representative will specify the following:

- minimum compressive strength at 28 days
- cement type (if other than Type 10)
- nominal maximum size coarse aggregate
- percentage of air to be entrained in the concrete
- slump at which the concrete is to be placed

Further, for Ministry-designed concrete, the following will be specified:

- cement content by mass per cubic metre of concrete
- masses of coarse and fine aggregates in a saturated surface dry condition per cubic metre of concrete
- the total maximum water content by mass per cubic metre of concrete
- characteristics and dosages of admixtures

For Contractor designed concrete, maximum water/cement ratio shall be specified.

**211.05.02 Mix Design** - Mix design, with its designated proportions for the concrete, shall be capable of producing concrete meeting the following requirements:

**i) Air Content** - Unless otherwise specified, air content shall be within the specified range as given in Table 211-H for the nominal maximum size coarse aggregate being used.

**ii) Slump for Workable Concrete** - Slump for workable concrete shall be as given in Table 211-I for the specific type of construction.

**iii) Characteristics** - Wet or dry density and other specified characteristics.

## 211.06 Batching

### 211.06.01 Batching Equipment

**i) General** - Batching equipment, such as weighing mechanisms, gates, water lines and dispensing systems, shall be maintained in good working order. Batching bins shall be completely emptied of all material before the first and succeeding batches are measured.

Batching equipment shall have the following capabilities and facilities:

- bins or silos for storage of aggregates, silos for storage of cement and pozzolan
- free movement of each type or size of material to discharge openings without contamination
- design of storage and hauling facilities to prevent:

**TABLE 211-H RANGE OF TOTAL AIR CONTENT**

	NOMINAL MAXIMUM SIZES OF COARSE AGGREGATE			
	10 mm	14 mm	20 mm	28 mm
PERCENT	7 - 10	6 - 9	5 - 8	4 - 7

**TABLE 211-I SLUMPS FOR CONCRETE CONSOLIDATED BY INTERNAL VIBRATORS**

TYPE OF CONSTRUCTION	SLUMP (mm)
Footings, Walls, Slabs, Beams, Columns	55 ± 20
Mass Concrete	30 ± 20
Bridge Decks	30 ± 20

- loss or intermingling of different sizes and types of materials
- contamination by deleterious substances
- harmful segregation and breakage
- covers to stockpiles of fine aggregates to ensure constant moisture content
- all fulcrums, clevises and similar working parts maintained in clean condition
- provision made, in remote control plants and/or where batch cycles are timed, for the complete filling and discharge of the measuring unit for each batch.

**ii) Batch Charging Mechanism** - Batch Charging Mechanism requirements shall be as follows:

- material flow control within the specified tolerances
- hopper construction to eliminate material accumulation and to permit the complete discharge of every batch
- cement weighing hopper:
  - self-cleaning and properly ventilated to allow air to escape
  - accessible for inspection
  - dust sealed between the charging mechanism and the hopper to maintain weighing accuracy.

**iii) Scales and Dispensing Mechanism** - Scales and Dispensing Mechanisms shall conform to the following requirements:

- beam type or springless dial type
- other methods of weighing (electric, hydraulic, load cells, etc.) are acceptable to the Ministry



Representative provided the specified weighing tolerances and accuracy requirements are met

- all accurate to  $\pm 0.4\%$  of the total capacity of the scale when static load tested
- zero balance adjustment capability
- unaffected by binding or vibration due to vibrators or other appurtenances
- working range between 10% and 90% of the scale reading
- equipped with prominent markers with individual batch weight setting capabilities for dial scales
- calibration facilities including an adequate number of standard test masses
- beam type scales provided with an indicator of at least the last 100 kg approach to the required load in the weighing hopper; major poises equipped with positive holding devices
- all weighing and indicating devices shall be in full view of the operator while charging the hopper, and the operator shall have convenient access to all controls.

**iv) Volumetric Devices for Water Measurement -**  
Volumetric devices for water measurement shall be:

- fitted with such valves and connections as are necessary to divert the water measured for a batch to easily verify the accuracy of measurement
- arranged so that measurements will be unaffected by variable pressures in the water supply line
- calibrated to an accuracy of 2% of the batch volume.

**v) Dispensing Systems for Liquid Admixtures -**  
Dispensing systems for liquid admixtures, other than weigh systems, shall have the following capabilities:

- visual, volumetric measuring or readout units located as close as possible to eye level for easy reading by the operator
- positioned in such a manner that discharge into the batch is observed by the operator from a normal working position
- volumetric measuring unit for periodic check of dispenser accuracy where a positive displacement system is used
- visual measuring unit for an accurate visual check of increments of 30 ml of air entraining agent or of chemical required to treat a maximum of 25 kg of cement

**vi) Certificate or Report of Inspection -** A certificate or report of inspection, from a Weights and Measures approved, independent testing authority, and which is not more than one year old for the plant in its present position, shall be on display in the plant at all times and

before weighing operations commence. The certificate or report will be accepted as proof of accuracy of the scales or weighing devices. Where there is reasonable doubt concerning the accuracy of the scales or weighing devices the Ministry Representative may require their recalibration, at the Contractor's expense, during progress of the work. Plant relocation or major alterations shall require such recalibration.

**211.06.02 Batching of Materials -** Material may be weigh-batched separately or cumulatively.

Aggregates shall be batched by mass, and cement and mineral admixtures in the powder form by mass or bag.

The mass of any ingredient to be batched shall not be less than 10% nor greater than 90% of the scale capacity.

When batched by 40 kg bags, only full and sealed bags of cement shall be used with no fractional bags permitted. Cement batched by mass shall be to an accuracy of  $\pm 1\%$  for batch quantities between 30% and 90% of the scale capacity. When the mass of cement being batched is between 10% and 30% of the scale capacity, the mass of cement batched shall not be less than the required mass nor more than 4% in excess. Intermediate bulk cement shall be weighed to an accuracy of  $\pm 1\%$ .

When aggregates are measured by mass, batch masses shall be based on the required mass of saturated surface dry aggregate corrected for the moisture conditions of the aggregate at the time of batching. Field determination of free moisture in the aggregates shall be made by any proven method such as CSA A23.2-11A or by the use of a device such as the "Speedy Moisture" gauge. Where doubt exists as to the accuracy of such methods, total moisture in the aggregate shall be determined in accordance with ASTM C 566.

Mixing water shall be measured by mass or volume to an accuracy of  $\pm 1\%$ . Adjustments for free water contained in batched materials, such as free water in the aggregates, water contained in admixture solutions shall be made to the quantity of water to be batched. The total amount of mixing water in the batch obtained from all sources shall be within  $\pm 3\%$  of the specified quantity and shall not vary the designed water-cement ratio of the mix by more than  $\pm 0.02$ .

Admixtures shall be batched in liquid form by either mass or volume; in powdered form by mass or bag. Volumetric measurements of admixtures or air entraining agents shall be to an accuracy of  $\pm 3\%$  of the required amount or 30 ml, whichever is greater. Measurement by mass shall be to an accuracy of  $\pm 3\%$ .



The addition of cement to a fully-batched load of aggregates will not be accepted.

### 211.07 Mixing

#### 211.07.01 Concrete Mixers

**i) General** - Concrete mixers shall conform to the following requirements:

- manufacturer's rating plate carried in a prominent position, indicating rated mixing capacity, and recommended speed of mixing which must be in the range of not less than 4 nor more than 18 rpm
- demonstrated capability of operating satisfactorily at the recommended mixing speed
- number of revolutions of the drum or blades registered with a counter in working condition
- charge and discharge openings and chute free from appreciable accumulations of cement or concrete, and hopper and chute surfaces clean and smooth
- batch water measuring equipment in good operating condition.

**ii) Auger-type Mobile Mixers** - Auger-type mobile mixers may be used provided that the accuracy of batching and uniformity of concrete is as required by CSA A23.1.

**211.07.02 Mixing Concrete** - Mixing drums shall be clean and empty before being charged. The drum shall be rotated at the manufacturer's recommended mixing speed during charging and mixing. Concrete shall be mixed to the uniformity requirements of CSA A23.1, Section 18.3.5. When a satisfactory mixing time is established it shall be maintained for all batches of the same design mixed with the same equipment.

### 211.08 Delivery

#### 211.08.01 Equipment

**i) General** - Sufficient plant capacity and transporting equipment shall be provided by the Contractor to ensure continuous delivery of concrete at the rate required with the necessary intervals between batches, for the proper placing and finishing of the concrete without the formation of cold joints in the finished concrete.

**ii) Truck Agitators** - Truck agitators are drums mounted on trucks, in which plant-mixed concrete is kept sufficiently in motion during delivery to prevent segregation.

Each agitator shall conform to the following requirements:

- manufacturer's rating plate, carried in a prominent position, indicating rated agitating capacity and recommended operating speed for agitating which must be in the range of not less than 2 nor more than 6 rpm
- demonstrated capability of operating satisfactorily at the recommended speed
- number of revolutions of the drum or blades, registered with a counter in working condition
- satisfactory charging and discharge opening, with the chute free from appreciable accumulations of cement or concrete and the hopper and chute surfaces clean and smooth

#### 211.08.02 Delivery

**i) General** - Off-site mixed concrete shall, after being mixed, be transported to the job site in either truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed.

When concrete is being mixed in mixer trucks while in transit, the speed of the mixing drum shall be reduced to agitating speed once the mixing time has elapsed. Delivery of mixed concrete in non-agitating equipment will not be permitted without written approval from the Ministry Representative.

Concrete shall be in place within 90 minutes, or 45 minutes for bridge deck concrete, after water and cement have been combined. The Ministry Representative may reduce this time to suit job conditions. The temperature of concrete, when delivered, shall not exceed 30°C. Aggregate and water shall be cooled as necessary to produce concrete below this temperature.

**ii) Adding Water** - No water shall be added after the initial introduction of the mixing water for the mix, except at the start of discharge, and when:

- the measured slump is less than that specified
- no more than 60 minutes have elapsed after water and cement have been combined
- the concrete is in a mixer or truck mixer.

If these conditions prevail, for Contractor-designed concrete, water may be added by the Contractor.

For Ministry-designed concrete, water may be added on the instruction of the Ministry Representative.

In either case, an amount not exceeding 16 ℓ of water per cubic metre of concrete or 10% of the mix design water may be added. After addition of water, the drum or blades shall be turned an additional 30 revolutions or



more if necessary at mixing speed. Water shall not be added to the batch at any later time.

**iii) Delivery Ticket** - Concrete delivered to the job site shall be accompanied by a ticket providing the Ministry's representative with legible information, as follows:

- serial number of ticket
- date
- name and location of concrete supplier
- name of purchaser
- specific job designation (name and location)
- specific designation of concrete mix design
- truck number
- volume of concrete in cubic metres
- water added at job site at the request of the receiver of the concrete and their signature
- time concrete was batched, arrived at job site, and completely discharged.

**211.09 Acceptance** - Sampling and testing shall be in accordance with the test methods listed in Table 211-J.

**211.09.01 Contractor-designed Concrete** - For Contractor-designed concrete, the Contractor shall sample and test concrete at point of discharge in the presence of and at the direction of the Ministry Representative. The Contractor shall perform tests for slump, air content, temperature and density, record atmospheric temperature, and make test cylinders and deliver them to a testing agency designated by the Ministry.

The Contractor shall provide written reports of field test results to the Ministry Representative.

Should the measured slump, air content and/or density fail to meet specifications, the concrete represented by the samples shall not be incorporated in the work until additional testing is carried out. With any second failure, the concrete may be rejected.

**211.09.02 Ministry-designed Concrete** - The Ministry Representative will sample and test Ministry-designed concrete. The Contractor shall provide assistance as required.

**211.09.03 Strength Tests** - A strength test shall be the average 28-day strength of three 150 mm x 300 mm test cylinders. For each strength test, a fourth cylinder shall be taken for supplementary testing (to be tested at seven days, if not required for other purposes).

The number of strength tests from randomly selected concrete batches shall be as shown in Table 211-K. At least one strength test shall be taken for each major structural element. The Ministry Representative may order

**TABLE 211-J TEST METHODS FOR SAMPLING AND TESTING**

CSA A23.2 - 1C	Sampling Plastic Concrete
CSA A23.2 - 4C	Air Content of Plastic Concrete by the Pressure Method
CSA A23.2 - 5C	Slump of Concrete
CSA A23.2 - 6C	Density, Yield, and Cementing Materials Factor of Plastic Concrete
CSA A23.2 - 9C	Compressive Strength of Cylindrical Concrete Specimens

more tests at the Ministry Representative's discretion.

Compression tests of cylinders will be performed at the Ministry's expense, by the Ministry Geotechnical and Materials Engineering Branch or by an independent testing laboratory. Copies of the test reports will be available to the Contractor upon request.

The strength of each class of concrete shall be considered satisfactory if:

- the averages of all sets of three consecutive strength tests equal or exceed the specified strength
- no test shows less than 90% of the specified strength

Each "class of concrete" will be taken as all of the concrete in one pay item in the Schedule. Where fewer than three strength tests are taken, the results of one test or the average of two will be used.

**211.09.04 Strength Test - Contractor-designed Concrete**

**i) Low Average** - where the average of the strength tests is low, but no test shows less than 90% of the specified strength, the concrete will be accepted at a reduced price (see Subsection 211.20.02).

**TABLE 211-K NUMBER OF STRENGTH TESTS FROM RANDOMLY SELECTED CONCRETE BATCHES**

QUANTITY OF ONE CLASS OF CONCRETE CAST	MINIMUM NUMBER OF TESTS
over 100 m <sup>3</sup>	3 for each 100 m <sup>3</sup>
between 50 m <sup>3</sup> and 100 m <sup>3</sup>	2
less than 50 m <sup>3</sup>	1



**ii) Understrength Concrete** - where testing shows lower strengths, the Ministry Representative may order replacement or reinforcing, at the Contractor's expense, of portions of the structure. Alternatively, at the Ministry Representative's discretion, the understrength concrete may be accepted at a reduced price (see Subsection 211.20.02).

**iii) Coring** - the coring of concrete, to verify its strength, will be allowed only for concrete, which is (otherwise) to be replaced or reinforced. Coring will not be allowed for concrete for which reduced payment is to be made for understrength. When coring is allowed, cores shall be taken at locations directed by the Ministry Representative.

**211.09.05 Coring** - Where coring is allowed, it shall be carried out at the Contractor's expense by an independent qualified testing firm.

Three cores shall be obtained and tested in accordance with CSA A23.2-14C "Obtaining and Testing Drilled Cores for Compressive Strength Testing" at each test location. Concrete in the region represented by the core tests may be considered structurally adequate if:

- the average strength test result of each set of three cores from the portion of the structure in question is equal to at least 100% of the specified strength
- the strength test result of any single core is not less than 80% of the specified strength

**211.10 Construction Joints** - Definition: Joint between adjacent or successive lifts of concrete where the previously cast concrete cannot be plasticized with a vibrator, or any joint required by the Contractor's method of construction.

**211.10.01 General Requirements** - Construction joints generally shall be in accordance with the following requirements:

- kept to a minimum
- concealed by a natural break or line in the structure
- provided for by the formwork design and placing techniques.

Emergency construction joints shall conform as nearly as possible to planned joints. In any case, concrete must be levelled as well as possible and, if lifts are partial, a vertical bulkhead shall be installed. Permission to complete the cast following any emergency joint shall be required from the Ministry Representative.

**211.10.02 Joint Edges** - Joint edges shall be preformed whenever possible for a true line upon form removal. Pour-strip shall be positioned relative to form ties so as to

minimize form bulge at the bottom of the subsequent cast, but concrete may be cast to the top of a form instead of the pour-strip. Concrete surfaces outside of the reinforcing steel shall be steel trowelled to a true line.

**211.10.03 Joint Surfaces - Cleaning** - Joint surfaces of the set concrete shall be thoroughly cleaned of foreign matter and laitance to present clean, sound surfaces with the coarse aggregate partially exposed and achieved by:

- brushing immediately following initial set
- treatment with a surface set retardant, followed by green cutting
- sand blasting
- water blasting.

**211.10.04 Bonding of Joints** - Bonding of joints shall be achieved through the use of a water-cement slurry or, if specified, an epoxy-type bonding agent conforming with ASTM C 881 applied in strict accordance with the manufacturer's specifications. Slurry, when used, shall have a water-cement ratio equal to that of the concrete being placed and be brush applied for 100% coverage on to the set concrete surface within five minutes of placing concrete.

**211.11 Placing** - Equipment for conveying concrete at the job site, such as buggies, buckets, hoppers, chutes, belts and pumps, shall be of such design, size and condition to deposit a continuous and adequate supply of concrete of the specified mix and consistency without segregation at the various locations necessary. Aluminum equipment to convey concrete is prohibited.

**211.11.01 Buggies** - Buggies shall have inflatable rubber tires. Inner surfaces of the bucket shall be smooth with fellated corners, mortar-tight and free of an excessive accumulation of hardened concrete, obstructions or deterioration interfering with the proper discharge of concrete. Grade and ramp-way surfaces shall be sufficiently smooth to prevent segregation of concrete being carried in buggies.

**211.11.02 Bottom-dump Buckets and Hoppers** - Bottom-dump buckets and hoppers shall have side slopes not less than 60° from the horizontal and shall be equipped with wide free-working and tight-closing discharge gates. The discharge gates shall be constructed to regulate the concrete flow, spring loaded to ensure complete closure and be capable of immediate closure at any time during discharge. Buckets and hoppers shall be cleaned of any accumulation of partially hardened or hardened concrete before and during concrete placement. Gate control mechanism shall be cleaned and lubricated before being used.

In the use of crane and bucket, segregation of concrete from



jarring or shaking shall be prevented. Side-dump buckets shall be used whenever necessary to avoid conflict with extended reinforcing steel or formwork.

**211.11.03 Chutes** - Chutes shall be of rounded cross section to avoid the accumulation of concrete in corners; be capable of slope adjustment sufficiently steep to permit flow without requiring a slump greater than that specified or required for placement (slope usually required is 1 vertical to 2 or 2-1/2 horizontal).

Baffles and changes in direction may be used to control flow, but not vibration, paddling or water spray.

Chutes or belts shall be rigidly supported but sufficiently mobile to permit discharge as close as possible to the placement location as it progresses. Any long line of chutes or belts shall be covered during hot, dry or windy weather to prevent drying of concrete and excessive slump loss.

**211.11.04 Conveyor Operation Rate** - Conveyor operation rate shall be dependent on the proper placement and consolidation of the concrete with the belt inclination such that no segregation occurs from any sliding or roll-back of the concrete.

**211.11.05 Hoppers** - Hoppers, set approximately level, shall be supported on specially framed bearers transmitting only vertical loads to the top of the formwork.

**211.11.06 Pumps** - Pumps shall be of sufficient capacity to supply unsegregated concrete, using the design mix proportions at the design maximum slump, to meet the required placement volume at the forms. Satisfactory operation and performance of the proposed pumping equipment with the concrete materials and mixes otherwise suitable and appropriate for the job, along with the line layout and grate size opening, shall be demonstrated to the Ministry Representative's satisfaction and approval.

**211.11.07 General Requirements** - Unless underwater concreting is approved by the Ministry, concrete shall be placed in the dry.

Concrete shall not be allowed to drop more than 1.5 m, unless confined within a hose or elephant trunk. Concrete shall be placed directly as near to its final position as possible (within 1.5 m).

Concrete flatwork shall not be placed when the rate of surface evaporation exceeds 1.0 kg/m<sup>2</sup>/hr as determined from Drawing SP211-01 "Surface Evaporation Rate."

In the event of unexpected rain, placing of concrete flatwork shall cease and the surface shall be protected immediately.

Surface concrete which has been rained on shall be immediately removed to the top of reinforcing steel.

Concrete shall be continuously placed from end to end of the section being cast in horizontal layers not exceeding 600 mm in depth and at such rate that subsequent lifts are added prior to the initial set of the preceding lift. Placement rate shall be adjusted to provide sufficient time for concrete consolidation and shall not exceed that indicated on the formwork drawings or specifications.

Placing shall be commenced at such time as to permit finishing during daylight hours unless adequate lighting facilities are provided.

## 211.12 Consolidation

**211.12.01 Vibrators - General** - The number, type, design and operation of vibrators will be subject to the approval of the Ministry Representative.

Vibrators shall have the following capabilities and requirements:

- diameter and frequency of vibrators shall conform to Table 211-L
- vibration transmission to the concrete at frequencies not less than 130 Hz
- vibration intensity sufficient to be visually observed on concrete with not more than 25 mm slump over a radius of at least 450 mm
- sufficient number of vibrators available to properly compact each 8 m<sup>3</sup> batch within 15 minutes after it is placed in forms, with at least two vibrators provided for each concrete placing unit
- stand-by vibrator and generator available on the job at all times in case of breakdown.

**211.12.02 Mechanical Vibrators** - Mechanical vibrators shall thoroughly consolidate concrete immediately after placing.

Vibrator usage shall be as follows:

- not inserted between reinforcing steel and formwork nor directly on to the reinforcing steel
- inserted vertically at a rate of 75 mm per second and penetrating into the preceding layer at least 50 mm
- withdrawn at a rate of 150 mm per second
- grid pattern movement starting 100 mm from a formed surface and at a maximum spacing of 300 mm thereafter.

**211.12.03 Form Vibrators** - Form vibrators may be permitted at the discretion of the Ministry Representative where rebar configuration would prohibit the use of internal



vibrators.

**211.13 Finishing Top Surfaces** - Plastic concrete, struck off immediately following casting and before the accumulation of bleed water, shall be finished by hand or mechanical floating with the least possible disturbance. Water, cement or proprietary topping material shall not be added to the surface during finishing.

No steel floats or trowels shall be used on exposed surfaces.

**211.13.01 Strike-off and Finishing Machines** - Strike-off and finishing machines for surfacing concrete such as slabs on grade, pavements, etc. shall conform to the following:

- type specified in the Special Provisions and/or as otherwise directed by the Ministry Representative
- capable of accurately finishing concrete surfaces to the grade and elevation shown on drawings or as directed by the Ministry Representative
- surface finish production free of open texturing, plucked aggregates or projections
- maintained in good mechanical repair and free of hydraulic fluid leaks, oil leaks, excessive grease and other contaminants.

**211.13.02 Trowel Finishing** - Trowel finishing where required:

- by the drawings or specifications,
- for unformed surfaces exposed to view from close at hand,
- by close tolerance requirements (such as bearing surfaces),

shall be commenced after bleed waters have disappeared to reduce the texture of the concrete surface and produce a smooth blemish-free surface.

**211.13.03 Other Textured Finishes** - Other textured finishes shall be applied as and where specified.

**211.13.04 Damage or Scaling** - Any damage to or scaling of surfaces shall be repaired to the satisfaction of the Ministry Representative.

**211.14 Curing** - Fresh concrete shall be protected during the hydration of the cement and the hardening of the concrete from premature drying, extremes of temperature, heavy shocks, excessive vibrations, and high stresses.

**211.14.01 Acceptable Methods and Procedures** - Acceptable curing methods and procedures shall include the following:

- concrete surfaces kept continuously moist for seven days, however, if high-early strength cement is used, this period may be reduced
- surface temperature maintained between 10°C and 35°C, unless high-temperature curing (i.e., by hot blankets or steam) has been permitted
- hot weather and cold weather special requirements are covered by Subsections 211.17 and 211.18
- formed concrete protection, with form-work left in place during the curing period (usually seven days), is generally not necessary except during extremes of hot or cold weather temperatures. Where formwork is removed before the end of the curing period, the concrete shall be protected in the manner specified below for unformed surfaces during the remainder of the curing period
- unformed surface protection using burlap and water or, where permitted, other moisture-retaining methods considered adequate to promote curing, shall include the following common methods and requirements:

**i) Burlap** - Burlap of acceptable quality shall be carefully laid on the surface of the concrete as soon as the concrete has set sufficiently to support the burlap without marking. Strips shall be overlapped 150 mm, adequately held down and maintained in place in a thoroughly wet condition throughout the curing period (usually seven days). Wetness of burlap shall be checked daily.

**ii) Vapour Barrier** - Vapour barrier of acceptable quality of opaque white-pigmental 0.10 mm thick ("4 mil") polyethylene sheet, white upper surfaced paper or other permitted material shall be of such size and placement to minimize the number of laps. The material shall be laid, lapped and held down around

**TABLE 211-L REQUIREMENTS FOR DIAMETER AND FREQUENCY OF VIBRATORS**

DIAMETER (mm)	FREQUENCY (Hz)	RATE OF PLACEMENT OF CONCRETE PER VIBRATOR (m <sup>3</sup> /h)	APPLICATION
20 - 40	170 - 250	1 - 4	very thin members
30 - 60	150 - 225	2 - 8	walls and slabs 200 mm - 300 mm
50 - 90	130 - 200	5 - 15	larger members



the edges and at the laps:

- to prevent displacement
- to provide and maintain an effective vapour barrier
- prevent any flow of air between the vapour barrier material and the concrete
- kept in place throughout the curing period (usually seven days).

However, the barrier material shall not be pulled tight against the fresh concrete surface so as to smooth the required surface texture.

**iii) Membrane Compounds** - Membrane compounds shall be white-pigmented resin-based membranes meeting the requirements of ASTM C 309 - "Liquid Membrane Forming Compounds for Curing Concrete". Membrane compounds shall not be used:

- on any construction joint
- on prestressed concrete
- in cold weather as defined in Subsection 211.18
- on surfaces exposed to view in the finished work or upon which the residual white membrane will be objectionable
- on any surfaces requiring weatherproofing sealants
- when air temperature exceeds 25°C
- on bridge decks.

The compound, agitated for homogenous liquid application under pressure, shall be applied by means of approved spraying equipment in such a manner as to form a completely uniform white membrane free of breaks or pinholes over the surface. Application shall be after the finishing of the concrete surfaces and as soon as the surfaces are free of any bleed waters. Any application considered of unsatisfactory uniformity, thickness or colour will necessitate further applications. The membrane, with reapplication where necessary, shall be maintained throughout the curing period (usually seven days).

**211.14.02 Removal of Protective Surfaces** - Protective materials shall be removed entirely from all concrete surfaces at the end of the curing period and the surfaces left clean.

**211.15 Dimensional Tolerances** - Dimensional tolerances shall be as shown in Table 211-M.

**NOTE:** The tolerances listed in Table 211-M are acceptable only in so far as they do not prevent the proper fit

of structural members.

### 211.16 Finishing Formed Surfaces

**211.16.01 Class 1 Finish** - Class 1 Finish is the basic finish to be produced on all formed surfaces not exposed to view unless a better finish is specified or required by the drawings.

In order to produce a Class 1 finish the formwork shall be mortar tight. Panel marks and texture are of no importance.

All ties, bolts, nails and other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm from the surfaces of the concrete and the resulting holes filled.

Honeycombs and voids over 500 mm<sup>2</sup> in area shall be filled. Honeycombs and voids shall not be repaired until inspected by the Ministry Representative as special methods of repair may be required where occurring in structural elements. Otherwise, concrete surfaces shall be repaired as follows:

- remove all porous concrete by cutting 20 mm into sound concrete
- thoroughly clean reinforcing steel without damaging same
- cut edges of cavities as nearly perpendicular to the concrete surface as possible and deep enough to hold the patching mortar
- keep surrounding concrete saturated for 30 minutes before patching
- apply a latex bonding agent, in strict accordance with the manufacturer's instructions, after the sheet of free water has disappeared from the concrete surfaces
- patch with mortar, proportioned as specified in Subsection 211.16.05 and mixed with the minimum amount of water necessary to make a workable paste: for voids deeper than 10 mm, multiple layers of mortar each with a maximum thickness of 10 mm shall be used with 30 minute intervals allowed between layers
- trowel the surface of the patch flush with the surface of the surrounding concrete.

**211.16.02 Class 2 Finish** - Class 2 Finish is to be produced on all formed surfaces exposed to view from a moderate distance, such as surfaces of abutments and piers, and to any surfaces for which a Class 2 finish is specified or required by the drawings. A Class 2 finish shall provide surfaces of uniform colour and texture as viewed from 25 m.

In order to produce a Class 2 finish, form-work shall be mortar tight and shall render a true surface. Fins 3 mm wide (maximum) shall be allowed at the panel joints; however, sheathing joints must be mortar tight. Irregularities of 3 mm



TABLE 211-M DIMENSIONAL TOLERANCES

Trueness of bearing surfaces	such that there is no gap over 1 mm under a 1 m straight edge
Trueness of bridge deck surfaces	such that there is no gap over 3 mm under a 3 m straight edge
Trueness of slope pavement surfaces	such that there is no gap over 12 mm under a 3 m straight edge
Trueness of other surfaces exposed to view	such that there is no gap over 12 mm under a 3 m straight edge
Curbs and parapets	such that no abrupt deviations are visible to the eye
Horizontal distance to concrete surfaces	± 50 mm
Elevations of concrete surfaces except bearings and decks	± 25 mm
Elevations of bridge deck surfaces	± 15 mm
Elevations of bearing surfaces	± 5 mm
Variation from plumb	1:400, but not more than 30 mm
Dimensions of members over 10 m	± 25 mm
Dimensions of members under 10 m	- 6 mm, + 15 mm
Location of anchor bolts	± 6 mm
Projections of anchor bolts, other embedments	± 13 mm

in height with areas of 50 x 75 mm shall be allowed to a maximum of four such areas per 3 m<sup>2</sup> of formwork. Patches of dissimilar material are prohibited. Horizontal and vertical joints shall be aligned.

All ties, bolts, nails and other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm from the surfaces of the concrete and the resulting holes filled.

Honeycombs and voids over 25 mm diameter shall be filled, and all bugholes over 5 mm diameter shall be pointed. All fins and projections shall be removed with a hand stone or by power grinder. The use of a power grinder shall be kept to a minimum and confined to the areas required.

When a rubbed finish is not to be applied, patches shall be textured with a mortar float or lightly brushed after trowelling smooth.

Where more than 50 voids or bugholes over 5 mm diameter occur per square metre, or if the surfaces are not acceptably uniform in colour or texture, the entire area affected shall be given a rubbed finish, as follows:

- allow patches to attain an initial set
- keep surfaces saturated with water for 60 minutes before applying mortar
- remove free water from surfaces

- apply mortar, proportioned as specified in Subsection 211.16.05 and mixed at least 60 minutes before it is applied, to the concrete surfaces with a sponge, float or a hand carborundum stone, and work mortar well into the surfaces
- allow mortar to dry 30 - 60 minutes
- remove residues from the surfaces by rubbing with clean dry burlap but with no addition of neat cement to the surface during the "sacking" operation and finally cure the surfaces as specified in Subsection 211.14.

**211.16.03 Class 3 Finish** - Class 3 Finish is to be produced on all formed surfaces exposed to view from close at hand, such as surfaces of curbs and parapets, and to any surfaces for which a Class 3 finish is specified or required by the drawings. A Class 3 finish shall provide surfaces of uniform colour and texture when viewed from less than 15 m.

In order to produce a Class 3 finish, the formwork shall render a true smooth surface free from fins and projections. New plywood or steel is necessary to produce the required finish. Re-use of plywood forms will be permitted only if in an "as new" condition. Repairs to the forms shall be with full panels of sheathing only.

Patching shall be:

- patch installation projecting slightly from the



surrounding concrete surface

- after 24 hours, saturated and carefully finished to render the surfaces of the patch true to the surrounding concrete, but any grinding using a hand carborundum stone kept to a minimum

When a rubbed finish is required, the applied mortar shall be carefully worked into the surface area being finished and, using a hand carborundum stone manipulated in a circular motion, the entire surface rendered true and smooth with all excess mortar removed.

**211.16.04 Class 3 Finish Alternative Procedures** - Class 3 Finish alternative procedures when, in the opinion of the Ministry Representative, the formwork may safely be removed at an early age and the concrete finished while still partly plastic, shall include the following:

- careful removal of the formwork when the concrete has sufficiently hardened so as to hold its shape
- finishing the surfaces immediately (within 4 to 8 hours of casting, depending upon weather)
- careful rubbing of the concrete surfaces with a carborundum stone, occasionally wetting same to produce a paste from the surface of the concrete
- rubbing continued, adding necessary sand-cement mortar in small quantities to fill voids, until all voids and form marks are obliterated
- surface curing as specified.

Modifications to the surface texture shall be achieved by grinding or other means.

**211.16.05 Patching Mortar** - Patching mortar where specified above shall be constituted as follows:

Cement: 60% Normal Portland  
 40% White Normal Portland  
 Liquid: 70% Water  
 30% Latex Bonding Agent  
 Sand: Passing a 1.25 mm sieve

**NOTE:** Cement blend above may be adjusted to provide close match to the concrete colour.

**211.17 Hot Weather Concreting** - Hot weather concreting procedures as outlined below, shall be used when the atmospheric temperature is 20°C or higher, unless directed otherwise for Section 582 by the Ministry Representative.

Concrete designed by the Contractor for piers, abutments and footings of bridges shall not have a temperature greater than 25°C at any time prior to placement and curing.

Concrete designed by the Ministry for bridge decks, including diaphragms, bridge parapets, medians, sidewalks

on bridges and approach slabs, shall not have a temperature greater than 15°C when placed. Prior to the placement of bridge deck concrete, the Contractor shall submit to the Ministry Representative for approval, the schedule of proposed placing operations complying with the requirements for hot weather concreting and Section 413. Unless the atmospheric and concrete temperatures are less than 25°C and 15°C respectively, bridge decks and sidewalks on bridges shall be cast at night, when temperatures are minimum, during the period from June 1 to September 15.

The initial temperature of concrete prior to placement may be estimated from the temperatures of its ingredients by using the following equation:

$$T = \frac{0.22(T_a M_a + T_c M_c) + T_w M_w + T_{wa} M_{wa}}{0.22(M_a + M_c) + M_w + M_{wa}}$$

where  $T_a$ ,  $T_c$ ,  $T_w$  and  $T_{wa}$

= temperature in °C of aggregates, cementing materials, added mixing water, and free water on aggregates, respectively

where  $M_a$ ,  $M_c$ ,  $M_w$  and  $M_{wa}$

= mass in kilograms of aggregates, cementing materials, added mixing water, and free water on aggregates, respectively

If deemed necessary, the Contractor shall employ the following hot weather concreting procedures to reduce the concrete temperature:

**a) Mixing Water**

- Shading of storage tanks and water supply lines;
- Adding shaved or chipped ice to mixing water, and ensuring ice is completely melted before being gauged into the mixer drum; and/or
- Refrigeration of mixing water.

**b) Aggregate**

- Shading of coarse and fine aggregate stockpiles; and/or
- Wetting of coarse aggregate and allowing time for drainage of free water.
- Note that wetting down of stockpiles of fine aggregate is not permitted.

**c) Mixing:** Mixing time should be kept to a minimum allowing adequate time for complete mixing of the concrete. The external surface of the mixing drum should be frequently wetted down.



**d) Placing:** Production of concrete during hot weather shall be scheduled for a continuous supply of concrete at the job site.

Adequate manpower, equipment and standby provisions shall be provided in order to place and consolidate the delivered concrete within 45 minutes after initial mixing. Also, the time interval between placing batches shall not exceed 30 minutes.

For large unformed surfaces, the quantity and rate of placing of concrete shall be dependent upon the rate of finishing and climatic condition.

When the rate of evaporation from unformed surfaces as estimated from Drawing [SP211-01](#) "Surface Evaporation Rate" exceeds 1.0 kg/m<sup>2</sup>/hr, either concrete operations shall cease or, upon approval of the Ministry Representative, necessary precautions taken to prevent plastic shrinkage.

**e) Curing during hot weather** shall be commenced as soon as possible.

Forms shall be kept moist and loosened as soon as this can be done without structural damage, with a flow of water introduced and allowed to run down inside.

Newly exposed concrete surfaces shall be protected from premature drying by the application of prewetted curing materials or a continuous water spray as the forms are removed.

Large exposures of concrete require special precautions as follows:

- burlap application commenced as soon as the surface will support the mass without excessive deformation, with this surface kept continuously wet by fog spraying until a waterproof barrier is securely in place
- concrete under the curing blanket is not allowed to dry out for a minimum of seven days from the time of initial covering, necessitating frequent checking and soaking by the addition of water under the top evaporation barrier
- wet curing followed by the removal of the evaporation barrier only under such conditions that the wetted burlap is permitted to dry slowly before removal and the surface is exposed to prevent excessive thermal shock.

**211.18 Cold Weather Concreting** - Cold weather concreting procedures shall be used when the mean temperature is below 4°C or when the anticipated or actual minimum temperature in any 24 hour period falls below

-1°C for six hours or longer. When these conditions are predicted or imminent, or when the temperature falls below 4°C during the first five days after placing, the Contractor shall provide adequate protection and take the necessary preheating precautions, for the maintenance of a temperature of 10°C or above in the newly placed concrete during that period, to include the following:

- a)** Mixing water shall be heated to a maximum of 65°C and introduced into the aggregates prior to the addition of cement, but the temperature of the combined water and aggregates shall not exceed 40°C.
- b)** Aggregates shall be heated to eliminate frozen lumps, ice and snow without overheating or excessive drying. Aggregates shall be heated to a maximum of 70°C.
- c) Formwork, Reinforcing Steel:** Before any concrete is placed, all ice, snow or frost shall be completely removed from the forms and the temperature of contact surfaces raised to a minimum of 2°C, with such minimum established and maintained for at least one hour prior to placement.

Heat shall be applied uniformly and at a rate which will not induce excessive thermal stresses in the section being heated. Ambient temperatures shall not exceed concrete temperatures by 13°C and shall be raised at a maximum rate of 2°C/hr.

Projecting reinforcing steel shall be insulated when temperatures are between 0°C and -10°C for a minimum of 300 mm away from the fresh concrete and for a minimum of 600 mm when temperatures are below -10°C.

**d) Other Contact Surfaces:** Concrete shall not be placed on frozen surfaces except in pile founded footings where a minimum layer of 25 mm rigid insulation shall be installed. Rock surfaces shall be heated by forced air. Heating shall continue until all standing frost crystals are dissolved. Frozen embankment shall be thawed and recompacted prior to placing concrete thereon. The temperature of existing concrete work shall be raised to a minimum of 5°C and maintained at this temperature for a time sufficient to raise the entire mass of concrete to this temperature.

**e) Curing and Protection** necessary to maintain a minimum concrete temperature (5°C) shall be provided throughout the curing period.

Heated enclosures shall be kept at 95% minimum relative humidity. Concrete surfaces shall be protected by formwork or impermeable membranes from direct



exposure to the combustion gases of heating.

At the end of the curing period, heating and protection shall be removed so as to produce a gradual temperature change. Protection shall not be completely removed until the temperature difference between the outside air and the concrete is 12°C or less.

Formwork shall be left in place for the seven day curing period.

**211.19 Underwater Concreting** - Underwater concreting procedures shall be used when structures, or parts of structures, are to be constructed under water. The concrete, methods of placement either by pumping or tremie pipes, and equipment shall be in accordance with the following, or as otherwise directed by the Ministry Representative:

**a)** Proposals outlining procedures shall be submitted for review and acceptance to the Ministry Representative 3 weeks prior to placement of concrete. Placement shall comply with the provisions of the proposal.

**b)** Materials shall conform to the requirements of Subsection 211.03, except that coarse aggregates shall contain not more than 25% angular particles by mass.

**c)** Mix proportions shall be as specified in Subsection 211.05, except:

- cement content not less than 400 kg/m<sup>3</sup>
- water-cement ratio no greater than 0.40
- slump of 150 mm ± 20 mm
- admixtures used to achieve plastic, cohesive and flowable concrete if approved by the Ministry Representative
- retarding type admixture as approved by the Ministry Representative shall be used to prevent the formation of cold joints with the lift method of placement or where the concrete surface area is large.

**d)** Heating of water or aggregates or both, to obtain a suitable placing temperature, shall be done in accordance with Subsection 211.18. Concrete, when mixed, shall have a temperature of between 15°C and 35°C and shall not be placed in water having a temperature less than 2°C.

**e)** Cofferdams or forms into which concrete is to be placed shall be sufficiently tight to prevent the loss of mortar and, if in running water, reduce the velocity of flow within the cofferdam or forms to not more than 3 m per minute. Dewatering will not be permitted until at least 24 hours after concreting has been completed.

**f)** Pumping and tremie pipe requirements shall be as follows:

- length sufficient to reach to lowest point of deposit but held 150 mm to 250 mm above the bottom of the placement
- submerged into the placed concrete and held in a near vertical position at all times
- supported in such a manner to allow vertical movement
- discharge at locations not farther apart than 7 m
- discharge end fitted with a 3 m section of steel pipe
- fed by either chutes or pumps with a continuous flow of concrete.

**g)** Priming of tremie pipes shall be by inserting a plug of burlap, 25 mm less in diameter than the tremie pipe, in the top of the pipe and carefully controlling concrete flow as the plug passes through the pipe. Where priming is lost, the priming procedure shall be repeated.

**h)** Concrete flow, once begun, shall be continuous through the pipe, at a minimum of 15 m<sup>3</sup> of concrete supplied to each tremie or pump per hour, but controlled so as not to overflow the feed hopper. The flow of concrete shall be continuous to the end of the batch and the pipe lowered in the placed concrete to maintain its prime.

**i)** Placement of concrete underwater shall be either to the full depth of placement or in lifts and shall conform to the following requirements:

- seals shall be placed by beginning at one end and continuing until final grade is achieved
- point of placement shall be relocated by approximately 3 m, either laterally or longitudinally and placement continued to grade
- above procedures repeated to the completion of the seal or when the lift method of placement is used
- flow of concrete shall be regulated to produce approximately horizontal surfaces
- each lift placed before the preceding lift has taken initial set
- depth and area of each lift dependent upon the rate of placement.

Concrete in its plastic state shall not be disturbed either directly or indirectly by puddling or vibration.

Should interrupted placement be sufficient for the concrete to take initial set, the laitance shall be removed from the concrete surface before concreting is resumed, but with the resumption of concreting delayed



indefinitely, laitance shall be removed not later than 36 hours after the interruption.

### 211.20 Measurement and Payment

**211.20.01 Formwork** - Payment for formwork will be made at the unit prices bid per square metre. Payment shall be for the supply, construction and removal (if required) of formwork, and for the finishing, as required, of formed surfaces. Areas shall be measured of the faces of forms in contact with the concrete.

Payment will be made for forming one face of vertical construction joints which are shown on the drawings or ordered by the Ministry Representative. No payment will be made for forming construction joints not so required. Payment will be made for forming both faces of joints formed by casting in sheets of styrofoam or other material, where such joints are required by the contract documents.

Payment will not be made for forming surfaces which are cast against permanent embedded items which are paid for separately.

Upper surfaces which form an angle of 45° or less with the horizontal will not usually be considered to be formed surfaces.

The undersides of members which are shown on the drawings to rest on ground or fill will not be considered formed surfaces. The undersides of members which are not shown on the drawings to rest on ground or fill will be considered formed surfaces.

Where sides of footings or faces of walls are cast against ground or fill (if permitted by the Ministry Representative) the surfaces so formed will be considered formed surfaces. Only the areas of the surfaces shown on the drawings will be paid for.

Progress payments will be made according to Table 211-N.

**211.20.02 Concrete** - Payment for concrete will be made at the unit prices bid per cubic metre (or at a reduced price for understrength concrete - see the fourth paragraph of this subsection) for the supply, transportation, placing, curing and finishing (except the finishing of formed surfaces) of concrete, and for everything supplied and done in connection therewith, except form-work, reinforcing steel and, in the case of concrete specified to be proportioned by the Ministry Representative, cement. Payment for concrete specified to be proportioned by the Contractor shall include payment for cement.

Payment as above shall cover the Contractor's quality control costs.

Measurement of volume will be made to the surfaces shown on the drawings or ordered by the Ministry Representative. Deductions will be made of the volumes of embedded ducts, timbers, etc., but not of the volume of reinforcing steel. No payment will be made for concrete placed outside the surfaces shown or ordered, as to fill spaces left by over excavation or irregularities in excavation. The reduced price to be paid for understrength concrete shall be calculated by the following formula:

$$P_R = \frac{S_{AV}}{S_{SP}} \times P_U$$

where  $P_R$  = reduced price

$P_U$  = bid price

$S_{SP}$  = specified strength

$S_{AV}$  = the lowest average of three consecutive strength tests for one class of concrete.

Where less than three strength tests are taken, the results of one test or the average of two will be used.

See Subsection 211.09.04 for circumstances under which a reduced price will be paid.

Where a reduced price is paid, it will be applied to all of the concrete in the applicable pay item.

**211.20.03 Cement** - Payment for cement will be made at the unit price bid per tonne, for the supply, transportation and handling of cement.

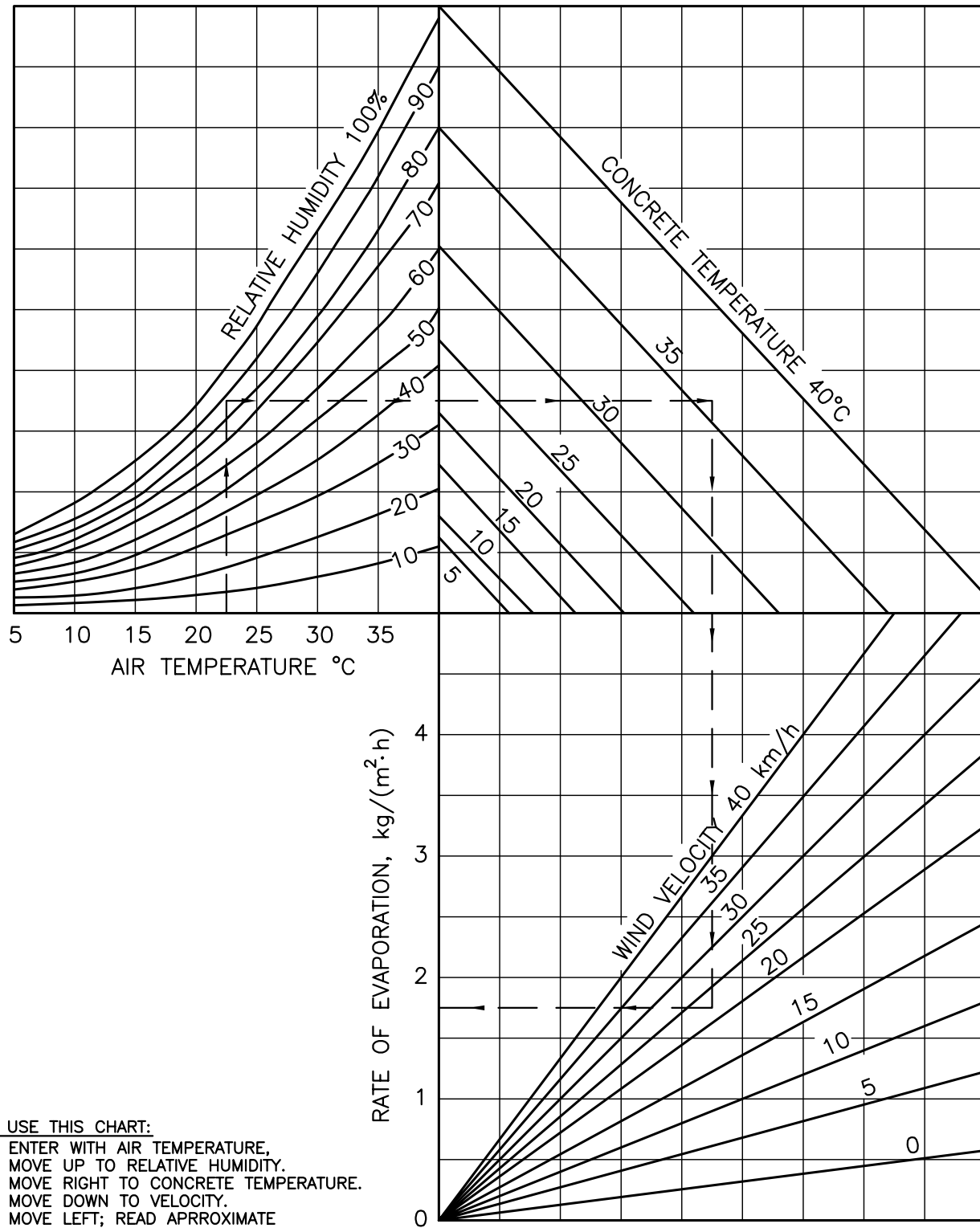
Payment will be made under the "Cement" item only for the cement used in concrete specified to be proportioned by the Ministry Representative. The cement used in concrete specified to be proportioned by the Contractor will not be paid for under this item.

The quantity of cement to be paid for will be determined from the design mixes and the volume of concrete paid for. Where concrete is not paid for by volume, the volume based on theoretical neat lines will be used in the determination of the quantity of cement to be paid for.

**TABLE 211-N PROGRESS PAYMENTS**

SUBSTRUCTURE	DECK	APPLICATION
20%	20%	for formwork materials on site
40%	50%	for formwork in place
20%	20%	for formwork removed
20%	10%	for surface finishing completed







## SECTION 213

### TIMBER BRIDGES - CONSTRUCTION

**213.01 Materials** - All materials shall be of the quality, grade and finish as shown on the bills and drawings and shall conform to the requirements of the Sections [903](#), [904](#), [905](#) and [908](#) that are relevant.

**213.02 Logs for Cribs and Log Stringers** - Logs for cribs shall be cut from live trees and shall be peeled before use.

Stringers shall be cut from live trees not less than 30 days before use and shall be seasoned with the bark on. Immediately before use in the work, all bark shall be peeled and the log trimmed smooth of all knots and projections.

**213.03 Work Practice** - The standard of work shall be first-class throughout and in accordance with the best modern practice.

**213.04 Handling and Storing Materials** - All materials shall be handled with reasonable care. Timber shall not be bashed, cut or punctured or otherwise damaged.

Dogs, hooks, peavies or other equipment shall not be used on the side surfaces of treated timber. All handling of treated timber with pointed tools shall be confined to end grain and shall be such as to avoid damage of the original pressure-treated surface.

Subject to the approval of the Ministry Representative, the Contractor shall make good any superficial damage of treated timber by the methods outlined in the current edition of C.S.A. 080 Specification for Wood Preservation. Timber which, in the opinion of the Ministry Representative, cannot be made good by such methods will be rejected.

Minor damage to untreated timber shall be repaired and severely damaged pieces will be rejected.

When unloading at the site of the work, the various pieces shall be sorted and stacked in such a manner as to require a minimum of rehandling before being placed in the structure.

Level ground cleared of snow, brush and weeds shall be provided for stacking the timber. The timber shall be placed on blocking to raise it above the ground.

The Contractor shall make good, at the Contractor's expense, any damage to materials supplied by the Ministry after having taken delivery of same.

**213.05 Framing** - Framing shall be first class in every respect and performed by skilled workers only. No open joints, blocking or shimming of joints will be allowed. Daps, gains and dove-tails in trestles, culverts, cribs, etc. may be finished with an adze, but all joints shall go together without pounding or excessive cramping up and have full bearing in contact.

Holes shall be bored with an auger to the sizes shown in Table [213-A](#).

Spikes that are likely to crack or unnecessarily damage the timber shall have holes bored 1/16" small.

**213.06 Field Treatment** - Unless so specified, treated timber shall not be cut or dapped except for cutting to length. Cut ends and specified cuts and daps of treated timber (except piles) shall be given three coats of the same preservative used in the treatment; creosote, if used, shall be hot.

The heads of all treated piles, after cut-off, shall be covered with alternate layers of hot roofing pitch and loosely



woven fabric using four applications of pitch and three layers of fabric.

The fabric shall measure at least six inches more in dimension than the diameter of the pile and shall be neatly folded down and secured by large-headed galvanized roofing nails or by binding with not less than seven complete turns of galvanized wire securely held in place by large-headed galvanized roofing nails or staples. The edges of the fabric projecting below the fastening shall be neatly trimmed.

The heads of all untreated piles, after cut-off, shall be thoroughly swabbed with three coats of hot creosote oil and if they are to be capped, they shall also be coated with hot roofing pitch.

All bolt holes drilled in the field in treated timber shall be treated with hot creosote oil applied with an approved pressure bolt hole treater.

All surfaces in contact and all bolt holes in untreated timber shall be swabbed with a water-borne preservative.

**TABLE 213-A HOLE SIZES**

	<b>FIR AND HARD-WOODS</b>	<b>CEDAR AND SOFT-WOODS</b>
<b>BOLTS</b>	1/16" Large	Same size as bolt
<b>DRIFT BOLTS</b>	Same size as bolt	1/16" Small
<b>DOWELS</b>	1/16" Large for ends of posts, but in sills make same size as dowel	1/16" Large for ends of posts, but in sills make same size as dowel

### 213.07 Preparation of Laminated Decks for Wearing Surface

**213.07.01 For Asphalt Plank** - Depressions in laminated decks shall be levelled by placing and compacting a fine sand levelling course.

The levelling course shall consist of a mixture of fine durable sand conforming to the gradation shown in Table 213-B.

The sand shall be thoroughly mixed with asphalt emulsion, Type SS-1 which shall conform to the requirements of Subsection 951.17. The asphalt emulsion content shall be such that an air void content of 5% to 8% in the compacted mixture is obtained. This will normally require an asphalt emulsion of 15% to 25% by weight of the total mixture.

Before laying and nailing asphalt plank, laminated decks shall be swabbed with oxidized mopping asphalt Type 2 conforming to the requirements of Table 213-C.

**213.07.02 For Asphalt** - Prior to placing asphalt wearing surface, creosote-treated laminated decks shall be lime-scrubbed where creosote oil has "bled" to the surface.

To prevent "bleeding" of the creosote oil, the mix temperature of hot-mix asphalt placed on these decks shall be as low as is practicable.

**TABLE 213-B CONSISTENCY OF THE  
LEVELLING COURSE**

<b>U.S. STANDARD AND ASTM SIEVE SIZES</b>	<b>PERCENTAGE PASSING BY WEIGHT (%)</b>
#8	100
#16	100 - 60
#30	80 - 46
#50	62 - 35
#100	46 - 25
#200	35 - 18



**213.08 Basis of Payment** - Payment will be made at the unit prices bid, for the various items in the Schedule of Approximate Quantities and Unit Prices, for material remaining in and forming a part of the finished structure. Such payment shall be accepted as full compensation for all labour, equipment, tools, materials, including hardware and furnishing and placing all other items required to complete the work.

**TABLE 213-C REQUIREMENTS FOR OXIDIZED MOPPING ASPHALT TYPE 2**

TEST DESCRIPTION	ASTM TEST METHOD	TYPE 2	
		MINIMUM	MAXIMUM
Softening Point (R & B), °F	D36	165	175
Flash Point, C.O.C., °F	D96	450	---
Penetration @ 32°F	D5	12	20
Penetration @ 77°F	D5	20	35
Penetration @ 115°F	D5	---	70
A.P.I. Gravity @ 60°F	D71	4.6	5.8
Ductility @ 77°F, 5 cm minimum	D113	3	---
Loss on Heating to 325°F, 5 hr., %	D6	---	0.3
Penetration of Residue, % of original	D5	80	0
Total Bitumen (soluble in CS <sub>2</sub> ) %: Mineral Stabilized Asphalt	D4	80	---
Total Bitumen (soluble in CS <sub>2</sub> ) %: Asphalt Without Mineral Stabilizer	D4	99	---
Proportion of Bitumen Soluble in CCl <sub>4</sub>		99.5	---



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 214

### TIMBER PILING CONSTRUCTION

**214.01 Materials** - All piling shall conform to requirements of Section 906, Round Timber Piles, and where specified to Section 908, Preservative Treatment.

**214.02 Pile Lengths** - When supplied by the Contractor, piles shall have minimum lengths in accordance with those listed on the Ministry's drawings or bills of materials. At the Contractor's expense, allowances will be made for such additional lengths of pile as may be required to provide fresh heading and to suit the method of operation.

Pile lengths determined by the Ministry, whether for its or the Contractor's supply, are those expected to remain in the completed structure plus 600 mm for cut-off, except for end bearing piles where the allowance for cut-off and bearing depth irregularity is 3.5 m.

**214.03 Handling of Piles** - The use of dogs, hooks, peavies or any other equipment which may damage the round surface of a treated pile will not be permitted.

Pointed tools used in the handling of treated piles shall be confined to end grain.

During lifting, long piles shall be supported at a sufficient number of points, properly located, to prevent damage due to excessive bending.

Subject to the approval of the Ministry Representative, the Contractor shall make good any superficial damage of treated piles by the methods outlined in the current edition of CSA 080 Specifications for Wood Preservation. Piles damaged by the Contractor, which, in the opinion of the Ministry Representative, cannot be made good by such methods, will be rejected and shall be replaced at the Contractor's expense.

**214.04 Hammer** - Piles may be driven with a drop hammer or a mechanical hammer. Drop hammers shall weigh not less than 1,400 kg for piles less than 15 m long and not less than 1,600 kg for piles 15 m and over in length, and in no case shall the weight of the hammer be less than the combined weight of driving head and pile. Mechanical hammers shall develop a total energy not less than 3,900 kg per blow.

**214.05 Leads** - Pile drivers with fixed leads or with hanging or swinging leads that can be held in a fixed position during driving shall be used to drive all piles.

Batter piles shall be driven using leads adaptable to their driving.

When driving treated timber piles, the use of spuds and chocks in the leads shall be kept to a minimum in order that the protective treatment will not become bruised or broken.

#### 214.06 Preparation for Driving

**214.06.01 Driving Caps and Bands** - The heads of timber piles, when driving is such as to unduly damage them, shall be protected by driving caps of approved design, preferably having a rope or other suitable cushion next to the pile head and fitting into a casting which in turn supports a timber shock block. Alternatively, the pile head may be banded with a pile ring and covered with a steel wire mat. When driving treated piles, a driving cap shall be used.

**214.06.02 Pointing** - Where soil conditions, in the opinion of the Ministry Representative, require the pointing of piles, the Contractor shall fit the piles with steel points.

Steel points fabricated in accordance with Drawing SP214-01 shall be supplied by the Contractor.

**214.06.03 Excavation** - Footing excavation and seal excavation, where applicable, shall be completed with any



necessary allowance made for upheaval before the driving of footing piles. Should too great an allowance be made, backfilling with gravel will, in general, be permitted to raise the bottom of the excavation to the correct elevation. Any material forced up between the piles to above the footing level shall be removed to the correct elevation. No extra payment will be made for the supply and placing of gravel or any additional excavation to obtain the correct elevation.

**214.07 Driving** - Unless otherwise specified, all piles shall be driven with the small end downward. The fall of a drop hammer shall be regulated to avoid damage to the piles and under no circumstances shall exceed 3 m.

Each pile shall be square-headed, properly pointed, and set fair in the leads; if it becomes split or broomed on the top it shall be fresh headed.

Piles shall be driven to the minimum depth indicated on the drawings or the supplemental specifications and unless otherwise ordered by the Ministry Representative, to practical refusal, which shall be to the depth at which the piles have a load carrying capacity of 20 tonnes and an average penetration per blow determined by the following formulae:

For drop hammers:

$$s = \frac{wh}{6p} - 0.03$$

For mechanical hammers:

$$s = \frac{wh}{6p} - 0.003$$

Where:  $s$  = average penetration per blow in metres under last 10 blows  
 $w$  = weight of moving part of hammer in newtons  
 $h$  = effective fall of hammer in metres  
 $p$  = allowable load capacity of pile in newtons

Where it is required by the Ministry Representative to penetrate a thin stratum (which may show practical refusal in driving) to obtain greater depth in a less resistant formation, driving shall be continued through the stratum regardless of the definition laid down for practical refusal.

Any pile which, in the opinion of the Ministry Representative, is so damaged in driving as to be unfit for the use for which it is intended, or is so far out of position, or off vertical or designated batter, as to require excessive force or manipulation to restore it to its proper position, shall be withdrawn and replaced by a new pile. If this is not possible, a new pile shall be driven adjacent to the defective pile. The damaged, out-of-position or misaligned piles shall be for the Contractor's account.

Where boulders or other large obstructions make it impossible to drive piles in the location shown on the drawings, the Ministry Representative may direct the Contractor to drive an additional pile, or piles, for which the Contractor will be paid in accordance with the various items of Subsection 214.12 - Payment.

**214.08 Additional Equipment** - Where, in the opinion of the Ministry Representative, the bounce of the hammer is excessive or where the required depth or resistance is not obtained by the use of a hammer complying with the above minimum requirements the Contractor shall provide a heavier hammer at the Contractor's expense.

**214.09 Accuracy of Driving** - All piles shall be driven in such manner that any variation from the vertical, or batter as shown on the drawings, shall not exceed 20 mm/m. Piles in trestle bents shall be so driven that the cap may be placed in its proper location without including excessive stresses in the piles. Cutting, springing, dapping or facing-off for placing bracings and planking on piles will not be permitted.

After driving, footing piles shall not be more than 75 mm out of the position shown on the drawings.



**214.10 Pile Heads** - The tops of all piling shall be cut off to a true plane as shown on the drawings or as established by the Ministry Representative. Piles shall show a solid head at the plane of cutoff.

Pile heads not encased in concrete shall be protected as follows:

**214.10.01 Treated Piles** - After cut-off, the pile heads shall be covered with alternate layers of hot roofing asphalt and loosely woven glass fabric, using four applications of asphalt and three layers of fabric.

The fabric shall measure at least 150 mm more in dimension than the diameter of the pile and shall be neatly folded down and secured by large headed galvanized roofing nails or by binding with not less than seven complete turns of galvanized wire securely held in place by large-headed galvanized roofing nails or staples. The edges of the fabric projecting below the fastening shall be neatly trimmed.

**214.10.02 Untreated Piles** - After cut-off, the pile head shall be thoroughly swabbed with three coats of hot creosote oil and if they are to be capped, they shall also be coated with hot roofing asphalt.

**214.11 Surplus Treated Piling** - When treated piling is supplied by the Ministry, surplus piling and pile cut-offs designated by the Ministry Representative shall be loaded on to Ministry trucks at the conclusion of the pile driving operation.

Payment for taking delivery, transporting and handling of surplus piling will be made under extra work as set forth in Clause 28 of the Contract Agreement.

**214.12 Payment** - When piling is supplied free to the Contractor by the Ministry, payment will be made under items (a), (b), and (d) as follows, and item (c), if applicable.

- a) Setting up
- b) Handling
- c) Pointing
  - i) Supply
  - ii) Install
- d) Driving

Payment under item (a) will be made at the lump sum bid for providing, setting up and removing the plant and equipment for driving the piles, and shall be accepted as full compensation for everything furnished and done in connection therewith.

Payment under items (b) and (c) will be made at the unit price bid per pile or pile point for the total number of piles or pile points remaining in and forming part of the completed structure, except that only piles and pile points called for on the drawings or ordered by the Ministry Representative will be paid for. Payment shall be accepted as full compensation for all cost in connection with taking delivery, transporting, handling, including loading of salvageable cut-offs and cutting off of piles or with supplying, handling and installing pile points. If pile points are not a bid item and are required, payment for (c) will be for extra work order.

Payment for item (d) will be made at the unit price bid per metre for the total number of metres of piling remaining in the structure for those piles paid for under item (b).

Payment shall be accepted as full compensation for everything furnished and done in connection with the driving of piles.

When piles are supplied by the Contractor, payment will be made for under an additional item, Supply and Delivery. When this item is included, item (b) shall not include payment for taking delivery of the piles.

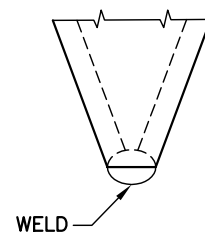
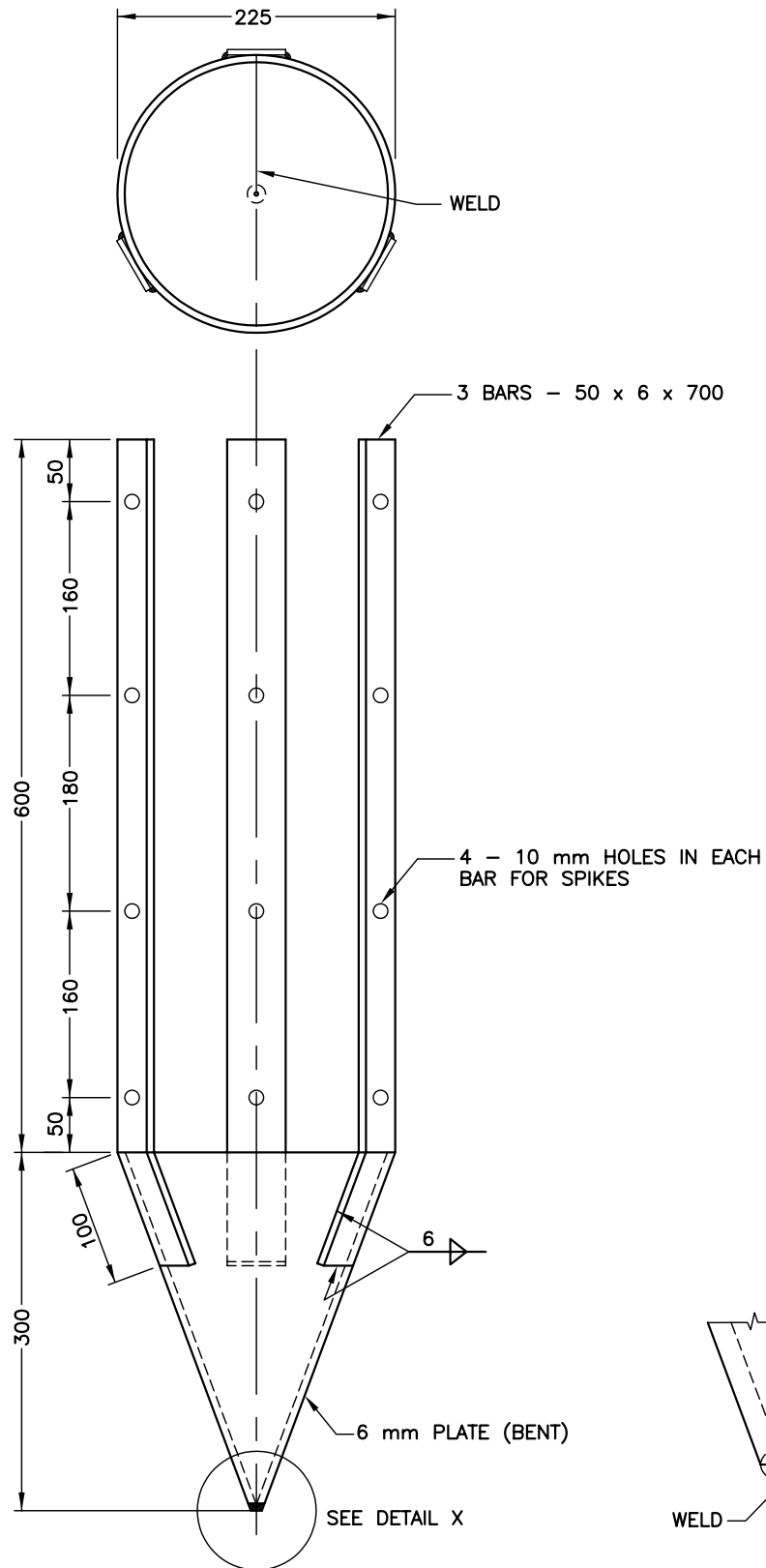


Payment for the item Supply and Delivery will be made at the unit price bid per metre for the total number of metres of piling as shown on the Ministry's drawings or bills of material. Such payment shall be accepted as full compensation for everything furnished and done in connection with the supply and delivery of the piles.



# PILE SHOE TYPE A

SP214-01



NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## **SECTION 215**

### **BRIDGES**

**215.01 General** - Bridges shall be designed in accordance with the current design codes for highway bridges. Fabrication and erection shall be in accordance with the specifications prepared for the particular structure.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 216

### PAINTING OF STEEL STRUCTURES

**216.01 Scope** - This Section covers the procedures required for the shop, field and maintenance painting of structural steel surfaces which will be exposed to exterior corrosive conditions.

#### **216.02 Definitions**

**216.02.01 Shop, Field and Maintenance Painting** - the series of operations that include the surface preparation, pre-treatment (if required) and application of paints to structural steel surfaces either in the shop or field. It includes the supplying of all labour, equipment and materials except those materials specifically exempted, which will be supplied by the Ministry. It also includes the drying and protection of newly painted surfaces and the protection of property and traffic.

**216.02.02 Shop Painting** - the painting of structural steel in a shop or plant before shipment to the site of erection.

**216.02.03 Field Painting** - the painting of new structures at the place of erection.

**216.02.04 Maintenance Painting** - the painting of structures in service that have previously been completely coated.

**216.02.05 Preparation Requirements** - Preparation requirements specified as Sa.2, St.2 and the like are references to standard cleaning methods defined in ASTM D 2200 - Pictorial Surface Preparation Standards for Painting Steel Surfaces (available from ASTM, 1916 Race Street, Philadelphia, PA 19103 USA).

**216.02.06 Colour Identification Numbers** - Colour identification numbers with the prefix DOH are those of the BC Ministry of Transportation set out in Section 308.

**216.03 Surface Preparation** - The method of cleaning shall be one or a combination of the following as specified:

**216.03.01 Washing** - Washing is a procedure for removing surface contaminants including oil, grease, drawing and cutting compounds, soil, salts, etc. from either steel or painted surfaces. Removal of the contaminants shall be accomplished by the use of any one or a combination of the following: alkaline cleaners, solvents, emulsion cleaners, steam cleaning (with detergents), high pressure water, scrubbing (with detergent) or other approved method.

**Note:** Alkaline cleaners, detergents, solvents, etc. shall not be used over streams, lakes, rivers, etc., or agricultural land without first obtaining approval from the Pollution Control Board who will require details of type, quantity and dilution strength of the materials to be used.

The washing procedure shall be as specified or as directed by the Ministry Representative.

The washing procedure shall be conducted so that any part of the structure which has already been cleaned or newly painted shall not be contaminated with the cleaning chemicals or solvents.

Immediately after treatment, the surfaces shall be thoroughly washed with clean water to remove detrimental residues. In the case of solvent washing, the final wiping shall be done with clean solvent and clean rags to prevent the spread of oil and other contaminants over the surface.

**216.03.02 Manual Cleaning** - Manual cleaning is a procedure for removing loose mill scale, loose rust, loose paint and other detrimental foreign matter by chipping, scraping, grinding and wire brushing, etc. The tools used for this method of cleaning may be either hand or power tools; they shall be of high quality, kept sharp and maintained in excellent condition.



The standard of cleaning obtained by this method shall be either St. 2 or St. 3 as specified:

- i) St. 2 is "Thorough Manual Cleaning." The appearance of the surface after cleaning shall correspond to the prints designated St. 2.
- ii) St. 3 is "Very Thorough Manual Cleaning." The appearance of the surface after cleaning shall correspond to the prints designated St. 3.

In both preparation grades St. 2 and St. 3, it is assumed that prior to treatment by this method the surface has been cleaned of dirt and grease. Heavier layers of rust shall be removed by chipping before any of the other cleaning tools are used.

Finally, all traces of dust shall be removed with a vacuum cleaner, clean and dry compressed air (See Subsection [216.03.03](#) for line filter requirements) or a clean brush.

**216.03.03 Blast Cleaning** - Blast cleaning is a procedure for removing mill scale, rust, rust scale, paint or other foreign matter by use of abrasives propelled through nozzles or by centrifugal wheels.

If compressed air is used, proper line filters, which remove all oil and water from the air, are mandatory.

The standard of cleaning obtained by this method shall be either Sa. 2, Sa. 2 1/2 or Sa. 3, as specified:

- i) Sa. 2 is "Thorough Blast Cleaning." Almost all mill scale, rust paint and foreign matter shall be removed - this corresponds to "Commercial Grade" blast cleaning. The surface after cleaning shall correspond to the prints designated Sa. 2.
- ii) Sa. 2 1/2 is "Very Thorough Blast Cleaning." Mill scale, rust, paint and foreign matter shall be removed to the extent that the only traces remaining are slight stains in the form of spots or stripes. This corresponds to "Near White" blast cleaning. The surface after cleaning shall correspond to the prints designated Sa. 2 1/2.
- iii) Sa. 3 is "Blast Cleaning to Pure Metal." Mill scale, rust, paint and foreign matter shall be removed completely. This corresponds to "White Metal" blast cleaning. The surface after cleaning shall correspond to the prints designated Sa. 3.

In all preparation grades Sa. 2, Sa. 2 1/2 and Sa. 3 it is assumed that prior to treatment by this method the surface has been cleaned of dirt and grease. If necessary, heavier layers of rust shall be removed by chipping before the blast cleaning operation commences.

Finally, all traces of dust and sand, etc. shall be removed with a vacuum cleaner, clean and dry compressed air, or a clean brush.

**216.04 Pretreatment** - When specified, the newly cleaned surface shall be pretreated prior to the application of the prime coat of paint. The application of the pretreatment shall be strictly in accordance with the manufacturer's directions or the application shall be the subject of a Special Provision of the Contract or Order for Extra work.

When pretreatments are used, particular care shall be taken to prevent contamination of surfaces which are already painted.

**216.05 Application of Paint** - Paint may be applied by brushing, air spraying or airless spraying. Daubers or sheepskins may only be used when approved by the Ministry Representative, and when no other method is practical for proper application in places of difficult access. Roller coaters may only be used, when approved by the Ministry Representative, on flat or slightly curved surfaces or when specified in the Contract or Order for Extra



Work.

**216.05.01 Mixing and Thinning** - All ingredients in any container of paint shall be thoroughly mixed before use and shall be agitated often enough during application to keep the paint in uniform condition. In all cases of heavily pigmented paints (e.g., "Zinc-Rich" paints, the material must be continuously agitated during application.

Paint in 4.55 ℓ (one Imperial gallon) containers may be mixed by hand; paint in containers larger than 4.55 ℓ (one Imperial gallon) shall be mixed by mechanical methods. In either case the paint shall be mixed in a manner which will ensure breaking up of all lumps, complete dispersion of settled pigment and a uniform composition. After mixing, all paint shall be strained to remove skins and other undesirable matter; the strainer shall not be so fine as to remove any pigment.

Thinner complying with the paint specification or manufacturer's instructions may only be added to the paint if it is necessary for proper application.

Thinner may only be added with the consent of the Ministry Representative and only after it is shown that satisfactory application cannot be obtained with proper adjustment of the spray equipment and air pressures. In no case shall more than 12.5% of thinner be added to paint unless specifically approved by the Ministry Representative.

Thinner, when approved, shall be added after initial mixing is completed. The quantity of thinner added shall be measured in and thoroughly mixed until the paint is again of uniform consistency.

**216.05.02 Temperature** - Paint shall not be applied when the ambient, surface or paint temperature is less than 7°C. Also, paint shall not be applied when the surface temperature is expected to drop to 0°C. before the paint has dried. Note that all paints specified in Subsection [216.08](#) through [216.11](#) require overnight drying.

Paint shall not be applied when the surface temperature is greater than 50°C.

**216.05.03 Moisture** - Paint shall not be applied in wet weather - fog, mist, rain, snow and/or relative humidity in excess of 85%. Paint shall not be applied to wet or damp surfaces and care shall be taken to ensure that any overnight dew has completely evaporated before painting commences in the morning.

**216.05.04 Spray Application** - The following requirements apply to both air spray and airless spray:

- i) The equipment shall be capable of properly atomizing the paint to be applied. The equipment shall be kept clean and maintained in excellent condition. Equipment which has dirty or malfunctioning parts shall not be used until the parts are cleaned, repaired or replaced as necessary.
- ii) Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun shall be released at the end of each stroke.

All runs and sags shall be brushed out immediately, or the paint removed and the surface repainted.

Areas inaccessible by spray such as cracks and crevices and the blind sides of rivets and bolts shall be painted by brush.

**216.05.05 Air Spray Application** - In addition to the requirements set out in Subsection [216.05.04](#) the following shall apply:



- i) The air caps, nozzles and needles shall be those recommended by the manufacturers of the material being sprayed and the equipment being used.
- ii) Proper air line filters shall be provided to remove oil and condensed water from the air. The air from the spray gun impinging against the surface shall show no condensed water or oils.
- iii) The pressure on the material in the pot and of the atomizing air shall be adjusted for optimum spraying effectiveness. Both material and atomization pressures shall be controlled by suitable pressure regulators with gauges. The atomizing air pressure shall be high enough to properly atomize the paint, but not so high as to cause excessive fogging of paint, excessive evaporation of solvent or loss by overspray. The air compressor used shall be of sufficient size to maintain the regulated air pressures constant at all times, irrespective of the amount of equipment being operated from the compressor.

**216.05.06 Airless Spray Application** - In addition to the requirements set out in Subsection [216.05.04](#) the following shall apply:

- i) Fluid tips shall be of proper orifice size and fan angle, and fluid control gun of proper construction as recommended by the manufacturers of the material being sprayed and the equipment being used.
- ii) The air pressure to the paint pump shall be adjusted so that the paint pressure to the gun is proper for optimum spraying effectiveness. The pump pressure shall be controlled by a suitable regulator with gauge.

Pressures higher than that necessary to properly atomize the paint shall not be used.

The air compressor used shall be of sufficient size to maintain the regulated air pressure to the pump constant at all times irrespective of the amount of equipment being operated from the compressor.

iii) Proper filters shall be provided in the high-pressure line so that dirt, dry paint or other foreign materials are not deposited on the paint film.

iv) The trigger of the gun shall be pulled fully open and held fully open during all spraying to ensure proper application of paint. The trigger shall be released at the end of each stroke.

**216.05.07 Brush Application** - Brush application brushes shall be of high quality and of a style that will enable proper application of the paint. Wide flat brushes shall be used for large flat areas; round or oval brushes shall be used for irregular surfaces, rough or pitted steel, rivets, bolts, etc.

The paint shall be brushed so that there are no runs or sags, a minimum of brush marks and a uniform thickness.

**216.06 Stripe Painting** - Unless otherwise specified, all sharp edges, interior corners and exterior corners, and all crevices, bolts, welds and the like shall be stripe painted.

Where, in the opinion of the Ministry Representative, the application of the first full prime coat of paint does not properly cover radiused edges and corners, the Ministry Representative may require the stripe painting of such areas and the cost of same shall be borne entirely by the Contractor.

Stripe painting, where required, shall be applied in conjunction with the application of the first full prime coat of paint applied to bare steel. Stripe painting may be applied before the first full prime coat, in which case it shall be allowed to dry thoroughly before the prime coat is applied or it may be applied after the prime coat has thoroughly dried, in which case the stripe coat shall be tinted to contrast with the prime coat. Stripe painting shall extend for at least 25 mm from the edge or from the affected area as applicable.



**216.07 Recoating** - Each coat of paint shall be in a proper state of cure or dryness before the application of the succeeding coat. Unless otherwise specified a minimum of overnight drying will be required. Under poor drying and curing conditions, this period will be extended at the direction of the Ministry Representative.

**216.08 Shop Painting** - Unless otherwise specified the following procedure shall apply to all new steel prior to shipment to the site of erection:

- a) Before painting, the steel shall be blast cleaned to Preparation Grade Sa. 2 (See Subsection 216.03.03 (i)). Blast cleaning will be permitted prior to fabrication provided that any contamination which occurs during fabrication is removed prior to painting. Small areas of contamination occurring during fabrication shall be cleaned by manual cleaning to Preparation Grade St. 3 (See Subsection 216.03.02 (ii)) and/or solvent washing if necessary (See Subsection 216.03.01). Large areas of contamination occurring during fabrication shall be blast cleaned again to Preparation Grade Sa. 2 (See Subsection 216.03.03 (i)).
- b) Before painting, all weld areas shall be blast cleaned to Preparation Grade Sa. 2 to remove all welding slag, spatter and alkaline deposits in the vicinity of the welds.
- c) When fabrication is completed and the surfaces cleaned as required in Subsections 216.08 (a) and 216.08 (b), they shall be inspected prior to the application of paint.
- d) Immediately after passing inspection and before any contamination has occurred, prime all steel surfaces with one coat of DOH A-2 Primer applied by spray (See Subsections 216.05.04 through 216.05.06) to a uniform dry film thickness of 35 to 50  $\mu\text{m}$ .
- e) Unless otherwise specified the following surfaces shall not be shop coated:
  - i) Surfaces which will be in contact with concrete.
  - ii) Faying surfaces on all field connections.
  - iii) Areas to be field welded shall have no paint applied for a distance of at least 100 mm back from the weld surface.
- f) Surfaces inaccessible after erection shall receive the field coats of paint (See Subsection 216.10) in the shop before shipment to the erection site.
- g) A minimum of 16 hours drying time shall be required between the application of any paint in the shop and the moving or handling of any piece so painted. This period may be increased by the Ministry Representative in cases where poor drying conditions exist, such as shop areas open to the weather in winter months.

**216.09 Field Repair of Shop Painting** - After the complete erection of shop coated steel members the following procedure shall apply:

- a) All field weld areas shall be blast cleaned to Preparation Grade Sa. 2 (See Subsection 216.03.03 (i)) to remove all welding slag, spatter and alkaline deposits in the vicinity of the welds.

**Note:** This cleaning shall include the 100 mm set back (See Subsection 216.08 e (iii)) whether shop coated or not.
- b) All areas of the shop coat which have been damaged during handling, shipping and erection, and all field connections shall be cleaned by Manual Cleaning to Preparation Grade St. 3 (See Subsection 216.03.02 (ii)) and/or Solvent Washing (See Subsection 216.03.01) as necessary.



c) All areas which have been cleaned to bare metal as required by Subsections 216.09 (a) and 216.09 (b) above shall be painted with a shop coat of DOH A-2 Primer applied by brush all to the approval of the Ministry Representative.

### 216.10 Field Painting

**216.10.01 Cleaning** - Before field painting commences, the surfaces shall be cleaned by Manual Cleaning to Preparation Grade St. 3 (See Subsection 216.03.02 (ii)) and/or Washing (See Subsection 216.03.01).

**Note:** Washing will be required when the shop coat as a whole has been contaminated with air-borne dirt, dust, salt, chemicals, etc.

All cleaned surfaces shall be inspected before any paint is applied.

**216.10.02 Field Coats** - After approval of inspected surfaces required in Subsection 216.10.01, the following three field coats shall be applied:

i) **First Intermediate Coat:** DOH B-1 applied by spray to a uniform dry film thickness of 35 to 50  $\mu\text{m}$ .

ii) **Second Intermediate Coat:** DOH B-3 White if finish colour is to be DOH C-4 Grey or DOH C-9 Yellow.

**OR** DOH B-2 Non-leaving Aluminum if DOH C-3 Silver is the finish colour.

**OR** DOH B-4 Grey if finish colour is to be DOH C-2, C-5, C-6, C-7, C-8 or C-10.

In all cases, the second intermediate coat shall be applied by spray to a uniform dry film thickness of 25 to 40  $\mu\text{m}$ .

iii) **Finish Coat:** Any DOH C-Series Finish Coat as specified applied by spray to a uniform dry film thickness of 25 to 40  $\mu\text{m}$ .

Each coat must be properly dry before the next coat is applied (See Subsection 216.07).

If for any reason the specified dry film thickness is not obtained, an additional coat shall be applied without additional expense to the Ministry.

**216.10.03 Finish Coat** - The Finish Coat shall not be applied until all concrete work is finished.

In addition to the field cleaning specified in Subsection 216.10.01, all cement or concrete spatter and drippings shall be completely removed before paint is applied. Such cleaning shall be done immediately after the concrete is placed and before the cement or concrete is set. If the cleaning is delayed and removal of the spatter and drippings causes damage to the paint, the damaged surface shall be repainted with the full number of coats applied to that time.

**216.10.04 Paint: Protection** - Wet paint shall be protected against damage from dust or other detrimental foreign matter. If necessary, painting shall be delayed until the cause of the dust, etc. has abated.

**216.10.05 Damage** - Damage to adjacent property, vehicles, pedestrians and other portions of the structure due to the painting operations is the sole responsibility of the Contractor and shall be made good without any additional expense to the Ministry.

**216.11 Maintenance Painting** - Unless otherwise specified, the following procedures for maintenance painting shall apply:



a) Before Maintenance painting starts the surfaces shall be cleaned by Manual Cleaning to Preparation St. 3 (See Subsection 216.03.02 (ii)) and/or Washing (See Subsection 216.03.01).

**Note:** Washing will be required when all or parts of the structure have been contaminated with air- or water-borne dust, salt, chemicals, etc.

Only loose, cracked, brittle or non-adherent paint shall be removed. All exposed edges of sound paint shall be properly feathered. Spot cleaning shall be conducted in a manner which will minimize damage to sound paint.

b) Before the application of a finish coat to the entire structure, all areas, which have been cleaned to bare metal, shall be spot primed and painted with three coats as follows:

i) **Primer:** DOH A-2 applied by brush to a uniform dry film thickness of 35 to 50  $\mu\text{m}$ .

ii) **First Intermediate Coat:** DOH B-1 applied by brush or spray to a uniform dry film thickness of 35 to 50  $\mu\text{m}$ .

iii) **Second Intermediate Coat:** DOH B-3 White if finish colour is to be DOH C-4 Grey or DOH C-9 Yellow.

**OR** DOH B-2 Non-leafing Aluminum if DOH C-3 Silver is the finish colour.

**OR** DOH B-4 Grey if finish colour is to be DOH C-2, C-5, C-6, C-7, C-8 or C-10.

In all cases, the Second Intermediate coat shall be applied by brush or spray to a uniform dry film thickness of 25 to 40  $\mu\text{m}$ .

**Note:** Primer DOH A-2 may be applied by spray if blast cleaning to Preparation Grade Sa. 2 or better has been specified as the cleaning method.

c) When spot painting (See Subsection 216.11 (b)) is completed, the entire structure shall be given one coat of any DOH C-Series Finish coats, as specified, applied by spray to a uniform dry film thickness of 25 to 40  $\mu\text{m}$ .

**Note:** Where the new finish coat specified is a different colour to that existing the Special Provisions may require the appropriate second intermediate coat of Subsection 216.11 b (iii) be applied to the whole structure.

d) Damage to adjacent property, vehicles, pedestrians and other portions of the structure due to the painting operations shall be made good without additional expense to the Ministry. No paint equipment, scaffolding, etc. shall obstruct traffic or pedestrians, except by written permission of the Ministry Representative, in which case proper warning signs, barricades, etc. shall be placed, maintained and removed without additional expense to the Ministry. If necessary, flagperson(s) will be required, which shall also be supplied without expense to the Ministry subject to Section 194 Part D.

**216.12 Special Coating -** When coating systems other than the DOH Standard system (See Subsections 216.08 (d), 216.10.02, 216.11 (b) and 216.11 (c)) are to be used, the requirements of this specification shall be modified as follows and as specified in the Contract or Order for Extra Work:

a) Two-package chemically cured coating systems such as catalyzed epoxies, and other special systems such as vinyl, chlorinated rubber, etc. shall only be applied to newly blast-cleaned surfaces, Preparation Grade Sa. 2 (See Subsection 216.03.03 (i)). Such coating shall not be applied over the DOH system. If both the standard system and a special coating system are used on one structure, the special coating shall be applied first, so that



any slight overlap between systems shall be the standard system over the special system and not vice versa.

**b)** In the case of two component coatings, the catalysts, curing agents or hardeners shall be added to the base paint after the latter has been thoroughly mixed (See Subsection 216.05.01). The proper volume of catalyst, also thoroughly mixed if pigmented, shall then be slowly poured into the required volume of base with constant agitation. The mixture shall be mixed until the two components are thoroughly blended. Care shall be taken to ensure that material on the sides and on the bottom of the can are incorporated. The mixture shall be used within the time interval specified by the manufacturer (typically more than 30 minutes, and less than 8 hours). Unused portions shall be discarded at the end of the time period.

If the addition of thinners is permitted (See Subsection 216.05.01) they shall be added after the two components are thoroughly mixed together.

The manufacturer's instructions concerning temperature and humidity conditions during application and cure shall be strictly adhered to (typical requirements for epoxy coatings are minimum temperature of surface, air and material of 13°C, and a maximum relative humidity of 80%).

**c)** Zinc-rich paints shall only be applied to newly blast-cleaned surfaces Preparation Grade Sa. 3 (See Subsection 216.03.03 (iii)) if the vehicle is inorganic or Preparation Grade Sa. 2 1/2 (See Subsection 216.03.03 (ii)) if the vehicle is organic. This applies to all Shop, Field and Maintenance cleaning and to all weld cleaning. Zinc-rich paints shall only be applied directly to the steel surface.

If the material is of a catalyzed type, the mixing of the two components shall be as specified in Subsection 216.12 (b). The zinc powder is normally supplied separately and must be added to the liquid component(s) slowly and thoroughly mixed. After mixing, the material shall be filtered through a 0.60 mm to 0.25 mm screen. During application, the material shall be mixed continuously by means of a mechanical agitator in the paint containers.

The manufacturer's instructions concerning temperature and humidity conditions during application and cure shall be adhered to.

**216.13 Inspection** - All work supplied under this specification shall be subject to acceptance by inspection and all parts of the work shall be accessible to the Ministry Representative.

All cleaning shall be inspected before paint is applied. Each coat of paint shall be inspected before the succeeding coat is applied.

A coat of paint will only be accepted provided that none of the following faults are apparent:

- a)** Sags, runs, holidays, pinholes, orange peel, shadowing or other application defects.
- b)** Poor coverage at rivet heads, bolts, plate edges, crevices, pockets, corners or re-entrant angles.
- c)** Surfaces damaged mechanically by moving scaffolding, equipment, etc., or damaged by rain, flying dust, etc., or damage from any other cause.

Rejected painted surfaces shall be made to comply with all requirements of this specification at the sole expense of the Contractor and without additional cost to the Ministry. Small affected areas may be repaired and touched up; large affected areas shall involve the repair and application of a complete recoat on the area affected.

Areas with insufficient dry film thickness shall be completely recoated to achieve the required thickness without additional expense to the Ministry.



**216.14 Measurement and Payment** - Shop painting (including repairs in the field to shop painting) of structural steel shall be considered as incidental to the fabrication, and all costs in connection with cleaning and painting shall be included in the contract price for the supply and fabrication of the structural steelwork.

Field and Maintenance painting of steel structures shall, unless otherwise provided for in the Special Provisions, be paid for at the price bid per tonne of steel. Payment, as above, shall be accepted as full compensation for everything furnished and done, including the supply of any thinners which may be required to facilitate application and for clean-up of equipment. The paint will be supplied by the Ministry unless otherwise specified in the Contract.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 218

### CONCRETE FOR MINOR WORKS

**218.01 General** - The whole work shall be carried out in accordance with the best modern practice of cement concrete manufacture.

The Ministry Representative shall be the sole judge as to the suitability of the materials, their quantity, quality and condition; of the Contractor's plant, equipment and personnel; of the time and manner of carrying out the work and of every operation and matters incidental thereto.

**218.02 Cement** - Portland cement shall conform to CSA Standard A5 - Portland Cement

**218.03 Aggregates** - The aggregates shall be the best procurable and shall comprise inert, inorganic mineral matter only. They shall be satisfactorily clean, durable, hard, sound, strong and tough and be practically free from alkali, clay, dust, loam, mica, shale, silt or any material deemed objectionable in nature or amount by the Ministry Representative. None of the particles comprising the aggregates shall be coated nor be unreasonably flat or elongated. No aggregate may be used while frozen.

**218.04 Grading of Aggregates** - The grading of all aggregates shall be such as will produce an economic, plastic, practical, smooth, workable mix which when placed, set and cured, will produce a concrete of the best character possible.

To secure such grading, the Ministry Representative may require the Contractor to modify the aggregate by the addition or subtraction of proportions of specific sizes of material. The cost of making such modifications, by screening or otherwise, shall be included in the price bid by the Contractor.

**218.05 Classes of Concrete** - The classes of concrete are A, B, C, X and Y. Each class of concrete shall be used in that part of the structure in which it is called for on the plans, or where directed by the Ministry Representative. Unless otherwise specified, Class "A" Concrete shall be used. The following requirements shall govern unless otherwise shown on the plans:

Class "A" concrete shall be used for all superstructures, except as noted below, and for reinforced substructures except where the sections are massive and lightly reinforced. The more important items of work included are slabs, beams, girders, columns, arch ribs, box culverts, reinforced abutments and retaining walls, and reinforced footings. Class "A" concrete shall be used for precast piles and cribbing. Class "A" concrete shall also be used for work exposed to salt water.

Concrete deposited in water shall be Class "A" with 10% additional cement.

Class "B" concrete shall be used for mass footings, pedestals, massive pier shafts and gravity walls with none or only a small amount of reinforcing.

Class "C" concrete shall be used for very massive unreinforced sections.

Class "X" concrete shall be used for massive sections lightly reinforced where a higher grade than Class "B" is desired.

Class "Y" concrete shall be used in thin reinforced sections, for handrails, except as specified, for precast railing under "Railings," and for filler in steel grid floors.

**218.06 Classification and Proportioning of Concrete Mixtures** - The materials shall be proportioned so that the amount of cement contained in 1 m<sup>3</sup> of concrete in place shall be approximately as shown in Table [218-A](#).



The proportions of water, cement, coarse and fine aggregate to be used shall be determined by the Ministry Representative on the ground from time to time. Measurement shall be made by mass, and the accuracy must be satisfactory to the Ministry Representative; all such allowances for contained water, bulking or otherwise must be made as found necessary to allow for the proportions ordered by the Ministry Representative, being accurately provided in each batch.

**TABLE 218-A CLASSIFICATION AND PROPORTIONING OF CONCRETE MIXTURES**

CLASS OF CONCRETE	REQUIRED STRENGTH AT 28 DAYS MPa	SIZE OF COARSE AGGREGATE (mm)	CEMENT (40 kg) SACKS PER CUBIC METRE	MAXIMUM WATER CONTENT PER SACK OF CEMENT (ℓ)
A	20	25.0 to 5.0	9.1	21.0
B	15	50.0 to 5.0	7.0	24.5
C	10	63.0 to 5.0	5.6	30.0
X	17.5	50.0 to 5.0	9.2	24.0
Y	20	20.0 to 5.0	9.8	21.0

**218.07 Machine Mixing** - The mixing of concrete, unless otherwise authorized by the Ministry Representative, shall be done in a batch mixer of type approved by the Ministry Representative. The mixer shall be equipped with a suitable charging hopper, water storage and water measuring device. It shall be cleaned at frequent intervals when in use and maintained in such a condition that the mixing action will be unimpaired.

**218.08 Duration of Mixing** - The mixing of each batch shall continue not less than 90 seconds after all the materials are in the mixer, during which time the mixer shall rotate at a speed of from 14 to 20 revolutions per minute unless otherwise rated by the manufacturer.

**218.09 Hand Mixing** - When hand mixing is authorized by the Ministry Representative, it shall be done on a watertight platform. The fine aggregate shall be spread on the platform and the cement spread evenly over the fine aggregate. The material shall then be shovelled into a cone shaped pile by casting centrally on the pile. This pile shall then be divided by casting into two or more cone shaped piles and the operation of dividing and reuniting continued until the batch is uniform in colour. Only sufficient water to produce the desired consistency shall then be added by sprinkling as the batch is turned. The coarse aggregate previously moistened shall then be mixed with the mortar in the manner specified for mixing fine aggregate and cement.

**218.10 Retempering** - The rettempering of concrete or mortar which has partially hardened, that is, remixing with or without additional cement, aggregate or water, will not be permitted.

**218.11 Forms** - Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the plans.

Lumber used in forms shall be free from warp. For exposed surfaces, it shall be dressed to a uniform width and thickness and be free from loose knots, decay or other defects. For unexposed surfaces and rough work, undressed lumber may be used if means are taken to prevent leakage of mortar.

Lumber once used in forms shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned and smoothed before being used again.



Unless otherwise specified, suitable moulding or bevels shall be placed at the angles of forms to round or bevel the edges and re-entrant angles of the concrete.

For internal ties, bolts and rods shall preferably be used. They shall be so arranged that when the forms are removed no metal shall be within 25 mm of any exposed surface. Wire ties may be permitted only on light work; they shall not be used through surfaces where discolouration will be objectionable.

The inside of forms shall be coated with non-staining mineral oil, or other approved liquid or thoroughly wetted, (except in freezing weather). Where oil is used it shall be applied before the reinforcement is placed.

Care shall be taken to ensure that forms do not become dried and warped before concrete is deposited. Before concrete is placed, forms and reinforcement shall be checked and approved by the Ministry Representative.

Forms shall not be disturbed until the concrete has adequately hardened. The proper time for removal of forms shall be determined by the Ministry Representative.

Care shall be taken when removing forms to avoid roughening or injuring corners and to keep edges sharp.

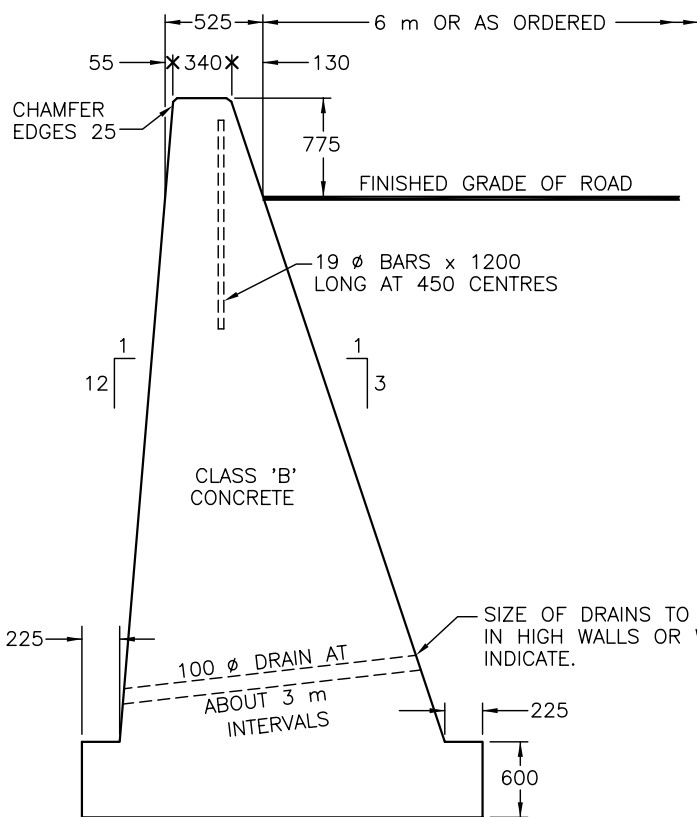
Whenever forms are removed from showing faces before the concrete has become hard and dry, the surface of the concrete shall be immediately wetted and kept wet for at least three days. Defects in showing faces shall be rectified to the satisfaction of the Ministry Representative.

**218.12 Depositing Concrete** - Concrete shall be deposited in forms in approximately uniform horizontal layers as near as practicable in its final position to avoid re-handling. Depositing shall be continuous until the unit of operation, as approved by the Ministry Representative, is complete and as rapid as practicable to ensure bonding of the successive layers.

Concrete shall be thoroughly worked around reinforcement and embedded fixtures and into all parts of the forms. Coarser particles shall be worked back from the face of the forms.

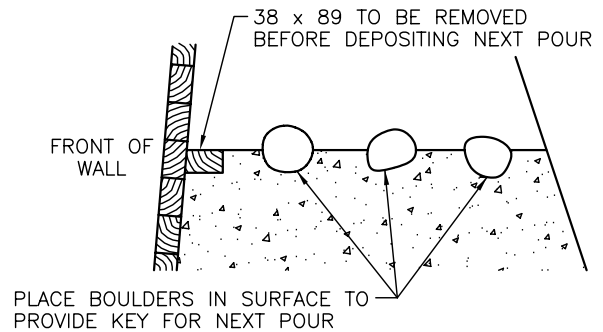
**218.13 Basis of Payment** - Payment shall be made at the prices bid per cubic metre of concrete and per pound of steel in place in and forming part of the finished structure; and in accordance with the various classes of concrete as defined in the specifications and as set out in the "Schedule of Approximate Quantities and Unit Prices"; and shall be accepted as full compensation for everything furnished and done in connection therewith.



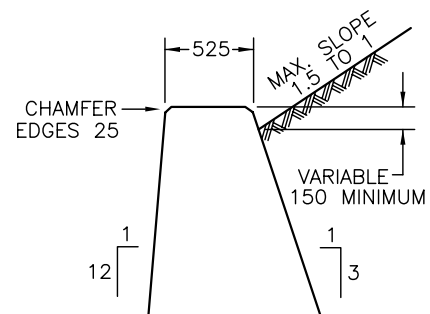


SECTION

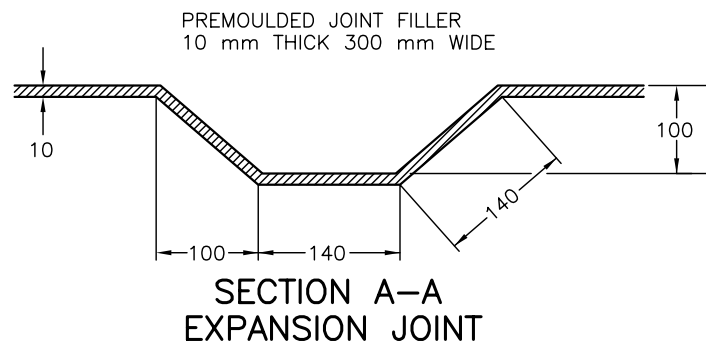
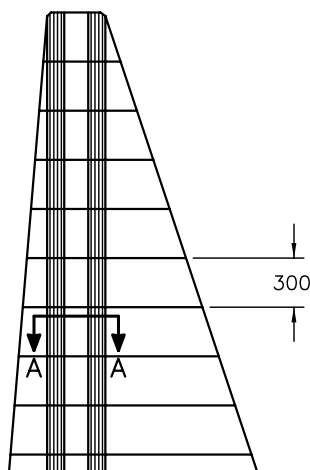
BACKFILLING BEHIND THE WALL MUST BE DEPOSITED IN HORIZONTAL LAYERS, OR PREFERABLY IN LAYERS SLOPING AWAY FROM THE WALL.



DETAIL OF HORIZONTAL CONSTRUCTION JOINT



SECTION MODIFIED FOR TOE WALL



JOINTS TO BE APPROXIMATELY 9 m APART

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 232

### METAL BIN-WALL

**232.01 Scope** - This Section covers the construction of metal bin type retaining walls in accordance with the general layout and details indicated on Drawings [1-SP232](#) through [3-SP232](#).

**232.02 Provision of Metal Bin-Wall** - Bin-wall of the design (depth to height ratio) called for shall be constructed at the locations and as shown on the Contract Drawings with the materials, accessories, and necessary ancillary work all in accordance with the details indicated on the Contract Drawings, Specifications, Special Provisions, the standard Drawings or as directed by the Ministry Representative.

**232.03 Materials** - Bin-wall material will be supplied by the Ministry in accordance with Subsection [145.16](#) f.o.b. the Contractor's job site yard or Ministry's yard, as noted, except where required by the Contract Drawings, Specifications or Special Provisions for supply in whole or in part by the Contractor.

Structure backfill shall be well-graded granular material with a maximum size of 75 mm and not more than 8% passing a 0.075 mm (#200) sieve.

#### **232.04 Construction**

**232.04.01 Construction** - Construction shall be carried out with all labour, tools, equipment and incidentals necessary to complete all bin-walling in accordance with good work practice.

**232.04.02 Foundation** - Foundation excavation shall be carried down to the depths shown on the drawings or to such greater depths as the Ministry Representative may direct. In the case where rock, hardpan or other unyielding material is encountered, it shall be removed to a depth 300 mm below the design grade and backfilled in accordance with Subsection [232.04.04](#).

**232.04.03 Erection** - The units shall be assembled as shown on the drawings. Components shall be handled carefully and any which are damaged shall be removed and replaced with new components at the Contractor's expense.

Before the assembly bolts are tightened, columns shall be checked for line and batter or plumbness, where applicable.

**232.04.04 Backfill** - Structure backfill material shall be placed as wall foundation, backfill inside the bins, and for 0.6 m behind the wall. The material shall be spread in layers not exceeding 150 mm in thickness and shall be compacted to a minimum 95% of the laboratory density obtained by the current ASTM test method D 698.

Backfill inside each bin shall progress simultaneously but not in advance of that behind the wall.

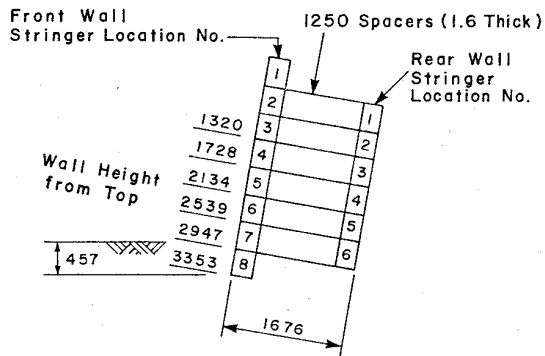
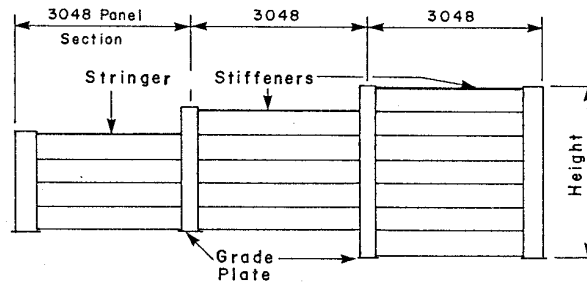
**Note:** Bin wall may be backfilled as it is erected provided that the columns are held in correct position while the backfill is being placed.

**232.05 Measurement and Payment** - Metal bin-type retaining walls shall be paid for at the price bid per square metre of facial area of wall which shall be full compensation for taking delivery, hauling to the site and erection.

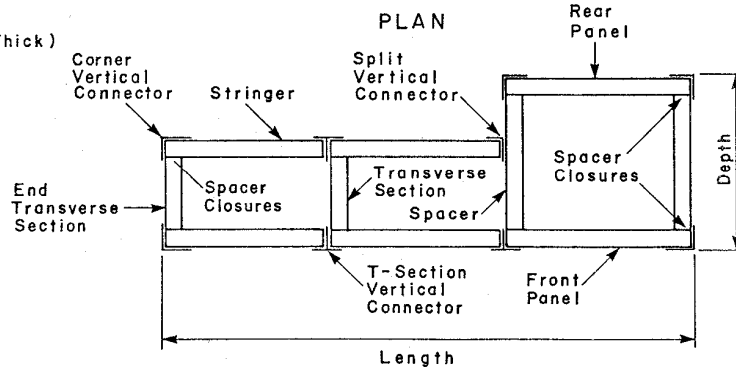
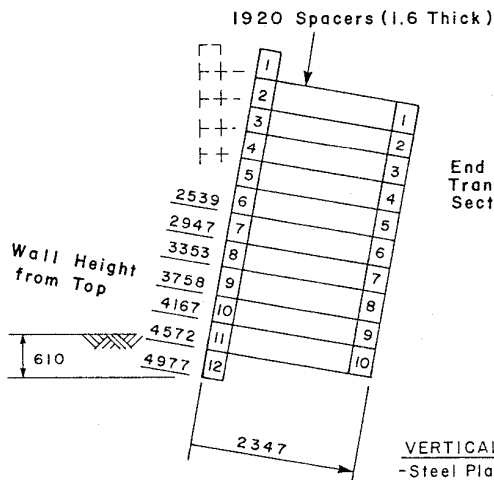
Excavation for foundation shall be paid for at the rate bid for "Foundation Excavation".

Backfill in and around the bins shall be paid for at the rate bid for "Structure Backfill" which shall be full compensation for supplying, hauling to the site, placing and compaction.

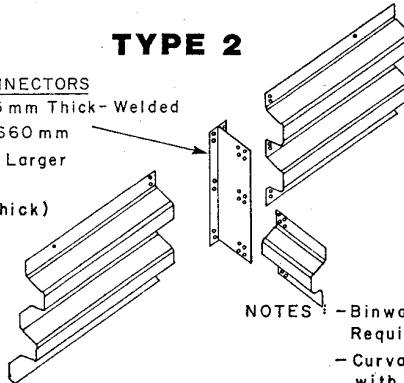
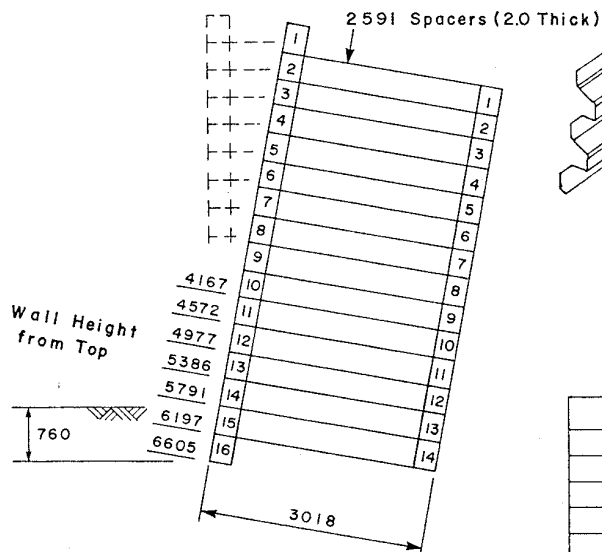


**DESIGN A****ELEVATION**

Front Wall Stringer Location No.	Rear Wall Stringer Location No.	Thickness
1 through 8	1 through 6	1.6
9 through 12	7 through 10	2.0
13 through 16	11 through 14	2.8

**DESIGN B****TYPE 2**

**VERTICAL CONNECTORS**  
 - Steel Plate 6.3 mm Thick - Welded  
 - Max. Length 3660 mm  
 - Splice Plate if Larger

**DESIGN C**

- NOTES**
- Binwall Batter = 1:6 or Vertical as Required by Contract Drawings.
  - Curvature Detail in accordance with Suppliers Manual.
  - All measurements in millimetres.
  - For Type 1 see Dwg. 3-SP 232.

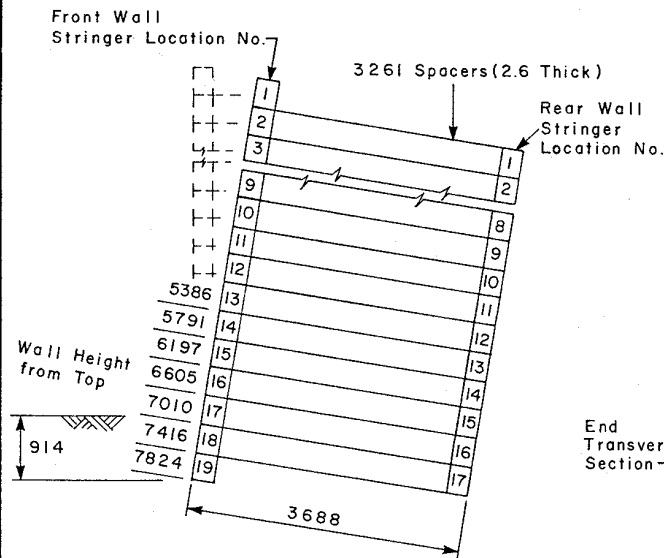
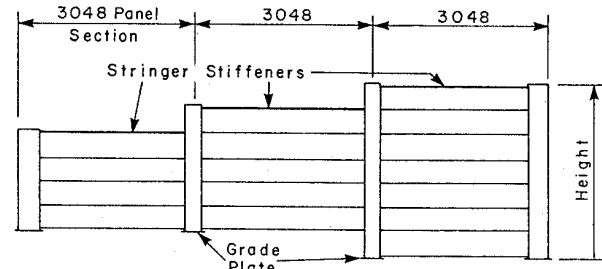
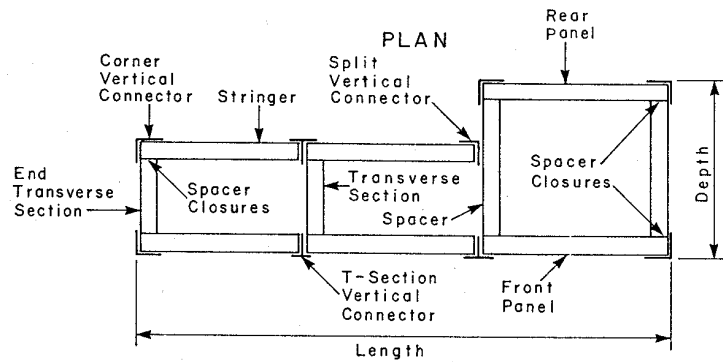
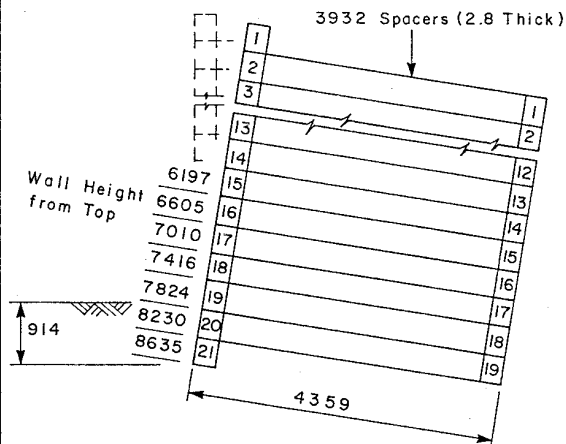


Province of  
British Columbia

Ministry of  
Transportation  
and Highways

Revisions	TYPE 2 METAL BIN WALL DESIGNS A, B & C	
	Date 1985 11 06	Approved MGE/elm Exec. Dir. of Engineering
		SPECIFICATION DRAWING No. 1-SP 232

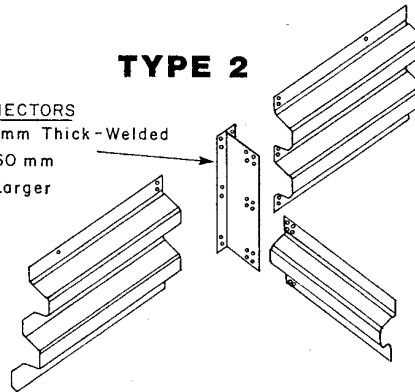
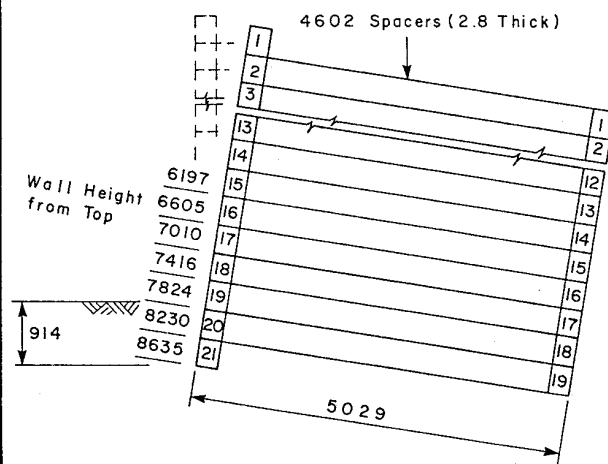


**DESIGN D****ELEVATION****PLAN****DESIGN E**

Front Wall Stringer Location No.	Rear Wall Stringer Location No.	Thickness
1 through 8	1 through 6	1.6
9 through 12	7 through 10	2.0
13 through 19	11 through 17	2.8
20 and 21	18 and 19	3.5

**TYPE 2****VERTICAL CONNECTORS**

- Steel Plate 6.3 mm Thick - Welded
- Max. Length 3660 mm
- Splice Plate if Larger

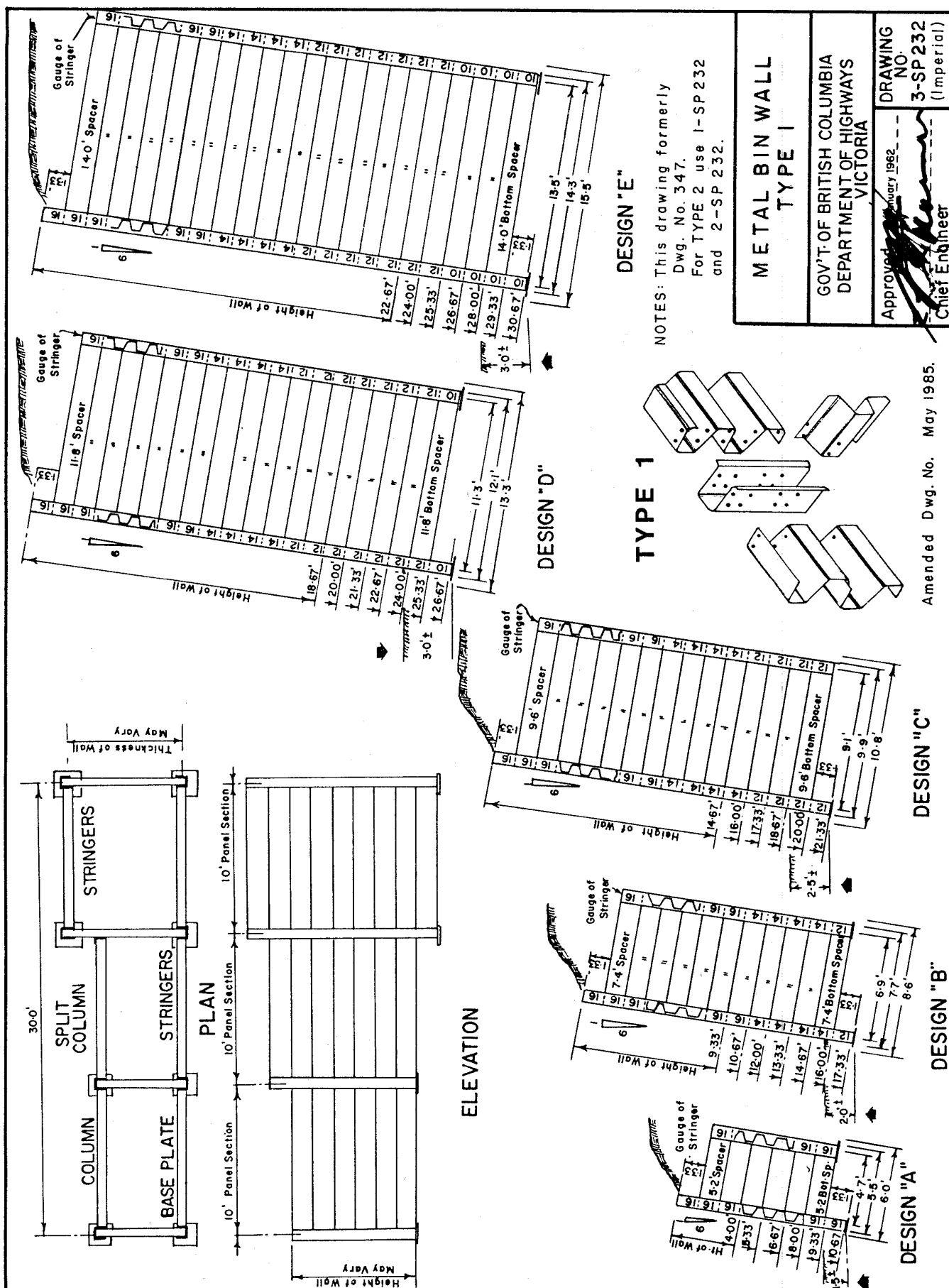
**DESIGN F**

- NOTES: - Binwall Batter = 1:6 or Vertical as Required by Contract Drawings.  
 - Curvature Detail in accordance with Suppliers Manual.  
 - All Measurements in Millimetres.  
 - For Type 1 see Dwg. 3-SP232.

Province of  
British ColumbiaMinistry of  
Transportation  
and Highways

Revisions	TYPE 2 METAL BIN WALL DESIGNS D, E & F		
	Date	Approved	SPECIFICATION DRAWING No. 2-SP 232
	1985	MGE/ctm	
	11		
	06	Exec. Dir. of Engineering	







## SECTION 303

### CULVERTS

#### DESCRIPTION

**303.01 Scope** - This Section covers the construction of pipe culverts where shown on drawings or as directed by the Ministry Representative, and in accordance with the drawings and Special Provisions covering the various types. The trench and other preparatory work shall be approved by the Ministry Representative before actual placing starts.

Culvert materials are normally durable under most conditions. Factors which affect the service life of culvert material are corrosion from acidic and alkaline conditions in the soil, abrasion from bedload carried by the stream and freeze/thaw cycles. Plastic culverts shall not be exposed to direct sunlight (ultra violet rays) or installed in areas where there is a potential fire hazard.

Filtration control devices, such as filter cloth, must not be attached to the end of culverts.

Obstructed culverts shall be cleared as outlined in Subsection [165.10.07](#).

All culvert pipe, unless otherwise specified, will be supplied by the Contractor to the requirements of the Contract, generally in accordance with Subsection [145.15](#).

#### MATERIALS

**303.11 Concrete Pipe** - Reinforced concrete pipe supplied will have joints of the tongue and groove type all in accordance with the current specification ASTM C 76 Series, and plain concrete pipe in accordance with the current specification ASTM C 14 series.

**303.12 Corrugated Steel Pipe** - Corrugated steel pipe supplied will conform to the requirements of Section [320](#).

**303.13 Polyethylene Pipe** - The materials for pipe and fitting shall be high-density polyethylene meeting ASTM D 3350 Cell Classification 335420C.

**303.14 PVC Pipe** - See Subsection [318.03](#)

**303.15 Structural Plate Corrugated Steel Pipe/Pipe-Arch (Field Assembled) Culverts** - Special care shall be taken in the installation of all structural plate corrugated steel culverts.

#### CONSTRUCTION

**303.31 Concrete, Corrugated Steel and Plastic Pipes** - This Subsection does not cover Structural Plate Corrugated Steel Pipe/Pipe Arch installations.

**303.31.01 Trenching** - A trench shall be excavated to the depth and grade as given by the Ministry Representative. A full trench condition shall be provided wherever possible, but in no case shall the trench be of lesser depth than 50% of the diameter of the pipe. If, in the opinion of the Ministry Representative, the material in the bottom of the excavation is of such a character as to cause unequal settlement along the length of the culvert, the trench shall be dug below the grade to such depth as ordered, backfilled with gravel or other suitable material, and thoroughly tamped or otherwise compacted to ensure a firm and uniform foundation.

Where rock, in either ledge or boulder formation, occurs in the bottom of the trench, the rock shall be excavated below grade and backfilled with sand or fine gravel so that there will be at least a 150 mm cushion between the rock and all portions of the pipe.

The bottom of the trench upon which the pipe is to be laid shall be shaped so that at least 25% of the circumference of the pipe is in contact with the prepared foundation for the whole of its length.

**303.31.02 Placing** - Concrete pipe shall be laid beginning at the lower end with the groove and pointing up-grade. Pipe with elliptical reinforcement shall be laid with the minor axis of the reinforcement as marked by the manufacturer in a vertical position.

When jointing concrete pipes the trench shall be in a dry condition and the joints shall be cleaned and wetted before sealing with mortar. The mortar shall consist of one part Portland Cement to two parts fine sand, mixed to the proper consistency. Sealing shall be neatly and thoroughly done, and the interior of the pipe cleaned of all surplus mortar. Joints shall be kept damp with burlap or earth for at least three days after sealing.

Corrugated steel pipe shall be laid beginning at the lower end with the outside laps pointing up-grade and the longitudinal joint on the side. The separate section shall be firmly jointed together and any steel in joints, which is not thoroughly protected by galvanizing, shall be coated with a suitable asphaltum paint.

**303.31.03 Backfilling** - Backfill and Bedding Material shall consist of mineral aggregate and shall meet the gradation specified in Table [303-A](#).

For metal structures with corrugation depths greater than 63 mm, the backfill maximum particle size may be as high as one-half the corrugation depth or 75 mm whichever is smaller.



Minimum bedding thickness is 150 mm or twice the corrugation depth whichever is greater.

For embankment installation, bedding and backfill will extend two-thirds of the span or 0.9 m beyond the culvert span on either side, whichever is greater. For trench installation, bedding and backfill will extend a minimum of 0.3 m on either side. Backfill will extend to the base of the pavement structure (to the surface in the case of high fines gravel surface) or to a depth of cover of two-thirds of the span (diameter) whichever is less. Bedding and backfill shall be placed in layers not exceeding 150 mm in depth. Backfill shall be placed symmetrically. The differential backfill height on either side of the culvert shall not exceed 0.3 m. Bedding and backfill shall be compacted to a minimum 95% of the laboratory density by following the current ASTM D 698, except the 0.3 m layer immediately above the pipe which shall be placed with no compaction.

**TABLE 303-A GRADATION REQUIREMENTS FOR CULVERT BACKFILL AND BEDDING MATERIAL**

SIEVE SIZE mm	PERCENTAGE PASSING
31.5	100
25	60-100
19	15-100
2.36	10-100
0.075	0-5

**303.31.04 End Walls** - End walls shall be built around the ends of pipe culverts, as directed by the Ministry Representative. The construction of these end walls shall meet the requirements governing the construction of Class "A" concrete (See Subsection [218.05](#)).

**303.31.05 Inlet and Outlet Ditches** - Inlet and outlet ditches to culverts shall be constructed to the lines and levels as given by the Ministry Representative, on the ground. The excavation shall be classified as "Roadway and Drainage Excavation," not "Foundation Excavation."

### **303.32 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts**

**303.32.01 Foundation Excavation** - If a coarse boulder material or solid rock is encountered when preparing the bed of the pipe, the material shall be excavated a minimum depth

of 300 mm below the pipe and backfilled with granular material having a maximum size of 75 mm.

**303.32.02 Backfilling** - All backfill materials for a minimum width of 3 m on either side of the pipe and to a depth of 1 m above the pipe, if grade allows, shall be granular material approved by the Ministry Representative.

End dumped or loose pushed material shall not be piled closer than 3 m from the pipe. Spreading in layers not exceeding 150 mm and compaction shall be carried out by equipment operating parallel to the pipe. The area close to the pipe shall be compacted by small mechanical tampers. No boulders in the backfill material of a size greater than 75 mm shall be closer than 1.2 m to the pipe surface.

Extreme care must be taken to ensure the backfilling operation is carried out equally on both sides of the pipe. Hauling equipment shall not be operated over the pipe until backfill operations have completed a minimum cover of 600 mm over the pipe.

### **MEASUREMENT**

**303.81 Concrete, Corrugated Steel and Plastic Pipe Culverts** – Culvert pipes will be measured by the METRE along its centre line as installed.

**303.82 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts** – The culverts will be measured by the METRE along its centre line as installed.

### **PAYMENT**

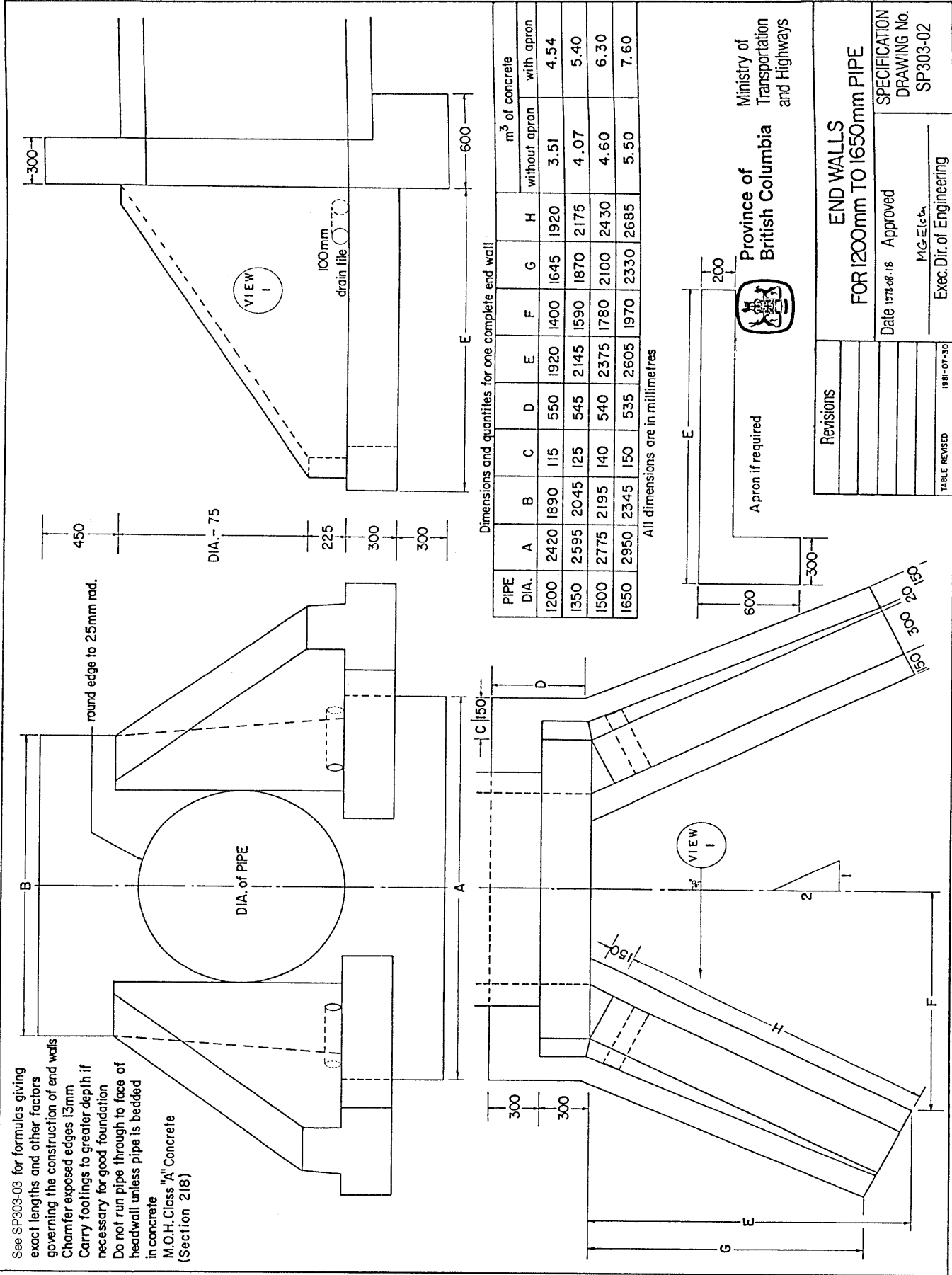
**303.91 Concrete, Corrugated Steel and Plastic Pipe Culverts** - Payment for CULVERT PIPE will be at the Contract Unit Price per metre. The Contract Unit Price shall be accepted as full compensation for everything furnished and everything done in connection therewith, but shall not include payment for excavation, riprap, paving, concrete cradles and end walls; these shall be paid for at their respective prices in the schedule.

**303.92 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts** - Payment for STRUCTURAL PLATE CULVERT PIPE will be at the Contract Unit Price per metre. The Contract Unit Price shall be full compensation for supply and placing all materials, including equipment, and incidentals necessary to complete the work as shown on the drawings. Foundation excavation shall be paid for under the item "Foundation Excavation." All materials excavated for inlet and outlet ditches, for channel work and for backfilling shall be paid for under the item "Roadway and Drainage Excavation."











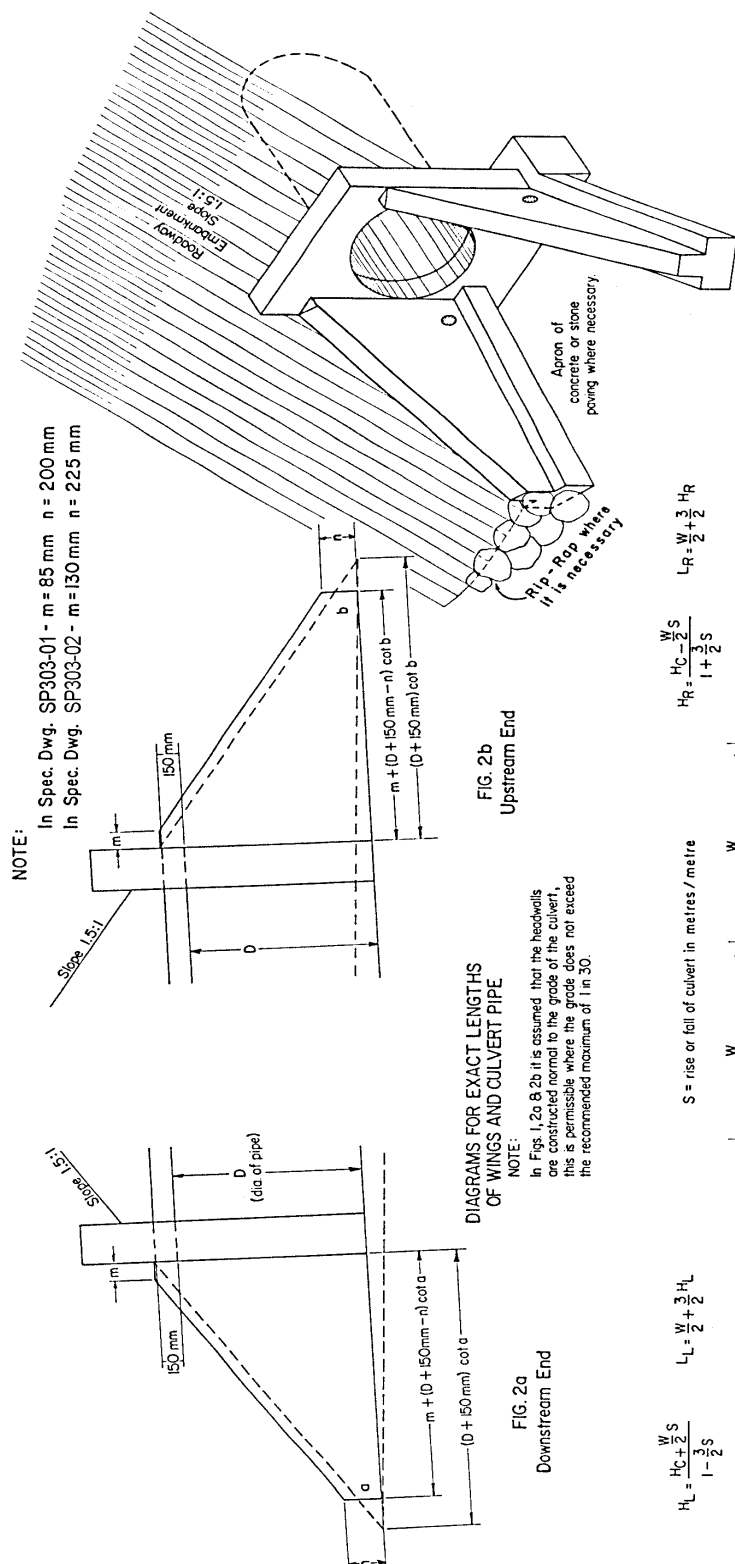


FIG. 3  
GENERAL VIEW OF END  
WALL IN PLACE

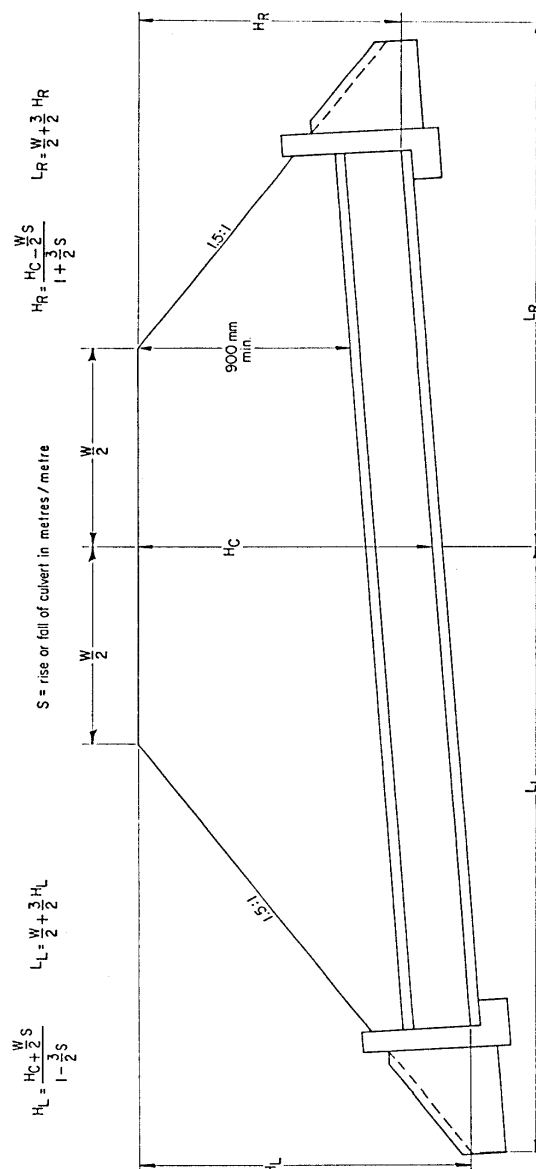
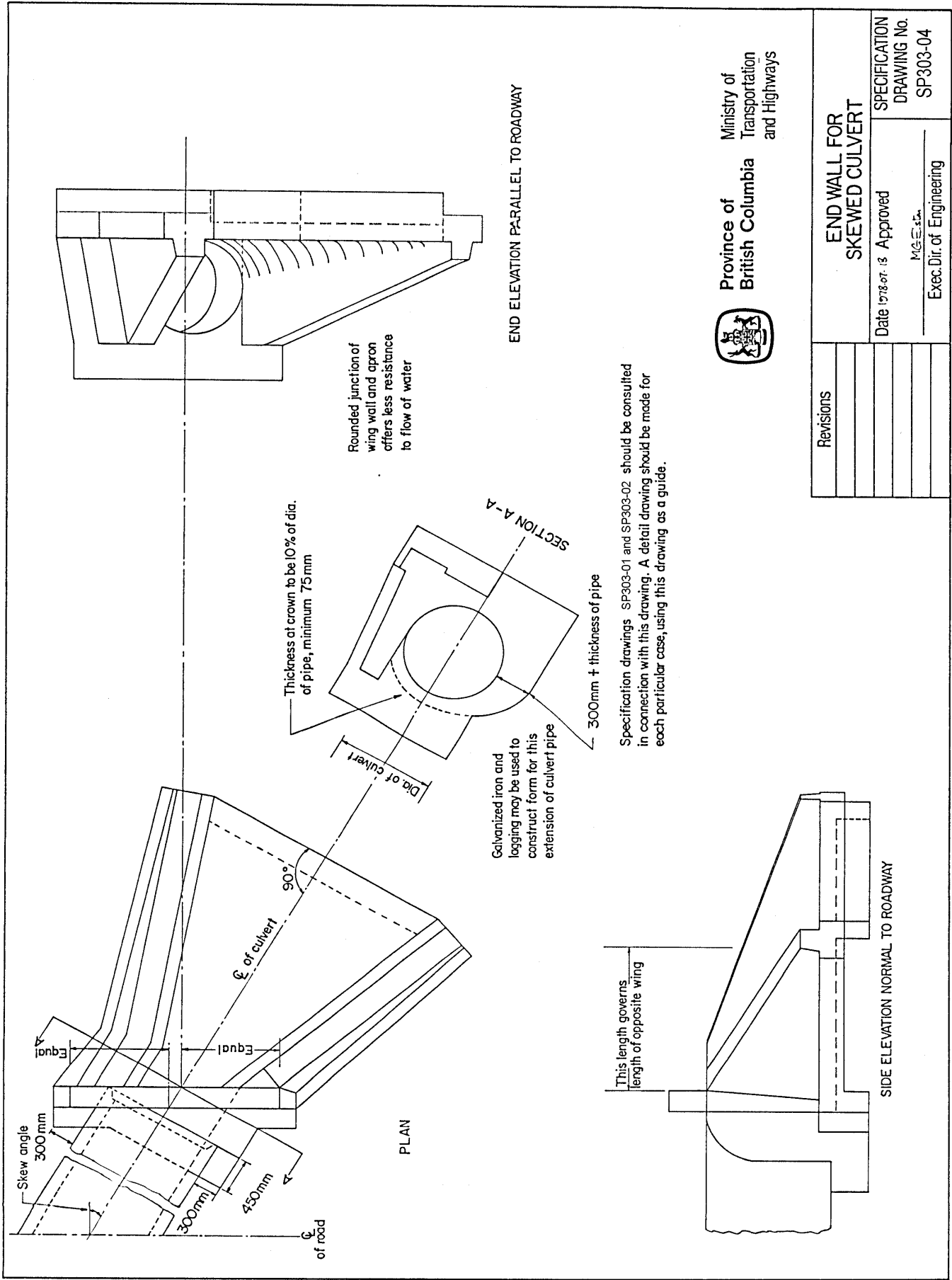


FIG.1 LAYOUT FOR INTERSECTION OF SLOPES

Revisions	<div style="text-align: center;"> <b>PIPE CULVERT LAYOUT FOR END WALLS</b> </div>	<b>SPECIFICATION DRAWING No.</b> SP-303-03
Date 15/8/08 01 Approved _____ M.G. Elze _____ Exec. Dir. of Engineering _____		







PIPE DIMENSIONS		CONCRETE CRADLES				
Inside Diameter mm	Wall Thickness mm	A mm	B mm	C mm	D mm	m <sup>3</sup> per m
600	95	1400	500	100	300	0.45
750	108	1580	605	115	300	0.58
900	121	1755	695	115	300	0.69
1050	133	1935	795	130	300	0.84
1200	146	2110	895	140	300	0.99
1350	159	2290	995	150	300	1.16
1500	172	2470	1100	165	300	1.35
1650	184	2645	1200	180	300	1.53
1800	197	2825	1300	190	300	1.73

## Notes.

Lower part of cradle to be a stiff mix of concrete, lay pipe to established line and grade. Follow immediately with concrete of a workable consistency to the required height. Cradles of these dimensions are for concrete pipe only.

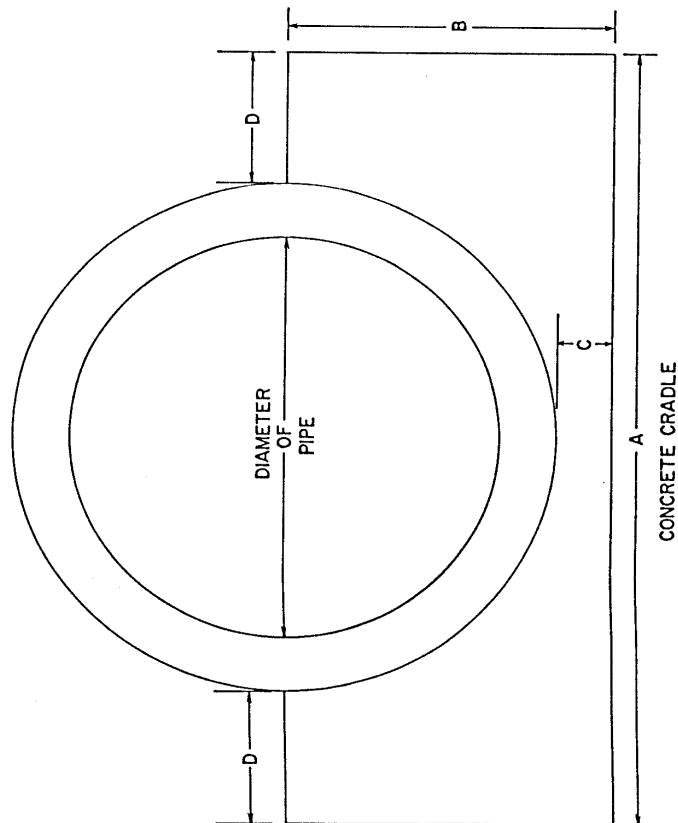
**Use concrete cradles under the following conditions.**

**High fill.**

**Steep culvert grade.**

**Rock foundation.**

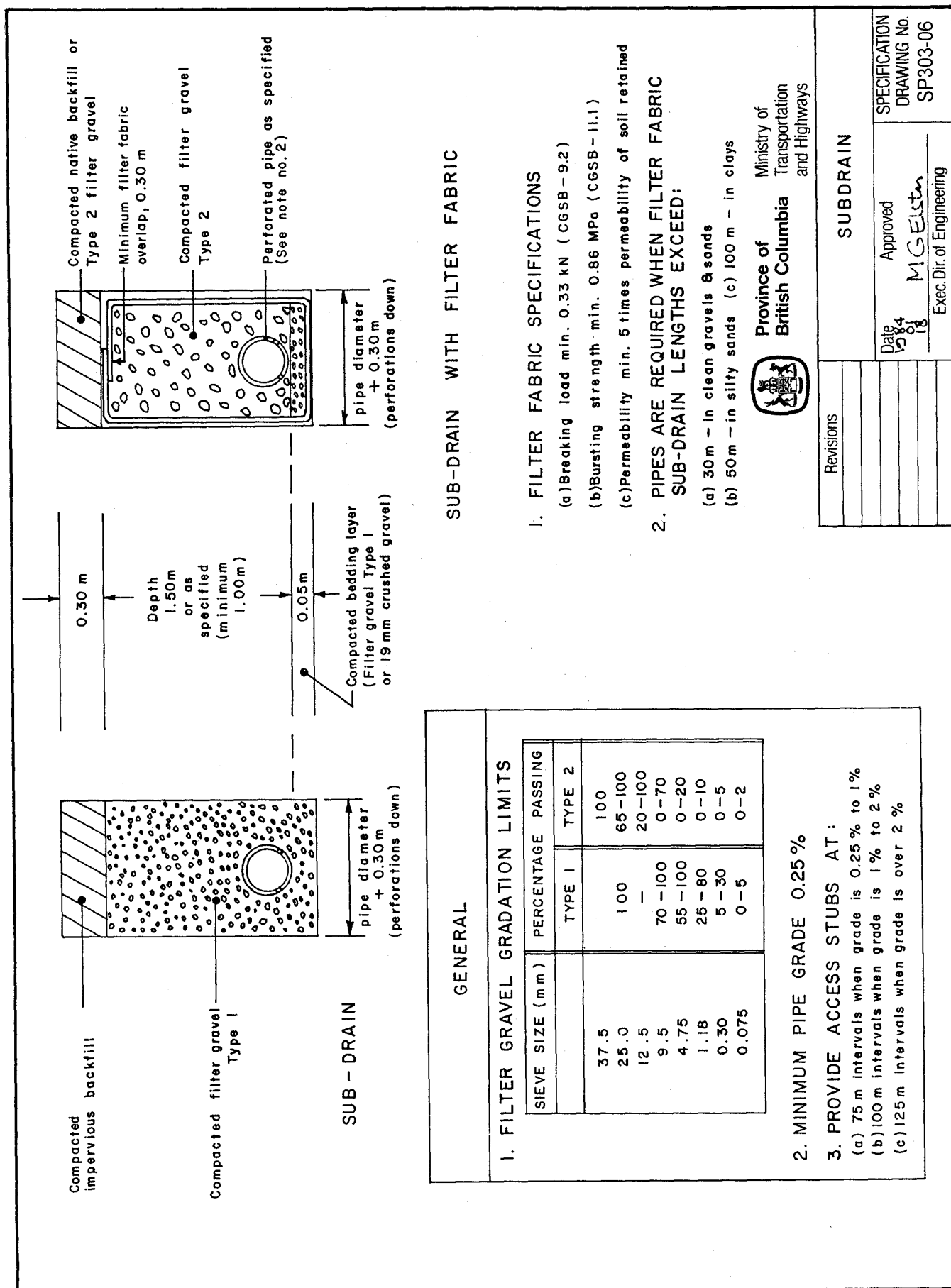
M.O.H. Class "A" Concrete. (Section 218)



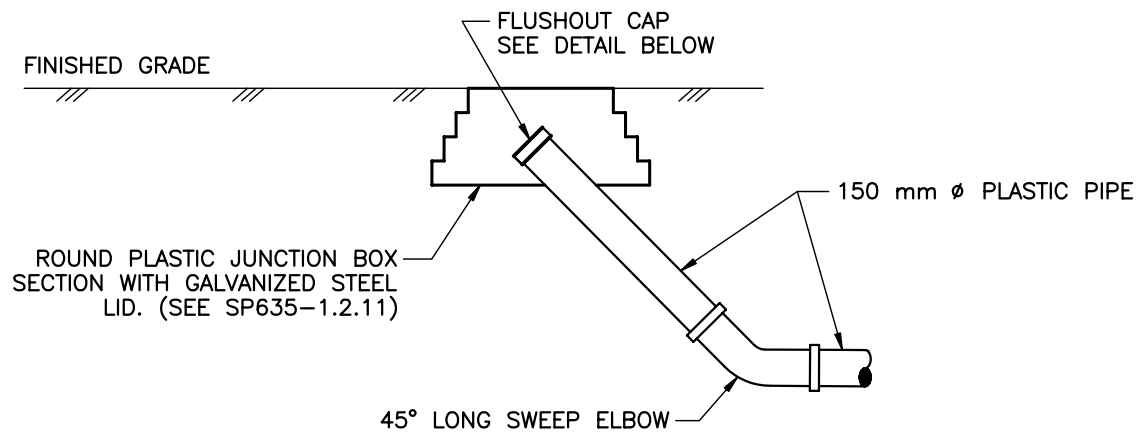
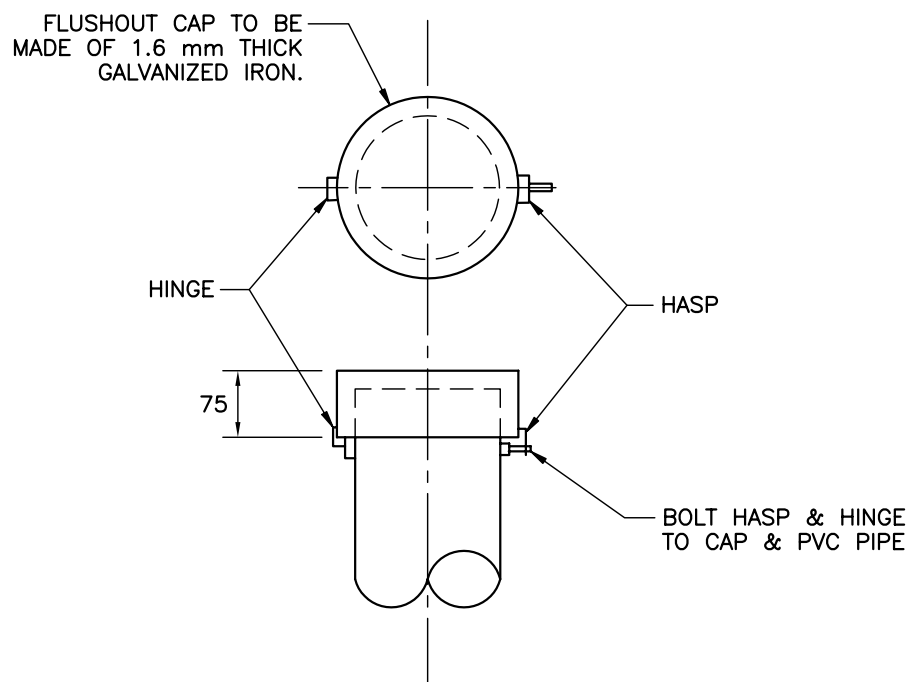
**Province of  
British Columbia**

Revisions	<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"> <p style="text-align: center;"><b>CONCRETE CRADLE FOR CULVERT PIPE</b></p> </div> <div style="width: 60%;"> <p><b>SPECIFICATION DRAWING No.</b>  <b>SP303-05</b></p> </div> </div>	
TABLE REVISED	1981-07-30	<p>Date 1978.07.18 Approved _____</p> <p style="text-align: center;">MGELEN</p> <p>Exec. Dir. of Engineering</p>







FLUSHOUT AND COVER DETAILFLUSHOUT CAP DETAIL

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 308

### COATING SYSTEMS

**308.01 Scope** - This Section defines the coating systems required for shop and field coating of structural steel or wood/concrete surfaces which may be exposed to exterior corrosive conditions.

#### **308.02 Definitions**

**"Shop and Field Coating"** are the series of operations that include the surface preparation, pre-treatment (if required) and application of coatings to structural steel surfaces either in the shop or field. It also includes the supplying of all labor, equipment and materials except those materials specifically exempted. Additionally it includes the drying and protection of newly coated surfaces and the protection of property and traffic as well as the protection of the environment from damages due to any of the above operations.

**"Shop Coating"** is the coating of structural steel in a shop or plant before shipment to the site of erection.

**"Field Coating"** is the coating of new structures at the place of erection.

**"Recoating"** is the removal of all existing coatings down to clean substrate and then coating to specification.

**"Overcoating"** is the application of a succeeding overall coating on an existing coating which has been repaired. Typically, this would be in lieu of a complete recoating.

**"Topcoating"** is the application of a finish coat with a specified colour and dry film thickness, over an existing coat which is ready for overcoating.

The **"Coating Inspector"** referred to shall mean the on-site Inspector acting on behalf of the Ministry.

#### **308.03 Standards and Specifications**

**a) Colour Specifications** using a five digit number refer to the US Federal Specification 595b colour numbers. Colour specification using the L\*a\*b\* values refer to ASTM D 2244, CIE 1976 L\*a\*b\*, D<sub>65</sub> 45/0 degree geometry. DOH colours are cross referenced in the coating colour table.

**b) Calibration of Measuring Instruments** shall be in accordance with SSPC-PA 2 "Measurement of Dry Paint Thickness with Magnetic Gauges." The Contractor shall set aside a suitable area of steel on the structure to be coated and blast the area with the Contractor's equipment and blast abrasive. This area shall be protected from moisture and shall be used as a standard for acceptable blast appearance and blast profile. A portion of the area shall also be used as an area to calibrate dry film thickness (DFT) gauges. It is recognized that the magnetic plane on the blasted surface is above the bottom of the profile. The Contractor shall fill that difference with coating. If requested by the Authority, the Contractor shall calibrate a secondary, portable calibration standard for dry film thickness gauges.

All references to dry film thickness (DFT) are based on instruments calibrated by this method. The metric unit (µm) or imperial unit (mil) can be used interchangeably, at the conversion factor of:

$$1 \text{ mil} = 25 \text{ } \mu\text{m} \quad (1 \text{ mil} = 1 \text{ thousandth of an inch})$$



**308.04 System Selection Table** - This table summarizes the coating systems currently in use.

**COATING SYSTEM SELECTION TABLE (PART 1)**

<b>System Code</b>	<b>Application Area</b>	<b>Structure Environment</b>	<b>Coating System Primer - Midcoat - Topcoat</b>
<b>STRUCTURAL STEEL</b>			
SS1	Steel, Shop	Severe	Inorganic zinc, epoxy, polyurethane
SSWP	Steel, Shop Weldable Primer	Under Development	
SF1	Steel, Field	Severe Field Application	Metallizing, epoxy, polyurethane
SF2	Steel, Field	Moderate to Severe Field Application in General	Organic zinc, epoxy, polyurethane
SF3	Steel, Field	Severe Adjacent buildings/traffic	Metallizing, vinyl, vinyl
SF4	Steel, Field	Moderate to severe Adjacent buildings/traffic	Organic zinc, vinyl, vinyl
SF5	Steel, Field	Moderate	Alkyd on steel
SF6	Steel Field	Moderate to Severe Field Application	Multi-Component Urethane Systems
SFO1	Steel, Field Overcoat	Under Development	Water-based Acrylics and Vinyls
SFO2	Steel, Field Overcoat	Under Development	Water Based Acrylic Epoxy
SFO3	Steel, Field Overcoat	Moderate to Severe	Solvent Based Single Component
SFO4	Steel, Field Overcoat	Moderate to Severe	Solvent Based Surface Tolerant Epoxy
SFO5	Steel, Field Overcoat	Moderate	Alkyd on steel 1-GP-59M alkyds
SFAG	Steel, Field Antigraffiti Coatings	Under Development	Varies with system
SFTA	Steel, Field Touchup Aerosol	Small Damaged Areas, or as a Holding Primer	Rust Inhibitive Primer / Topcoat
SFTB	Steel, Field Touchup Brushable	Small Damaged Areas, or as a Holding Primer	Rust Inhibitive Primer / Topcoat
<b>WEATHERING STEEL</b>			
SW *	Steel, Weathering Field Coatings	Under Development	Two or three coat systems

For a current listing of approved coating systems consult the Recognized Products List available via the Ministry web page at: [www.th.gov.bc.ca/publications/eng\\_publications/geotech/rpb.htm](http://www.th.gov.bc.ca/publications/eng_publications/geotech/rpb.htm)



COATING SYSTEM SELECTION TABLE (PART 2)

System Code	Application Area	Structure Environment	Coating System Primer - Midcoat - Topcoat
<b>CONCRETE</b>			
CF1	Concrete, Field	Under Development	Cementitious
CF2	Concrete, Field	Under Development	Non-Cementitious
CFAG	Concrete, Field Antigrffiti	Under Development	Concrete Antigrffiti
<b>HOT DIPPED GALVANIZING</b>			
GO	Hot Dip Galvanizing, Overcoat	Under Development	
<b>STEEL RAILINGS</b>			
SRF	Steel, Flame-Applied Coatings	Primarily for Railings as Colour Coat	Thermoplastic Powder
SRD	Steel, Fluid Bed Dipped Coatings	Primarily for Railings as Colour Coat	Thermoplastic Powder
SRG	Steel, Hot Dip Galvanizing	Preferred Treatment for Removable Railings	Hot Dip Galvanizing
SRM	Steel, Metallizing	Primarily for non-removable posts	Zinc - Zinc Aluminum Powder or Wire
<b>WOOD</b>			
WFR	Wood, Railings and Rubrails	Moderate to Severe	Primer, Midcoat, Topcoat 1-GP-59M alkyds
WF1	Wood, Fencing	Under Development	Oil based sealer 1-GP-145M
WF2	Wood, Fencing	Under Development	Latex Based Sealer 1-GP-204M
WFT	Wood, Field Touchup	Moderate to Severe	Primer, Midcoat, Topcoat 1-GP-59M alkyds
<b>INLAND FERRIES</b>			
InFer	Steel Inland Ferries	Under Development	

**308.05 Not Used**

**308.06 System Selection Criteria** - The selection of a coating system is dictated by the location and environment of the structure to be coated. The location can be in a shop or in the field. The field location may necessitate a specific maintenance regimen, for example, a complete recoat or a single overcoat. The environment may be moderately or severely corrosive. In addition, there may be concerns with limiting overspray.

The following general comments apply to all coatings supplied.

- Coatings shall not be mixed and matched between suppliers, or within a supplier's product line.
- All coatings shall bear the manufacturer's name and address, batch number, paint type, DOH or US Federal Specification 595b color code, and mixing and application instructions. All labels shall contain the requisite WHMIS label information and be accompanied by a valid MSDS sheet
- All coatings are subject to inspection and testing before acceptance or at times of application.



**308.07 Coating Systems** - Each system is defined on the following pages. Systems under development are not included. Each system defined in this Section has been approved through testing. Each system that has been developed has a qualified products list of approved products. Products not on the qualified products list shall not be used without prior approval from the Ministry Representative. This list can be reviewed via the Ministry web page at: [www.th.gov.bc.ca/publications/eng\\_publications/geotech/rpb.htm](http://www.th.gov.bc.ca/publications/eng_publications/geotech/rpb.htm)

The following pages list each system in the order appearing in Subsection 308.04 - Coating System Selection Table.

**STEEL, SHOP - SYSTEM SS1: Inorganic Zinc primer, Epoxy midcoat, Polyurethane topcoat**

**MoT Usage:** This system is designed for use in a shop coating environment where the new steel is protected from the weather during coating and curing. The system will provide good service in a severe field environment.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
65-90 $\mu\text{m}$ (2.5-3.5 mils)	None	Midcoat 65-90 $\mu\text{m}$ (2.5-3.5 mils)	100-150 $\mu\text{m}$ (4-6 mils)	None	40-65 $\mu\text{m}$ (1.5-2.5 mils)
SSPC-SP10 "Near-White Metal", Minimum Profile: 38-50 $\mu\text{m}$ (1.5-2.0 mils)					

**Total Thickness:** 200 - 300  $\mu\text{m}$  (8 - 12 mils) not including stripe coat.

**Notes for use:**

- Depending on the system chosen, the inorganic zinc primer may require a mist coat to prevent bubbling in the mid-coat material.
- Inorganic zinc shall be dry and cured before stripe and topcoats.
- Note that any stripe coating shall be placed on top of the inorganic zinc and brushed to a strip width of 50 mm (2 inches) minimum.
- While most of the above systems require SSPC-SP 10 surface preparation, SSPC-SP 5 "White Metal" blasting will typically give a longer service life.



**STEEL, FIELD - SYSTEM SF1: Metallizing primer, Epoxy midcoat, Polyurethane topcoat**

**MoT Usage:** This system is designed for use in a field coating environment where extreme exposure such as splash zones on through trusses, fence posts (panels should be galvanized), bearings, expansion joints and any steel exposed to de-icing chemical solutions dripping from above; structures adjacent to pulp mills or smelters are present.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Zinc wire or powder 150-200 µm (6 - 8 mils)	15% thinned midcoat 65-90 µm (2.5 - 3.5 mils)	None	100-150 µm (4 - 6 mils)	None	40-65 µm (1.5 - 2.5 mils)
SSPC-SP5 "White Metal", Minimum Profile: 38-50 µm (1.5-2 mils)					

**Total Thickness:** 325 - 500 µm (14.0 - 20.0 mils) including seal coat.

**Notes for use:**

- Previously galvanized railings, fence posts, and panels shall be "Brush-off" cleaned and top-coated with a different colour than the structure, after a wash primer is applied.
- Metallizing can be either of using zinc or zinc:aluminum (85:15) alloy wire thermal spray, flame process or spray and fuse powder process.
- If field steel has been exposed to weather, deicing salts or dirt, a high pressure water wash shall be done before blasting.

**STEEL, FIELD - SYSTEM SF2: Organic Zinc primer, Epoxy midcoat, Polyurethane topcoat**

**MoT Usage:** This system is designed for use in a field coating environment that is moderate to severe.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
65-90 µm (2.5 - 3.5 mils)	None	Midcoat over primer 65 - 90 µm (2.5 - 3.5 mils)	125 - 200 µm (5 - 8 mils)	None	40 - 65 µm (1.5 - 2.5 mils)
SSPC-SP 6 "Commercial Blast", Minimum Profile: 38 - 50 µm (1.5 - 2.0 mils)					

**Total Thickness:** 230 - 350 µm (9.0 - 14.0 mils) not including stripe coat

**Notes for use:**

- Note that any stripe coating shall be placed on top of the primer coat and brushed to a strip width of 50 mm (2 inches) minimum.



**STEEL, FIELD - SYSTEM SF3: Metallizing primer, Vinyl midcoat, Vinyl topcoat**

**MoT Usage:** This system is designed for use in a field coating environment where extreme exposure areas such as splash zones on through trusses, fence posts (panels should be galvanized), bearings, expansion joints and any steel exposed to de-icing chemical solutions dripping from above and no adjacent pulp mills or smelters are present. This system shall be used only when epoxies cannot be used due to adjacent buildings, traffic, etc.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Zinc wire or powder 15 - 200 µm (6 - 8 mils)	65-90 µm (2.5 - 3.5 mils)	None	125 - 200 µm (5 - 8 mils)	None	65 - 100 µm (2.5 - 4.0 mils)
SSPC-SP 5 "White Metal", Minimum Profile: 38 - 50 µm (1.5 - 2.0 mils)					

**Total Thickness:** 400 - 590 µm (16.0 - 23.5 mils) including seal coat

**Notes for use:**

- The metallizing material may be pure zinc or zinc:aluminum (85:15) alloy wire or powder.
- Metallizing can either use zinc wire thermal spray, flame process or spray and fuse powder process.

**STEEL, FIELD - SYSTEM SF4: Organic Zinc primer, Vinyl midcoat, Vinyl topcoat**

**MoT Usage:** This system is designed for use in a field coating environment that is moderate to severe. This system shall be used only when epoxies cannot be used due to adjacent buildings, traffic, etc. (e.g., pedestrian overpasses)

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
65 - 90 µm (2.5 - 3.5 mils)	None	65 - 90 µm (2.5 - 3.5 mils)	125 - 200 µm (5 - 8 mils)	None	65 - 100 µm (2.5 - 4.0 mils)
SSPC-SP 6 "Commercial Blast", Minimum Profile: 38 - 50 µm (1.5 - 2.0 mils)					

**Total Thickness:** 250 - 390 µm (10.0 - 15.5 mils) not including stripe coat

**Notes for use:**

- Note that any stripe coating shall be applied on top of the organic zinc primer, brushed to a strip width of 50 mm (2 inches) minimum.



**STEEL, FIELD - SYSTEM SF5: Alkyd System on Steel**

**MoT Usage:** This system is designed for use in a field coating situation where more moderate conditions are expected.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Alkyd Primer CAN/CGSB 1.40-89	None	Midcoat over prime	Alkyd Midcoat CAN/CGSB 1.59-89M	None	Alkyd Topcoat CAN/CGSB 1.59-89M
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Total Thickness:** 140 - 175  $\mu\text{m}$  (5.5 - 7 mils)

**Notes for use:**

- While this system will work on the cleaning regimen listed above it will perform better on SSPC SP-6 "Commercial blast".

**STEEL, FIELD - SYSTEM SF6: Multi-Component Urethane Systems**

**MoT Usage:** This system is designed for use in a field coating environment in moderate to severe exposure areas.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Zinc Primer 60 - 90 $\mu\text{m}$ (2.5 - 3.5 mils)		Midcoat Material 75 - 100 $\mu\text{m}$ (3 - 4 mils)	75 - 100 $\mu\text{m}$ (3 - 4 mils)		90 - 120 $\mu\text{m}$ (3.5 - 5 mils)
High Pressure Water Wash then SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Total Thickness:** 225 - 310  $\mu\text{m}$  (9 - 12.5 mils) not including stripe coat

**Notes for use:**

- These materials contain isocyanates which are toxic and which may cause allergic sensitivities. Avoid Contact.



**STEEL, FIELD OVERCOAT - SYSTEM SFO1: Water-based Acrylic or Vinyl System**

**MoT Usage:** This system is designed for use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools before repair and topcoating.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
90 - 120 $\mu$ m (3.5 - 5 mils)		90 - 120 $\mu$ m (3.5 - 5 mils)	90 - 120 $\mu$ m (3.5 - 5 mils)		90 - 120 $\mu$ m (3.5 - 5 mils)
High Pressure Water Wash then SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Total Thickness:** 270 - 360  $\mu$ m (10.5 - 14.5 mils) not including stripe coat

**Notes for use:** None

---

**STEEL, FIELD OVERCOAT - SYSTEM SFO3: Solvent-based System Single Component**

**MoT Usage:** This system is designed for use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools before repair and topcoating. It may be used in moderate to severe exposures.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
None	As per manufacturer's instructions				As per manufacturer's instructions
Rusted areas and Delaminated areas: High pressure water wash then SSPC SP-11 "Powertool Cleaning to Bare Metal". Undamaged areas high pressure water wash					

**Notes for use:**

- The coatings listed under SF03 are too different to list a common application thickness.
- This system is designed as a two coat system.



**STEEL, FIELD OVERCOAT - SYSTEM SFO4: Solvent-based Surface Tolerant Epoxy**

**MoT Usage:** This system is designed for use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools. It may also be used in damp or condensing areas on structures. It may be used in moderate to severe exposures.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
100 - 150 $\mu\text{m}$ (4 - 6 mils)		100 - 150 $\mu\text{m}$ (4 - 6 mils)			100 - 150 $\mu\text{m}$ (4 - 6 mils)
Rusted areas and Delaminated areas: High pressure water wash then SSPC SP-11 "Powertool Cleaning to Bare Metal". Undamaged areas high pressure water wash					

**Total Thickness:** 200 - 300  $\mu\text{m}$  (8 - 12 mils) not including stripe coat

**Notes for use:**

- This system is designed as a two coat system.
- This material shall not be applied to damp or condensing surfaces.
- Edges shall be feathered and where possible, bare areas shall be built up to the level of the previous topcoat before overcoating.

**STEEL, FIELD OVERCOAT - SYSTEM SFO5: Alkyd System on Steel Structures**

**MoT Usage:** This system is designed for use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools. It may be used for moderate exposures.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Alkyd Primer CAN/CGSB 1.40-89	None	Midcoat over prime	Alkyd Midcoat CAN/CGSB 1.59-89M	None	Alkyd Topcoat CAN/CGSB 1.59-89M
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Total Thickness:** 140 - 175  $\mu\text{m}$  (5.5 - 7 mils)

**Notes for use:**

- While this system will work on the cleaning regimen listed above it will perform better on SSPC SP-6 "Commercial blast".
- Edges shall be feathered and where possible, bare areas shall be built up to the level of the previous topcoat before overcoating.



**STEEL, FIELD TOUCH-UP COATING SYSTEM - SYSTEM SFTA: Aerosol Products**

**MoT Usage:** This system is designed for touch-up use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Zinc Rich Inhibitive alkyd	None	None	None	None	As needed
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Notes for use:**

- All coatings will work better on a properly prepared surface (i.e., high pressure water washed and sandblasted).
- These products shall not be used on faying surfaces.

**STEEL, FIELD TOUCH-UP COATING, BRUSHABLE PRODUCTS - SYSTEM SFTB: Brushable Products**

**MoT Usage:** This system is designed for brush application in a field touchup situation where the original alkyd system is intact and where loose rust/paint can be removed by hand/power tools.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
Alkyd Primer CAN/CGSB 1.40-89  Zinc Rich Inhibitive alkyd	None	Midcoat over prime	Alkyd Midcoat CAN/CGSB 1.59-89M	None	Alkyd Topcoat CAN/CGSB 1.59-89M
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning" or SP-11 Industrial					

**Notes for use:**

- These products require different surface preparation and application thickness, refer to manufacturer's literature.
- All coatings will work better on a properly prepared surface (i.e., high pressure water washed and sandblasted).
- These products shall not be used on faying surfaces.



**PRODUCTS FOR UNIQUE SITUATIONS: ENCLOSED SPACES AND PROTECTED AREAS -**  
**SYSTEM U1: Products for Enclosed Spaces and Protected Areas**

**MoT Usage:** This system is designed to use in situations where low temperature and /or high humidity preclude the use of other coating systems.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
	Penetrating Sealer	Topcoat material if needed	None	None	235 - 285 $\mu\text{m}$ (9.5 - 11.5 mils)
SSPC SP-6 "Commercial" blast.					

**Total Thickness:** 235 - 285  $\mu\text{m}$  (9.5 - 11.5 mils) not including stripe coat.

**Notes for use:**

- The penetrating sealer shall be used to penetrate and seal rusted areas and lap joints that cannot be cleaned.
- The topcoat is a soft, inhibitive coating that is surface tolerant and application tolerant. It does not harden enough to place in areas that are abrasive, traveled, or accessible to the public.

**PRODUCTS FOR UNIQUE SITUATIONS: LOW TEMPERATURE / HIGH HUMIDITY -**  
**SYSTEM U2: Products for low temperature / high humidity use**

**MoT Usage:** This system is designed to use in situations where low temperature and/or high humidity preclude the use of other coating systems.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
65 - 90 $\mu\text{m}$ (2.5 - 3.5 mils)	None	Midcoat material	75 - 100 $\mu\text{m}$ (3 - 4 mils)	None	65 - 90 $\mu\text{m}$ (2.5 - 3.5 mils)
SSPC SP-6 "Commercial" blast, New Steel SP-10 Near white blast.					

**Total Thickness:** 200 - 280  $\mu\text{m}$  (8 - 11 mils) not including stripe coat.

**Notes for use:**

- These coatings are moisture cured, therefore the entire can shall be used at once to prevent reaction of the coating in the can resulting from contact with atmospheric moisture.
- This coating may also be used at normal coating temperatures and humidities.



### STEEL, RAILINGS, FLAME APPLIED COATINGS - SYSTEM SRF: Flame applied Railing Coatings

**MoT Usage:** This system is designed as a colour coat for railings exposed to a high abrasion environment.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
None	None	None	None	None	TII 20
High pressure water blast , then MINIMUM SSPC SP-10" Surface profile 3 - 4 mils.					

**Total Thickness:** 250 - 500  $\mu\text{m}$  (10 - 20 mils)

**Notes for use:**

- This is a specialty coating available only from Thermoplastic Industries Inc.
- The application shall be made in one pass to avoid disbondment problems at the interface.
- This product is prone to osmotic blistering if soluble salts are present on the substrate. For this reason, the bottom of the posts shall be metallized for the first 50 mm above the concrete if the post is bolted in or imbedded to concrete.
- An application of 10 to 20 mils is considered ideal.
- The primary use for this coating is for non-removable steel fence posts in the field.
- Currently only a bright yellow colour has been tested and approved. Other colours shall be tested for light fastness before use.

### STEEL, RAILINGS, FLUID-BED DIPPED COATINGS - SYSTEM SRD: Fluid-bed Dipped Coatings

**MoT Usage:** This system is designed for coating railings exposed to a high abrasion environment.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
None	None	None	None	None	TII 20
MINIMUM SSPC SP-10" Surface profile 3 - 4 mils.					

**Total Thickness:** 250 - 500  $\mu\text{m}$  (10 - 20 mils)

**Notes for use:**

- This is a specialty coating available only from Thermoplastic Industries Inc.
- An application of 10 to 20 mils is considered ideal.
- The method involves heating the railing after cleaning and then dipping it in a fluidized thermoplastic powder. Then the railing is placed in an oven to melt the coating material to a uniform layer. The method is particularly good for intricate sections.
- Railings with small tubes shall not be coated with this method.
- Currently only a bright yellow colour has been tested and approved. Other colours shall be tested for light fastness before use.



**STEEL, RAILINGS, HOT DIP GALVANIZING - SYSTEM SRG: Hot Dip Galvanizing Coating of Removable Rails**

**MoT Usage:** This system is designed for use where small parts such as railing can be removed and sent to the galvanizing plant.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
None	None	None	None	None	Zinc
Surface preparation is done at the galvanizing plant.					

**Notes for use:**

- This is the preferred treatment for rails as it provides a very long life combined with low maintenance.
  - The colour is grey, if colour is required, then the SRF or SRD coatings shall be specified.
  - Sections with closed tubes shall not be done without relieving the tubes by drilling holes to let the hot gases escape. This shall be designed into the item.
  - Both the inside and outside of sections are coated with zinc.
  - Defects include inclusions, dross, runs and mottling.
- 

**STEEL, RAILINGS AND POSTS, METALLIZING - SYSTEM SRM: Metallizing For Steel Railings And Posts**

**MoT Usage:** This system is used primarily to coat steel fence posts for corrosion protection.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
None	None	None	None	None	Zinc 200 - 400 $\mu\text{m}$ (8 - 15 mils)
SSPC SP-5 White metal, 1.5 to 2.5 mil profile					

**Total Thickness:** 200 - 400  $\mu\text{m}$  (8 - 16 mils)

**Notes for use:**

- Substrate shall be very clean.
- Zinc or zinc:aluminum (85:15) wire or powder can be used.
- This material is available from a number of different manufacturers and if metallurgically pure, will provide equivalent service.



**WOOD, FIELD, RAILINGS AND RUBRAILS - SYSTEM WFR: Alkyd System Wood Railings and Rubrails**

**MoT Usage:** This system is designed for use in a field over coating situation for wooden railings and rubrails, where the original alkyd system is intact or where loose paint can be removed by hand/power tools.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
DOH A-3 CGSB 1-GP-189M	None	None	DOH B-3 White DOH B-4 Grey CAN/CGSB 1.59M89	None	DOH D-1 White latex CAN/CGSB 1.138-93  DOH D-2 White alkyd CAN/CGSB 1.59M89  For guardrails: DOH D-3 White alkyd CAN/CGSB 1.28M89  For sign/posts: DOH T-1 Green alkyd DOH T-2 Yellow DOH T-3 White CAN/CGSB 1.59M89
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Notes for use:** None

**WOOD, FIELD TOUCHUP - SYSTEM WFT: Alkyd System for Touchup on Wood Structures**

**MoT Usage:** This system is designed for use in a field over coating situation where the original alkyd system is intact or where loose rust/paint can be removed by hand/power tools.

PRIMER	SEALCOAT	STRIPECOAT	MIDCOAT	2nd MIDCOAT	TOPCOAT
DOH A-3 CGSB 1-GP-189M	None	None	DOH B-3 White DOH B-4 Grey CAN/CGSB 1.59M89	None	DOH D-1 White latex CAN/CGSB 1.138-93  DOH D-2 White alkyd CAN/CGSB 1.59M89  For guardrails: DOH D-3 White alkyd CAN/CGSB 1.28M89  For sign/posts: DOH T-1 Green alkyd DOH T-2 Yellow DOH T-3 White CAN/CGSB 1.59M89
SSPC SP-2 "Hand Tool Cleaning" or SP-3 "Power Tool Cleaning"					

**Notes for use:** None



## SECTION 312

### STEEL TRAFFIC BARRIERS AND WOOD POSTS

**312.01 Scope** - This Section covers the quality and manufacture of steel beam guardrails, wood posts and accessory material for use as traffic barriers.

The layout and installation of materials specified in this Section are generally indicated on the Drawings of the [SP312](#) series.

Section [604](#) covers the installation of the material of this Section together with the construction of ancillary work

**312.02 Standards of Reference** - Standards of various authorities are referred to herein generally in sufficient detail for the purpose of this Section. For detailed testing and other requirements reference to the Standards may be necessary from actual copies obtainable as follows:

CSA	Canadian Standards Association: Standards Sales, 178 Rexdale Blvd, Rexdale, ON M9W 1R3
ASTM:	American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103
ARTBA:	American Road and Transportation Builders Association, 525 School Street SW, Washington DC 20024
AASHTO:	American Association of State Highway and Transportation Officials, 444 North Capitol Street N.W., Suite 225, Washington, DC 20001.

**312.03 General** - Steel traffic barriers shall consist of rail sections fabricated for installation to develop a continuous beam strength with the necessary safety end feature components.

All rail sections and other components shall match the design profiles and dimensions of the AASHTO/ARTBA requirements cited below for full interchangeability of similar components regardless of the source of manufacture.

The name and/or trademark of the manufacturer and the metal thickness shall be clearly and permanently marked on each component clear of the splicing overlap and on the opposite face to the traffic side.

**312.04 Steel Beam Guardrail** - Guardrail shall be manufactured from open hearth, electrical furnace or basic oxygen semi-spring steel sheet galvanized before forming (or afterwards as may be specified or ordered for authorized special installations) all in general accordance with the AASHTO Standard Designation M-180 "Corrugated Sheet Steel Beams for Highway Guardrail" and shall conform to the following detail requirements.

**Note:** Design and part numbers are taken from the ARTBA Technical Bulletin #268-B, current edition (unless stated to be BCH Part numbers) and are reproduced on Drawings [6-SP312](#) through [10-SP312](#).

**312.04.01 Beam Classification (According to the AASHTO Standard)** - The shape, class and type together with the ARTBA design and part numbers shall be as specified on the Purchase Order, Work Order or Special Provisions in accordance with any applicable Contract Drawings and/or Drawings of the [SP312](#) series, as selected from the following, the standard Drawings or as may be otherwise required or approved.

**i) Shape** - W-Beam are for ARTBA Design G4 and MB4 installations and Thrie-Beam for Design G9 and MB9 installation and both shall be accurately formed to profile, dimensions and tolerances of the AASHTO Standard with overall cross sections of 311 mm x 85 mm and 508 mm x 85 mm respectively (ARTA Designation RE-3 and RE-63).

**ii) Class and Type** - Unless otherwise specified or ordered, beams shall be Class A, Type 1. Authorized special installations for corrosive conditions and environment of industrial and marine areas may necessitate a Class A, Type 2 requirement.

**Note:** Type 4 shop primed beams will not normally be specified.

**iii) Length** - Normally 3.81 m (12' 6") nominal length beams (4.19 m, +0, -75 mm overall) will be required.

**Note:** 1.9 m (6' 3") and other lengths if specified or ordered may be considered a special order.

**iv) Punchings** - In addition to joining bolt holes, punchings may be designed as 7.82 m, 3.81 m or 1.9 m (25' 0", 12' 6", 6' 3" respectively), see Drawings, [1-SP312](#) and [2-SP312](#) for requirements.

**Note:** Punchings at 0.95 m, 1.27 m (3' 1 1/2" and 4' 2") and other centres if specified or ordered may be considered a special order.

**v) Curved Rails** - For curved rail data see Drawing [SP312-11](#).

#### 312.04.02 Metal

**i) Properties** - Properties of the base metal for beams and any transition section shall conform to the following requirements:



- Yield point minimum: 345 MPa
- Tensile strength minimum: 483 MPa
- Elongation minimum in 50 mm: 12%

**Note:** End and buffer sections shall have minimum yield point of 227 MPa and minimum tensile strength of 310 MPa.

**ii) Sheet Thickness** - Class A base metal thickness shall be 2.8 mm nominal (2.67 mm minimum) and for special authorized installations Class B 3.5 mm nominal (3.43 mm minimum).

**iii) Sheet Widths** - Sheet Widths shall be minimum 483 mm for W-Beams and 749 mm for Thrie-Beams both with a permissible tolerance of minus 3.2 mm.

**312.04.03 Zinc Coating** - Zinc for coating beams and ancillary sections shall be at least equal to “Prime Western” conforming to CSA Standard HZ2 or AASHTO Standard M120 (ASTM B 6) “Slab Zinc”.

The coating shall be firmly bonded to the base metal whether fabrication is from galvanized sheet or galvanizing is specified after fabrication.

The average mass of zinc coating Type 1 (AASHTO M180) shall be 610 g/m<sup>2</sup> for three specimens but minimum 550 g/m<sup>2</sup> for any individual specimen being the total amount on both sides of the sheet or beam. When Type 2 is specified or ordered (see Subsection 312.04.01 (ii)) the coating shall have average 1220 g/m<sup>2</sup> and 1100 g/m<sup>2</sup> individual minimums.

**312.04.04 Quality of Work** - Beams shall be punched for splice and post bolts in strict conformity with the AASHTO Standard to the designated number of and centre to centre spacing of posts.

Upon delivery the beams shall be ready for assembly and installation.

**Note:** No punching, cutting or welding will be permitted on site except for special details in unforeseen and exceptional cases and to the prior approval of the Ministry Representative.

Warped or otherwise deformed beams will be rejected as will those with injurious defects or excessive roughness of the zinc coating.

Beams for concave and/or convex curved installations with a radius of 45 m or less shall be accurately and smoothly bent in the shop with minimum deformity. The radius of curvature shall be clearly stencilled on the back of each

curved rail section.

**312.04.05 Inspection** - No material shall be shipped prior to inspection or until a release for shipment has been issued by the Ministry Representative.

All materials may be inspected before shipment to the construction site, or at the construction site, or both. The supplier or manufacturer shall provide the necessary facilities to enable the Ministry Representative to expeditiously examine selected pieces or take specimen samples for testing from the material lot(s) clearly identified for intended supply to the Ministry. Identification shall be such that after inspection and testing the lot may be subsequently identified for acceptance or rejection.

Inspection of material before shipment shall not exclude its subsequent rejection at the construction site if found to fail any requirements of this specification.

**312.04.06 Examination** - Examination may include the following:

- i) Dimension measurements for size and thickness all of which shall be within the tolerance measurements specified by Subsection 312.04.01 (i) and Table 312-A.

**TABLE 312-A**

GALVANIZED BEAM THICKNESS			
FINISH			
Base Metal	Type 1	Type 2	Tolerance
Class A (2.8 mm nominal)	2.74 mm	2.82 mm	minus 0.23 mm
Class B (3.5 mm nominal)	3.51 mm	3.58 mm	minus 0.25 mm
<b>Note:</b> Tolerance given is for under specified thickness; there is no limit for over thickness.			

- ii) Coating generally shall be smooth, free of beading or sharp projections at edges. Coating adherence shall prevent the peeling of any portion of the zinc coating so as to expose the base metal by cutting or prying with a stout knife under considerable pressure.

**312.04.07 Testing** - When required by the Ministry Representative, testing shall be carried out according to ASTM A 90 - “Weight of Coating in Zinc Coated . . . . Articles” (also AASHTO T65) to determine the mass of galvanizing in conformity with the requirements of



Subsection 312.04.03. Alternatively magnetic gauge determination in accordance with ASTM E 376 may be permitted.

The testing of the mechanical properties of the base metal may be carried out by the Ministry Representative for compliance with the requirements of Subsection 312.04.02.

**312.04.08 Rejection and Retests** - Should the beam tested fail to meet the testing requirements specified above, two additional beams as selected by the Ministry Representative shall both meet the test requirements in every respect, otherwise the complete lot represented by the samples will be subject to rejection.

In the event of complete lot rejection and prior to any further testing by the Ministry, the intended replacement lot shall be satisfactorily tested by a mutually acceptable independent testing agency at no expense to the Ministry. When the time delay for retesting is unacceptable to the Ministry the order or part thereof will be subject to cancellation.

Rejected material shall be replaced at the Supplier's or Contractor's expense, including shipping charges and removal of rejected material at the construction site, if applicable.

### 312.05 Guardrail Accessories

**312.05.01 Transition Section** - Transition section for W-Beam to Thrie-Beam shall be of matching metal thickness and finish and fabricated to the ARTBA design profile (RE-69) to provide a smooth and uniform transition of beam widths and corrugations.

**312.05.02 End Sections** - End sections shall be of the type specified or ordered as indicated on standard Drawing 2-SP312. Double face buffer (ARTBA Designation RE-7) sections for breakaway cable terminal (BCT) assemblies shall be of the stipulated radius and the metal thickness and finish to match the beams. Terminal connectors (RE-8), as return sections of the BCT buffer ends and as normal beam connections (RE-8 or RE-67) to bridge parapets, abutments and the like, the metal thickness shall be Class B with matching finish.

**312.05.03 Back-up Plates** - Back-up Plates required where steel beams between splices are to be installed to any square or channel section steel posts (standard 305 mm lengths) shall be fabricated of the stipulated lengths from the standard beam section (as or similar to RE-4 or RE-64 ARTBA Designation).

**312.05.04 Bolts, Nuts and Washers** - Button-head bolts for joining beam sections in the length or to end sections and

for fixing beams to posts (ARTBA Designation F-3) and hexagonal-head bolts elsewhere shall be of the stipulated diameter, thread length and/or bolt length.

Bolts generally shall conform to the requirements of ASTM A 307, nuts to ASTM A 563 Grade A and plain washers to ANSI B27.2 Type A requirements, and unless otherwise specified, all galvanized according to ASTM A 153.

Plate washers where required (as ARTBA Designations F-12, F-36 and F-38) shall be of the size and thickness stipulated to ASTM A 36 and galvanized to ASTM A 153 requirements.

**312.05.05 Post Sleeve** - Post Sleeve for BCT breakaway cable fixing through the wood post shall be a 150 mm length of 60 mm outside diameter galvanized pipe conforming to ASTM A 120 for "standard weight" pipe (ARTBA F-34).

**312.05.06 Cable Assembly** - Cable Assembly for BCT installation shall consist of a swaged fitting, 25 mm diameter threaded stud, locking pin, nut and washer at each end of a cable of 19 mm nominal diameter, 6 x 19 wire strand core independent wire rope core, galvanized, right regular lay wire rope with a minimum breaking strength of 200 000 N (45,000 #) and conforming to AASHTO M-30 with the overall assembly length of 1980 mm developing a similar breaking strength (ARTBA F-37, F-35 and complete with plate washers, F-36 one end and F-38 the other).

**312.05.07 Anchor Plate** - Anchor Plate for the breakaway cable attachment to the steel beam for BCT assemblies shall be fabricated to the ARTBA design profile (RE-71) from steel plate conforming to ASTM A 36 and galvanized according to ASTM A 123 after forming and drilling for and including eight 16 mm diameter hexagonal-head bolts 38 mm long each with nut and 3.5 mm thick plain washer 44 mm outside diameter (ARTBA F-8 and F-13) complying with Subsection 312.05.04.

**312.05.08 Anchor Inserts** - Anchor Inserts for fixing terminal connector end sections to existing concrete shall be heavy duty hexagonal bolt type expansion anchor "Hilti" size HSL M16/25, or other pre-approved alternative with hardened plain washer minimum 4 mm thick and 57 mm outside diameter with all metal surfaces galvanized.

Anchors of alternative manufacture may be approved by the Ministry Representative provided equivalence of design and effect can be demonstrated.

**312.05.09 Steel posts** - Where required for installation on concrete, steel posts shall be fabricated from standard structural steel H-beam or bent steel plate to channel or "C" shape and with similar section short length offset "blocks"



and heavy base plates and all shall conform to CSA Standard G40.21M type 300 W or ASTM A 570, Grade 45 and/or ASTM A 36.

All welding shall conform to the requirements of the American Welding Society Code AWS D1.1. All welding shall be carried out by qualified operators of a contractor approved by the Canadian Welding Bureau or the American Welding Society to the requirements of CSA Standard W47.1 Division 3 or the AWS Code.

Galvanizing, according to CSA Standard G164 or ASTM A 123, shall be carried out after all punching, drilling, cutting and welding.

Post type, size and length similar to ARTBA Designation P-42 or P-53, complete with connecting bolts (F-8), expansion anchors similar to Subsection 312.05.08 or through bolts and backing plates or other fixing devices shall be as stipulated and/or detailed.

Alternative shape, type and size of post members and fixing devices to those detailed or ordered may be permitted by the Ministry Representative provided equivalence of design and effect can be demonstrated.

### 312.06 Wood Posts

**312.06.01 Square Posts** - Square posts and offset blocks shall be Douglas Fir/Hemlock "No. 1, Structural Posts and Timber", graded in conformity with the requirements of NGLA "Standard Grading Rules for Canadian Lumber".

Wanes on any face shall not exceed the following width:

- Above grade (including blocks): 25 mm
- Below grade: 60 mm

being the minimum permissible post width less the portion entirely free of wane.

Posts and blocks shall be supplied in the exact lengths ordered or specified and unless otherwise required on the Purchase Order, Work Order, drawing or specification the scantling shall be nominal 200 mm x 200 mm, and pair of 200 mm x 150 mm for each BCT installation, with dressed on four sides minimum dimension of 189 mm x 189 mm and 189 mm x 138 mm respectively and a tolerance of plus 3 mm.

**312.06.02 Preservation Treatment** - All posts and blocks shall be pressure treated in accordance with CSA Standard 080-M "Wood Preservation".

Unless otherwise specified or stipulated on the Purchase Order, Work Order, specifications, or drawings, the preservatives and retention of preservatives shall conform to the recommendation of CSA Standard 080.14-M Table I "Minimum Retention of Preservatives in Pressure Treated Wood for Highway Construction" under the heading of "Posts-Guardrail..." for square posts and blocks.

Prior to treatment all material shall be air seasoned in accordance with AWP Standard M1 Paragraph 1.31 to a moisture content of 15% to 22% before pressure treatment. In exceptional circumstances the Ministry Representative may permit conditioning by steaming for a total of not more than 6 hours at a temperature not in excess of 115°C.

**312.06.03 Inspection** - All processing of the material shall be open for inspection by the Ministry Representative with free entry to the treating plant while the work is being performed.

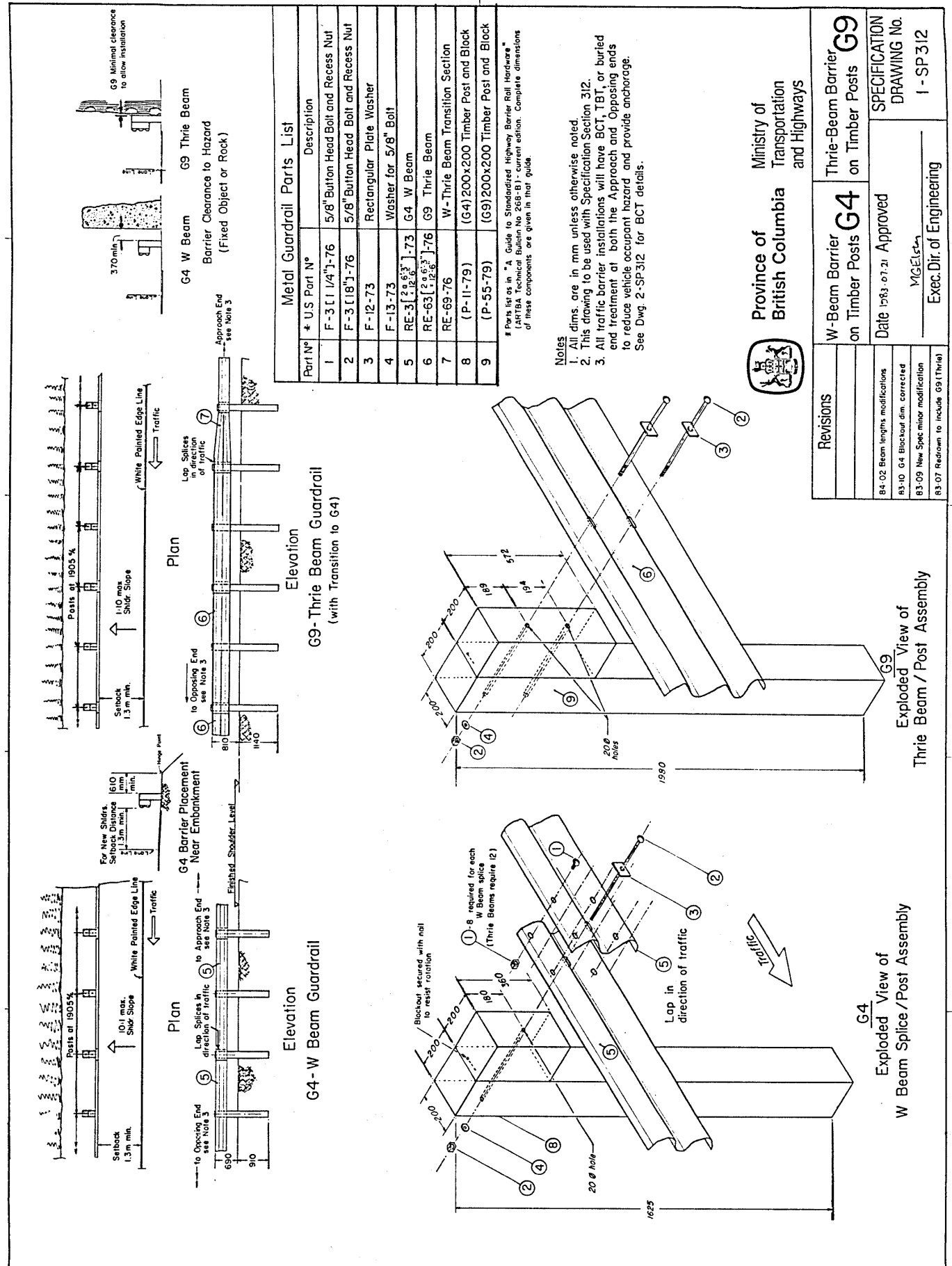
No material shall be shipped prior to inspection or the written release for shipment by the Ministry Representative.

Material inspected before shipment shall not bar its subsequent rejection after delivery if found to fail any requirements of this specification. Rejected material shall be replaced at the Supplier's expense including shipping charges and removal of rejected materials if applicable.

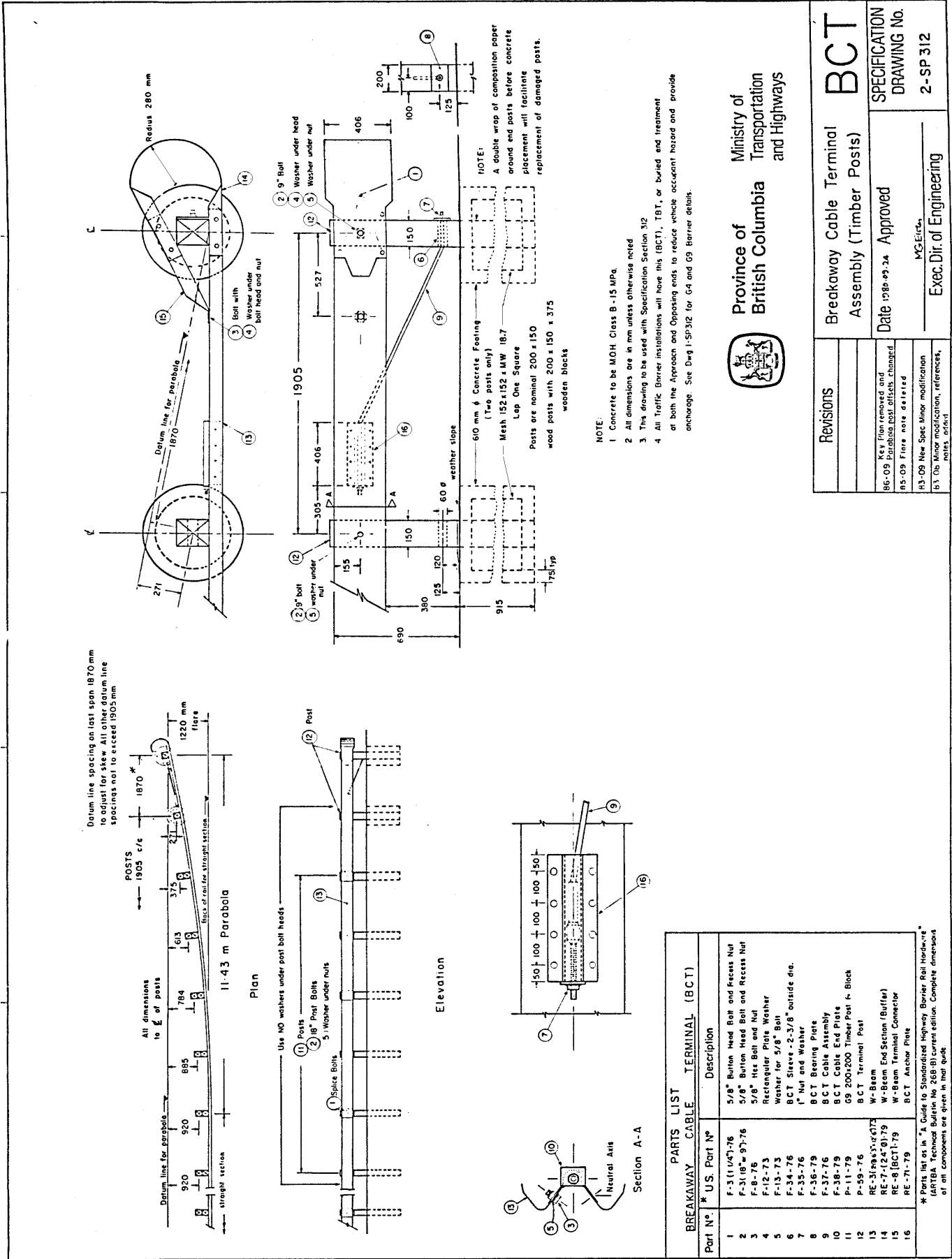
**Note:** Inspection of material already in bundles ready for shipment shall be considered as "incomplete", and the material will be subject to final inspection by the Contractor only when the bundles are opened immediately prior to use.

The Supplier shall advise the Ministry Representative at least two full working days before the material is ready for inspection prior to shipment. A Supplier in a distant location or outside B.C. shall advise the Ministry Representative at least one full week before the material is ready for inspection prior to shipment. After inspection the Ministry reserves the right to conduct whatever tests are deemed necessary to confirm that the material complies with the requirements of this specification before a release for shipment is issued.

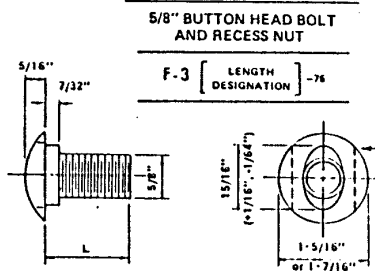
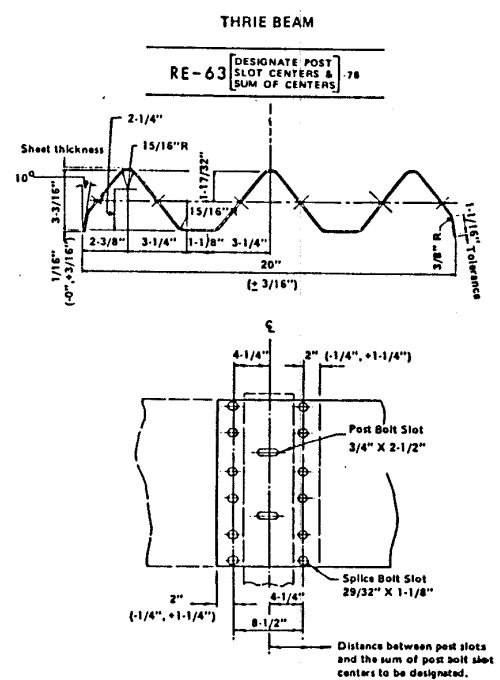
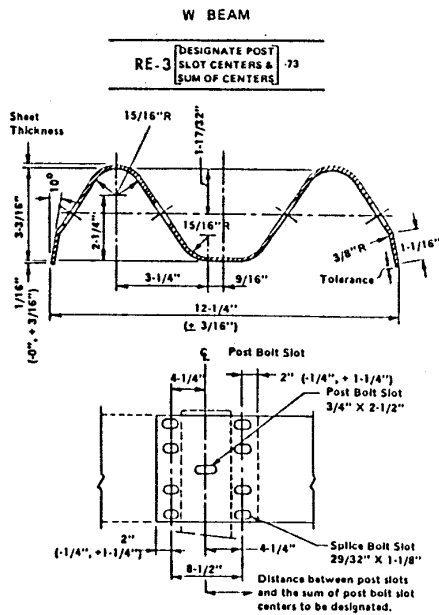






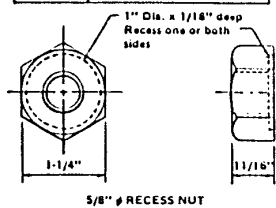




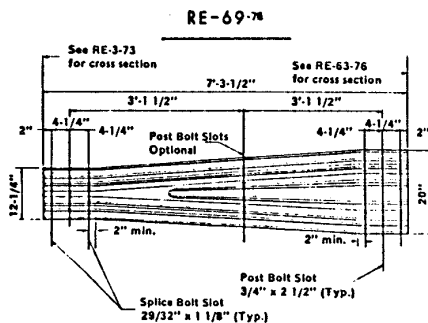


5/8"  $\phi$  BUTTON HEAD BOLT

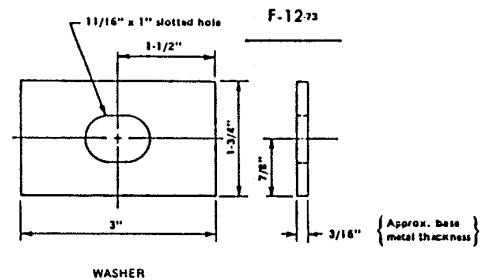
L	Thread Length
3-1/4"	Full length thread
2"	1-1/2" min. thread length
9-1/2"	1-3/4" min. thread length
18"	2-1/2" min. thread length
25"	2" min. thread length



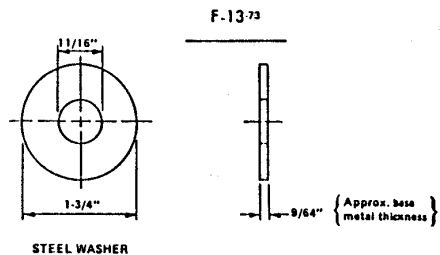
W - THRIE BEAM TRANSITION SECTION



RECTANGULAR PLATE WASHER



WASHER FOR 5/8" BOLT

Province of  
British ColumbiaMinistry of  
Transportation  
and Highways

## Revisions

STEEL GUARDRAIL  
BEAM PARTS  
(ARTBA DESIGNATIONS)

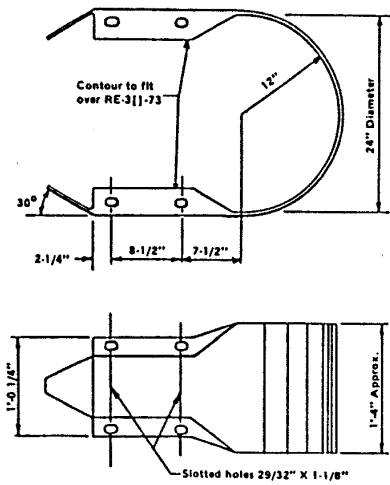
Date 1984-04-24 Approved

MGEI:sta  
Exec. Dir. of EngineeringSPECIFICATION  
DRAWING No.  
6-SP 312



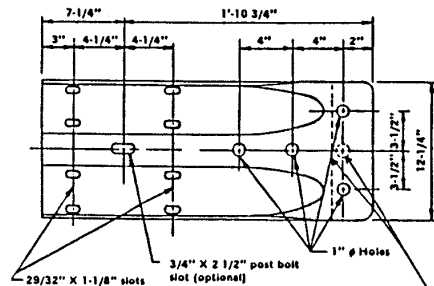
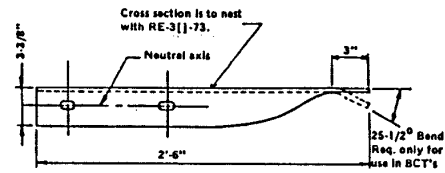
W BEAM END SECTION ( BUFFER )

RE - 7 [ 24" DIAMETER ] -78



W BEAM TERMINAL CONNECTOR

RE - 8 - 78

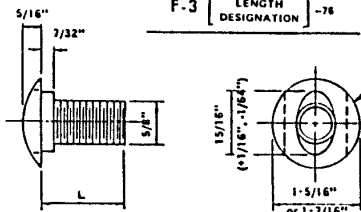


Bend and hole only required to modify connector for use in BCT's.\*\*

\*\*To obtain BCT details show part number as RE-8[BCT]-78.

5/8" BUTTON HEAD BOLT AND RECESS NUT

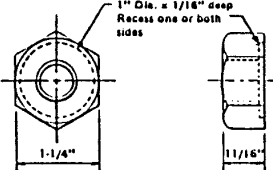
F-3 [ LENGTH DESIGNATION ] -78



NOTE: Optional 1 1/4" long splice bolt heads with flat sides are available to facilitate easier removal for maintenance purposes (AWI part No. G58 114).

5/8" # BUTTON HEAD BOLT

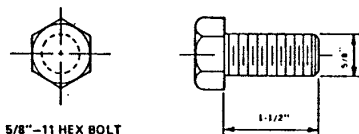
L	Thread Length
1-1/4"	Full length thread
2"	1-1/2" min. thread length
3-1/2"	1-3/4" min. thread length
18"	2-1/2" min. thread length
25"	2" min. thread length



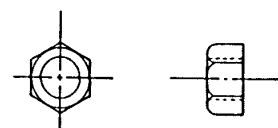
5/8" # RECESS NUT

5/8" HEX BOLT AND NUT

F-8 -78



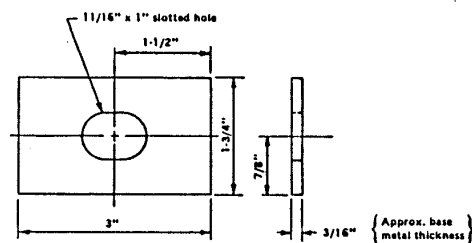
5/8"-11 HEX BOLT



5/8"-11 HEX NUT

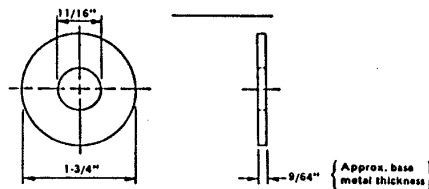
RECTANGULAR PLATE WASHER

F-12-78



WASHER FOR 5/8" BOLT

F-13-78



Province of British Columbia

Ministry of Transportation and Highways

## Revisions

STEEL GUARDRAIL  
B.C.T. END ASSEMBLY  
PARTS (TO ARTBA DESIGNATIONS)

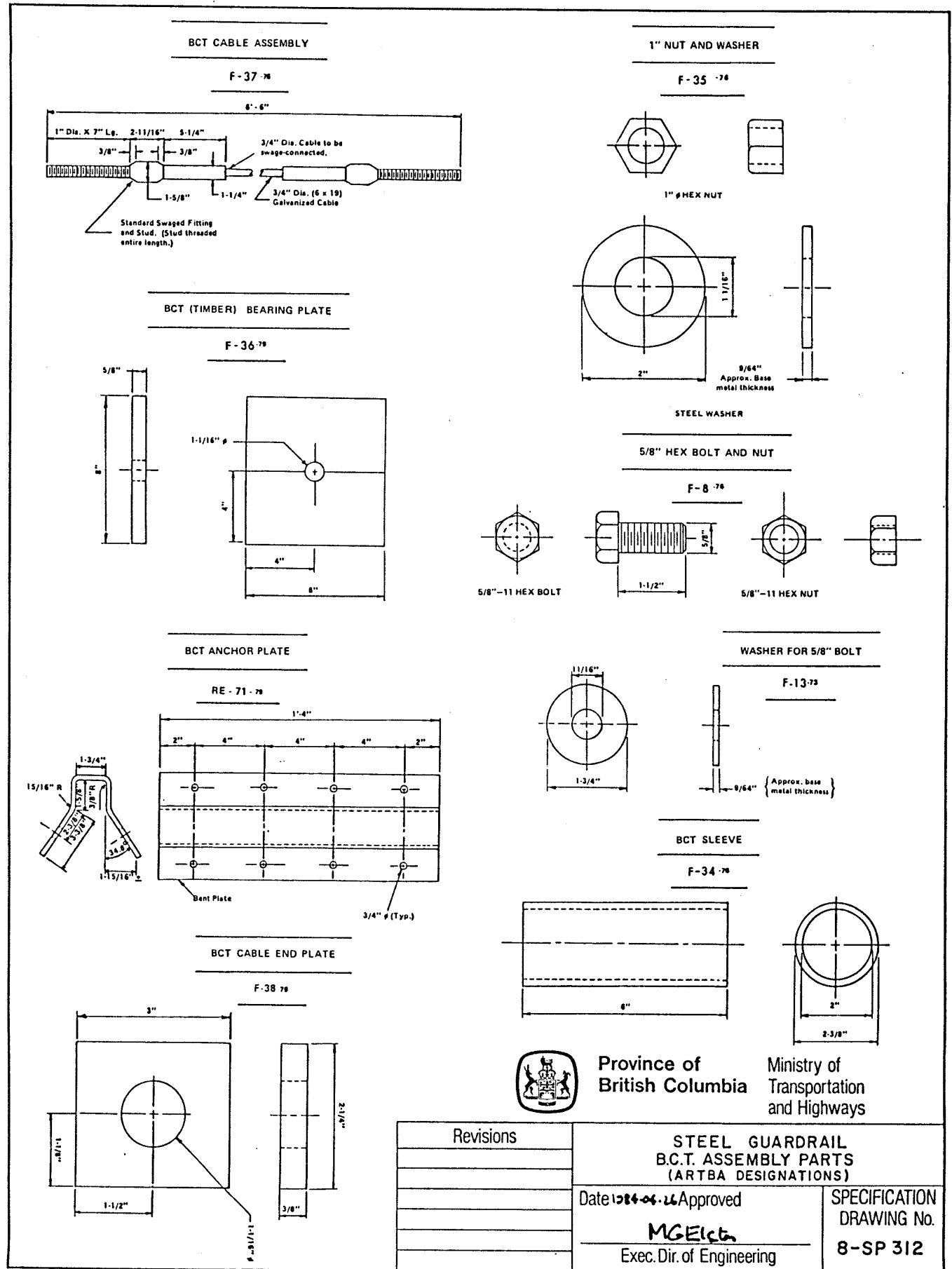
Date: 1984-04-26 Approved

MGE/ctm

Exec. Dir. of Engineering

SPECIFICATION  
DRAWING No.  
7-SP 312

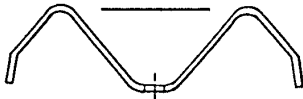






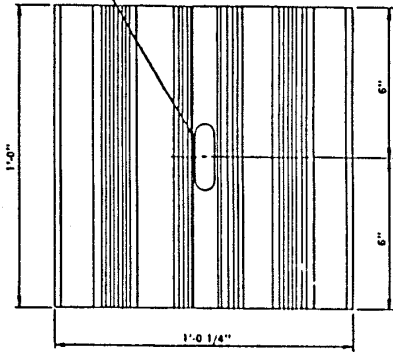
W BEAM BACK-UP PLATE

RE-4-78



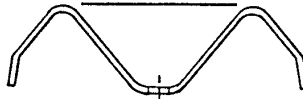
Dimensions same as RE-3-73

Slot 3/4" X 2-1/2"



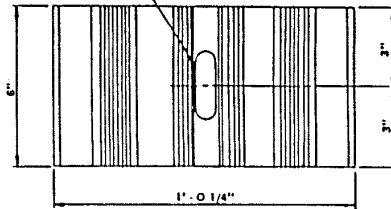
W BEAM BACK-UP PLATE

RE-4- [6"] -78

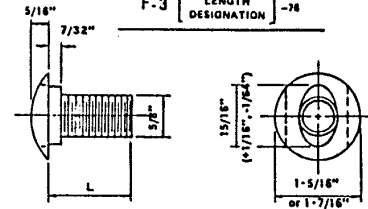


DIMENSIONS SAME AS RE-3-73

SLOT 3/4" X 2-1/2"

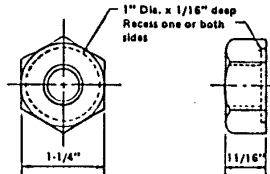
5/8" BUTTON HEAD BOLT  
AND RECESS NUT

F-3 [LENGTH DESIGNATION] -78



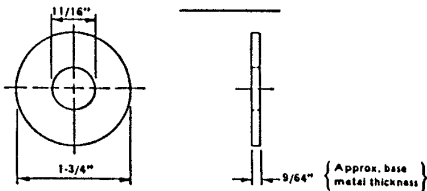
NOTE: Optional 1 1/4" long splice bolt heads with flat sides are available to facilitate easier removal for maintenance purposes (AWI part No. G58 114).

L	Thread Length
1-1/4"	Full length thread
2"	1-1/2" min. thread length
3-1/2"	1-3/4" min. thread length
18"	2-1/2" min. thread length
25"	2" min. thread length



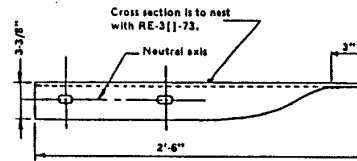
WASHER FOR 5/8" BOLT

F-13-73



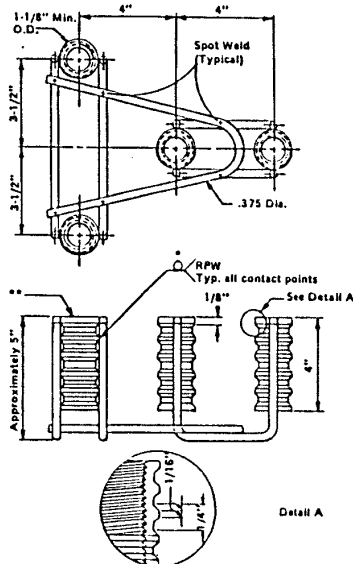
W BEAM TERMINAL CONNECTOR

RE-8-78

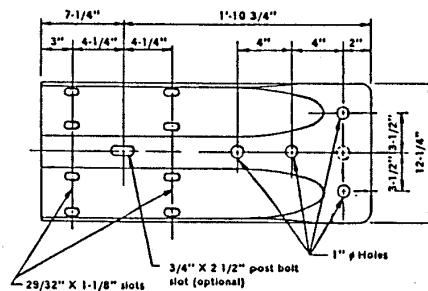


CONCRETE INSERT ANCHOR ASSEMBLY

F-33-73



NOTE: F-33-73 includes 7/8" - 9 X 2-1/2" galvanized High Strength Hex Bolts and a 15/16" I.D., 2-1/4" O.D., 5/32" Thk., Type A Plain Washer.

Province of  
British ColumbiaMinistry of  
Transportation  
and Highways

## Revisions

STEEL GUARDRAIL  
T.B.T. ASSEMBLY PARTS  
(ARTBA DESIGNATIONS)

Date 1984-04-24 Approved

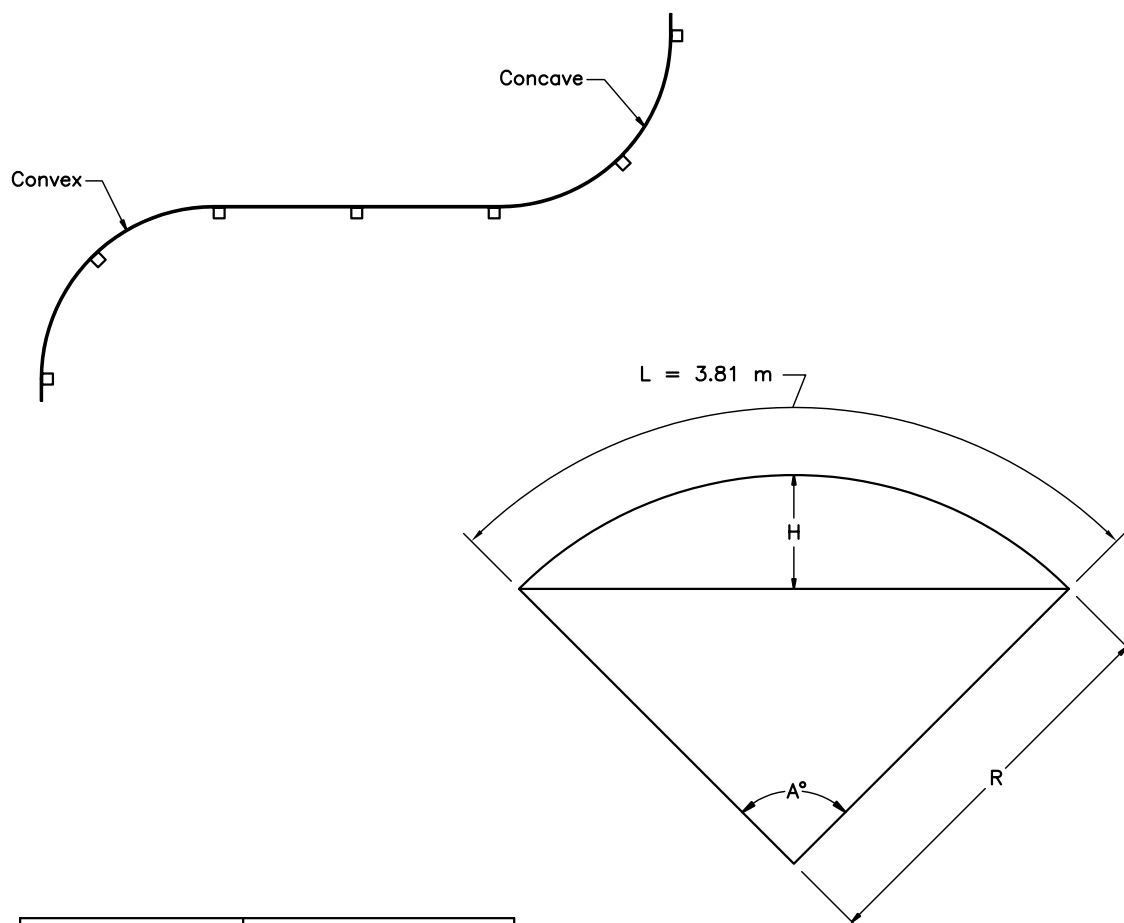
MGEIsten  
Exec. Dir. of Engineering

SPECIFICATION  
DRAWING No.  
9-SP 312









Typical Radii R (m)	Approximate A (deg)   H (mm)	
1.5 (min. convex)	145	1055
3.0 (min. concave)	72	585
5.0	43	360
7.5	29	240
10.0	21	180
12.5	17	145
15.0	14	120
18.0	12	100
21.0	10	85
25.0	8	70
30.0	7	60
35.0	6	50
40.0	5	45
45.0	4.5	40

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 316

### STEEL AND WIRE FENCE MATERIALS

**316.01 Scope** - This Section covers the quality and manufacture of wire fencing material, steel posts, gates and hardware, and various accessory material.

Treated wood fence posts are specified by Section 909.

For convenience, chain link fabric necessary for protection on rock slopes is included in this Section.

The uses of materials specified in this Section are generally indicated on Drawings of the SP741 series for construction of fences and Section 207 for rock protection.

The types of Standard Wire fencing and Chain Link fabric for fencing and protection on rock slopes covered by this Section are designated as follows:

- Type A - Special Wire Fabric Fence for use only on railway rights-of-way
- Type B - Standard Wire Fabric Fence
- Type C - Standard Barbed Wire Fence
- Type D - Chain Link Fence.

Chain link fence protection on rock slopes and tentative requirements for High-tensile Smooth-wire Fences are also included.

**316.02 Applicable Documents** - See Table 316-A.

**Note:** Standards referred to in this Section are obtainable from:

CGSB: Canadian Government Publishing Centre  
Supply and Services Canada  
Ottawa, ON K1A 0S9

ASTM: American Society for Testing and Materials  
1916 Race Street  
Philadelphia, PA 19103

**316.03 Type A & B Fence Fabrics** - Fence fabric for railway and highway rights-of-way shall be manufactured from good commercial quality galvanized steel wire in general accordance with ASTM A 116, but shall conform to the requirements following and those listed in Table 316-B.

**316.03.01 Styles** - See Table 316-B. Length of fabric rolls shall be 101 m unless otherwise ordered.

**Note:** Other standard and specialty fabrics when specified shall meet the following general specifications.

**316.03.02 Wire Size and Strength** - All wire used in the fabric shall have a minimum galvanized coated nominal diameter of 2.50 mm (12 1/2 ga.). The variation permitted from the measured nominal diameter shall be  $\pm 0.1$  mm. The minimum breaking force shall be 4250 N.

**316.03.03 Zinc Coating** - The zinc used for coating shall be any grade of zinc conforming to ASTM B 6. All wire shall have a uniform coating of zinc which shall adhere firmly to the base metal. The average mass of zinc coating shall be 90 g/m<sup>2</sup> of uncoated wire surface for three specimens but minimum 80 g/m<sup>2</sup> for any individual specimen.

**316.03.04 Quality of Work** - Splicing of individual line wires by means of a wrap joint, electric butt weld or galvanized sleeve is permitted.

The maximum number of line wire joints shall not exceed half of the number of line wires in any roll of fencing.

All joints shall be made in accordance with good work practice.

All stay wires shall be properly spaced and substantially perpendicular to the line wires.

The locks or fastenings at the intersections of the longitudinal and vertical wires of the woven wire fencing shall be of such construction as will prevent them from slipping, either longitudinally or vertically. All locks and fastenings shall be effectively galvanized.

Horizontal wires of all woven wire fencing shall be provided with tension curves to accommodate temperature changes after erection.

#### 316.03.05 Testing

**i) Samples:** Sufficient length of fabric to include at least three vertical stay wires shall be cut from each roll to be tested as required by Subsection 316.15 from which line wire and stay wire specimens shall be taken for testing.

**ii) Diameter of coated wire:** The average of two readings taken at right angles to each other at random on uniformly coated areas shall all be within the tolerance measurements specified in Subsection 316.03.02.

**iii) Strength:** The tensile strength of three line wire specimens shall be tested in accordance with ASTM A 370 on a machine calibrated to ASTM E 4 standards. The tensile strengths shall meet the requirements of



Subsection [316.03.02](#).

**iv) Coating adhesion:** Three line wire specimens shall be wrapped in a close helix at least twice around a cylindrical mandrel having a diameter four times the nominal diameter of the wire: wrapping speed shall not exceed four seconds per turn. The coating shall adhere to the wire without flaking or being removed by rubbing with bare fingers.

**v) Coating mass:** Three line wire specimens (from each roll), each more than 400 mm in length, and three stay wire specimens of short lengths between knots, etc., but each specimen totalling more than 400 mm shall be tested in accordance with ASTM A 90 for conformity with the requirements of Subsection [316.03.03](#).

**vi) Rejection and Retest:** Refer to Subsection [316.16](#).

**316.04 Type D Fence Chain Link Fabric** - Chain link fence fabric shall be manufactured from good commercial quality galvanized steel wire (or other specified finish) in general accordance with CAN/CGSB-138.1M and shall conform to the requirements listed in Subsections [316.04.01](#) through [316.04.04](#).

**316.04.01 Fabric Classification (according to CGSB Standard)** - The type, class, style and grade of chain link fence fabric shall be as specified on the Purchase Order, Work Order or Special Provisions in accordance with the Plans and/or Drawings [SP741-05.01](#) and [SP741-05.02](#), selected from the following or as may be otherwise specified or approved.

**i) Type/Class 1A** - Zinc coated (galvanized) steel wire fabric normally will be specified for all heights of chain link fences as indicated on Drawing [SP741-05.01](#), unless Type/Class 1B Vinyl coated steel is required for authorized special installations.

**ii) Style** - nominal diameter of zinc coated wire:

- Heavy, for highway protection fence from rolling rock
- Medium, for Standard and Security height fences
- Light, for Residential height fences (see Drawing [SP741-05.01](#))
- See Table [316-C](#) and [316-D](#) (when permitted).

**iii) Grade** - mass of zinc coating per unit area of uncoated wire: Grade 1, average  $490 \text{ g/m}^2$  for three specimens, minimum  $440 \text{ g/m}^2$  for any individual specimen. The zinc used for coating shall be any grade of zinc conforming to ASTM B 6. All wire shall have a uniform coating of zinc which shall adhere firmly to the base material.

**Note:** When specified, Grade 2 heavy coating (average  $610 \text{ g/m}^2$ , individual  $550 \text{ g/m}^2$  minimums) for corrosive environments and the zinc coating (average  $90 \text{ g/m}^2$ , individual  $80 \text{ g/m}^2$  minimums) for vinyl coated wire and the vinyl coating requirements shall be in accordance with CAN/CGSB-138.1M.

**316.04.02 Fabric Height, Length and Mesh** - Wire shall be woven throughout to a uniform diamond mesh  $50 \text{ mm} \pm 3.0 \text{ mm}$  clear between parallel mesh wires: fabric height as specified  $\pm 25 \text{ mm}$  with both selvage edges twisted and/or knuckled:

- fabric 1.5 m high and under: knuckled both edges
- fabric 1.8 m high and over: knuckled one edge, and twisted the other
- Residential height fence light style fabric 1.0 m and 1.2 m high: knuckled both edges.

Length of rolls with slack removed by nominal tensioning shall be 100 m unless otherwise ordered.

**Note:** Typical (normal) ordering designation from above: Type 1, Class A, Grade 1, Medium Style with roll width (height), length, mesh size and quantity.

**316.04.03 Quality of Work** - Fabric shall be of uniform quality and condition, free from all defects and imperfections affecting serviceability and appearance.

#### 316.04.04 Testing

**i) Samples:** Three full height pickets shall be provided from each roll as required by Subsection [316.15](#).

**ii) Diameter of coated wire:** The average of two readings taken at right angles to each other at random on uniformly coated portions of each pair of pickets between bends shall be within the tolerance measurement specified in Subsection [316.04.01 \(ii\)](#).

**iii) Strength:** The tensile strength of three line wire specimens shall be tested in accordance to ASTM A 370 on a machine calibrated to ASTM E 4 standards. The tension applied to the undeformed portion between two adjacent bends shall meet the requirements of Subsection [316.04.01 \(ii\)](#).

**iv) Coating adhesion:** Three specimens of undeformed portions between two adjacent bends shall be wrapped in a close helix once around a cylindrical mandrel having a diameter four times the nominal diameter of the wire: wrapping speed shall not exceed four seconds per turn. The coating shall adhere to the wire without flaking or being removed by rubbing with bare fingers.



**TABLE 316-A DOCUMENTS APPLICABLE FOR REFERENCE**

CAN/CGSB-138.1-M and 1-GP-181M	Fence, Chain Link, Fabric Coating, Zinc-Rich, Organic, Ready Mixed
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 90	Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A 116	Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 121	Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 123	Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 641	Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM B 6	Specification for Zinc (Slab Zinc)
ASTM B 211M	Specification for Aluminum-Alloy Bar, Rod, and Wire [Metric]

**TABLE 316-B STYLES OF FENCES**

Fence Types	Fabric Style No.	Number of Horizontal Wires	Fabric Height (mm)	Stay Wire Spacing (mm)	Wire Diameter (mm)
A	1047-6	10	1195	150	2.50 MIN
B	939-6	9	990	150	2.50 MIN

**TABLE 316-C ZINC COATED WIRE**

Type 1A	Style	Nominal Diameter of Zinc Coated Wire	Breaking Force Minimum N
	Heavy	5.0 mm ± 0.1 mm	10 000
	Medium	3.5 mm ± 0.1 mm	5 000
	Light	3.0 mm ± 0.1 mm	3 600

**TABLE 316-D VINYL COATED ZINC-COATED WIRE (when permitted)**

Type 1B	Style	Vinyl Coated Zinc-Coated Wire Nominal Diameter	Breaking Force Minimum N
	Heavy	5.0 mm ± 0.1 mm	6 000
	Medium	3.5 mm ± 0.1 mm	3 000
	Light	3.0 mm ± 0.1 mm	2 600

**v) Coating mass:** Three specimens (from each roll) each more than 400 mm long excluding knuckled or twisted ends shall be tested in accordance with ASTM

A 90 for conformity with the requirements of Subsection 316.04.01 (iii).



vi) **Rejection and Retest:** refer to Subsection 316.16.

### 316.05 Chain Link Fabric and Accessories on Rock

**Slopes** - Chain link fabric for protection on rock slopes shall be manufactured and tested in general conformity with Subsection 316.04 and to the following requirements:

- Fabric shall be to CAN/CGSB-138.1M designation of wire woven to 75 mm diamond mesh in rolls 3.0 m wide, knuckled on both selvage edges, and 15 m long. See Table 316-E.

**Note:** For corrosive conditions and environment Grade 2 - heavy galvanizing may be specified as a special order with possible extended lead time required for delivery.

**316.06 Barbed Wire** - Barbed wire for Type B & C fences and for security height Type D fences shall be manufactured from good quality galvanized steel wire in general accordance with ASTM A 121 but shall conform to the following detail requirements:

- a) Wire Size and Strength:** The wire shall be continuously twisted double strand of 2.5 mm nominal diameter (12 1/2 ga.) and to have a minimum breaking force of 4000 N.
- b) Barbs:** Four point barbs shall be of not less than 2.0 mm nominal diameter (14 ga.) and regular 150 mm maximum spacings.
- c) Zinc Coating Class (according to ASTM A 121):** The zinc used for coating shall be any grade of zinc conforming to ASTM B 6. All wire, including barbs, shall have a uniform coating of zinc which shall adhere firmly to the base metal.

The average mass of zinc coating per unit area of uncoated wire for three specimens and the minimum for any individual specimens shall be in accordance with the class of coating as follows:

- i) Class 1** for use in the construction of Type C fences and for the top strand of Type B fences (see Drawings SP741-01.01 and SP741-02.01), the coating shall be average 90 g/m<sup>2</sup> and 80 g/m<sup>2</sup> individual minimums.

- ii) Class 3** for use with Security height Type D Chain Link fences (see Drawing SP741-05.01), coating shall be average 240 g/m<sup>2</sup> and 215 g/m<sup>2</sup> individual minimums.

**d) Length:** Spools shall be 400 m unless otherwise ordered.

**e) Quality of Work:** Splicing of individual strand wires by means of a wrap joint or an electric butt weld is permitted. Not more than three splices or joints shall exist in any 400 m spool of barbed wire. Such splices or joints shall be made in accordance with good work practice.

The twist in the double strand barbed wire shall be uniform and continuous in one direction to lock the barbs in place. The barbs shall be sharp and well formed.

Wire strands showing nicks or indentures likely to cause the wire to break under flexure are not acceptable.

### f) Testing

**i) Samples:** Sufficient length of barbed wire shall be cut from each spool to be tested as required by Subsection 316.15.

**ii) Strength:** The tensile strength of three line wire specimens shall be tested in accordance to ASTM A 370 on a machine calibrated to ASTM E 4 standards. The tensile strength shall meet the requirements of Subsection 316.06 (a).

**iii) Coating Mass:** Three single wire specimens (from each spool), each aggregating more than 400 mm in length shall be tested in accordance with ASTM A 90 for conformity with the requirements of Subsection 316.06 (c).

**iv) Rejection and Retest:** Refer to Subsection 316.16.

**Note:** Smooth (barbless) galvanized wire, not specified to be "high-tensile," shall be double strand meeting all the above requirements except those for barbs.

**TABLE 316-E FABRIC DESIGNATION**

i.e.	Type 1	Class A Grade 1	Light Style	OR Nominal Diameter	Medium Style
	Steel	zinc coated (galvanized)	3.0 mm		3.5 mm



**316.07 High-tensile Wire** - Requirements for galvanized wire for high-tensile smooth-wire (no barbs) fencing are shown in Table 316-F.

### 316.08 Brace, Tension and Tie Wire

**316.08.01 Brace Wires** - Brace wire shall be manufactured of good commercial quality soft temper steel wire 3.5 mm nominal diameter gauge and zinc coated (galvanized) normally minimum 80 g/m<sup>2</sup> (Class 1 according to ASTM A 641) or as otherwise specified or approved.

Brace wire for high-tensile smooth-wire fencing may be fence wire specified in Subsection 316.07.

**316.08.02 Tension Wire** - Tension wire to secure bottom of chain link fencing and at top where specified shall be manufactured of good commercial quality coil spring crimped steel wire 5.0 mm nominal diameter gauge and zinc-coated (galvanized) normally 400 g/m<sup>2</sup> (Class B according to ASTM A 641) for Standard and Security height fences, or as otherwise specified or approved. Residential height fences tension wire shall be 3.5 mm nominal diameter.

**316.08.03 Tie Wire and Wire Hog Ring Clips** - Tie wire and wire hog ring clips shall be of steel of the nominal diameter gauge specified and zinc coated equivalent to that specified for the relevant fencing fabric: aluminum tie wire shall be of specified gauge and according to ASTM B 211M.

**316.09 Steel Fence Posts on Rock (Excluding Chain Link Fence)** - Steel fence posts and braces for Type A, B and C fences where specified or required on exposed rock or rock with minimum over-burden shall be of good commercial quality steel conforming to either Category A or Category B as specified in Subsection 316.10 with the following exceptions:

- Line post mass shall be not less than 1.9 kg/m and angles 4.75 kg/m minimum, both drilled for attaching barbed wire or a substantial number of fence fabric line wires with wire ties or clips.

- Channel braces shall be 1.5 kg/m minimum.

### 316.10 Steel Pipe Posts, Rails and Braces - Chain Link Fencing

**316.10.01 Category and Sizes** - All posts, rails and braces shall be of Category 1 or Category 2 at the discretion of the supplier and shall be supplied in the nominal outside diameter as specified on the Purchase Order, Work Order or Special Provisions in accordance with the Plans and/or Drawing SP741-05.02 and selected from Tables 316-G or 316-H or as may be otherwise specified or approved.

**Note:** Specifications or Purchase Order may permit thin wall tubing and consequent lower zinc coating for proprietary galvanized and vinyl coated residential fence posts and gates.

Bolts and nuts for fastening braces to posts shall be galvanized Class D (305 g/m<sup>2</sup> individual pipe posts, rails and braces for chain link Type D fences shall be manufactured in general accordance with ASTM A 53.

**a) Category A** - Category A posts, braces and rails shall be steel butt weld pipe, Schedule 40, as specified by ASTM A 53, except that the hydrostatic testing requirement is waived, and the minimum weight shall be no less than 95% of the nominal weight. Pipe shall be zinc-coated in accordance with ASTM A 53. This ASTM Standard requires, among other things, an average zinc coating of 550 g/m<sup>2</sup> and a minimum zinc coating of 490 g/m<sup>2</sup>.

**b) Category B** - Category B posts, braces and rails shall be made from steel pipes. The pipe shall be formed from steel strip conforming to ASTM A 569. The steel in the formed pipe shall have a minimum yield strength of 350 MPa (50,000 psi). The product of the yield strength and section modulus of the pipe shall be not less than that of pipe meeting the requirements for Category A posts and rails.

The outer surface of Category B posts, braces and rails

**TABLE 316-F REQUIREMENTS FOR GALVANIZED WIRE FOR HIGH TENSILE SMOOTH-WIRE (NO BARBS) FENCING**

Diameter:	2.5 mm nominal diameter (12 1/2 ga.)
Tensile Strength:	between 1170 MPa and 1590 MPa (170,000 to 230,000 psi)
Breaking Force:	in excess of 5800 N (1300 lbf)
Zinc Coating (Class 3):	minimum 240 g/m <sup>2</sup>
Coil Length:	in excess of 1200 m (approx. 100 lb.)



shall have all of the following protective coatings, applied in the following order:

- i) Hot dip zinc coating, conforming to ASTM B 6, High Grade or Special High Grade, applied at an average weight of  $305 \text{ g/m}^2$  ( $1.0 \text{ oz/ft}^2$ ) and at a minimum weight of  $275 \text{ g/m}^2$  ( $0.9 \text{ oz/ft}^2$ ), as determined by the test method in ASTM A 90.
- ii) Chromate conversion coating, with a weight of 30 micrograms/sq. in.  $\pm$  15 micrograms/sq.in., as determined by a strip and weight method for the zinc and chromate and by determining the percentage of each by atomic absorption spectrophotometer.
- iii) Clear acrylic polyurethane coating with a thickness of  $0.100 \text{ mm} \pm 0.025 \text{ mm}$  ( $0.4 \pm 0.1$  mils). The combined outer coating shall have an ability to resist:
  - 1000 hours of exposure to salt fog with a maximum of 5% red rust when tested in accordance with ASTM B 117.
  - 500 hours of exposure to 100% relative humidity without blistering and peeling when tested in accordance with ASTM D 2247; and
  - 500 hours of exposure in a weatherometer without

film cracking of the clear coat when tested in accordance with ASTM G 23, Type E or EH carbon arc, or ASTM G 26, Type B or BH xenon arc.

The inner surface of Category B, posts, braces and rails shall have either a zinc coating as per ASTM F 1234, Type B, applied at an average rate of  $305 \text{ g/m}^2$  and a minimum rate of  $275 \text{ g/m}^2$ ; or an ASTM F 1234, Type D zinc coating with a minimum zinc powder loading of 91% by weight and a minimum thickness of 0.075 mm (0.3 mils). The inner coating shall have an ability to resist 650 hours of exposure to salt fog with a maximum 5% red rust when tested in accordance with ASTM B 117.

**316.10.02 Quality of Work** - The finished pipes shall be reasonably free from injurious defects. All burrs at ends of pipes shall be removed.

The zinc or zinc/chromate/acrylic coating shall be free from injurious defects and excessive roughness.

#### 316.10.03 Testing

**a) Samples:** A 100 mm specimen shall be cut from each end of one pipe in every lot of 500 or fraction

**TABLE 316-G REQUIREMENTS FOR PIPE COMPONENTS FOR CHAIN LINK FENCING - CATEGORY A**

Pipe Sizes	Nominal Outside Diameter (mm)		
	Residential	Standard	Security
Line Posts	42	48	60
End, Corner & Straining Posts	48	60	73
Gate Posts, gates 2.5 m and less	48	60	73
Gate Posts, gates over 2.5 m	48	73	89
Top Rails	33	33	42
Brace Rails	--	33	42

**TABLE 316-H REQUIREMENTS FOR PIPE COMPONENTS FOR CHAIN LINK FENCING - CATEGORY A**

Actual Outside Post Diameter (mm)	26.7	33.4	42.1	48.3	60.3	73.0	88.9
Wall Thickness (mm)	2.87	3.38	3.56	3.68	3.91	5.16	5.49
Mass (kg/m)	1.7	2.5	3.4	4.0	5.4	8.6	11.3
Tolerances:	Diameter $\pm$ 1%			Mass $\pm$ 5%			



thereof.

**Note:** Specimens may be taken from the extreme ends of pipe that has been cut to length after galvanizing; otherwise, specimens shall be taken at least 200 mm clear of each galvanized end build-up.

**b) Dimensions:** Specimens shall be measured for diameter and wall thickness/mass and all shall be within the tolerance measurements specified by Subsection [316.10.01](#).

**c) Mass Coating:** Specimens shall be tested for the mass of zinc or composite coating in accordance with Subsection [316.10.01](#) and ASTM A 90.

**d) Rejection and Retest:** Refer to Subsection [316.16](#).

**316.11 Gates and Hardware** - Gates shall be supplied with hardware ready for installation as specified by the Purchase Order, Work Order or Special Provisions in accordance with the Plans and/or Drawings [SP741-04.04](#), [SP741-04.05](#), [SP741-05.03](#) and [SP741-05.04](#) or as may be otherwise specified or ordered.

Gates may be specified by the types as follows:

- **Type I** Pressed sheet steel frame, in-fill and brace members
- **Type II** Pipe frame and horizontal pipe in-fill members
- **Type III** Pipe frame, bracing and wire fabric in-fill
- **Type IV** Pipe frame, bracing and chain link fabric in-fill
- **Type V** Slip wire range gates barbed wire and wood droppers

with the general requirements of material, finish, hardware and quality of work specified in Subsections [316.11.01](#) through [316.11.06](#).

**316.11.01 General** - Gate sizes shall be the fence height or as otherwise stipulated and the nominal width designated by the clear opening width between gate posts with allowance made for hinges and latches, etc.

Gates shall be fabricated of galvanized pipe, tubing or formed sheet metal sections properly joined, braced and with in-fill all as specified by type below.

All pipe joints shall be cut to fit closely together and fully welded, vertical stiles neatly capped or mitred to horizontals with drilled holes to vent and drain closed end pipe members. Bends where permitted at corners shall be made without deforming tube or pipe section.

All welds, conforming to the best commercial practice, shall be smooth, and with adjoining and other marred galvanized pipe surfaces, shall be painted with two heavy coats of zinc rich paint manufactured in accordance with Standard 1-GP-181M.

All hardware and required fittings and fasteners shall be of suitable aluminum alloy or of steel or malleable or ductile cast iron, galvanized in accordance with ASTM A 153. Hinges generally shall be so designed as to permit the gate to swing back against the fence and to prevent the easy removal of gate and hinges. Hinges and other fittings shall all be of adequate strength for fastening securely without distortion and shall be sound and free of defects. Chain and/or latching gate catch for padlocking together with keepers to hold the gate open and centre drop bolt and sleeve for double swing gates shall be provided as and where specified or ordered.

All galvanizing and other finished surfaces shall be smooth and free of sharp dangerous protrusions.

**316.11.02 Type I Gate (sheet metal members)** - Formed heavy duty galvanized sheet metal sections with rolled edges as horizontal rails and vertical stiles, braced vertically and/or diagonally with similar members as necessary shall be rigidly riveted together to form a rugged non-sagging prefabricated gate.

Nominal sizes: 1220, 2440, 3050, 3660, 4270 and 4880 mm wide and 1220 mm high.

Gates to be supplied completely assembled with required hardware for wood (or metal) gate posts all as specified or ordered.

**316.11.03 Type II Gates (all pipe)** - Galvanized pipe 42 mm OD, 3.4 kg/m mass with zinc coating minimum 490 g/m<sup>2</sup> (see Subsections [316.10.01](#) and [316.10.03](#)) shall be welded together as gate frame and horizontal pipe in-fill members at 305 mm on centres. Vertical centre bracing of 5 mm x 19 mm flat bar on both sides of all horizontals is not required for gates 3050 mm and 3660 mm nominal widths. Gussets shall be welded to opposite corners of the gate as shown on Drawing [SP741-04.05](#).

Nominal sizes: 3050, 3660, 4270 and 4880 mm wide and 1220 mm high.

Gates shall be supplied completely assembled with required hardware for wood (or metal) gate posts all as specified or ordered.

**316.11.04 Type III Gates (pipe and fabric)** - Galvanized pipe 33 mm OD, 2.5 kg/m mass with zinc coating minimum



490 g/m<sup>2</sup> (see Subsections 316.10.01 and 316.10.03) shall be formed with even radius bent corners or neatly welded corners and vertical bracing at 1/3 points in the width of 27 mm OD, 1.7 kg/m pipe. Cleats or gussets shall be welded to opposite corners of gate frame/panel(s) as indicated on Drawing SP741-04.05, holed for securing under tension a diagonal brace consisting of 5.0 mm nominal diameter galvanized coil spring wire (see Subsection 316.08) with or without forged turn-buckle as and when specified or ordered.

In-fill shall be wire fabric all of 3.5 mm galvanized diameter wire with seven or more horizontal line wires, and stay wires not more than 600 mm apart. Fabric shall be securely fixed taut without sag to gate frame all round and to vertical brace in an approved manner.

Nominal sizes: 3050, 3660, 4270, 4880 and 5490 mm wide and 1070 and 1220 mm high.

Gates shall be supplied completely assembled with required hardware for wood (or metal) gate posts all as specified or ordered.

**316.11.05 Type IV Gates (pipe and chain link)** - Gate frame and required vertical bracing and/or diagonal bracing to cleats all welded as generally indicated on Drawing SP741-05.04 for hinged swing gates shall be fabricated to the designated size(s) complete with chain link in-fill and hardware for fixing to metal posts all as detailed, specified or ordered.

Pipe shall be in accordance with Subsection 316.10 and welding with Subsection 316.11.01. In-fill of chain link fabric as specified for fencing (see Subsection 316.04), shall be attached to gate frame stiles with tension bars and bands (see Subsection 316.12), and to horizontal members and vertical bracing with tie wire (see Subsection 316.08.03), all taut and sag free.

Sliding gates may be specified for gate openings over 4.0 m and shall be fabricated as generally indicated for swing gates but with diagonal tension rod bracing to support centre from both ends. The rolling hardware shall hold the gate vertical and parallel to the gate posts and adjoining fence at all times to allow free operation from any position while not retained by latches or keepers.

Roller assembly sheaves and wheels with bearings, grease fittings, necessary clamps, supports and fasteners, and chain and/or latching gate catch for padlocking, all of approved design, shall be provided as and when specified or ordered.

**316.11.06 Type V Gates (range slip wire)** - Barbed wire continued across standard width gate opening (for possible

future farm gate) with 50 mm diameter full fence height treated wood droppers securely figure of eight wire tied and stapled to each line wire shall be provided with a galvanized steel strap loop at bottom and either similar loop at top with an intermediate chain (for padlocking) or, when specified, a Princeton or other approved cinch-up lockable latch device all for securely attaching to fence or gate posts to hold open-end dropper.

**316.12 Accessory Material** - All required fittings, fasteners, hardware and accessories shall be of suitable aluminum alloy or steel, malleable or ductile cast iron, and galvanized in accordance with ASTM A 153, or as may be otherwise specified and/or ordered.

a) Staples for securing wire and fabric to treated wood fence posts shall be nominal 3.5 mm diameter steel wire with a driving length of at least 45 mm heavy galvanized finish.

b) Hog ring clips for securing wire fabric and/or barbed wire of Type A, B and C Fences to steel posts and to tension wire of Type D Fences see Subsection 316.08.03.

c) Dowel, Spikes, Bolts and Nuts shall be of good commercial quality, galvanized where specified or ordered.

d) Metal Droppers for high-tensile fencing will be prefabricated "Waratah" or other acceptable galvanized formed sheet metal droppers, 1070 mm for 5-wire and 1170 mm long for 6-wire fences, with preformed wire clips: such metal droppers or other acceptable manufacture may be specified or permitted as an alternative to the wood droppers specified by Subsection 909.08 for barbed wire (Type C) fences.

**Note:** Galvanized twisted double wire fence stays are permitted only for the extension of normal fence heights to deer height and the like.

e) All terminal and tensioning posts, for Type D chain link fences, shall be provided with aluminum or galvanized weather tight caps to fit and fasten securely and with extended arms for engaging barbed wire of security fences.

f) Caps for line posts for Type D chain link fences, shall carry top rail. Rail and brace end caps shall be provided for securing to rails and bolting with steel bands to posts.

g) Tension Bars for securing chain link fencing to terminal and tensioning posts and to vertical stiles of gates of Type D Fences shall be merchant quality mild



steel strip 5 mm x 19 mm in minimum lengths of 50 mm less than full height of the chain link fabric, hot dip galvanized.

- h) Tension and Brace Bands for securing brace and top rail caps and tension bars to posts shall be formed of minimum 2.5 mm x 19 mm mild steel strip, hot dip galvanized complete with bolt and nut.
- i) Tensioning Devices for individual in-line high-tensile wire will be "Hayes" or other acceptable manufacture and operation.
- j) Mechanical Splices and Fasteners shall be of "Nicopress FW2-3" or other acceptable manufacture applicable to the respective diameter and tensile strengths of wires.

**316.13 Packaging and Marking** - Each roll of fencing fabric or chain link mesh and spool of wire shall be tightly rolled and firmly tied to prevent loosening during shipment and handling.

Posts shall be securely fastened in bundles or sets, and accessories packaged in cartons or other suitable containers, to prevent loss or damage during shipment and handling.

Each product, roll, bundle or container etc., shall be clearly marked with the name, brand and/or trade mark of the manufacturer; the heat or lot number and other information sufficient to identify the style, type, class, grade, finish, height and/or length, nominal or outside diameter, gauge and the applicable Standard to which the product conforms.

**316.14 Inspection** - No material shall be shipped prior to inspection or until a release for shipment has been issued by the Ministry Representative.

All material may be inspected before shipment to the construction site or at the construction site, or both. The Supplier or manufacturer shall provide the necessary facilities to enable the Ministry Representative to expeditiously examine selected pieces from the material lot(s) clearly identified for intended supply to the Ministry. Identification shall be such that after inspection and testing

the lot(s) may be subsequently identified for acceptance or rejection.

Inspection of material before shipment shall not exclude its subsequent rejection at the construction site if found to fail any requirements of this specification.

**316.15 Sampling** - One roll of fabric or spool of wire, in every lot of 50 or fraction thereof, in the shipment may be selected at random for testing but in no case will less than two samples be tested.

Specimens for testing will be required from the outside ends of the selected sample roll or spool material and both ends of one post in every 500 or fraction thereof.

Sufficient length of each roll, spool or pipe shall be taken to provide the number of specimens for each of the testing requirements specified.

Wire used for knots, knuckling, twisting and wraps and wire containing welds shall be excluded from tests.

See respective material tests for pertinent sample lengths.

**316.16 Rejection and Retests** - If any tested specimen fails to meet the testing requirements specified above, the roll, spool or pipe represented by the specimens shall be replaced with two additional rolls, spools or pipes selected by the Ministry Representative and both shall meet the test requirements in every respect, otherwise the complete lot represented by the samples will be subject to rejection.

In the event of complete lot rejection and prior to any further testing by the Ministry, the intended replacement lot(s) shall be satisfactorily tested by a mutually acceptable independent testing agency at no expense to the Ministry: where the time delay for retesting is unacceptable to the Ministry the order or part thereof will be subject to cancellation.

Rejected material shall be replaced at the Supplier's or Contractor's expense including shipping charges and removal of rejected material at the construction site, if applicable.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 317

### P.E. PLASTIC DRAINAGE PIPE

**317.01 Scope** - This Section covers the requirements and methods of testing corrugated polyethylene (P.E.) drainage pipe. The inside wall may be corrugated or smooth. It covers nominal pipe diameters 200 mm, 250 mm, 300 mm, 400 mm, 450 mm and 600 mm.

#### **317.02 Applicable Documents**

ASTM D 883:	Definition of Terms Relating to Plastics
ASTM D 2122:	Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D 2412:	Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading
ASTM D 2444:	Standard Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by means of a Tup (Falling Weight)
ASTM F 405:	Standard Specification for Corrugated Polyethylene Tubing and Fittings
ASTM F 412:	Definition of Terms Relating to Plastic Piping Systems
ASTM F 667:	Standard Specification for 8", 10", 12", 15", 18" and 24" Corrugated Polyethylene Tubing

**Note:** ASTM Standards are obtainable from: American Society for Testing and Materials,  
1916 Race Street,  
Philadelphia, PA 19103.

**317.03 Materials** - The pipe, fittings and couplers shall be manufactured from virgin polyethylene plastic of Type III or IV, Class C, Category 5 and Grade P33 as defined in ASTM D 1248.

**317.04 Joining Systems** - The assembly of joints shall be in accordance with the pipe manufacturer's recommendations. Manufacturers wishing to supply joint systems other than those listed below shall submit details to the Ministry Representative for approval prior to the awarding of the Contract.

Approved joint systems are as follows:

#### **a) Integral Bell Gasketed Joint**

- i) The joint shall be designed so that when assembled, the gasket will be compressed radially on the pipe spigot or in the bell to form a watertight seal.
- ii) The joint shall be designed to avoid displacement of the gasket when assembled in accordance with the manufacturer's recommendation.

#### **b) Corrugated Screw-On Coupler (Nominal Pipe Diameters 250 and Larger)**

- i) Coupler shall be manufactured of polyethylene plastic as specified in Subsection [317.03](#).
- ii) Coupler length shall be a minimum of 1.1 times the nominal pipe diameter or 270 mm, whichever is greatest (a minimum of 0.4 times the length of the coupler shall be engaged on both pipes to be joined).
- iii) Average coupler wall thickness shall be a minimum 2.6 mm for nominal pipe diameters of 250 mm and 300 mm and 3.2 mm for all other diameters up to and including 600 mm.



**317.05 Requirements**

**317.05.01 Quality of Work** - The pipe shall be homogenous throughout and free from visible cracks, flaws, foreign inclusions or other injurious defects. The pipe shall be uniform in colour, opacity and other physical properties.

**317.05.02 Pipe Diameter**

**i) Nominal Diameter** - The nominal diameter shall be the average inside diameter rounded to the nearest whole number (mm).

**ii) Inside Diameter** - The permissible inside diameter tolerances shall be +3% and -1.5%. Measurement shall be taken in accordance with ASTM D 2122.

**317.05.03 Length** - Laying length shall be 4 m or 6 m for all diameters otherwise specified on the Purchase Order, Work Order or Drawings. A tolerance of  $\pm 25$  mm on the nominal laying length will be permitted.

**317.05.04 Physical Properties**

**i) Impact Strength** - The minimum drop weight impact strength shall be 36.8 Joules when tested in accordance with Subsection [317.07.01](#).

**ii) Pipe Stiffness** - The minimum pipe stiffness shall be 210 kPa when tested in accordance with Subsection [317.07.02](#).

**iii) Pipe Flattening** - There shall be no evidence of splitting, cracking or breaking when tested in accordance with Subsection [317.07.03](#).

**317.05.05 Joint Separation Resistance** - Joint systems when installed in accordance with the manufacturer's instructions shall not separate when tested in accordance with Subsection [317.07.04](#).

**317.06 Marking** - All pipe shall be clearly marked at intervals of no more than 1.5 m with 5 mm or larger letters with the following information:

- Manufacturer's name or trademark
- Nominal diameter
- Materials designation and cell class: PEGR33
- The words "Drainage" or similar
- The class: PS210
- The applicable Specification designation (ASTM F 405 or F 667)
- Date of manufacture and plant designation.

**317.07 Test Methods**

**317.07.01 Impact Resistance** - Five specimens, each at least as long as the nominal pipe diameter, shall be tested in accordance with ASTM D 2444, using a 2.5 kg Tup "B" and the flat plate holder "B". The height of the drop shall be 1.5 m (total drop energy = 36.75 Joules). The test shall be performed at 0°C ( $\pm 0.5^\circ$ ) allowing no more than 15 seconds to complete the test after removing the sample from the conditioning medium. Any cracking or other signs of material fatigue evident after the test shall constitute a failure. All five specimens must pass. If one specimen fails, five more specimens shall be tested. Nine out of ten specimens passing will be acceptable.



**317.07.02 Pipe Stiffness** - The pipe stiffness shall be determined at 5% deflection of the initial inside diameter in accordance with ASTM D 2412. Three specimens, each at least as long as the nominal pipe diameter, shall be tested. The exact specimen length shall be an integer multiple of the corrugation pitch. All test specimens shall meet the required stiffness.

**317.07.03 Pipe Flattening** - The three specimens tested in Subsection 317.07.02 shall be flattened between parallel plates in a suitable press until the distance between the plates is 40% of the original inside diameter. The loading rate shall be uniform and such that the compression is completed within two to five minutes. Remove the load and examine the specimen. All three specimens shall meet the requirements.

**317.07.04 Joint Separation** - A test specimen shall be constructed using the manufacturer's joining system centred on two pieces of pipe each 0.75 m in length. The specimen shall be hung vertically and a dead weight test force applied to the bottom end of the pipe. The vertical test force shall be 0.87 N/mm of nominal pipe diameter. Any separation of the joint shall be considered a failure.

### 317.08 Inspection

- a) The Ministry shall have access to the fabrication plant for inspection and every facility shall be extended for this purpose.
- b) Inspection may include checks on physical dimensions and general quality of work.
- c) For the purpose of sampling for Subsections 317.05 and 317.07, one pipe from each lot of 50 pipes or fraction thereof in a shipment shall be selected for sampling. All test specimens shall be cut from the selected pipe(s).
- d) If the test sample fails to meet the requirements of Subsection 317.05 when tested in accordance with Subsection 317.07, that batch will be rejected and shall be replaced by the Supplier with a new batch that conforms to this Specification at no additional cost to the Ministry.

### 317.09 Quality Assurance

- a) The Supplier shall develop and maintain an effective quality control system to ensure that adequate inspection coverage is maintained throughout the manufacturing process. Evidence of such inspection shall be available to the authorized inspector of the Ministry prior to shipment from the place of manufacture or the Supplier's storage facility.
- b) The Ministry reserves the right to maintain surveillance over the Supplier's quality control system to ensure conformance with this Specification.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 318

### PVC PLASTIC DRAINAGE PIPE

**318.01 Scope** - This Section covers the requirements and methods for testing for:

- Type PSM\* Poly Vinyl Chloride Drainage Pipe
- Ribbed Poly Vinyl Chloride Drainage Pipe

and the perforation requirements of type PSM pipe up to a nominal diameter of 375 mm.

**Note:** The term PSM\* is not an abbreviation but rather an arbitrary designation for a product having certain outside dimensions.

#### 318.02 Applicable Documents

- CSA B182.2: Large-diameter, Type PSM PVC Sewer Pipe and Fittings
- CSA B182.4: Large-diameter, Ribbed PVC Sewer Pipe and Fittings
- ASTM D 883: Definition of Terms Relating to Plastics
- ASTM D 1784: Standard Specification for PVC and CPVC Compounds
- ASTM D 2122: Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings
- ASTM D 2152: Standard Test Method for Quality of Extruded PVC and CPVC Compounds
- ASTM D 2412: Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
- ASTM D 2444: Standard Test Method for Impact Resistance of Thermo-plastic Pipe and Fittings by Means of a Tup (Falling Weight)
- ASTM D 3034: Standard Specification for Type PSM PVC Sewer Pipe and Fittings
- ASTM D 3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- ASTM F 412: Definition of Terms Relating to Plastic Piping Systems
- ASTM F 477: Standard Specification for Elastomeric Seals for Joining Plastic Pipe
- ASTM F 794: Standard Specification for PVC Large-diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

**318.03 Materials** - The pipe shall be made of virgin PVC plastic having a cell classification of 12454-B, 12454-C, or 13364-C, as defined in ASTM D 1784.

The fittings shall be made of virgin PVC plastic and shall have a cell classification of 12454-B, 12454-C, or 13343-C, as defined in ASTM D 1784.

Elastomeric gaskets shall comply with the requirements of ASTM F 477.

**318.04 Quality of Work** - The pipe shall be homogenous throughout and free from visible cracks, flaws, foreign inclusion, or other injurious defects. The pipe shall be uniform in colour, opacity and other physical properties.



**318.05 Joining System** - All sizes of pipe shall be supplied with Elastomeric Gasket Joints providing a watertight seal in accordance with ASTM D 3034.

- a) Integral Bell Gasketed Joints shall be designed so that when assembled, the gasket shall be compressed radially on the pipe spigot or in the bell to form a watertight seal.
- b) The joint shall be designed to avoid displacement of the gasket, when assembled in accordance with the manufacturer's recommendation.
- c) Joint assembly shall be in accordance with the pipe manufacturer's recommendations.

Note: Manufacturers wishing to supply pipe joining systems other than those listed under this specification shall submit details to the Ministry Representative for approval prior to the awarding of the contract.

### 318.06 Requirements

**318.06.01 Length** - Laying length shall be 4 m or 6 m for all diameters unless otherwise specified by the Purchase Order, Work Order or Drawings. A tolerance of  $\pm 25$  mm on the nominal laying length will be permitted.

**318.06.02 Type PSM, PVC Drainage Pipe Dimensions** - The average outside diameter and the minimum wall thickness of Type PSM PVC drainage pipe shall be as specified in Table 318-A when measured in accordance with ASTM D 2122.

**TABLE 318-A PIPE DIMENSIONS - TYPE PSM**

NOMINAL DIAMETER (mm)	OUTSIDE DIAMETER (mm)				
	AVERAGE	TOLERANCE	MINIMUM	MAXIMUM	MINIMUM WALL THICKNESS
100	107.06	$\pm 0.22$	106.84	107.28	3.06
150	159.38	$\pm 0.28$	159.10	159.66	4.58
200	213.36	$\pm 0.30$	213.06	213.66	6.10
250	266.70	$\pm 0.38$	266.32	267.08	7.62
300	317.50	$\pm 0.46$	317.04	317.96	9.07
375	388.62	$\pm 0.58$	388.04	389.20	11.10
450	475.00	$\pm 0.70$	474.30	475.70	13.57
525	560.00	$\pm 0.85$	559.15	560.85	16.00
600	630.00	$\pm 0.95$	629.05	630.95	18.00
680	710.00	$\pm 1.05$	708.95	711.05	20.29

**318.06.03 Ribbed, PVC Drainage Pipe Dimensions** - The average inside diameter and minimum wall thickness of Ribbed PVC drainage pipe shall be as specified in Table 318-B when measured in accordance with ASTM D 2122.



TABLE 318-B PIPE DIMENSIONS RIBBED

INSIDE DIAMETER (mm)					
NOMINAL DIAMETER	AVERAGE	TOLERANCE	MINIMUM	MAXIMUM	MINIMUM WATERWAY WALL THICKNESS
450	448.31	$\pm 1.41$	446.90	449.72	3.30
525	527.05	$\pm 1.50$	525.55	528.55	4.06
600	596.90	$\pm 1.78$	595.12	598.68	4.58
680	673.10	$\pm 2.00$	671.10	675.10	5.20
760	749.30	$\pm 2.30$	747.00	751.60	5.96
900	901.70	$\pm 2.70$	899.00	904.40	7.36
1000	1003.30	$\pm 3.00$	1000.30	1006.30	8.26
1200	1206.50	$\pm 3.55$	1202.95	1210.95	10.16

**318.06.04 Perforations** - Perforated pipe up to the nominal diameter of 37.5 mm shall be type PSM and perforated in accordance with Figure I and Table 318-C. The perforations shall be 8 to 10 mm in diameter, circular, and cleanly cut. The gasketed bell and spigot end of the pipe shall be unperforated for a length equal to the depth of the socket and/or shoulder.

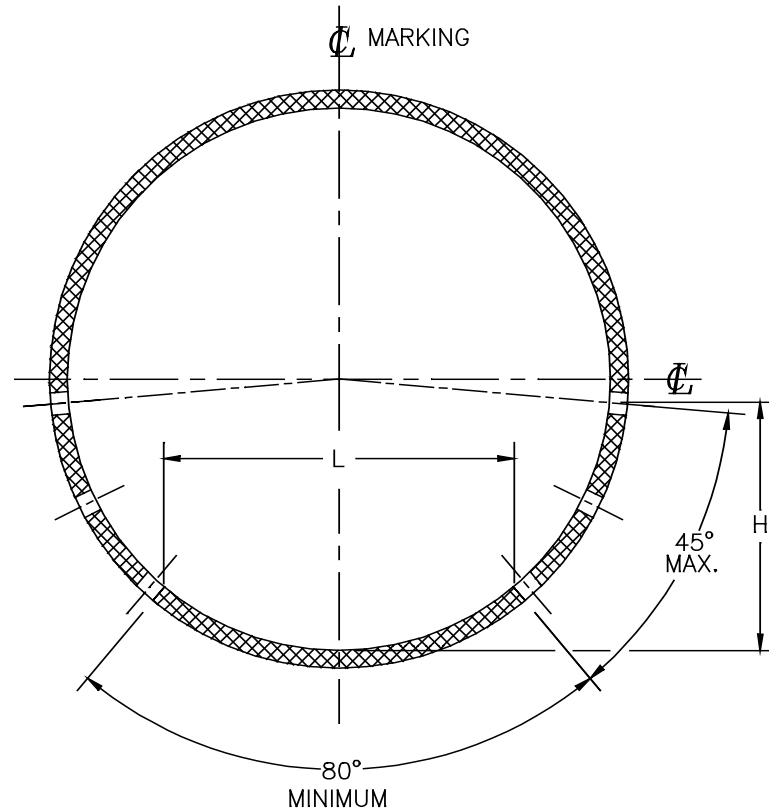


FIGURE I



TABLE 318-C PERFORATION REQUIREMENTS

NOMINAL DIAMETER (mm)	MINIMUM ROWS OF PERFORATIONS	HORIZONTAL HOLE SPACING (mm)	H (mm) *	L (mm) **
100	2	80 ± 5	30	65
150	4	80 ± 5	70	73
200	4	80 ± 5	93	130
250	4	100	115	163
300	6	150	140	195
375	6	150	175	240

\*H: maximum height of the centreline of the uppermost perforations above the Invert.

\*\*L: minimum length of the unperforated inner surface at the bottom of the pipe.

### 318.07 Physical Properties

**318.07.01 Impact Strength** - The minimum drop weight impact strength for pipe shall meet the requirements of Table 318-D when tested in accordance with Subsection 318.09.01.

**318.07.02 Pipe Stiffness** - The minimum pipe stiffness when tested in accordance with Subsection 318.09.02 and ASTM D 2412 shall be 320 kPa.

**318.07.03 Pipe Flattening** - There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Subsection 318.09.03.

**318.07.04 Extrusion Quality** - The pipe shall not flake or disintegrate when tested in accordance with ASTM D 2152.

TABLE 318-D IMPACT STRENGTH AT 0°C

NOMINAL DIAMETER (mm)	joules	ft. / lb.
100	93	69
150	147	108
200	175	129
250	190	140
300	205	151
375	230	170
450 and larger	250	184

**318.08 Marking** - All pipe shall be clearly marked at intervals of no more than 1.5 m with 5 mm or larger letters with the following information:

- Manufacturer's name or trademark
- Nominal diameter
- Material designation and cell class: PVC-12454-B



- The word "Drainage" or similar
- The class: SDR35 or PS320
- The applicable specification designation (ASTM D 3034 or F 794)
- Date of manufacture and plant designation

The marking on perforated pipe shall be 180° from a point equidistant between the bottom row of holes as shown in Figure I and Table 318-C.

### 318.09 Test Methods

**318.09.01 Impact Resistance** - Five specimens, each nominally 150 mm long for the PSM pipe and 300 mm long for the ribbed pipe, shall be tested in accordance with ASTM D 2444, using a 15 kg Tup "A" and the flat plate holder "B". The height of the drop shall not be less than 600 mm or more than 3 m. The test shall be performed at 0°C ( $\pm 0.5^\circ\text{C}$ ), allowing no more than 15 seconds to complete the test after removing the sample from the conditioning medium. Perforated samples shall be positioned as shown in Figure I. Any cracking or other signs of material fatigue evident after the test shall constitute a failure. All five specimens must pass. If one specimen fails, five more specimens shall be tested. Nine out of ten specimens passing will be acceptable.

**318.09.02 Pipe Stiffness** - The pipe stiffness shall be determined at 5% deflection of the initial inside diameter in accordance with ASTM D 2412. Three specimens, each with a length equal to one pipe diameter shall be tested; all shall meet the required stiffness. Perforated samples shall be positioned as shown in Figure I.

**318.09.03 Pipe Flattening** - Three specimens, each nominally 150 mm long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40% of the original nominal diameter of the pipe. The loading rate shall be uniform and such that the compression is completed within two to five minutes. Remove the load and examine the specimen. All three specimens shall meet the requirements.

**318.09.04 Pipe Dimensions** - Measurements shall be taken in accordance with ASTM D 2122.

### 318.10 Inspection

- a) The Ministry shall have access to the fabrication plant for inspection and every facility shall be extended for this purpose.
- b) Inspection may include checks on physical dimensions and the quality of work.
- c) For the purpose of sampling for Subsections 318.07 and 318.09, one pipe from each lot of 50 pipes or fraction thereof in a shipment shall be selected for sampling. All test specimens shall be cut from the selected pipe(s).
- d) If a test sample fails to meet the requirements of Subsection 318.07 when tested according to Subsection 318.09, that batch will be rejected and shall be replaced by the Supplier with a new batch that conforms to this specification at no additional cost to the Ministry.

### 318.11 Quality Assurance

- a) The Supplier shall develop and maintain an effective quality control system to ensure that adequate inspection coverage is maintained throughout the manufacturing process. Evidence of such inspection shall be available to the authorized inspector of the Ministry prior to shipment from the place of manufacture or from the Supplier's storage facility.



**b)** The Ministry reserves the right to maintain surveillance over the Supplier's quality control system to ensure conformance with this specification.



## SECTION 320

### CORRUGATED STEEL PIPE

**320.01 Scope** - The Section covers the material and fabrication requirements for corrugated steel pipe and structural plate corrugated steel pipe.

**Abbreviations:**

**CSP** - Corrugated Steel Pipe: Galvanized sheet steel formed to finished shape by the fabricator.

**SPCSP** - Structural Plate Corrugated Steel Pipe: Hot rolled sheets or plates, corrugated, hot-dip galvanized, curved to radius, assembled and bolted together to form large pipes, pipe-arches, and other shapes.

**320.02 Materials**

**320.02.01 Galvanized Steel Sheet** - All culverts supplied under this specification shall be fabricated from steel sheets meeting all requirements of ASTM A 444 "Standard Specification for Zinc Coated (Galvanized) Iron or Steel Sheets for Culverts and Underdrains," with the following exceptions and additions:

**320.02.01.01** - Steel shall conform to the chemical composition as specified in Table 320-A

**TABLE 320-A CHEMICAL COMPOSITION**

ELEMENT	HEAT ANALYSIS (MAXIMUM) %
Carbon	0.15 (except SPCSP)
Manganese	0.60 (except SPCSP)
Phosphorous	0.04
Sulphur	0.05

**320.02.01.02** - Each sheet, or each 600 to 1500 mm of coil or strip shall be identified by showing the following:

- i) Brand or name of sheet manufacturer (mill).
- ii) "CSP Sheet/Tole TTAO"
- iii) Nominal overall zinc coated sheet thickness in mm.
- iv) Heat and Coil numbers.
- v) Zinc coating designation.
- vi) "ASTM A 444" or "CSPI-501-M" or "CSA G401-M."

**Exceptions and additions to ASTM A 444 requirements:-**

**320.02.01.03** The requirement for the sheet manufacturer to run tensile tests on samples from each cast or heat (See ASTM A 444 Paragraph 5.2) will be waived if the sheet or plate is authorized to be stamped "CSPI-501-M."

**320.02.01.04.** - In addition to the Coating Adherence requirements of ASTM A 444 Paragraph 6, the Finish and Adherence of casting requirements of ASTM A 123, Paragraph 9 shall also apply.



**320.02.01.05.** - The mass of zinc coatings, total both sides shall be not less than Z610 (610 g/m<sup>2</sup>) when tested by the Triple Spot Test or not less than 550 g/m<sup>2</sup> by the Single Spot Test.

**320.02.01.06.** - Thickness and Tolerances shall conform to the requirements of Table 320-B.

**TABLE 320-B CSP SHEET THICKNESS AND TOLERANCES**

CSP SHEET - THICKNESS AND TOLERANCES (mm)		
Nominal Overall Thickness * (including Zinc)	Tolerance on Nominal Overall Thickness (over or under)	Design Base Metal Thickness **
1.0	0.13	0.82
1.3	0.15	1.12
1.6	0.18	1.40
2.0	0.18	1.82
2.8	0.20	2.64
3.5	0.23	3.35
4.2	0.23	4.08

\* Thickness shall be measured at a point on the sheet not less than 10 mm from an edge. Field measurement shall be made on a corrugation tangent.

\*\* Minimum Base Metal Thickness shall be not less than 95% of the Design Base Metal Thickness. Minimum Base Metal is equal to the nominal Overall Thickness minus the Tolerance on Overall Nominal Thickness minus an allowance for zinc of 0.09 mm.

Nominal Overall Thickness is Order Thickness.

**320.02.01.07** - Flatness tolerances shall apply to cut lengths only.

For specified thickness of 2.0 mm and thicker, the tolerance, or maximum deviation from a horizontal flat surface, shall not exceed 13 mm for specified width up to 1500 mm.

For thickness less than 2.0 mm the tolerance shall not exceed 20 mm for 900 to 1500 mm width, and 13 mm for less than 900 mm width.

**320.02.01.08** - Permissible variations in width, length, and camber of flat sheet shall be in accordance with CSA G163.2.

**320.02.02 Structural Plate Corrugated Steel Sheet and Plate** - SPCSP sheet and plate shall conform to the relevant requirements of Subsection 320.02.01 except:

- i) The maximum carbon shall be 0.10% and maximum manganese of 0.50%.
- ii) Each lift shall be identified by the mill name or brand, test number, nominal mass, mill order number and dimensions either by marking the top plate of the lift or by a durable tag attached to the lift.
- iii) Thickness and Tolerances shall conform to the requirements of Table 320-C.



**TABLE 320-C SPCSP SHEET AND PLATE BASE METAL THICKNESS AND TOLERANCE**

Nominal Base Metal Thickness * (mm)	3.0	3.5	4.0	5.0	6.0	7.0
Design Base Metal Thickness ** (mm)	2.84	3.37	3.89	4.95	6.0	7.0
Width of Blank (mm)	<b>SHEET TOLERANCES *** (mm)</b>			<b>PLATE TOLERANCES *** (mm)</b>		
1340	± 0.20	-	± 0.20	+0.40/-0.30	+0.40/-0.30	+0.50/-0.30
1585	± 0.28	-	± 0.28	+0.50/-0.30	+0.50/-0.30	+0.50/-0.30
2315	± 0.30	-	± 0.30	+0.60/-0.30	+0.60/-0.30	+0.70/-0.30

\* Nominal Base Metal Thickness is the specified Order Thickness. For field thickness check, add 0.09 mm to the Base Metal Thickness to account for galvanizing. Thickness shall be measured at a point on the sheet not less than 20 mm from a longitudinal edge. Field measurement shall be made on the corrugation tangent.

\*\* Minimum Base Metal Thickness shall be not less than 95% of the Design Base Metal Thickness.

\*\*\* Mill terminology.

**320.02.03 Hardware** - Hardware shall conform to the following requirements:

**320.02.03.01 Rivets** - Rivets shall conform to ASTM A 31, Grade A copper bearing, and shall be galvanized in accordance with ASTM A 153 Class D or ASTM A 164 Type RS.

**320.02.03.02 Bolts and Nuts** - Bolts shall be M20 x 2.5 nominal diameter and thread pitch as shown in [Figure I](#). Bolts shall meet the chemical and mechanical properties of ASTM A 449. Nuts shall be as shown in [Figure I](#) and shall meet the requirements of ASTM A 563 Grade C. Bolts and nuts shall be galvanized to CSA G164 Class 5.

**320.02.03.03 Coupler Band Hardware** - Nuts and bolts on coupler bands shall conform to ASTM A 307, Grade A and shall be galvanized according to ASTM A 153 Class C or ASTM A 164 Type RS.

Other hardware on coupler bands such as lugs and flanges shall be of material approved at the time the design of the coupler band is approved and they shall be galvanized in accordance with CSA G-164 Class 4.

If lugs or flanges are welded in place the weld shall be thoroughly wire brushed followed immediately by the application of a dry thickness of 50 µm of zinc rich coating in accordance with CGSB 1-GP-181M Coating, Zinc Rich, Organic, Ready Mixed.

### **320.03 Fabrication From Culvert Sheet**

**320.03.01 Corrugation Profile** - CSP shall have corrugations which form smooth continuous curves in either helical or annular rings about the pipe axis with nominal inside diameters and profile dimensions as specified in Table 320-D. The profile radius of curvature (R) shall not be less than 50% of the depth of the corrugation as shown in [Figure II](#).



TABLE 320-D CSP DIAMETER RANGE - CORRUGATION PROFILE (mm)

NOMINAL INSIDE RANGE (mm)	CORRUGATION PROFILE DIMENSIONS Pitch * x Depth ** (mm)
100, 150, 200 and 250	38 x 6.5
200 to 2400 ***	68 x 13
1200 to 3600	76 x 25
1200 to 3600	125 x 26

\* Pitch shall be measured perpendicular to the direction of corrugations. Average pitch tolerance  $\pm 3.0$  mm.

\*\* Depth shall be measured from outside crests to outside valley, with a straight edge laid across crests perpendicular to the direction of corrugation. Depth tolerance minus 5%.

\*\*\* Flexibility Factor of concern for diameters greater than 2000 mm.

### 320.03.02 Standard Sizes and Tolerances

320.03.02.01 Riveted CSP - Minimum outside circumferences for riveted CSP shall be as shown in Table 320-E

TABLE 320-E RIVETED CSP - MINIMUM OUTSIDE CIRCUMFERENCE

NOMINAL INSIDE DIAMETER (mm)	MINIMUM OUTSIDE CIRCUMFERENCE			NOMINAL INSIDE DIAMETER (mm)
	13 mm	13 mm	25 mm or 26 mm	
200	680	3830	3900	1200
250	840	4460	4520	1400
300	1000	5080	5150	1600
400	1310	5700	5770	1800
500	1630	6330	6390	2000
600	1940	6950 *	7020	2200
700	2260	7570 *	7640	2400
800	2570		8580	2700
900	2880		9510	3000
1000	3200		10450	3300
			11380	3600

\* Flexibility Factor of concern for diameters greater than 2000 mm.

a) Measurement of minimum outside circumference may be made with a band which covers adjacent corrugation crests.



## b) Dimensional Tolerances:

- **Diameter** - The average nominal inside diameter tolerance shall be  $\pm 13$  mm or  $\pm 1\%$ , whichever is greater, measured between inside crests of the corrugations perpendicular to pipe axis.
- **Length** - The specified individual pipe length shall be measured from the inside crest of the last corrugation at one end to the inside crest of the last corrugation at the other end. The overall length is greater than the specified length by approximately 50% of the corrugation pitch.

**320.03.02.02 Helical CSP** - Minimum outside circumferences for Helical CSP shall be as shown in Table 320-F.

**TABLE 320-F HELICAL CSP - MINIMUM OUTSIDE CIRCUMFERENCE**

MINIMUM OUTSIDE CIRCUMFERENCE (mm)							
Nominal Inside Diameter (mm)	CORRUGATION DEPTH (mm)						Nominal Inside Diameter (mm)
	6.5	11	13	11	13	25 & 26	
100	350			2900	2910	2970	900
150	500			3210	3220	3290	1000
200	660			3840	3850	3920	1200
250	820				4480	4550	1400
300		1000	1010		5110	5170	1600
400		1320	1330		5730	5800	1800
500		1630	1650		6360	6430	2000
600		1950	1960		6980	7050	2200
700		2260	2280		7610	7680	2400
800		2580	2590			8620	2700
						9560	3000
						10500	3300
						11440	3600

**Note:** Dimensional Tolerances:

**Diameter** - Average nominal inside diameter tolerance shall be  $\pm 6.0$  mm or  $\pm 0.5\%$  whichever is greater, measured between inside crests of the corrugations perpendicular to pipe axis.

**Length** - The length tolerance shall be  $\pm 25$  mm of the specified length. For CSP with recorrugated ends, the length tolerance for individual pipes shall be plus 50 mm minus 25 mm.

**320.03.02.03 Pipe Arch - Helical or Riveted** - Standard pipe-arch dimensions measured from the inside crests of corrugations shall be as shown in Table 320-G.

### 320.03.03 Riveted Construction

**320.03.03.01** All rivets shall be according to the requirements of Subsection 320.02.03.01. All rivet diameters and lengths shall be not less than those shown in Table 320-H.

### 320.03.03.02 Fabrication Requirements



- a) Hole centres shall not be closer than twice the hole diameter from any sheet edge, and shall be in reasonable alignment.
- b) Rivets shall be driven cold without bending. Sheet edges shall be drawn tightly together throughout an entire lap length with rivet holes in reasonable alignment.
- c) Rivets shall have full heads and shall completely fill the holes.
- d) Longitudinal seams shall have at least one rivet for each corrugation, in the valley.
- e) Double-riveting, or two rows of rivets along a longitudinal seam, shall be as in Table 320-I. The distance between centrelines of rows of rivets shall nominally be three times the hole diameter.
- f) Circumferential seams shall have a maximum rivet spacing of 150 mm measured on centres, except that six rivets will be sufficient on 300 mm diameter or smaller.
- g) Longitudinal seam lap shall equal or exceed minimums shown in Table 320-I. Circumferential seam lap shall be 30 mm minimum.

**TABLE 320-G STANDARD PIPE-ARCH DIMENSIONS (mm)**

SPAN	RISE	EQUIVALENT DIAMETER	MINIMUM CORNER RADIUS
450	340	400	75
560	420	500	75
680	500	600	75
800	580	700	85
910	660	800	100
1030	740	900	110
1150	820	1000	125
1390	970	1200	150
1630	1120	1400	175
1880	1260	1600	200
2130	1400	1800	225

**Note:** Span and Rise dimensional tolerance is  $\pm 25$  mm or 2% of equivalent round diameter, whichever is greater.

#### 320.03.04 Helical Construction

##### 320.03.04.01 Fabrication Requirements

- a) The edges of the sheets forming the pipe shall be jointed with a continuous lock seam formed by folding over the edges of adjacent sheets so that they interlock with each other to form a tight joint. See Figure III.
- b) The sheets shall be continuous throughout the length of the pipe, the joining of sheets by butt welding shall only be permitted provided the weld meets the following requirements:



- The butt joint shall be made by shielded electric arc process with a continuous deposit of material throughout the length of the joint. Penetration shall be to the full depth of the material and no undercut, splatter or scale shall be permitted. If deemed necessary, sample of the joint shall pass a 90° bend test.
  - The weld and adjacent area of damaged zinc shall be thoroughly wire brushed followed immediately by the application of a dry thickness of 50 µm of zinc rich coating conforming to CGSB 1-GP-181M Coating, Zinc Rich, Organic, Ready Mixed.
- c) Ends of Helical CSP shall be finished with a straight cut perpendicular to the longitudinal centreline and any saw cut mismatch shall not exceed 15 mm. The ends shall be finished without significant burr. Cutting of previously manufactured stock to a shorter length with a hand held cutting torch is not permitted.
- d) Standard fabricated lengths shall be in full metre lengths, as ordered. The length tolerance shall be  $\pm 25$  mm of ordered length. For CSP with recorrugated ends, length tolerance for individual pipes shall be plus 50 mm minus 25 mm.

**TABLE 320-H RIVET DIAMETERS AND LENGTH (mm)**

NOMINAL OVERALL CSP SHEET THICKNESS (mm)	NOMINAL RIVET DIAMETER (mm)		MINIMUM RIVET LENGTH (mm)
	CORRUGATION DEPTH		
	13 mm	25 mm or 26 mm	
1.0	8		16
1.3	8		16
1.6	8	10	16
2.0	8	10	16
2.8	10	12	20
3.6	10	12	25
4.2	10	12	25

**TABLE 320-I RIVETED CSP - LONGITUDINAL SEAM LAP AND ROWS OF RIVETS**

DIAMETER RANGE (mm)	CORRUGATION DEPTH (mm)	ROWS OF RIVETS	MINIMUM LONGITUDINAL SEAM LAP (mm)
200 to 500	13	Single	40
600 to 1000	13	Single	50
900, 1000	25	Double	75
1200 and larger	13 or 25	Double	75

**320.03.04.02 Visual Inspection** - by reference to [Figure III](#) the quality of the lock seam shall be judged by visual inspection. The pipe shall be cut so as to show the cross-section normal to the seam. The cut shall be of sufficient length to show the complete lock seam profile including offset.

- a) The minimum seam lap dimensions shall be as shown in [Table 320-J](#).



- b) There shall be no roller indentations on either side of the 180° fold or beyond the lapped area.
- c) The retaining offset as shown in [Figure III](#) shall be that portion of the sheet profile adjacent to the lock seam, and in tight contact with the 180° fold. The total retaining offset of both sides shall be a minimum of 1 t where t is equal to the nominal overall thickness of the sheet of which the pipe is constructed. The retaining offset on any one side shall be a minimum of 0.3 t. [Figure III](#) shows retaining offset of 1 t on both sides, for a total retaining offset of 2 t.
- d) The 180° fold of metal at the lock seam shall have a smooth curvature both inside and outside with no angularity of the interior of the fold.
- e) The gaps opposite the interior fold shall be equal on both sides of the seam, and each gap individually shall not exceed 1.0 t where t is equal to the nominal overall thickness of the sheet of which the pipe is constructed.
- f) The helix angle (see [Figure IV](#)) shall be not more than 30° for helical CSP 600 mm diameter and greater.

**TABLE 320-J HELICAL CSP - MINIMUM SEAM LAP DIMENSIONS**

CORRUGATION PROFILE (mm x mm)	38 x 6.5	51 x 11	68 x 13	76 x 25	125 x 25
LAP (mm)	4.0	6.5	6.5	8.0	8.0

**320.03.04.03 Shear Strength of the Lock Seam** - If the visual inspection required by Subsection [320.03.04.02](#) indicates that the joint is not tight for any reason, such as the lapping surfaces apparently not in intimate or complete contact, then the shear strength of the seam shall be tested by the test method defined in [Appendix I](#). The minimum shear strength of the lock seam shall be 80 N/mm. If this test is performed, it shall be in addition to, not in lieu of, the visual inspection requirements in Subsection [320.03.04.02](#) and all requirements must be met.

**320.03.04.04 Recorrugated Ends** - Helical pipe ends may be recorruagated to provide two or four annular corrugations on each end of pipe for coupling purposes.

The visual checks and/or pull tests required by Subsection [320.09.04](#) Quality Control - Helical CSP shall (where possible) be carried out prior to recorruagation. Additional quality control pull tests will be required in the reformed end and the minimum lateral seam strength of the lock seam as per Table [320-K](#) shall be not less than 60% of that required for the remainder of the pipe. There shall be no visible cracks in the base metal in the reformed end.

**TABLE 320-K HELICAL CORRUGATED LOCK SEAM PIPE MINIMUM LATERAL SEAM STRENGTH**

NOMINAL OVERALL THICKNESS (mm)	MINIMUM LATERAL SEAM STRENGTH (N/mm)
1.0	36
1.3	51
2.0	65
2.8	88
3.5	136
4.2	182
Greater than 4.2	234

The Ministry reserves the right to obtain a sample of the lock seam from the undamaged portion of a recorruagated pipe by means of a 38 mm hole saw. (See [Appendix IV](#)).



**Note:** If recorrigated ends are specifically requested, then annular corrugated couplers (see Subsection 320.04.02) shall be provided.

### 320.04 Coupler Systems

**320.04.01 Purpose** - Coupler systems for corrugated pipe shall resist water leakage, preserve pipe alignment, resist separation of adjoining pipe sections and resist root penetration or infiltration of normal backfill materials.

**Note:** When culverts are to be installed on steep grades, extra wide annular corrugated couplers are recommended for diameters greater than 600 mm.

### 320.04.02 Fabrication Requirements

**320.04.02.01** Coupler bands shall be compatible with the conduit shape and corrugation profile, and designed so that it can be installed to lap equal portions of the pipes being connected.

**320.04.02.02** Coupler bands shall be either corrugated or have circumferential rows of projections (i.e., dimpled). Both systems shall be designed to substantially mesh with the pipe corrugations and meet the requirements of Subsection 320.04.01.

**320.04.02.03** Coupler standard dimensions shall be as shown in Table 320-L.

**TABLE 320-L MINIMUM COUPLER DIMENSIONS**

COUPLER TYPE	PIPE DIAMETER (mm)	NOMINAL OVERALL THICKNESS (mm)	MINIMUM WIDTH (mm)	NO. OF BOLTS	DIMPLES	
					MINIMUM NO. OF CIRCUMFERENTIAL ROWS	MINIMUM NO. PER ROW *
Flat	100-600	1.30	140	2		
Corrugated	300-600	1.30	180	2		
	700-1600	1.60	300	2		
	over 1600	1.60	300 or 600 **	3		
Universal	300-600	1.30	300	2	4	6
Dimple	700-1200	1.60	300	2	4	7
	Over 1200	1.60	600	3	4	8

\* Minimum number of dimples per row is 6 for 76 mm x 25 mm corrugation profile.

\*\* Width dependent on application.

**320.04.02.04** Coupler ends shall be drawn together about the pipe by bolts, wedges or other means of fastening to meet the requirements of Subsection 320.04.01.

**320.04.02.05** Coupler flanges shall consist of rolled or formed angles or lugs (meeting the requirements of Subsection 320.02.03.03) of at least 3.2 mm effective thickness riveted or welded to the coupler.

**320.04.02.06** - The minimum number of 12 mm diameter bolts (meeting the requirements of Subsection 320.02.03.02) per connection shall be two for the 180 and 300 mm coupler, three for the 600 mm coupler and four for the 900 mm coupler. Bolt length shall be not less than 150 mm.



**320.04.02.07 Riveted & Weld Fasteners** - Where flanges are riveted, the rivets shall have a minimum diameter of 10 mm (and shall meet the requirements of Subsection [320.02.03.01](#)). The minimum number of rivets per angle shall be two for the 180 mm coupler, three for the 300 mm coupler, five for the 600 mm coupler and seven for the 900 mm coupler.

Where flanges or lugs are welded in place the weld area shall be thoroughly wire brushed followed immediately by two coats of zinc-rich coating conforming to CGSB 1-GP-181M.

**320.04.02.08 Wedge Fastening** - Coupler flanges shall be integrally formed in a manner to utilize fully the available areas of contact with the wedge. Lips of both coupler and wedge shall be formed to a contained angle of approximately 45° and shall be nominally 10 mm wide. Wedge shall be at least 16 mm high at the wide end suitable for hammering into position over the coupler and shall be at least 75 mm longer than the width of the couplers. Lips of wedges with engage lips of couplers shall be 13 mm minimum width. Wedges shall be no less than 2.0 mm thickness.

**320.04.02.09** Where gasketed joints are required for watertightness, they shall meet ASTM D 1056, ASTM C 361M, or requirements as stated in Special Provisions of the Contract.

### **320.05 Pipe Arch Corrugated Steel Pipe Construction**

**320.05.01** Pipe arch CSP is a multi radii shape having integral top, bottom and corners. The pipe arch shall conform to the dimensions shown in Table [320-G](#).

**320.05.02** For riveted CSP pipe arch the staggered lapped longitudinal seam or seams shall be placed in the top arch section and not located in an area of change of radius or minimum radius.

**320.05.03** - In the case of helical CSP pipe arch the minimum corner radii (see Table [320-G](#)) apply also to the lock seams located at the corners; no transverse creasing of the seams will be permitted.

**320.05.04** The longitudinal axis of the pipe centreline must be preserved straight, it shall not bend appreciably either vertically or horizontally. In the case of dispute the pipe arch shall be placed on a flat surface; the invert shall be in uniform contact with the flat surface throughout the length of the pipe and the inside of the pipe shall appear straight when viewed from either end.

**Note:** The requirements of Subsections [320.05.03](#) and [320.05.04](#) are unlikely to be met consistently without the use of properly designed interior mandrels. Only if a manufacturer can demonstrate that he can consistently produce CSP Pipe Arch meeting these requirements without such equipment will the use of alternative methods or equipment be accepted.

### **320.06 Perforated Corrugated Steel Pipe**

**320.06.01** Helical and riveted perforated CSP shall meet all requirements of this specification for helical and riveted CSP before perforation.

**320.06.02** The perforations shall be approximately circular and cleanly cut; they shall have a nominal diameter of 10 mm and shall be not less than 8.0 mm. The perforations shall be arranged in rows parallel to the axis of the pipe and shall be located in the outside valleys or along tangents of corrugations. Perforations are not required within 150 mm of each end of each length of pipe. The rows of perforations shall be arranged in two equal groups placed symmetrically on either side of a lower unperforated segment, corresponding to the flow line of the pipe. The spacing of the rows shall be uniform. The distance between the centrelines of rows shall be not less than 25 mm.



**320.06.03** The minimum number of longitudinal rows of perforations, the maximum heights of the centrelines of the uppermost rows above the bottom of the inverts and the inside surface of chord lengths of the unperforated segments illustrated in [Figure V](#) shall be as specified in [Table 320-M](#).

**TABLE 320-M CSP INVERT PERFORATIONS**

DIAMETER OF PIPE (mm)	MINIMUM ROWS OF PERFORATIONS	H * (mm)	L ** (mm)
100	2	46	85
150	4	70	120
200	4	92	160
250	4	115	195
300	6	138	240
400	6	184	315
500	6	230	370
600	6	276	465

\* **Maximum** Heights "H" of the Centreline of the Uppermost Rows above the bottom of the invert.

\*\* **Minimum** Lengths of Inner Chord "L" of unperforated segments (See [Figure V](#)).

**320.06.04** Flat band couplers shall be supplied with perforated pipe unless corrugated or dimpled couplers are specified. Couplers shall comply with all requirements of Subsection [320.04](#).

### **320.07 Structural Plate Corrugated Steel Pipe Construction**

**320.07.01** This Subsection covers the fabrication of SPCSP products, using sheet and/or plate as specified in Subsection [320.02](#). Shapes in addition to round include vertical and horizontal ellipse, pipe-arch, arch, vehicular, pedestrian, or animal underpasses, and others. Nominal inside diameters are given in [Table 320-N](#).

**TABLE 320-N SPCSP - NOMINAL INSIDE DIAMETERS (mm)**

1500	2590	4610
1660	2740	4920
1810	3050	5230
1970	3360	5540
2120	3670	5850
2280	3990	
2430	4300	

**320.07.02** SPCSP shall have annular corrugations. Crests and valleys shall form circumferential rings about a pipe axis. Profile (pitch x depth) shall be: 152 mm x 51 mm. Tolerances are given in [Figure VI](#).

**320.07.03 Standard Round** - Nominal inside diameter for round pipe shall be as given in [Table 320-M](#).



**320.07.03.01** Structural plates shall be fabricated to standard dimensions shown in Table 320-O and Figure VII. Nominal corrugated plate lengths shall be 3050 and 3660 mm. Overall structure lengths shall be any combination of these two lengths, plus 100 mm.

**TABLE 320-O SPCSP - FLAT PLATE WIDTH DIMENSIONS**

WIDTH DESIGNATION NUMBER OF HOLE SPACES	NET ARC WIDTH (mm)	OVERALL OR BLANK WIDTH (mm)	NUMBER OF CIRCUMFERENTIAL BOLT HOLES
5N	1220	1340	6
6N	1465	1585	7
9N	2195	2315	10

**Note:** Number of circumferential bolt holes spaces (N) at 244 mm along plate net (arc) width. See Figure VII.

**320.07.03.02** Plates shall be punched along the edges with holes to form longitudinal and circumferential lap seams when assembled by bolting. Hole diameter shall not exceed bolt diameter by more than 6.0 mm.

**320.07.03.03** The longitudinal hole pattern shall be a minimum of two holes per corrugation. Dependent on the seam strength requirements, three or four holes per corrugation may be specified (See Figure VII).

**320.07.03.04** Plate arrangements in structures are normally designed with seams staggered such that not more than three plates come together at any one bolt hole.

**320.07.03.05** Plate arc width equals the number of circumferential bolt hole spaces (N) at 244 mm centres along the plate, in accordance with Table 320-O and Figure VII.

#### **320.07.04 Plate Curvature**

**320.07.04.01** Plates shall be curved to a radius along the inner crest dimension (plate net arc width) to form the circular arcs as required for the shape specified.

**320.07.04.02** Tolerance on calculated rise shall be  $\pm 13$  mm (See Figure VIII). Length of straight-edge shall be not less than 75% of chord length.

**Note:** Structural plate fabricators shall make available on request the standard rise dimensions for plates of varying curvature, using varying straight-edge inspection lengths.

**320.07.05** Bolts and nuts shall be in accordance with Subsection 320.02.03.02

**320.07.05.01** Bolt lengths shall be sufficient to provide full thread engagement in the nut when the assembled plates are tightened in place.

**320.07.05.02** The number of bolts of each length furnished shall be plus 2% in excess of the theoretical number to field erect the structure.

**320.07.05.03** Bolts and bolt containers shall be identified by length of bolt using colour codes given in Table 320-P.



TABLE 320-P SPCSP BOLT AND CONTAINER COLOUR CODE

BOLT LENGTH (mm)	COLOUR BOLT	COLOUR CONTAINER MARK	BOLT LENGTH (mm)	COLOUR BOLT	COLOUR CONTAINER MARK
30	None	White	50	Black	Black
40	Green	Green	80	None	Yellow
45	Red	Red	Nuts *	None	Blue

\* Nuts may be shipped in Bolt containers

### 320.07.06 Drawings and Plate Identification

**320.07.06.01** SPCSP plates shall be adequately identified by fabricator for field erection. Marking shall be clear and distinct for each job or order number. Identification may include thickness, radius, and drawing or code numbering.

**320.07.06.02** For each structure order the fabricator shall provide a bill of material. Erection drawing(s) shall be provided where required showing plate arrangements together with assembly instructions.

**320.07.06.03** Cut plates for bevelled or skewed ends shall be legibly identified to designate positions in a finished structure, and referenced on erection drawings.

**320.08 Asphalt Coated Pipe** - This Subsection covers asphalt coatings applied to CSP products; it does not cover pipe manufactured of asbestos bonded sheet.

#### Coating Designations:

AC - Asphalt coated

ACPI - Asphalt coated Paved Invert

**320.08.01 AC - Asphalt Coated** - The completed CSP manufactured in accordance with this specification shall be uniformly coated by a hot dip process with asphalt inside and outside to a minimum thickness of 1.3 mm each side measured on a corrugation crest. A minimum of two dips shall be required for each length of pipe. The first dip shall be prolonged sufficiently to ensure that the metal in the pipe is substantially at the same temperature as the asphalt, to ensure proper adhesion. The second dip shall be prolonged only sufficiently to build to the required thickness. No pin holing, bubbles or breaks in the asphalt coating shall be apparent after the second dip. During the cooling period after each dip the asphalt shall be protected from rain or snow and shall not be rolled or handled in any way to damage the coating.

**320.08.02 ACPI - Asphalt Coated Paved Invert** - In addition to the requirements of Subsection [320.08.01](#) asphalt shall be applied to provide a smooth surface in the invert filling the corrugations for at least 25% of the circumference of a round pipe and 40% of the periphery of a pipe arch. Pavement shall have a minimum thickness of 3.0 mm above the crests of the inside corrugations, except where pavement edges feather into corrugations.

**320.08.03 Coupler Bands** - Unless otherwise specified, the coupler bands ordered with AC or ACPI pipe shall be coated as required by Subsection [320.08.01](#). Coupler band hardware shall not be coated.



**320.08.04 AC Perforated Pipe** - Shall be uniformly coated inside and out to a minimum of 0.8 mm per side. Not more than 15% of the specified perforations shall be covered with a film of asphalt. The diameter of the clear perforations shall be not less than 7.0 mm.

**320.08.05 Coatings Generally** - Surface of the asphalt coating immediately after solidification (and prior to any treatment with anti-stick material) shall have a smooth and shiny appearance free of pinholes and bubbles.

Asphalt coating shall not spall under normal handling within the range of maximum summer and minimum winter temperatures.

Asphalt coating sampled from the finished pipe shall be capable of meeting the Shock, Flow, and Imperviousness Tests as defined in [Appendix II](#).

**320.08.06 Handling** - To prevent bruising, scaling, or scuffing of asphalt coated CSP, proper and careful handling shall be observed. Asphalt coated pipe shall not be dragged or pushed along the ground, or otherwise roughly handled.

The fabricator may use an anti-stick material such as soapstone, chalk, or sand to spray or dust on the finished pipe coating after cooling.

**320.08.07 Storage** - Prolonged storage in open sunlight of asphalt coated CSP is not recommended. Long exposure to sunlight may evaporate asphaltic volatiles, resulting in drying with alligator cracking. Asphalt coated CSP shall be installed and backfilled within a reasonable period after coating to ensure maximum protective benefits against hydraulic, abrasive, and corrosive conditions.

**320.08.08 Repair** - Spots where the asphalt coating has been damaged shall be repaired. The fabricator shall be responsible for the repair of any damage to the asphalt coating preceding shipment. Repair may be made with cold asphalt mastic, provided the area is small. Redipping will be required for large areas.

## **320.09 Inspection, Quality of Work, and Quality Control**

### **320.09.01 Inspection**

**320.09.01.01** The Purchaser shall have access to the fabricating plant for inspection, and every facility shall be extended to the Purchaser for this process.

**320.09.01.02** Inspection may include checks on gauge thickness, weight of zinc coating, corrugation profile, outside circumference, quality of riveting or lock seam, and such other features as deemed necessary by the Ministry to meet this specification.

**320.09.01.03** Sampling of the base metal for chemical analysis shall be made in accordance with ASTM A 444.

### **320.09.02 Quality of Work**

**320.09.02.01** In addition to compliance with the details of construction, the complete pipe shall show careful, proper quality of work in all particulars.

**320.09.02.02** Among others, the following defects constitute poor quality of work, and the presence of any of them in a corrugated steel pipe may be cause for rejection: uneven laps, undue deviation from true shape, lack of rigidity, excessive variation from a reasonably straight centreline, ragged or diagonally sheared edges, loose, unevenly aligned or spaced rivets or bolts, poorly formed rivet heads of lock seams, or damaged lock seam metal, bruised, scaled or broken zinc coating, corroded or improperly cleaned and painted welds, illegible brand,



significant dents or bends in the steel itself, and ragged or unfinished ends.

### **320.09.03 Repair of Damaged Zinc Coating**

**320.09.03.01** Small localized areas, scratches or burns in which the zinc coating has been damaged by welding or other fabrication procedures shall be repaired by careful wire brushing followed immediately by the application of a dry film thickness of 50 µm of zinc rich coating conforming to CGSB Standard 1-GP-181M Coating, Zinc Rich, Organic, Ready Mixed.

**320.09.03.02** Gross uncoated areas shall be repaired by re-galvanizing by hot-dip process in accordance with Subsection [320.02.01](#) or by metallizing process which shall meet the requirements of CSA Standard G-189.

**320.09.04 Quality Control Helical CSP** - The supplier shall develop and maintain an effective quality control system to ensure that adequate inspection coverage is maintained throughout the manufacturing process. Evidence of such inspection shall be available to the authorized inspector of the Ministry prior to shipment from the place of manufacture or from the supplier's storage facility.

The Ministry reserves the right to maintain surveillance over the supplier's quality control systems to ensure conformity with this specification.

The supplier shall furnish the Ministry Representative with an outline of the supplier's quality control procedures. The outline shall include the intended method of identification of production runs, frequency of visual checks and pull tests, method of reporting and recording, and/or retention of samples.

**320.09.04.01** Production run shall be considered to include all pipes of the same metal thickness and diameter produced continuously, with only minor adjustments to the machinery being required. A new production run shall be considered to start with a change in metal thickness or a change in pipe diameter.

**320.09.04.02** Visual checks shall at least include observations or measurement, as applicable, of metal thickness, corrugation depth, diameter, length, square end cut and zinc coating. They shall also at least include observation or measurement, as applicable, of the lock seam as follows: lap, gap, retaining offset, loss of seam contact, interior angularity, and roller indentation.

**320.09.04.03** Pull tests shall be conducted in accordance with [Appendix III](#). The lateral seam strength shall meet the minimum requirements of Table [320-K](#).

If any sample fails this requirement, all pipe already produced in that production run or all pipe produced since the last pull test was conducted shall be subject to rejection. The manufacturer may however conduct additional pull tests on the previously produced pipe and thereby ascertain which, if any, can be considered acceptable.

**320.09.04.04** The Ministry reserves the right not to accept bids from manufacturers whose Quality Control procedures are below the norm set by the industry as a whole in British Columbia.

To be considered acceptable a lock seam must meet all visual criteria as well as the minimum lateral seam strength requirement.



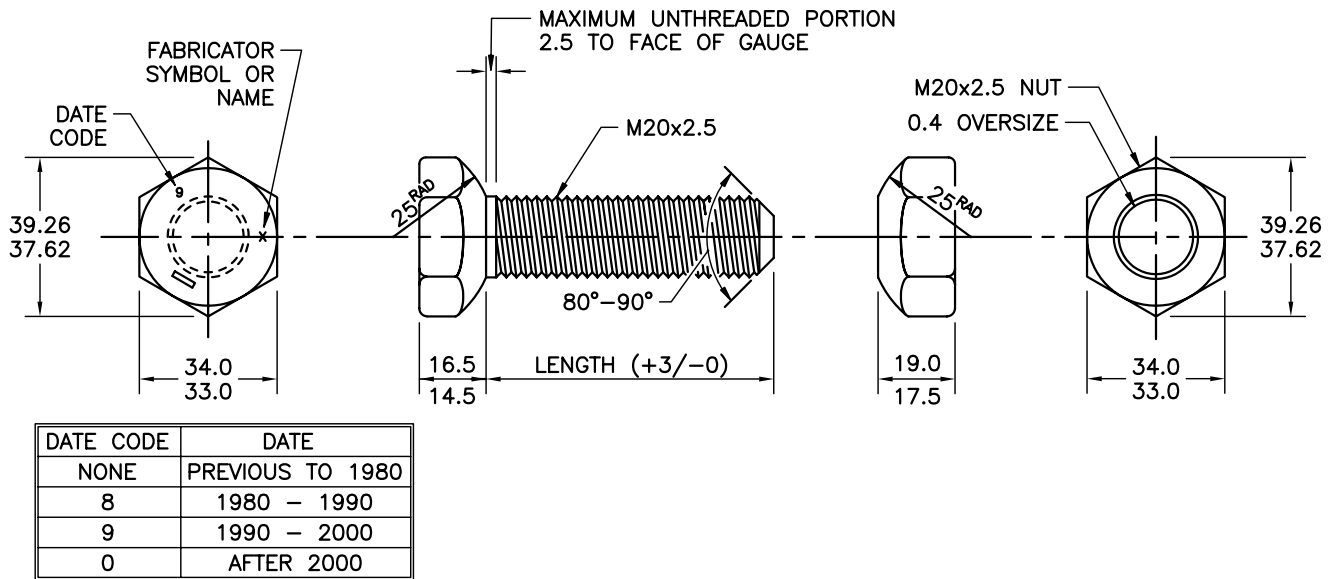


FIGURE I: SPCSP BOLTS AND NUTS

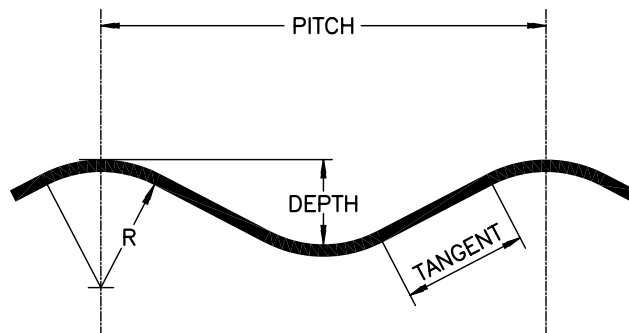


FIGURE II: TYPICAL CSP CORRUGATION PROFILE

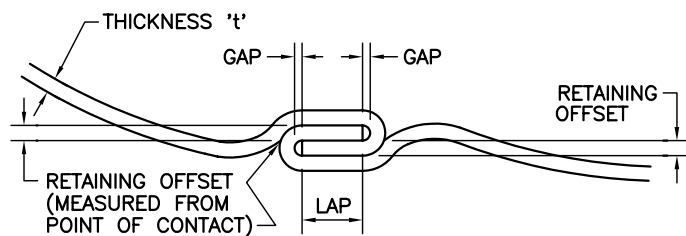


FIGURE III: LOCK SEAM CROSS-SECTION



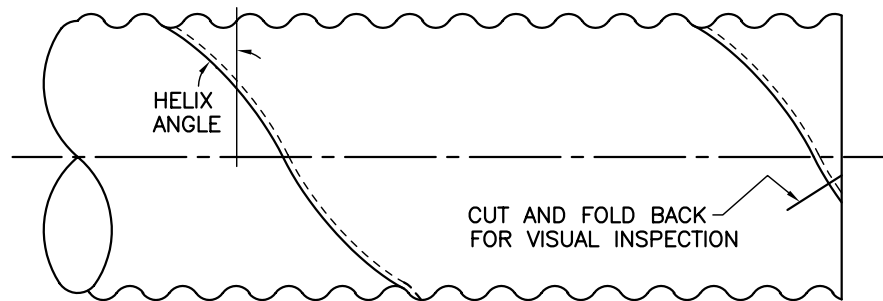


FIGURE IV: HELIX ANGLE AND LOCK SEAM INSPECTION

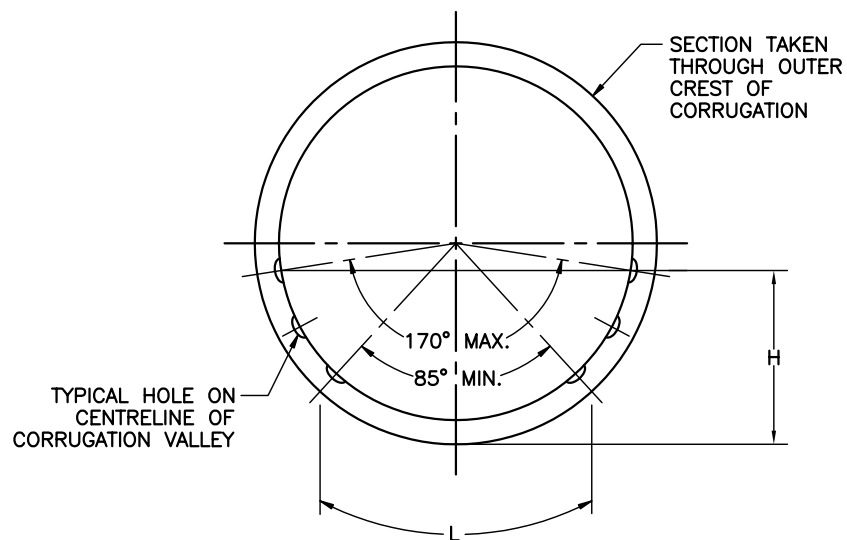


FIGURE V: REQUIREMENTS FOR INVERT PERFORATED CSP

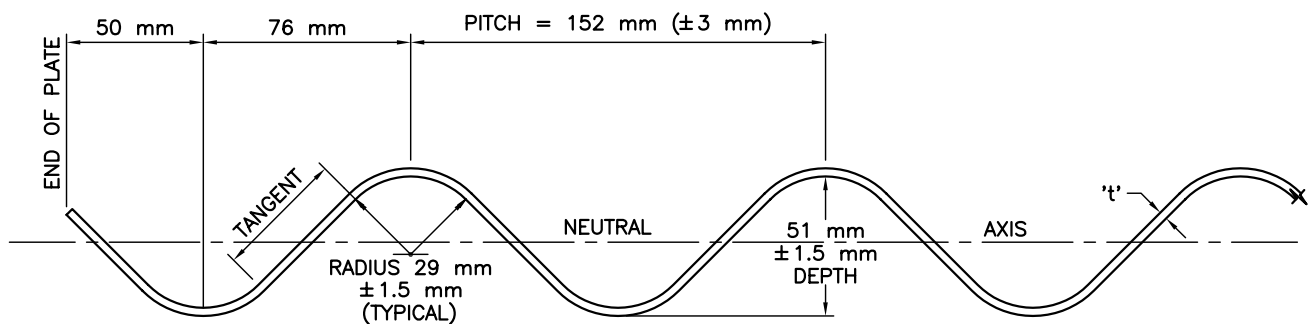


FIGURE VI SPCSP CORRUGATION PROFILE



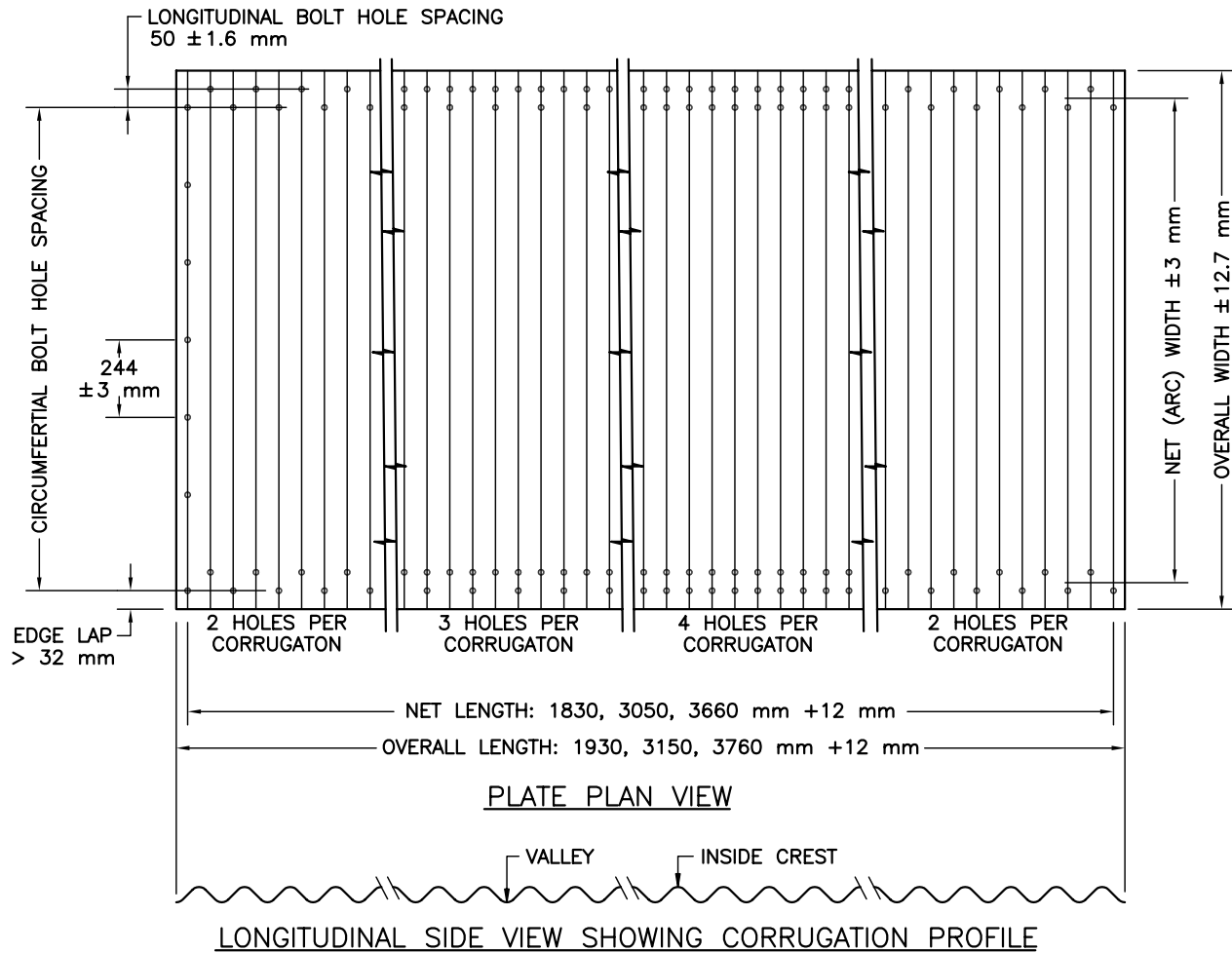


FIGURE VII: STANDARD SPCSP PLATE CONFIGURATION AND DIMENSIONS  
(AFTER CORRUGATION AND BEFORE CURVING)

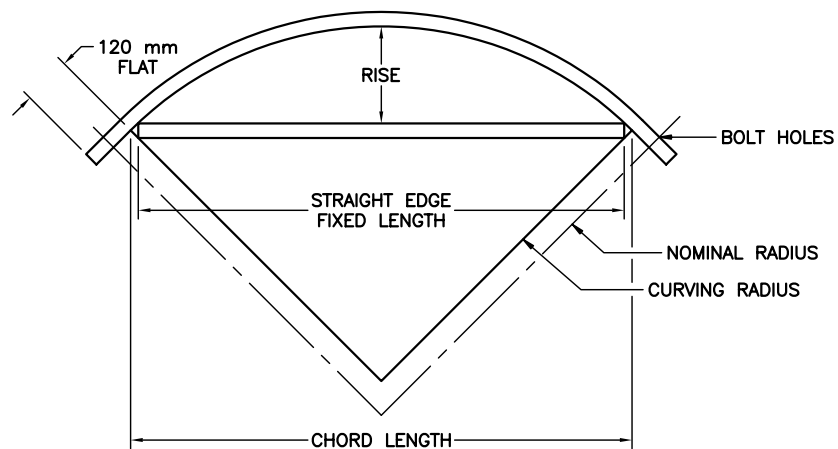


FIGURE VIII: SPCSP PLATE CURVATURE



**SECTION 320**  
**CORRUGATED STEEL PIPE**  
**APPENDIX I**

**Test Method for Shear Strength  
of the Lock Seam of Helical Pipe**  
(Referred to in Subsection [320.03.04.03](#))

**A1.1 Apparatus**

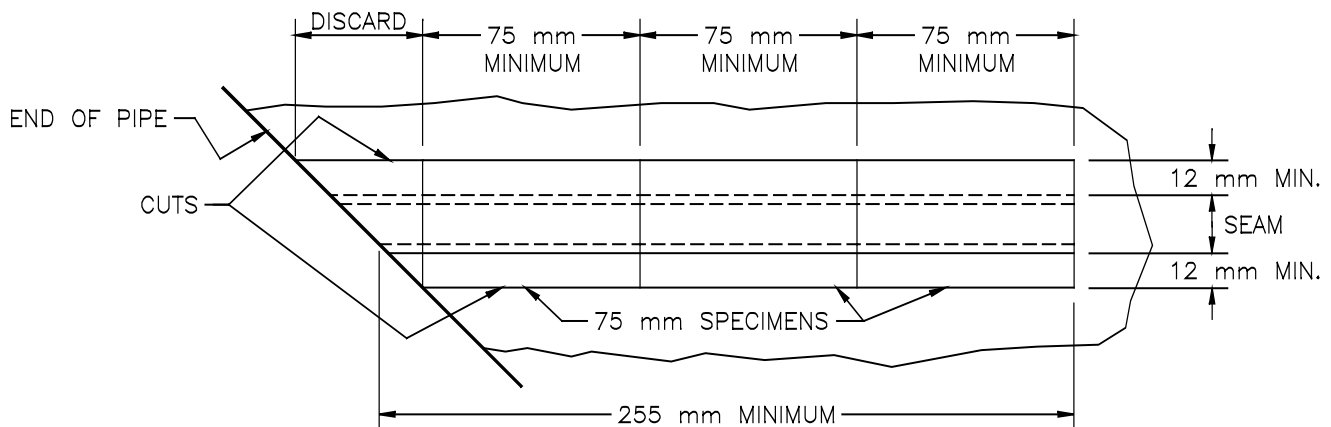
- a) Testing Machine - Any standard testing machine capable of maintaining the specified rate of strain and of measuring the tensile load with an error not to exceed  $\pm 50$  N.
- b) Grips - The grips for holding the test specimen in the testing machine shall be of the self-aligning type.

**A1.2 Test Specimens**

- a) Sample - A sample shall be taken from the end of a completed pipe. The sample shall be cut out with a metal cutting saw, the cuts being made at least 12 mm on either side of the seam. The length of the sample measured along the shorter side of the seam shall be at least 255 mm. The end cut shall be made at right angles to the direction of the seam.
- b) Specimen - Three separate specimens, each 75 mm long, shall be cut from the sample commencing at the end of the sample opposite the end of the pipe. See [Figure 1](#). The remaining piece of seam at the end of the pipe shall be discarded. Each specimen shall then be prepared as shown in [Figure 2](#). Extreme care shall be exercised in preparing the specimen to ensure that the seam is not loosened. If prepared in a vise it shall be held and cut such that no forces are applied which will tend to warp, twist or flatten the specimen.

**A1.3 Procedure**

- a) The gauge length of each specimen shall be measured with calipers to an accuracy of  $\pm 0.2$  mm.
- b) Each test specimen shall be carefully placed in the grips of the testing machine in such manner as to ensure that the axis of the test specimen coincides with the direction of the applied pull.



**FIGURE 1 - DIAGRAM FOR CUTTING SEAM SAMPLE FROM END OF HELICAL PIPE**



c) The load shall be applied at the rate stated in [Appendix A1.4](#) until the test specimen has slipped 6.0 mm. The maximum load in Newtons shall be recorded.

#### A1.4 Speed of Testing

The load shall be applied continuously throughout the test at a uniform rate of motion of the moveable cross head of 2.5 mm per minute.

#### A1.5 Calculation

The shear strength of the lock seam of each specimen shall be calculated by the following formula:-

$$S = P/L$$

Where: S = Shear strength of lock seam, Newtons per lineal millimetre.  
P = Maximum load obtained within first 6.0 mm of slippage, Newtons  
L = Gauge length, millimetres.

#### A1.6 Report

The shear strength of the three specimens shall be reported and the average shall be the shear strength of the sample.

#### A1.7 Acceptance

A test sample shall be considered to meet the test requirements provided that the above average shear strength exceeds the requirements of 80 N/mm required by Subsection [320.03.04.03](#) and provided that at least two of the specimens also exceed that requirement. Should any test sample fail to meet the test requirements, the manufacturer shall be allowed a retest on two additional samples for each sample that failed. Both retest samples are required to meet the test requirements before the pipe can be considered acceptable.

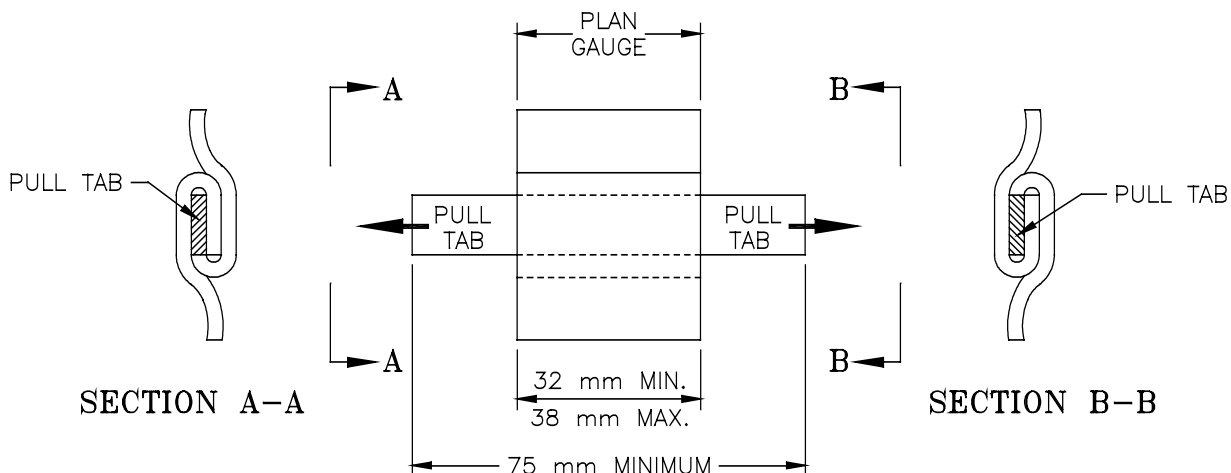


FIGURE 2 - DETAIL OF SPECIMEN FOR SHEAR STRENGTH TEST OF LOCK SEAL



## SECTION 320 CORRUGATED STEEL PIPE

### APPENDIX II

#### ASPHALT COATING

(Referred to in Subsection [320.08](#))

##### A2.1 Coating

The asphalt used for the AC and ACPI pipe shall have the following properties:-

	Limit %	Test Method
Asphalt soluble in trichloroethylene, not less than	99.5	ASTM D 2042
Loss on heating to 163°C, not more than	1	ASTM D 6
Penetration of residue after heating compared with penetration of same sample before testing for loss on heating, not less than	85	ASTM D 5 & D 6

##### A2.2 Sampling

All tests on the asphalt coating shall be made on samples obtained from the pipe on or about to be delivered to the project.

A 150 g sample of asphalt coating shall be obtained by gathering strippings from the inside top of one or more lengths of pipe. (Care should be taken in sampling to avoid contamination from sand or soapstone that may have been applied after dipping).

##### A2.2 Shock Test

The ability of coated pipe to withstand handling in cold weather is indicated by successfully passing the following shock tests:

**a) Apparatus:** The apparatus for the shock test shall consist essentially of a rigid metal anvil or base plate not less than 12 mm thick and resting on a solid foundation, and a hammer weighing 2 kg arranged to fall freely in suitable guides against a plunger weighing 1 kg and sliding freely in a vertical sleeve. The lower end of the plunger shall be hemispherically shaped, with a radius of 12 mm. The hammer shall be held in its guide by a trip mechanism at a distance of 130 mm above the plunger. Split molds for preparing the specimens shall be made of brass with the surfaces amalgamated to prevent sticking and held together by slip rings pressed on the slightly tapered outside surfaces.

**b) Procedure:** Four test specimens shall be prepared in the form of discs 9.5 mm thick and 45 mm diameter. Approximately 115 g of the material sample shall be heated over a low flame until it becomes fluid, then poured into a mold or molds. The sample shall be melted at the lowest possible temperature. The sample shall be stirred thoroughly until it is homogeneous and free from air bubbles when poured into the molds. The material may be poured in a 45 mm diameter cylinder of such length that the four test specimens may be cut from it, using a wire cutter. Two of the samples used in the shock test may be used later to prepare samples for the flow test.



The four specimens shall be cooled in a brine of ice and salt at a temperature of  $-1^{\circ}\text{C}$  for a period of at least one hour. The samples shall then be removed one at a time and quickly placed on the anvil of the test apparatus and centered under the plunger. The hammer shall then be tripped from a height of 130 mm. Not more than eight seconds shall elapse from the time each specimen is removed from the brine until the hammer strikes the plunger.

For material to be acceptable, not more than one of the four test specimens shall show a crack. If it is difficult to determine visually whether a specimen has cracked, it may be removed from the test apparatus and bent slightly.

#### A2.4 Flow Test

The ability of the coating on the pipe to remain in place and not flow or sag at summer temperatures is indicated by successfully meeting the following flow tests:

**a) Apparatus:** The apparatus for the flow test shall consist of a corrugated brass plate 0.8 mm thick, 200 mm long and 100 mm wide, with corrugations running the long way of the plate and a metal support to hold the plate on a  $45^{\circ}$  angle with the horizontal. The corrugations shall have a crest-to crest dimension of 16 mm and depth of 4.8 mm. A line shall be scribed 150 mm from the lower edge. Split molds shall be similar to those specified above for the shock test.

**b) Procedure:** Two test specimens in the form of cylinders, each 9.5 mm in diameter and 19.0 mm in length, shall be obtained by pouring the excess molten from the shock test into the amalgamated brass molds. Each specimen shall be placed in a corrugation of the corrugated slide (slide to be on the  $45^{\circ}$  slope) so that the lower end of each specimen will rest exactly along a line scribed 150 mm from the bottom edge of the slide. The test apparatus, with the specimens in place, shall then be placed in an oven maintained at  $64^{\circ}\text{C}$  ( $\pm 1^{\circ}$ ). After 4 hours it shall be removed and allowed to cool to room temperature. The distance from the bottom of the corrugated plate to the lower edge of each test specimen subtracted from 150 mm, determines the amount of sag or flow. To be acceptable, the flow must not exceed 7.0 mm for either of the two specimens.

#### A2.5 Imperviousness Test

The imperviousness of the coating shall be determined by placing 25 to 50 millilitres each of a 25% solution of sulphuric acid, a 25% solution of sodium hydroxide, and a saturated salt solution, in three adjacent corrugations of the coated pipe or in three corrugations of a section approximately 100 mm wide cut from the pipe. The three solutions shall remain in corrugations for a period of 48 hours during which time no loosening or separation of the coating from the galvanizing shall have taken place.



## SECTION 320 CORRUGATED STEEL PIPE

### APPENDIX III

#### Test Method for Lateral Seam Strength of Helical CSP Lock Seam

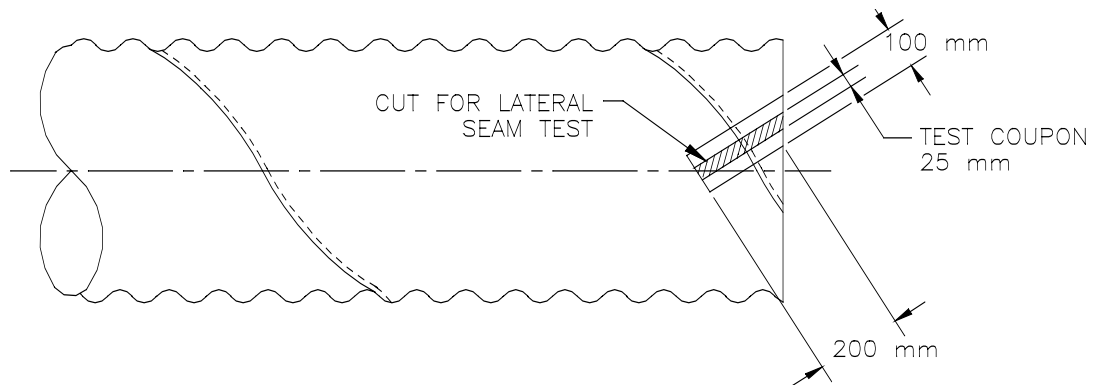
(Referred to in Subsection [320.09.04.03](#))

##### A3.1 Apparatus

- a) **Testing Machine** - Any standard testing machine capable of maintaining the specified rate of strain and of measuring tensile load with an error not to exceed  $\pm 50$  N.
- b) **Grips** - The grips for holding the test coupon shall be of the self-aligning type.

##### A3.2 Preparation of Sample

- a) Torch or saw cut a piece approximately 100 mm x 200 mm from the end of the pipe (See [Figure 1](#)).
- b) Saw cut a 25 mm by 150 mm coupon with parallel sides perpendicular to the lock seam (See [Figure 1](#)).



**FIGURE 1 - LOCATION OF LOCKSEAM SAMPLE**

- c) Flatten ends of the coupon for gripping in the testing machine. Do this in a vise one end at a time, insert strip in vise to 12 mm from the lock seam. As vise flattens corrugation, strip will rotate. Realign lock seam with flattened ends by use of crescent wrench or vise grips tightened over the lock seam to prevent distortion of the seam itself while bending the strip back into line.

##### A3.3 Procedure

The gauge length of the test coupon shall be measured in the direction of the seam with calipers to an accuracy of  $\pm 0.2$  mm.

The coupon shall be carefully placed in the grips of the testing machine in such manner as to ensure that the axis of the test coupon coincides with the direction of the applied pull.

The load shall be applied at a uniform rate of motion of the movable cross head of 2.5 mm per minute. The maximum load in Newtons shall be recorded.



**A3.4 Calculation**

The lateral seam strength shall be calculated by the following formula:

$$S = P/L$$

where: S = Lateral Seam Strength in N/mm

P = Maximum Load N

L = Gauge length of test coupon in the direction of the seam in mm



**SECTION 320  
CORRUGATED STEEL PIPE****APPENDIX IV****Method of Obtaining Lock Seam Sample  
from Pipe With Recorrugated Ends**

(Referred to in Subsection [320.03.04.04](#))

**A4.1 Tools**

The following tools are required:

- Heavy duty 12.5 mm variable speed drill complete with a 38 mm and a 64 mm hole saw.
- Hammer
- Centre punch
- Crescent wrench (200 mm)
- Screwdriver.

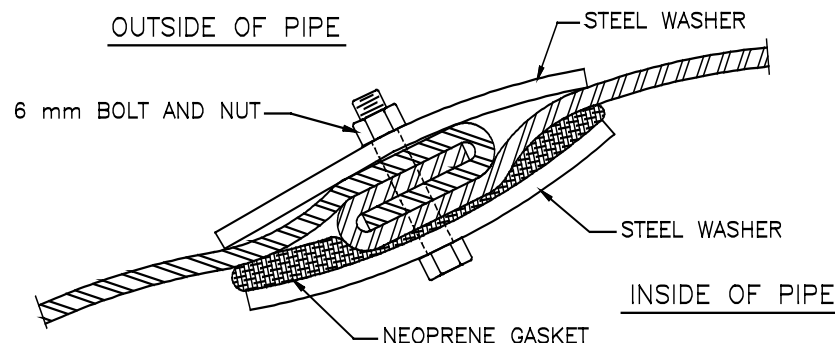
**A4.2 Procedure**

Drill a 38 mm diameter sample with the hole saw. Centre the drill on the centre of the lock seam about 600 mm from the end of the pipe clear of the recorruagated portion.

The sample of the lock seam shall be ground flat across the seam and shall be examined for all the visual inspection requirements contained in Subsection [320.03.04.02](#).

**A4.3 Repair**

Repair the pipe by bolting 64 mm zinc coated washers on either side of pipe. See [Figure 1](#). Washers may be obtained by use of the 64 mm hole saw on the tangent of a piece of corrugated sheet.



**FIGURE 1**



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 321

### TRAFFIC PAINT

**321.01 Scope** - This Section applies to paint suitable for spray application at a temperature of  $50^{\circ}\text{C} \pm 5^{\circ}\text{C}$  to asphalt or concrete pavements for marking of traffic lines. It will be used with overlay glass reflectorized beads, and will be supplied in white or yellow without any "pre-mix" beads.

#### **321.02 Not Used**

**321.03 General Requirements** - The composition of the paint will be at the discretion of the manufacturer but shall be a product pre-qualified by the specified procedure. (See Subsection [321.11](#) for tendering prerequisites).

**321.04 Detail Requirements** - Paint to this specification shall comply with the following:

- a) **Consistency:**  $85 \pm 5$  Kreb units. Test method ASTM D 562.
- b) **Drying Time:** Maximum 30 minutes at  $21^{\circ}\text{C}$  at 50-60% relative humidity. Test method ASTM D 711.
- c) **Bleeding:** The paint shall have a degree of resistance to bleeding of seven or greater. Test methods ASTM D 969 and D 868.
- d) **Road Service Life:** The paint shall obtain satisfactory ratings for general appearance, durability and night visibility during seven to eight months of service (June to December approximately) under heavy traffic on bituminous pavement in the vicinity of Victoria or Vancouver, British Columbia. Satisfactory ratings are defined as being equal to or better than those obtained by paints currently "Qualified" by the Ministry.

**Test Method:** British Columbia Ministry of Transportation Standard Method of conducting and rating Road Service Tests on Traffic Paint (See Subsection [321.11](#)).

#### **e) Handling Qualities:**

- i) The degree of settling after five months storage shall be such that the paint can be readily re-mixed to a uniform consistency and there shall be no skinning. The paint shall not have marked thixotropic properties.
- ii) The paint shall be capable of being sufficiently atomized to produce a uniformly applied line 100 mm in width with absence of side splatter, overspray, or cobwebbing within the limits imposed by the application equipment used on the Ministry's line striping machines.
- iii) The paint shall be capable of being successfully applied to at least 2 km of dash line without the necessity of making adjustments to any machine settings and without showing any evidence of distortion of the spray pattern or appreciable build up of paint in the spray gun tips.

**Test Method:** British Columbia Ministry of Transportation Standard Method of conducting Handling Quality Tests on Traffic Paint (See Subsection [321.11](#)).

#### **f) Colour:**

- i) White paint shall comply with US Federal Specification 595b White 17886.
- ii) Yellow paint shall match British Columbia Ministry of Transportation Standard Yellow Traffic Paint colour chip.



**g) Quality Control:** Paint supplied under contract shall be identical with the sample submitted for qualification (See Subsection 321.03). Paint shall be considered identical if it has been manufactured within the following tolerances:

- i) Mass per litre:  $\pm 25$  g of the value on the Traffic Paint Data Form.
- ii) Drying time: Maximum 30 minutes and within  $\pm 5$  minutes of the value shown on the Traffic Paint Data Form.
- iii) Composition of Paint: Within the tolerances indicated by the manufacturer on the Traffic Paint Data Form.

The Ministry reserves the right to conduct whatever other tests are deemed necessary to identify the paint supplied with the paint submitted for qualification.

**321.05 Packaging** - Paint required to be supplied in 204.6 ℓ (45 Imperial gallon) drums shall be shipped in heavy duty, leakproof, clean, open head steel drums. Special precautions are necessary to ensure that lids are sufficiently secure to withstand offloading by rolling or dropping from a truck deck.

Drums must be sealed vapour proof.

The drums may be chargeable but must be returnable for credit or cash equal to the charge.

**321.06 Delivery** - Delivery at 36 000 ℓ (8,000 Imperial gallons) a week shall commence within 3 weeks of date of the award of the contract. This rate shall be maintained until advised in writing by the Ministry that a slower rate is required. In the event that the delivery rate is to be increased after having been decreased or temporarily stopped, the manufacturer shall increase production within one week of notification. The delivery rates and notification times apply to paint released for shipment and the manufacturer shall allow 24 hours for such release to be authorized (See Subsection 321.07). If a batch is rejected for non-compliance with these Specifications, the resulting deficit in delivery rate shall be made good within one week.

A manufacturer unable to meet this requirement may obtain qualification and may supply paint to the Ministry, provided that the manufacturer states clearly the rate at which the paint can be delivered at the time of applying for qualification and on any quotation submitted after qualifications has been obtained. If awarded part of the contract this requirement will apply as modified by the lower rate quoted.

#### **321.07 Release for Shipment**

- a) The manufacturer shall run quality control tests for each batch of material and shall report the results on the prescribed form.
- b) The manufacturer shall notify the Ministry of times at which each batch is to be filled into drums. Samples shall be taken by the Ministry Representative at that time.
- c) The batch will be released for shipment by the Ministry after sufficient tests have been run to identify the batch with the sample originally qualified and after receipt of the manufacturer's quality control test results. Such release shall not be a bar to subsequent rejection of the material if it is found to have unsatisfactory handling qualities in the field (See Subsection 321.04 (e)) or if its properties of consistency and drying time fail the requirements within one month of the date of manufacture.

**321.08 Labelling** - Each container shall be clearly marked with Batch Number, Date of Manufacture, Name of



Manufacturer and Manufacturer's Code Number on both drums and lids. These markings shall be affixed so that they will not be affected by weather or handling.

**321.09 Rejection** - Paint rejected for non-compliance with these specifications shall be replaced with paint that does so comply, at the manufacturer's expense, including handling and transportation charges.

**321.10 Non Delivery Penalty** - Failure of a manufacturer to deliver paint at the specified rate (See Subsection [321.06](#)) necessitating the Ministry obtaining a proportion of the order from an alternative supplier will result in cancellation of that proportion of the contract and payment of a penalty based on that proportion. The penalty will be negotiated by the Chairman of the Purchasing Commission at the time of default.

**321.11 Qualification Procedures and Ministry Test Methods** - Details regarding procedures for qualification and Ministry Test Methods may be obtained from the Manager, Centreline Operations, (phone (604)576-2907).

**Note:** Samples for qualification must be received not later than April 1st of each year to obtain qualification for the following year's supply.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 407

### FOUNDATION EXCAVATION

**407.01 Scope** - This Section covers foundation excavation (i.e., excavation for abutments, piers, culverts, walls, manholes, paving, riprap, etc., not requiring cofferdams), as specified herein, and shall apply generally to all structures other than those in deep water, and where it is distinctly stated that the prices bid are inclusive of excavation.

**407.02 Extent of Work** - Foundations shall be excavated to the lines, levels and grades established by the Ministry Representative. All organic and soft materials shall be entirely removed to a firm formation and piled well back from the work. The use of explosives shall be limited strictly to the necessities of the job. As nearly as practicable, the foundation provided shall be of uniform bearing capacity.

**407.03 Description of Material Types** - Foundation excavation classified under the following material types:

Type A, Type B, Type C and Type D material shall be as defined in Subsection [201.11](#).

No distinction shall be drawn between wet and dry excavation, the prices being the same for both.

**407.04 Method of Measurement** - This excavation shall be measured by the cubic metre in its original position for the actual volume moved, with the following limitations:

- a) No allowance shall be made for the excavation for Catch Basins.
- b) No allowance shall be made for slides, cave-ins, siltings or filling in of excavations due to the carelessness of the Contractor.
- c) No allowance shall be made for any overbreak.
- d) On structural footings, foundations and box culverts, no payment shall be made for material removed outside of an area which is bounded by vertical planes 600 mm outside and parallel to the neat lines of the footings or floor.
- e) Excavation for pipe culverts, other pipes and underdrains shall be limited to the width of trench actually constructed, but not to exceed a width of trench greater than 600 mm plus the outside diameter of the pipe.
- f) Excavation for manholes shall be limited to the dimensions actually constructed, but shall not exceed the width, breadth or diameter of the outside dimensions of the manhole by 1.2 m.
- g) No payment will be made for any material removed from below the elevations shown on the plans or established by the Ministry Representative for the bottom of the excavations. Any such material excavated below the established elevations shall be replaced at the Contractor's expense. Replacement shall be made with concrete or other material acceptable to the Ministry Representative.

**407.05 Quantities and Payment** - Payment shall be at the unit price bid for each class and shall be accepted as full compensation for everything furnished and done in connection therewith.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 412

### REINFORCING STEEL

#### DESCRIPTION

**412.01 Scope** - This Section describes the supply, fabrication and installation of reinforcing steel for concrete structures.

The requirements of CAN/CSA A23.1, Section 12 shall apply unless specified otherwise herein or in the Special Provisions.

References to standards shall be to the current editions at time of tendering.

#### MATERIALS

**412.11 General** - All reinforcing bars shall be deformed except for spirals and ties where plain bars may be used.

The type and grade required shall be as specified on the Purchase Order, Work Order, Plans or Special Provisions.

Wire ties for reinforcing steel, conforming to CSA G30.3-M, shall be minimum 1.6 mm diameter, cold drawn, annealed steel wire.

Two copies of mill certificates giving chemical and physical properties of the reinforcing steel shall be furnished to the Ministry Representative.

The identification of reinforcing bars shall be maintained throughout the fabrication, coating (if required) and shipping processes to the installation on the job.

The Ministry Representative may select random samples of the reinforcing bars for testing.

**412.11.01 Uncoated Reinforcing Steel** - Concrete reinforcement shall conform to the requirements of the CSA Standards shown in Table 412-A, as applicable.

**412.11.02 Epoxy Coated Reinforcing Steel** - Epoxy-coated reinforcing steel bars shall conform to the requirements of ASTM A 775M. Application plants shall be certified under the Concrete Reinforcing Steel Institute (CRSI) Voluntary Certification Program for Fusion-Bonded Epoxy Coating Applicator Plants, and proof of certification shall be submitted to the Ministry Representative. Pre-treatment of the near white blast cleaned surfaces with chromate or equivalent is mandatory prior to the application of a minimum of 180 µm of cured thickness of protective epoxy coating by an electrostatic spray method. All epoxy coated bars shall be clearly labelled with the name of the manufacturer, the primer and the coating system used and

**TABLE 412-A REQUIREMENTS FOR UNCOATED REINFORCING STEEL**

G30.3-M	Cold-Drawn Steel Wire for Concrete Reinforcement
G30.5-M	Welded Steel Wire Fabric for Concrete Reinforcement
G30.14-M	Deformed Steel Wire for Concrete Reinforcement
G30.15-M	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
G30.18-M	Billet Steel Bars for Concrete Reinforcement

the date of production. The method of labelling shall be determined by the applicator plants and test certificates of performance of coated bars shall be submitted to the Ministry Representative.

The Ministry Representative may require samples of epoxy resin and epoxy patching material for acceptance testing as called for in ASTM A 775M. The Ministry Representative may require tests of coated bars as called for in ASTM A 775M.

**412.11.03 Order Lists and Bending Diagrams** - All order lists and bending diagrams shall be submitted to the Ministry Representative for review before material is ordered.

The review of order lists and bending diagrams by the Ministry Representative shall not relieve the Contractor or suppliers, as applicable, of responsibility for the correctness thereof.

#### CONSTRUCTION

**412.31 Bending** - Reinforcement bars shall be cut and bent to the shapes shown on the plans. Bending shall be sufficiently accurate that the placing tolerances (Subsection 412.33.01) can be met. All bars shall be bent cold, unless otherwise permitted. Bars partially embedded in concrete shall not be field bent except as shown on the plans or specifically permitted.

**412.31.01 Hooks and Bend Dimensions** - Where hooks are shown on the plans, they shall have the following dimensions, unless shown otherwise:

- 180° bend plus extension of 4 bar diameters, but not less than 60 mm.
- 90° bend plus extension of 12 bar diameters.
- for stirrups and ties, 135° bend plus extension of 6 bar



diameters, but not less than 60 mm.

Minimum inside diameters of bends shall be as shown in Table 412-B.

Exceptions:

- Minimum inside diameters of bends of stirrups and ties shall be 4 bar diameters.
- Minimum inside diameters of bends of welded wire fabric shall be 8 wire diameters.

Bars partially embedded in concrete shall not be field bent except as permitted by the Ministry Representative.

**TABLE 412-B MINIMUM INSIDE DIAMETERS OF BENDS**

BAR DESIG- NATION	UNCOATED BARS (mm)		EPOXY COATED BARS (mm)
	300 MPa	400 MPa	
10M	55	65	90
15M	80	95	130
20M	100	120	155
25M	125	150	200
30M	150	240	240
35M	330	360	360
45M	440	440*	440
55M	550	550*	550
* Special fabrication is required for bends exceeding 90° for bars of these sizes.			

**412.32 Handling and Storage** - Reinforcing bars shall be stored on platforms, skids or other suitable supports clear of the ground and shall be protected as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, or other materials that would reduce bond.

**412.32.01 Epoxy Coated Reinforcing Steel** - Epoxy coated reinforcing bars shall be handled and stored so as to minimize damage to the coating. Equipment for handling the bars shall have protected contact areas. Nylon slings or padded wire rope slings shall be used. Suitable bundling bands shall be used to prevent damage. Bundles of coated bars shall be lifted at multiple pick-up points to prevent bar-to-bar abrasion from sags in the bundles of bars. The bars or bundles shall not be dropped or dragged.

The storage of coated bars shall be kept to a minimum. If coated bars must be stored for an extended period of time they shall be protected from direct rays of sunlight.

Coated bars shall not be cut or bent on the job without the permission of the Ministry Representative. In any case, the flame-cutting of coated bars will not be permitted.

Coated bars shall be tied with nylon-, epoxy-, or plastic-coated tie wire or other acceptable material. Metallic clips, spacers and chairs (where such are permitted) shall be plastic coated.

Any bar with coating damage exceeding 2% of the surface area shall be rejected. Bars with damage over lesser areas shall be patched as required by ASTM A 775M, Section 12.

The "Guidelines for Jobsite Practices", contained as an Appendix of ASTM A 775M, shall be mandatory.

Where on-site inspection or testing by the Ministry Representative does not confirm the coating thickness or integrity for any shipment of bars, such bars may be rejected, and in any case shall not be placed in the structure until the Ministry Representative is satisfied as to their acceptability.

The Contractor shall make available to the Ministry Representative, for inspection and acceptance, all repairs performed to protective coatings on any reinforcing steel. Repairs of epoxy coatings shall not be performed when the coated bar or ambient air temperature is 5°C or less, or when moisture is present on the bar. Patching material shall not be applied if precipitation is expected within four hours of the procedure, as the coating may wash off. If precipitation does occur within four hours, the Ministry Representative shall make a determination as to whether the material as applied is acceptable or must be replaced. If the placed coated bars have been exposed to salt spray or road salts, the bars shall be rinsed with fresh water to remove any chloride contamination prior to placing concrete.

**412.33 Placing and Fastening** - Before any concrete is placed, the placing and securing of reinforcing steel shall be approved by the Ministry Representative. The reinforcing steel shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material.

Reinforcement shall be placed in the positions shown on the Plans, within the tolerances specified below, adequately supported and secured against displacement.

The locations of the top reinforcing steel in bridge decks shall be checked by running a full deck-width template along the longitudinal screeds. The lower edge of the



template shall be set at the nominal cover dimension (see plans) below the level of the deck surface. No steel shall touch the template nor be more than 6 mm distant from it.

The location of reinforcing steel near deck joint anchors shall be adjusted so that there will be no interference with the deck joint anchors.

Tack welding of reinforcement for cage assembly or securing of reinforcement will be permitted only with the written approval of the Ministry Representative. In no cases shall stirrups be welded to tensile reinforcement.

**412.33.01 Tolerances** - Tolerances for placing reinforcement shall, unless otherwise specified, be as shown in Table 412-C.

**TABLE 412-C TOLERANCES FOR PLACING REINFORCEMENT**

Concrete cover to top reinforcing steel in bridge decks	+ 6 mm - 0 mm
Concrete cover to reinforcement, other than top reinforcing steel in bridge decks	± 8 mm
Bar location, except cover, when depth of a flexural member, thickness of a wall or smallest dimension of a column is 200 mm or less	± 8 mm
Bar location, except cover, when depth of a flexural member, thickness of a wall or smallest dimension of a column is larger than 200 mm but less than 600 mm	± 12 mm
Bar location, except cover, when depth of a flexural member, thickness of a wall or smallest dimension of a column is 600 mm or larger	± 20 mm
Longitudinal location, except cover, of bends and ends of bars	± 50 mm
Longitudinal location, except cover, of bends and ends of bars at discontinuous ends of members	± 20 mm

**412.33.02 Bar Supports and Spacers** - Bar supports and spacers shall be adequate to ensure concrete cover and bar spacings are maintained within the specified tolerances.

Bar supports and spacers shall be sufficient in number and strength to support the reinforcement and prevent displacement by workers or equipment before and during concreting and shall be adequately spaced to ensure that any sagging between supports does not intrude on the specified concrete cover.

Bar supports and spacers shall be of a type and material that

will not cause rust spots, blemishes or spalling of concrete surfaces.

Bar supports and spacers shall be precast concrete, plastic, steel wire, stainless steel or steel bar, except that, supports or spacers over 200 mm in height shall be precast concrete or steel bar.

Bright wire and uncoated steel supports and spacers may only be used where they are not in contact with soil surfaces, finished concrete surfaces or epoxy coated reinforcement.

Where concrete surfaces are to be exposed to sandblasting, sea water, or de-icing chemicals the bar supports and spacers shall be either stainless steel, hot dipped galvanized steel, epoxy coated reinforcing steel, plastic or precast concrete.

Precast concrete supports shall have a compressive strength and quality not less than that of the concrete in which they are embedded. For finished surfaces, the face of the support in contact with the forms shall not exceed 50 mm in any dimension and shall have a colour and texture to match that of the finished concrete surface.

Bar supports and spacers for approach slabs and formed horizontal slabs such as bridge decks, bridge sidewalks, and top slabs of culverts shall meet the following additional requirements:

- a) Supports or spacers up to 200 mm in height shall be either precast concrete or plastic.
- b) Supports and spacers over 200 mm in height shall be either:
  - i) precast concrete,
  - ii) bent or welded steel bar that has been hot-dipped galvanized after fabrication,
  - iii) stainless steel bar, or
  - iv) epoxy coated reinforcing steel bar
- c) Plastic supports or spacers shall have an individual minimum breaking strength of 4.5 kN (1000 lbs) and shall be capable of maintaining strength and dimensional properties for the range of temperatures encountered on site.
- d) Maximum spacing between supports, for each mat of bars, shall be 1200 mm, except that the maximum spacing between plastic supports, for each mat of bars, shall be 1000 mm.



e) Each support shall carry the load from not more than one mat of reinforcing steel, except as provided below:

i) Where a support is used that is specifically designed by the manufacturer to carry two mats at two separate positions, or

ii) If the top mat of reinforcing steel is more than 200 mm above the slab soffit, then the top mat may be supported by epoxy coated reinforcing steel spreader bars secured between the top and bottom reinforcing mats, provided that, the bottom reinforcing mat is supported on precast concrete chairs which are sufficient in number and adequately spaced to carry the additional weight of the top mat of reinforcing steel.

**412.33.03 Concrete Cover** - Concrete cover for reinforcing steel shall be as listed in Table 412-D, unless shown otherwise on the Plans.

**TABLE 412-D CONCRETE COVER FOR REINFORCING STEEL**

Concrete cast against ground	85 mm
Tops of deck slabs	70 mm
Undersides of deck slabs	40 mm
Other surfaces	60 mm

**412.33.04 Spirals** - Spirals shall be held in place and to line by vertical spacers.

For spiral rods less than 15M spacing shall be as follows:

- two spacers per loop for spirals less than 500 mm in diameter.
- three spacers per loop for spirals 500 mm to 800 mm in diameter.
- four spacers per loop for spirals over 800 mm in diameter.

For spiral rods 15M and larger spacing shall be as follows:

- three spacers per loop for spirals up to 600 mm in diameter.
- four spacers per loop for spirals over 600 mm in diameter.

If vertical reinforcements are to serve as spacers, spirals shall be securely tied to vertical reinforcement at the spacing required for spacers.

**412.34 Splicing of Bars** - Special requirements for splicing,

such as particular locations for splices, use of overlength bars or special lap lengths, shall be as shown on the plans.

Splices in bars larger than 35M shall be mechanical coupler splices or welded. The detail of such splices shall be subject to approval by the Ministry Representative.

#### **412.34.01 Lapped Splices**

a) Horizontal bars shall not be spliced unless greater than standard mill lengths - 12 m for 10M bars and 18 m for larger bars - would otherwise be required.

b) Splices to be staggered so that no more than one third of the reinforcing steel in a member shall be spliced in any transverse section that is within the required lap length.

c) If not shown on the plans, the length of lapped splices shall be in accordance with CAN/CSA-S6-00, "Canadian Highway Bridge Design Code", Clause 8.15.9.

d) Adjacent reinforcing bars shall not be spliced at the same locations unless shown on the plans or authorized by the Ministry Representative.

Column spirals shall be lapped 48 rod diameters at splices.

**412.34.02 Welded Splices** - Welded splices shall be used only if detailed on the plans or approved by the Ministry Representative in writing. Welding shall conform to the requirements of CSA Standard W186, Welding of Reinforcing Bars in Reinforced Concrete Construction and shall be performed by a company certified by the Canadian Welding Bureau to the requirements of CSA Standard W186. Welded splices shall not be used on epoxy coated bars.

**412.34.03 Mechanical Coupler Splices** - Mechanical couplers shall be used for splices only if preapproved or detailed on the plans or authorized in writing by the Ministry Representative. Such couplers shall develop in tension or compression, as required, at least 120% of the specific yield strength of the bars, but not less than 110% of the mean yield strength, representative of the bars to be used, in the test of the mechanical connection.

The total slip of the reinforcing bars within the splice sleeve of the connector after loading in tension to  $0.5f_y$  and relaxing it to  $0.05f_y$  shall not exceed the following measured displacements between gauge points straddling the splice sleeve:

Up to and including 45M bars	0.25 mm
55M bars	0.75 mm



**MEASUREMENT**

**412.81 General** - Reinforcing steel will be measured by KILOGRAMS for the total mass in each part of the structure(s) as computed using Table 412-E.

The mass of clips, separators, tie wires, chairs and other fastening devices, and epoxy or other coating shall not be added into the calculations of mass of reinforcing steel.

will be made at the Contract Lump Sum Prices for reinforcing steel in each part of the structure(s), for the supply, cutting, bending, coating (if required), shipping, placing and securing of reinforcing steel.

Payment for increases or reductions in quantities of reinforcing steel ordered by the Ministry Representative will be made at the following Unit Prices per kilogram:

uncoated reinforcing steel .....\$1.50  
coated reinforcing steel .....\$1.80

**PAYMENT**

**412.91 General** - Payment for REINFORCING STEEL

**TABLE 412-E NOMINAL LINEAR MASS**

BAR DESIGNATION	10M	15M	20M	25M	30M	35M	45M
MASS kg/m	0.785	1.570	2.355	3.925	5.495	7.850	11.775



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 413

### BRIDGE DECKS AND HIGH-DENSITY CONCRETE OVERLAYS

#### DESCRIPTION

**413.01 General** - This Section describes requirements for the construction of bridge decks, and for the construction of high-density concrete overlays on previously constructed (old) bridge decks and on newly constructed (new) bridge decks. The requirements of Section 211 shall apply except as otherwise specified in this Section.

#### CONSTRUCTION

##### 413.31 Bridge Decks

**413.31.01 General** - Deck construction shall be continuous between the joints shown on the drawings, and shall be full-width unless otherwise approved by the Ministry Representative.

The Contractor shall submit to the Ministry Representative for review four weeks before the deck is cast, a complete description of the method, equipment and personnel to be employed. This shall include the equipment for mixing, transporting, placing, vibrating and curing the concrete and shall also include details of the finishing equipment and support rails. All equipment shall be subject to inspection and approval by the Ministry Representative. Equipment may be rejected during operation if it is unsatisfactory.

Only experienced personnel shall be employed to mix concrete and finish the deck.

Two weeks before the deck is cast, the Contractor shall meet with the concrete supplier and the Ministry Representative to review the mix as designed with respect to mixing, placing and curing equipment and methods.

**413.31.02 Diaphragms** - Diaphragms shall be placed either:

- a) about two hours before the deck concrete. In this case, diaphragm concrete shall have a slump less than 40 mm and shall be retarded so that it sets at the same time as the deck concrete, or
- b) earlier, so that the diaphragm concrete attains a compressive strength of 15 MPa before the deck is cast.

**413.31.03 Placing Concrete** - The top surfaces of stringers shall be sandblasted to remove all foreign material and laitance. The surfaces shall be in a saturated dry/damp condition immediately before the deck is cast.

Concrete shall be placed at a rate of not less than 6 m/hr. The concrete front and finishing operation shall be kept

parallel to the substructure. Placing shall be started at such time as to permit finishing during daylight hours, unless adequate lighting is provided. Concrete shall be completely in place within 45 minutes after water and cement have been combined.

In the event of unexpected rain, concrete placing shall cease and the surface shall be protected immediately. Surface concrete which has been rained on shall immediately be removed to the top of reinforcing steel.

**413.31.04 Finishing** - The deck surface shall be finished by a drum-type deck finisher on support rails. Two work bridges shall be provided. Support rails shall be accurately installed and adequately supported outside the area to be concreted. They shall be completely installed before concrete is placed, unless otherwise approved by the Ministry Representative. No inserts will be permitted in the finished roadway surface.

The surface behind the finisher shall be floated transversely to eliminate ridges and open texture. Areas which cannot be machine-finished shall be hand screeded and floated to conform to the machine-finished deck.

Deck surfaces shall be repeatedly checked for accuracy of alignment.

Bridge decks shall be textured by tining. The tining shall create transverse grooves 3 mm wide by 1.5 mm to 3 mm deep at 20 mm centre to centre spacing.

**413.31.05 Repairs** - Areas of the deck not meeting the required accuracy of alignment (Subsection 211.15) shall be corrected as follows:

- a) where the required alignment can be obtained with a maximum cut of 6 mm, the bumps shall be cut with a bump cutter which will provide an acceptable longitudinal-grooved texture;
- b) where the required alignment cannot be obtained with a maximum cut of 6 mm, the concrete shall be broken out with vertical edges to a minimum depth of 40 mm and shall be replaced with new concrete of the required quality.

Any physical damage to the deck surface shall be cut out and replaced. Any areas of open texture or plucked aggregates shall be repaired to the satisfaction of the Ministry Representative.

**413.31.06 Interim Strength Requirements** - Deck concrete shall attain a strength of 15 MPa before parapets



are placed and 25 MPa before heavy loads, such as concrete trucks, are allowed on the bridge.

**413.31.07 Curing** - The Contractor shall submit a detailed plan for curing deck concrete as required in Subsection 413.31.01. The plan shall contain details such as water source, the distribution system, the collection and run-off control system, person[s] responsible for quality control, and staff to maintain the system.

The curing period for monolithic decks, concrete overlays, parapets, and sidewalks shall be seven consecutive uninterrupted twenty-four hour periods. The curing period will begin following the completed placement of the concrete in the section cast. Curing shall consist of a continuous film of free water on the surfaces of the areas noted herein. Burlap shall be placed immediately following texturing and shall be saturated in a manner which does not damage the finished concrete surface.

Curing for parapets shall be the same as for flat work except that if the surface finish is completed within four hours of removal of the formwork, the Contractor may apply an approved curing compound to the parapet surfaces.

### **413.32 High-Density Concrete Overlays**

**413.32.01 General** - The requirements of Subsection 413.31 shall apply except as otherwise specified in this Section.

**413.32.02 Grades** - For old decks, the Ministry Representative will measure the grade of the present deck and establish the grade for the finished deck.

Subsequent to scarifying, the Contractor shall supply to the Ministry Representative a grid of elevations of the scarified deck for calculation of concrete quantities. The spacing of the grid points shall be 3 m each way unless agreed otherwise by the Contractor and the Ministry Representative.

**413.32.03 Surface Preparation** - For old decks, the surface concrete shall be removed by use of a scarifier, hydro-demolition or other acceptable means. If scarified, equipment shall be capable of scarifying to an accuracy of  $\pm 3$  mm. The depth of cut will be established by the Ministry Representative on the job site by a trial method. The maximum cut will be to within 10 mm of the reinforcing steel.

Further, the Contractor shall inspect and chain-drag the scarified surface and remove any unsound concrete by use of jackhammers or hand tools. In the case of previous overlays, concrete shall be removed to below the old bond

line. Where the bond line is within 10 mm of the reinforcing steel the remaining concrete and the old bonding material shall be removed by hydro-demolition. Where reinforcing steel is exposed, remove concrete to allow finger space around the bar. The contractor may at his option do this secondary concrete removal using pneumatic tools, however the surface will then require high pressure water blast. Corroded and/or damaged reinforcing steel shall be replaced. All debris shall be removed and disposed of. The Ministry Representative will check the prepared surfaces and require further concrete removal, as necessary, to ensure a sound substrata. Deck joints shall be modified or replaced as shown on the drawings or directed by the Ministry Representative. The deck surface shall be thoroughly cleaned by means of a high-pressure (110 MPa) water blast no earlier than 2 days before placing the overlay concrete

For new decks, the surface shall be sand or high-pressure (110 Mpa) water blasted to remove all foreign material and laitance.

In either case, the deck shall be kept clean for the application of bonding agent by using oil-free compressed air or other acceptable means. Immediately ahead of the placement of overlay, the Contractor shall apply a pre-approved bonding agent, and if epoxy, it shall conform with ASTM C 881, Type II, Grade 2. The Class of bonding agent shall be appropriate for the temperature at the time of application. The bonding agent shall be applied according to the manufacturer's recommendation, by an experienced applicator approved by the manufacturer. The bonding agent shall not set before it is covered with overlay.

**413.32.04 Mixing and Placing** - Concrete shall be produced on site by use of an auger-type mobile mixer with a minimum 2.75 m mixing chute.

The overlay shall be placed in strips with longitudinal joints near lane markings. Each strip shall be placed continuously between joints; adjacent strips shall not be cast for 24 hours. An epoxy bonding agent shall be used on construction joints.

Overlay shall be placed at a rate of not less than 8 m/hr. Overlay shall be consolidated and finished by means of special overlay finishers such as Bidwell OF400's. For structures over 50 m long and structures over 20 m long having a grade over 3%, two finishing machines shall be used in tandem. The speed of the trailing machine shall be such that its motion is continuous.

Any open texture remaining after two finishing machine passes shall be repaired by hand.

**413.32.05 Interim Partial Strength** - Overlay shall attain a



strength of at least 20 MPa before removing the burlap and opening to traffic.

All other requirements of seven day curing will be required.

## MEASUREMENT

**413.81 General** - Bridge deck concrete will be measured according to Subsection [211.20.02](#).

High-density concrete will be measured by the CUBIC METRE. The volume of overlay concrete shall be computed from the final grades established by the Ministry and the as-prepared surface of the existing concrete.

Concrete removal of the deck will be measured by the SQUARE METRE to a nominal depth of 50 mm. The area will be determined by measurement of the actual surface area of the concrete removed and computed to the nearest square metre.

Concrete removal within 10 mm of the reinforcing steel shall be by hydro-demolition or pneumatic tools in 12 mm layers and will be measured by the SQUARE METRE. The area of removal will be as directed by the Ministry Representative following examination of the surface exposed by the previous pass. The area will be determined by measurement of the actual surface area on each 12 mm pass and computed to the nearest square metre.

## PAYMENT

**413.91 General** - Payment for bridge deck FORMWORK, REINFORCING STEEL, CONCRETE and CEMENT will be made as outlined in Subsections [211.20](#) and [412.91](#) unless otherwise provided for in Section [413](#).

### 413.92 High-Density Concrete Overlays

#### 413.92.01 Old Decks

- a) Payment for CONCRETE REMOVAL will be at the Contract Unit Price per square metre to the estimated depth called for on the drawings and as required by Subsection [413.32.03](#) and shall include the removal and disposal of all debris.

- b) Payment for HYDRO-DEMOLITION or PNEUMATIC TOOLS will be at the Contract Unit Price per square metre for each pass made and shall include the removal of all concrete and bond line not removed by the initial concrete removal. The Unit Price shall include setup and removal of debris.

- c) Payment for HIGH-DENSITY CONCRETE overlay will be at the Contract Unit Price per cubic metre. The Unit Price will be for all things furnished and done including the water blasting of the prepared surface, supply and application of an approved bonding agent, the supply, placing, consolidation and finishing of concrete and the supply of cement.

**413.92.02 New Decks** - Payment for HIGH-DENSITY CONCRETE overlay will be at the Contract Unit Price per cubic metre. The Unit Price will be for all things furnished and done including the cleaning of the surface, supply and application of an approved bonding agent, the supply, placing, consolidation and finishing of concrete and the supply of cement.

**413.92.03 Curing** - Payment for curing will not be made as a separate item but as a specific part of the payment for decks, parapets and overlay concrete as outlined in Subsections [211.20.02](#) and [413.92](#).

Payment for deck, parapet and overlay concrete will be in two parts:

- a) supply, delivery, placing and finishing
- b) curing

Payment for part (a) will be 90% of the Contract Unit Price bid and payment for part (b) will be 10% of the Contract Unit Price bid.

Payment for part (b) will be made pending satisfactory completion of the specified curing process. No payment will be made for partial curing. Failure of strict compliance will result in forfeiture of payment of part (b). The Ministry Representative shall take such measures as necessary to provide the specified curing. Should the cost of these measures exceed the monies recovered from part (b), the balance will be deducted from part (a).



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 415

### MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

#### DESCRIPTION

**415.01 Scope** – This Section covers the manufacture and erection of precast and prestressed concrete members

#### **415.02 General**

**415.02.01** The manufacture and erection of precast and prestressed concrete members shall conform to the requirements of these specifications and the details as shown on the drawings.

**415.02.02** Precast concrete elements shall be manufactured in plants certified to the current CSA A23.4 in the appropriate category by a certification organization accredited by the Standards Council of Canada in the subject area of building products and structures. Certification shall be in effect prior to the beginning of Work, and maintained throughout the period of manufacture.

**415.02.03** Materials and construction shall conform to the current CSA A23.4 and the current PCI "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products".

**415.03 Working Drawings** - Working drawings shall consist of the following:

- Shop drawings,
- Transportation details, and
- Erection drawings

Transportation details and erection drawings shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC).

Shop drawings shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) when the Contractor is responsible for the design of items that are detailed on the shop drawings.

Working drawings shall be in the same system of units as the design drawings.

Working drawings shall be on sheets approximately 600 mm by 850 mm (one drawing per sheet). Lettering for notes and dimensions shall be at least 2.5 mm and 4 mm for headings. Drawings shall be legible when half-sized or microfilmed.

**415.03.01 Shop Drawings** –Shop drawings shall show all information and details needed for the fabrication of the members including, but not limited to, such items as member

shapes and dimensions, mark numbers and general arrangement of member locations, mass, prestressed and non-prestressed reinforcement, embedments, openings, block outs, chamfers, recesses, finishes, concrete mix, stressing details, special tolerances, special handling instructions, lifting details and lifting locations.

In the case of simple items where the design drawings are complete enough to be used for fabrication, the Contractor may, with the approval of the Ministry, dispense with shop drawings. The Contractor shall notify the Ministry Representative of such intention in writing. Erection drawings and transportation details will be required for all members.

**415.03.02 Transportation Details** – Transportation details shall include such items as:

- Description of hauling and handling equipment,
- Weight of members,
- Length and height of loads,
- Location and method of member support, and engineering calculations where members are to be supported during transportation further from their ends than outlined in Subsection 415.48,
- Details for handling, storing, and loading of members.

#### **415.03.03 Erection Drawings**

Erection drawings shall show in detail the method of erection including, but not limited to, the following:

- Erection procedures
- Procedures for off loading of members upon delivery
- Details for temporary storage and support of members on site prior to erection
- Equipment to be used
- Layout or general arrangement drawing showing the layout of the members, equipment positioning, and access roads
- Crane make, model, and capacity charts, boom length(s) , crane placement, and access for transporting of members to crane(s)
- Radii and loads for crane lifts
- Rigging details
- Mass of members , rigging and special installation equipment
- Details for installation and removal of all falsework, temporary supports, temporary bearings, bracing, guys, dead-men, and lifting devices
- Attachments to the bridge members and bridge structure for temporary support and special launching equipment



## SECTION 415

- Detailed description of sequence of operations
- Details for special installation equipment such as a launching truss, launching nose, head frames, spreader beams and rollers
- Details for installation of members onto the permanent bearings
- Traffic control plan for roadway and rail traffic
- Details for protection of existing utilities affected by the erection procedures

The Contractor shall be responsible for the lateral stability of members and shall design and provide bracing as necessary until completion of the Work.

The erection drawings shall be complete in detail for all anticipated phases and conditions during erection and during the temporary support of members. The Contractor shall submit calculations, upon request, to the Ministry Representative that demonstrate that allowable stresses are not exceeded in members, falsework, temporary bracing and temporary supports and that member capacities and final geometry will be correct. The calculations shall be sealed by the professional engineer that sealed the erection drawings.

Erection drawings must also show the layout and detail of fall protection and their sequence of installation.

Falsework, temporary supports and temporary bracing shall meet the requirements of CSA Standard S269.1 –1975, “Falsework for Construction Purposes”. Falsework, temporary supports and temporary bracing shall meet all the requirements for falsework given in Clauses 20.17 through 20.26 of the WCB Occupational Health and Safety Regulations.

A professional engineer registered with APEGBC shall be responsible for any field designs and any changes made to the erection procedures. Field designs and changes to the erection procedures must be documented and sealed by the responsible professional engineer and must be available at the Site prior to the affected erection work being carried out.

Immediately before placement of loading on falsework, the Contractor must ensure that the falsework is inspected and an engineering certificate is issued by a professional engineer registered with APEGBC which:

- Indicates the specific areas inspected, and
- Certifies that the falsework has been erected in accordance with the latest approved erection drawings and supplementary instructions.

Prestressed concrete stringers shall not be set on their bearings, nor shall the bridge deck be cast, until 30 days after the casting of the stringers. If it is necessary to erect the stringers earlier, they shall be placed on temporary

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

supports. Prestressed concrete twin cell box stringers up to a maximum length of 20 metres may be shipped and erected after 10 days if the specified 28 day compressive strength has been attained.

**415.03.04 Submittals** - The Contractor shall submit to the Ministry Representative three sets of all working drawings. These drawings shall be submitted at least fourteen days prior to the fabrication of the work. The Ministry will review the drawings for general compliance with the contract requirements.

If modifications to the drawings are required, the Ministry Representative will return one set of drawings, marked up, to the Contractor. The Contractor shall re-submit three sets of revised drawings to the Ministry Representative.

If no exceptions are taken to the drawings, the Ministry Representative will return one set of reviewed drawings to the Contractor. The Contractor shall forward an additional two sets of the reviewed drawings to the Ministry Representative.

SHOP DRAWINGS WILL NOT BE REVIEWED WITHOUT THE TRANSPORTATION AND ERECTION DRAWINGS APPLICABLE TO THE MEMBERS IN QUESTION.

Any work done on materials ordered prior to the review of working drawings shall be at the Contractor's risk. Erection will not be allowed to proceed without the Ministry's review of the method proposed.

Review of working drawings shall not relieve the Contractor of any responsibility for dimensions or detail or for carrying out the work in full accordance with the drawings and specifications.

**415.04 Alternative Details** - All details shall, in general, conform to those shown on the Drawings. Subject to the Ministry's consent, alternative details may be substituted to facilitate the Contractor's work methods. Such alternative details shall comply in all respects with this specification and shall not require an increase in weight or size of material.

**415.05 Quality Control** - The Contractor shall implement a quality control program to the requirements of CSA Z299.3 or as noted in Subsections 415.61 through 415.74.

**415.06 Quality Assurance** - The Ministry will implement a quality assurance program by auditing the Contractor's quality control program and by inspection at its discretion.

The Contractor shall notify the Ministry Representative at



least 14 days before fabrication is commenced. The Contractor shall allow the Ministry's representatives access to all parts of work, and shall supply such information and assistance as is required. When the Ministry requests, the Contractor shall provide samples of any materials. Inspection by the Ministry shall not relieve the Contractor from obligation to perform the work in accordance with the contract.

Concrete tests shall be in accordance with the current CSA A23.2. The Contractor shall make available at the plant a sheltered, heated space for the casting and storage of test cylinders, with curing tanks and a concrete cylinder testing machine.

The Ministry may reject any items which, in its opinion, do not comply with the requirements of this specification.

Each unit shall be certified or acceptable by a Ministry Inspector before it is shipped from the shop. This certification shall not relieve the Contractor of responsibility for subsequent damage or for defects which become apparent before the work is finally accepted by the Ministry.

## **MATERIALS**

### **415.11 Materials Supplied by the Contractor**

**415.11.01 Cement** - Portland cement shall conform to the current CAN/CSA A5-M.

**415.11.02 Aggregates** - Fine and Coarse Aggregates shall conform to the current CSA A23.1. Coarse aggregates shall not exceed 20 mm nominal size.

**415.11.03 Water** - Water shall conform to the current CSA A23.1. The mortars and tests shall be made in accordance with the current CSA A23.2.

**415.11.04 Reinforcing Steel** - Reinforcing steel shall be in accordance with the current CAN/CSA G30.18-M, G30.3-M and G30.5-M.

All reinforcing shall be of the lengths called for on the Drawings and all bends shall be made in accordance with Section 412.

All bending schedules shall be furnished by the Contractor for the Ministry's review and any material ordered before such review shall be at the Contractor's risk. The review of bending diagrams by the Ministry shall in no way relieve the Contractor of responsibility for the correctness thereof.

**415.11.04 Epoxy-Coated Reinforcing Steel** - All reinforcing steel labelled "E" on the drawings shall be

epoxy-coated to the requirements of ASTM A775.

**415.11.05 Prestressing Steel** - Pre-tensioning steel shall consist of seven-wire, uncoated, low relaxation strands as called for on the drawings and complying with the requirements of the current CSA G279-M.

All strands for each project shall be obtained from one mill, and preferably strands from one heat shall be used for one project. Each reel of strand shall be identified by a secure tag showing the size of strand, CSA or ASTM Designation number, heat number, and name or mark of the manufacturer.

The Contractor shall supply to the Ministry, for each heat number, one set of the standard mill test reports. Strands shall be protected at all times to prevent corrosion and shall be dry and clean (free from scale, rust, oil, soap, grease, and other materials) immediately before the concrete is placed. No strand which has previously been tensioned or gripped by strand chucks shall be incorporated into the members.

**415.11.06 Admixtures** - Admixtures shall conform to the current CSA A266.2-M. Air-entraining agent shall conform to the current CSA A266.1-M.

Water reducing admixtures shall be of a lignosulfonic acid or salt, or hydroxylated carboxylic acid or salt.

**415.12 Storage of Materials** - All materials shall be stored in accordance with the requirements of the current CSA A23.1. Cement shipments shall be used in the order in which they are received.

**415.13 Premixed Aggregates** - Pre-mixed aggregates in which the fine and coarse aggregates are combined in definite proportions will be permitted provided that the aggregates are delivered in batches directly to the hopper of the concrete mixer. Pre-mixed aggregates shall be transported and delivered in batches each containing the correct quantity for one batch of concrete. At no time after the fine and coarse aggregates are combined shall any batch come in contact with or intermingle with any other batch.

**415.14 Forms** - All exterior forms shall be of steel and shall be mortar-tight and of sufficient rigidity to prevent distortion due to incidental loadings during construction. Forms for skewed ends may be of rigid steel-reinforced plywood.

Forms shall produce 20 mm chamfers and fillets as shown on the Drawings.

**415.15 Ministry's Office** - Except for "on site" precasting work where an office is already provided under the general



## SECTION 415

contract, the Contractor shall provide at the point of manufacture a suitable lock-up office for the sole use of the Ministry.

The office shall be weatherproof and reasonably soundproof and provided with ample window area and ventilation. Location of the office shall be approved by the Ministry. The office shall measure not less than 3 m x 4 m. In the event that the office is to be used concurrently with other inspection agencies, the minimum area required for Ministry's use shall be 3 m x 4 m. The Contractor shall install satisfactory heat and lights and provide a telephone and a draughting table 1 m x 2.5 m in size with a plywood top, desk 0.75 m x 1 m, two chairs, draughting stool and one square metre of shelves.

Long distance calls made by Ministry personnel will be to the Ministry's account.

The Contractor shall, during the life of the work, regularly clean and properly maintain, heat and light the office.

The office and contents shall be for the use of the Ministry for the duration of the work and may, if necessary, be used concurrently with other inspection agencies.

### CONSTRUCTION

**415.31 Reinforcing Steel** - All reinforcing bars shall be accurately placed in the positions shown on the drawings and firmly held during placing and setting of the concrete. Tolerances shall be as specified by the current CSA A23.4.

When placed in the work the reinforcing steel shall be free from dirt, rust, loose scale, paint, oil, or other foreign materials. Bars shall be tied at all intersections except that where spacing is less than 300 mm, alternate intersections shall be tied. Form clearance shall be maintained by stays, ties, hangers or other approved supports. Before placing concrete, the placing and securing of reinforcing in the forms shall be inspected by the Ministry.

All reinforcing shall be placed in the full lengths called for on the Drawings. Splicing of bars will not be permitted except when authorized by the Ministry. Splices shall be staggered. Unless otherwise shown or called for on the drawings, splices shall be made by lapping in accordance with the requirements of Section 412. The bars shall be placed so as to maintain the minimum specified clearances between bars and the concrete surface. Welding of reinforcing steel shall be done only if called for on the Drawings or if authorized by the Ministry.

Tack welding of reinforcing steel, if permitted, shall be in accordance with the current CSA W186-M.

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

**415.32 Stressing** - The dials of gauges shall be at least 200 mm in diameter. Gauges shall be calibrated, with the hoses and jacks with which they are to be used, by an approved testing agency. The calibration must have been performed within the previous 6 months of use or 12 months maximum. Before stressing commences, certified calibration curves shall be furnished to the Ministry.

If during the work any gauges give erratic results, the tension system or tension device shall be recalibrated.

The Contractor shall schedule the work so that placement of concrete follows tensioning of strands within 24 hours. In cases of unavoidable delay, a maximum period of 80 hours will be allowed, provided that the strands do not show unacceptable corrosion (see PCI Manual for Quality Control, Section 2.2.2).

Before tensioning, an initial force shall be applied to each strand to equalize stresses and eliminate slack. This force shall not exceed 22 kN. After the initial tension forces have been applied, each strand shall be marked at the outer end of each chuck as a reference line from which the elongation of the strand can be measured.

The method of tensioning shall be such that the specified tension is maintained in the strands until the forces in the strands are transferred to the concrete member(s). The maximum jacking load in each strand shall be 80% of the ultimate strength of the strand.

A tensioning force shall be determined both by reading the jacking load on the calibrated gauge and by measuring the elongation of the strand. When the difference between the two methods is greater than 5%, the cause of the discrepancy shall be ascertained and corrected.

Elongations of strands shall be calculated and shown on the working drawings. Calculations for elongations shall include appropriate allowances for possible slippage or relaxation of the anchorages, friction at hold down points, temperature difference, and strand relaxation.

**415.33 Forms** - The design of the forms shall take into account the effect of vibration of concrete as it is placed.

All exterior forms shall be set and maintained true to the designated lines until the concrete has hardened. When forms are unsatisfactory in any way, either before or during the placing of concrete, the Ministry may order the work stopped until the defects have been corrected.

The shape, strength, rigidity, mortar-tightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged formwork must be realigned before



being re-used. Forms which are unsatisfactory in any respect shall not be reused.

Void forms shall be of an approved product and shall be anchored firmly by a means acceptable to the Ministry, to prevent displacement during the placing of the concrete. Any member with a void out of position in excess of the specified tolerance will be rejected.

Exterior forms shall be treated in moderation with form oil before placing the concrete. Any material which will adhere to or discolour the concrete shall not be used.

Side forms and any attachments which would obstruct strain of the members shall be removed before transfer of stress.

**415.34 Admixtures** - The Contractor shall add sufficient air-entraining agent to entrain  $5\% \pm 1\%$  air as determined by an air-meter used in accordance with the current CSA A23.2.

The use of other admixtures, such as water-reducing agent or super plasticizer, shall be subject to the consent of the Ministry.

**415.35 Measurement of Materials** - Measurement of materials shall conform to the current CSA A23.1. The Contractor shall produce a certificate of accuracy for the batching equipment from the Dominion Government Weights and Measures Division which is not over 6 months old. Cement in standard packages need not be weighed.

The surface moisture shall be determined in accordance with the current CSA A23.2 and the batch weights of aggregates and water adjusted accordingly.

**415.36 Mix Requirements** - Minimum compressive strength at time of transfer of stress to the concrete and at 28 days as determined by the current CSA A23.2 shall be as called for on the Drawings.

Slump measurement shall be determined by the current CSA A23.2. The mix design shall specify the slump and the tolerances in the measured slump shall be  $\pm 20$  mm for super plasticized concrete. Slump shall not exceed 200 mm for super plasticized concrete and shall be measured within 5 minutes after discharge from the mixer.

In order to minimize shrinkage and creep the cement/aggregate ratio shall be kept as low as is consistent with strength requirements.

**415.37 Batching and Mixing** - The batching plant and mixing of concrete shall conform to the current CSA A23.1.

Mixing shall begin within 15 minutes after the cement has been added either to the water or aggregate.

Within 30 minutes after the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, the concrete shall be placed in its final position in the forms. In hot weather or under other conditions contributing to quick stiffening of the concrete, the maximum allowable time may be reduced by the Ministry.

Concrete mixing and transporting equipment shall be capable of placing concrete in the forms at the rate of 20 cubic metres per hour. Batch delivery shall be uniform and at a maximum interval of 10 minutes.

The maximum size of each batch shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer of the mixer.

Concrete when placed in the form shall have a temperature not less than  $10^{\circ}\text{C}$  nor greater than  $30^{\circ}\text{C}$ .

**415.38 Handling and Placing Concrete** - In preparation for the placing of concrete, all construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces inside the forms shall be kept to a minimum and entirely removed when the concrete placing has reached an elevation rendering their service unnecessary.

Concrete shall be handled and placed in accordance with the requirements of the current CSA A23.1 and shall be placed in the shortest possible time after mixing is completed. When rectangular void forms are used, concrete under voids shall be placed and compacted before void forms are in position.

Concrete may be deposited a maximum of 2 m without the use of pipes, provided, when required, suitable measures are taken to prevent segregation and premature coating of upper reinforcing steel. When pipes are used they shall, as far as practicable, be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete.

After initial set of the concrete the forms shall not be jarred and no stress shall be placed on reinforcing bars which project.

**415.39 Vibration** - Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be accomplished by mechanical vibration subject to the following provisions:

- a) Vibration shall be internal for all accessible parts and



## SECTION 415

shall be external for inaccessible parts.

**b)** Vibrators shall be of a type and design approved by the Ministry. They shall be capable of transmitting vibration to the concrete at frequencies recommended in the current CSA A23.1.

**c)** The intensity of vibration shall be such as to visibly affect a mass of concrete of 50 mm slump over a radius of at least 500 mm.

**d)** The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms.

**e)** Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcing and embedded fixtures and into the corners and angles of the forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted into and withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

**f)** Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

**g)** Vibration shall be supplemented by such spading as is necessary to ensure a smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

**h)** Vibrator heads shall be smaller than the minimum clear distance between prestressing strands.

**415.40 Test Cylinders** - The Contractor shall make available, as may be required by the Ministry, samples of the concrete to be used in casting the members.

Further, the Contractor shall take samples and make test cylinders in the presence of the Ministry Representative and in accordance with the current CSA A23.2-1C, -3C and -9C. At least 8 cylinders per casting bed shall be made for testing.

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

**415.40.01 Release Strength** - Two cylinders from each end of the casting bed shall be cured in the same manner as the members and tested by the Contractor under the discretionary observation of the Ministry Representative at the Contractor's plant to assess the strength of the concrete at the time of transfer of force to the concrete. Only one cylinder from each end need be tested if the average strength of the two cylinders is equal to or greater than the required release strength at transfer and no test cylinder is more than 1.4 MPa below the release strength. No transfer of force shall occur until authorized by the Ministry.

If all release cylinders are tested and the release strength has not been attained, further testing with an impact hammer shall be allowed, provided a written procedure acceptable to the Ministry is provided by the Contractor. The procedure shall correlate readings from areas of a prestressed girder where the release strength has been determined by concrete test cylinders with similar areas on the girder in question. If this situation occurs, extra pairs of release cylinders shall be made on future casts until confidence in determining the release strength is re-established.

**415.40.02 28 Day Strength** - Two cylinders from each end of the casting bed shall be identified as "acceptance cylinders" and shall be cured in the Contractor's curing tanks. These cylinders shall be tested by the Contractor under the discretionary observation of the Ministry Representative to determine the twenty-eight day strengths. The strength of the concrete in the member shall be taken as the average of the compressive strength of the "acceptance cylinders", however, no individual cylinder shall be more than 3.5 MPa below the specified strength and the average strength shall equal or exceed the 28 day strength.

**415.40.03 Additional Cylinders** - For special cases, extra cylinders shall be made and tested if required by the Ministry. In the case of ready mix, and plant mixed concrete with no established records, extra cylinders, in addition to the release strength or 28 day strength cylinders, shall be made from each load.

**415.41 Surface Finish** - Throughout the work, special precautions shall be employed in formwork and concrete placing to produce a smooth and dense concrete. Exposed surfaces shall be as free as possible from form marks, fins, honey-combing and pock marking. Only a minimum amount of pointing will be allowed. Poor surface finish upon the removal of the forms shall be sufficient cause for the rejection of any member. All exposed edges shall be chamfered unless otherwise noted on the Drawings.

Roadway and surfaces to be bonded to shall be rough screeded by wood floating following initial strike off. Surfaces to be bonded to shall be sandblasted or exposed



with chemical retarder and water blasted to remove all laitance and foreign matter and to roughen the surface. The amplitude of the surface roughness shall be equal to one third of the nominal size of the concrete coarse aggregate or 6 mm, whichever is less. Loose sand and debris shall be washed or blown off. Water, cement or proprietary topping material shall not be added to the surface during finishing.

Walkway surfaces shall be given a coarse transverse broomed finish following initial screeding and floating. Roadway surfaces not requiring any wearing surface shall be given a tined surface in accordance with Subsection 413.31.04. Roadways receiving a membrane shall be finished in accordance with Subsection 419.33.

The outer surfaces of the outside stringers and any other surfaces indicated on the drawings shall be given a Class 2 finish in accordance with Subsection 211.16.

**415.42 Curing** - Members may be cured by steam or heat as outlined herein.

**415.42.01 Steam Curing:** The concrete shall be allowed to attain its initial set before application of steam (generally 2 to 4 hours after the final placement of concrete or as justified by previous experience and permitted by the Ministry).

After the placement of concrete, sufficient steam shall be applied during initial curing to hold the air surrounding the member at a temperature not less than 13°C.

Steam curing shall be done within a suitable enclosure to contain the steam and minimize moisture and heat losses. The enclosure shall allow free circulation of steam around the sides and tops of members and shall not be in contact with the member.

Steam at the outlets shall be at 100% relative humidity and low pressure. Application of the steam shall not be directly on the concrete or test cylinders and shall be from outlets distributed uniformly along the whole length of the member.

During application of the steam the ambient air temperature shall increase at a rate not to exceed 22°C per hour until an optimum temperature of 55°C is reached. In no case shall the ambient curing temperature exceed 80°C. The maximum temperature shall be held until the concrete has reached the transfer strength. In discontinuing the steam, the ambient air temperature shall not decrease at a rate to exceed 33°C per hour until a temperature has been reached about 11°C above the temperature of the air to which the concrete will be exposed. The forms shall not be stripped until the completion of this cooling off period.

Provision shall be made for checking the ambient air temperature either by placing minimum-maximum thermometers under the enclosure or periodically checking with hand thermometers.

**415.42.02 Curing With Radiant Heat and Moisture** - Curing with radiant heat and moisture shall be done by heating the casting area in combination with the continuous application of moisture.

Heat shall be applied by means of pipes circulating steam, hot oil or hot water or by electric heating elements. Pipes shall not be in contact with concrete, form surfaces or test cylinders.

Moisture shall be applied by a continuous sprinkling to a cover of burlap or cotton matting or any other approved method for keeping the members continuously moist.

An auxiliary cover in addition to the moisture retaining cover shall be used above the entire bed to retain the heat. This cover shall be supported at a sufficient distance above the member to allow circulation of the heat.

The cycle of application of heat, temperature limitations, reduction of temperatures and use of recording thermometers shall be similar to the cycle specified for steam curing.

**415.43 Draped Strands** - Where called for on the Drawings strands shall be draped in accordance with the current CSA A23.4.

**415.44 Transfer of Force to Concrete Members** - The transfer of the forces in the strands to the concrete member(s) shall be in accordance with the current CSA A23.4 (section on Detensioning).

**415.45 Protective Coating for Ends of Strands** - After completion of concrete curing the ends of tensile strands shall be ground flush with the concrete surface. Where the ends of the members are to be embedded in concrete, the ends of the strands shall be painted with two coats of Ministry approved organic zinc rich paint. Where the ends of the members are not to be embedded in concrete, the ends of the members shall be covered with thixotropic epoxy to provide at least 3 mm cover for a band width of 50 mm on each side of all strands. This material is to be applied in accordance with the manufacturer's recommendations.

**415.46 Tolerances** - For bridge stringers, the tolerances specified in the PCI Manual for Quality Control shall be modified so that the length of each member, measured parallel to the longitudinal axis, to extreme corners, at 20°C, does not exceed the specified length by more than 10 mm /



## SECTION 415

10 m (25 mm maximum).

The Contractor shall employ an adequate method of checking tolerances both before and after placement of concrete. Review of the method of checking tolerances by the Ministry will not limit the Contractor's responsibility for the accuracy of the members.

**415.47 Repairs to Members** - Defective areas should be repaired immediately following removal of forms and before detensioning of strands. Holes, honeycomb spots, etc., shall be treated as for Class 2 finish in accordance with Subsection 211.16. The method of repair for cracks, broken corners and edges, bulges and other defects shall be submitted to the Ministry Representative for review.

**415.48 Handling, Storing and Loading of Members** - Stringers shall at all times be kept in their normal upright position during handling, storage and transportation. They shall be picked up by means of vertical forces or forces inclined towards the opposite ends of the members by no more than 30 degrees from the vertical, applied to lifting devices near the ends of the stringers. I-beams shall be adequately stiffened during lifting and transportation.

Stored stringers shall rest on unyielding level supports near the ends of the stringers.

When loaded for transportation, members shall be supported so that they will not be overstressed. In general, beams with straight strands may be supported up to one-tenth of their lengths from each end, whereas beams with draped strands should be supported at their bearings. If the Contractor believes that it is possible to safely support members further from their ends, the Contractor shall submit to the Ministry, sketch(es), sealed by a registered professional engineer, showing the proposed support arrangement. Adequacy of support shall be based on the following assumptions:

- 100% impact on cantilevering ends, when checking stresses at supports,
- 50% negative impact on the whole member, when checking stress near midspan,
- 50% of prestress losses at time of shipping (unless circumstances dictate otherwise),
- allowable tensile stress =  $0.5\sqrt{f_c}$
- allowable compressive stress =  $0.6f_c$
- where  $f_c$  = estimated strength of concrete at time of shipping.

Such sketch(es) shall be submitted at the time of submittal of the working drawings (see Subsection 415.03). Members transported on supports further from their ends than outlined above, without the submittal of sketch(es) acceptable to the Ministry, will be rejected.

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

Piles shall be lifted in the horizontal position at the pick-up positions shown on the drawings and at no other points. When stacking for storage or for delivery, piles shall be supported at the pick up points. They shall be handled carefully, avoiding dropping and jarring and avoiding surface abrasions or other damage.

Any member damaged so as to be, in the opinion of the Ministry Representative, unfit for the use for which it is intended shall be replaced at the Contractor's own expense.

**415.49 Placement of Concrete in Keyways** - Keyways between box stringers shall be clean and shall be treated with a water-cement slurry, applied to damp surfaces, before being filled with concrete.

Concrete in keyways shall obtain a strength of at least 15 MPa before light traffic is allowed on the bridge, and at least 20 MPa before heavy loads such as concrete trucks are allowed on the bridge.

**415.50 Post-Tensioning** - All post-tensioning shall be done in accordance with the Section 416 - "Manufacture and Installation of Post-Tensioned Concrete Members".

### QUALITY CONTROL PROGRAM

**415.61 Quality Control Program** – These Subsections describe the general Quality Control Program required by the Ministry of Transportation for any Fabricator undertaking the fabrication of permanent precast concrete bridge components.

The term "Quality Control" defines those activities that the Fabricator performs to conform to the contract.

The term "Quality Assurance" defines those activities that the Ministry performs to ensure conformance to the contract.

These Subsections contain statements of the Quality Objectives and Policies that the Ministry considers essential for successful and economical quality management. They also outline the Procedures and Documentation to implement and confirm that the Objectives are met.

The provisions of the Quality Control Program set forth in these Subsections shall apply to all precast concrete bridge components contracted by or for the Ministry.

These Subsections require the establishment of a Quality Organization with the responsibility for the successful and timely implementation of all necessary Quality Control activities. Some positions shown in the Suggested Organization Chart (see Figure 1) may be held by the same individual. For example, the General Manager may also be



the Contract Administrative Manager and the Purchasing Manager. The Plant Superintendent may also be the Receiver and the Structural Supervisor.

### 415.62 Quality Objectives and Policies

**415.62.01 Quality Objectives** - The Quality Objectives of the Ministry of Transportation cover all precast concrete bridge components produced under contract to the Ministry, as follows:

- a) Completed products shall conform fully to the governing Codes and Specifications stipulated in the contract document.
- b) The Quality Control Program shall be fully integrated into the ongoing manufacturing activities of the Fabricator.
- c) The operations of the Quality Control Program shall protect the interests of the Ministry with respect to scheduled delivery date and contracted price.

**415.62.02 Quality Policy** - It is Ministry policy that the interests of the Fabricator and the Ministry coincide when a product meets the Quality requirements of the contract, is delivered on time, and is produced in a cost-effective manner.

The Quality Control Program is an essential part of this policy. It is based on the fact that the best way to do any job is to do it right the first time. This applies to all stages of the design, drafting, procurement, manufacturing and testing of the product.

The Quality Control Program involves all Ministry and Fabricator personnel. Their activities must be consistent with the Quality Objectives of the Ministry.

A Quality Control Manager shall be appointed with defined responsibilities in resolving quality matters and shall report to a senior management level. At each hold point, the Quality Control Manager shall:

- Document the successful completion of each stage as it progresses through fabrication and erection.
- Identify and report nonconforming components.
- Initiate or recommend disposition of nonconforming components.
- Verify corrections.

Any persons assigned to perform quality control inspections shall be other than those performing or directly supervising the work and they shall not report directly to immediate supervisors responsible for producing the work.

The Quality Control Program is not subordinate to any design, drafting, procurement, manufacturing and testing activities, it is an essential part of them.

**415.63 Scope of the Quality Control Programs** - This Quality Control Program governs the fabrication of precast concrete bridge components for the Ministry of Transportation. The Suggested Organization Chart is shown in [Figure 1](#)

The General Manager shall be responsible for:

- adhering to this Quality Control Program in all respects.
- ensuring that completed bridge components shall conform fully to the applicable design and fabrication codes stipulated in the Contract.
- ensuring that all required documentation is produced according to this Quality Control Program.

**415.64 Range of Capability** - Within the Company, there shall be the necessary knowledge, skill (in-house or on a contract basis) and equipment to do the following work on precast concrete bridge components:

- Design of lifting and erection devices not shown on drawings
- Preparation of shop fabrication drawings
- Preparation of bills of material
- Preparation of material requisitions and purchase orders
- Receiving, checking and storing materials for bridges
- Layout, form set-up, reinforcing steel, prestressing and post-tensioning
- Mix designs, batching, mixing, placing and curing of concrete
- Sampling, testing, making and breaking of concrete test cylinders
- Dimensional checking and verification
- Resolution of non-conformances
- Documentation of all stages of work with capability of tracing all major components
- Finishing, patching, storing and shipping
- Erection of bridge components

**415.65 Drawings and Specifications** – The Chief Design Engineer shall be responsible for:

- the design and location of lifthooks and the preparation of stressing sheets for prestressing or post-tensioning; and for the design of the erection procedures and any special erection equipment needed.

The Chief Draftsperson shall be responsible for:

- obtaining the latest revision of the design Drawings



## SECTION 415

and Specifications for the work.

- submitting shop drawings and erection drawings to the Ministry for acceptance before commencement of the work.
- preparing material requisitions containing a full description of the material sizes, material specifications, and certifications required for conformance to the contract.
- delivering the material requisitions to the Purchasing Manager in ample time to permit ordering, delivery and documentation and not delay the progress of the work.
- issuing requisitions for all sub-contracted drafting work and shall ensure that all conditions of the Contract are part of such sub-contracts.

**415.66 Material Control** - All materials for bridge components shall be ordered by the Purchasing Manager in full conformance with the material requisitions provided by the Chief Draftsperson.

The Purchase Orders shall contain all information necessary to ensure that materials purchased will comply fully with the terms of the Contract. Where mill certificates and test reports are required, it shall be so stated on the Purchase Order. Instructions shall state when the certificates and reports are to be delivered to the Fabricator.

If a supplier proposes a substitute for any material, the Purchasing Manager shall refer the proposed substitution to the Chief Design Engineer for review. If the substitute is acceptable to the Ministry, the Chief Draftsperson shall amend all drawings and requisitions, withdraw old issues and issue the new versions.

The Receiver shall:

- inspect all materials on arrival for conformance with the Purchase Orders.
- confirm that mill certificates and test reports are provided and that they correctly identify the materials delivered.
- arrange with the Plant Superintendent to store all materials for the Contract in segregated areas.
- ensure all materials are clearly identified with the Contract.
- issue a non-conformance report covering overage, shortage or damage to the materials. Copies of the report shall be provided to the Purchasing Manager and the Quality Control Manager.

The Purchasing Manager shall deliver all documentation to the Quality Control Manager for inclusion in the Quality Control file for the Contract.

**415.67 Pre-Pour Inspection and Reporting** - The Quality

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

Control Manager shall ensure only documented materials are used for the contract.

Forms used in the casting of members shall be inspected prior to use and shall meet all the requirements of the current CSA-A23.4 and the special provisions of the contract Specifications.

Reinforcement shall be fabricated and placed to satisfy the current CSA-A23.4 and the detailed shop drawings for quantity and spacing. Any reinforcement used to anchor cast in hardware by being welded to it will require the Fabricator to be certified to CSA W186-M.

All cast in hardware shall be fabricated and placed according to the current CSA-A23.4. Any hardware requiring welding, including stud welding, will require the fabricator to be certified under CSA W47.1 Division 3 and have approved procedures for each weld.

All pre-tensioning operations shall be done according to the current CSA-A23.4. Care shall be taken to properly execute, supervise and record the operations in a clear and legible manner.

The Quality Control Manager shall file a written report of verification with the General Manager and report any non-conformance that may exist on any of the above items in Subsection 415.67.

**415.68 Concrete Control** - All materials used in concrete mixes such as cement, fine and coarse aggregates, and admixtures, shall have representative certificates that can verify the quality of them.

Production of concrete shall be done according to the specifications. Records shall be kept of the mix type and quantity used in each pour.

Handling, placing and vibration of freshly mixed concrete shall be done as per specifications. Any variations and interruptions in the process shall be recorded.

The sampling and testing of freshly mixed concrete shall be in accordance with the specifications and procedures laid out in the current CSA-A23.2. Concrete test cylinders shall be made, cured and tested in accordance with the Specifications.

Reports for all concrete testing shall be kept on file and all non-conformities reported.

**415.69 Post Pour Inspection and Reporting** - Dimensions of all members shall be verified to ensure tolerances are being maintained as per the specifications.



## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

## SECTION 415

Verification shall be made of finishes, blockouts, keyways, projecting rebar, sole plates and protection of the cut off strands.

Camber shall be monitored at release and 28 days.

Members shall be stored according to the fabricator's documented procedures.

Members shall only be allowed to be shipped out for erection after they have been approved by both Quality Control and Quality Assurance.

Records shall be kept on file for all items in this section.

**415.70 Correction of Non-Conformities** - When a non-conformance is encountered, the Quality Control Manager shall determine a recommended disposition and obtain the Ministry's approval as quickly as possible.

If there is non-conformance to the material specification stipulated in the Purchase Order, the Purchasing Manager shall immediately find out the reasons for the delivery of non-conforming materials. If the material is of a grade superior to that ordered, the Quality Control Manager and the Chief Engineer shall be notified. They shall verify that the material is an acceptable alternative in all respects. This verification shall include consultation with the Ministry. If the material is of a grade inferior to that ordered, it shall be rejected and the correct material or a superior material shall be obtained.

If there is non-conformance of material delivery that will delay production, the Contract Administrative Manager and Plant Superintendent shall be notified immediately. They shall be given revised delivery dates for the adjustment of production scheduling. The General Manager shall determine the alternatives available and shall notify the Ministry.

If there are pre-pour non-conformities in form set-up, prestressing, rebar placement, hardware and blockout size and location, the Quality Control Manager and Structural Supervisor shall immediately review the non-conformance and notify the Chief Design Engineer who may require further investigation prior to submitting corrective action to the Ministry for approval. If the necessary corrective action will result in delay to production, the General Manager shall be notified for adjustment to the production schedule. The Plant Superintendent shall inform the Quality Control Manager when the corrective actions are being done so that conformance can be verified and the non-conformance report cancelled.

If there are post-pour non-conformities such as honeycombs

or large voids after form removal, before de-tensioning the Quality Control Manager shall notify the Chief Design Engineer who will investigate and submit corrective action to the Ministry for approval. Other non-conformities such as low concrete strength, dimensional errors due to faulty forms, variations in camber from design and missing hardware shall all be reported by the Quality Control Manager.

**415.71 Welding** - All welding on structural components shall conform to the Welding Standards of the Contractor as Approved by the Canadian Welding Bureau.

All welding consumables shall conform to the Approved Welding Standards and shall be received, stored and conditioned according to the applicable Welding Standards.

All welders and welding operators on the contract shall be qualified under the requirements of the current CSA W47.1 division 3 or better.

All welding of reinforcing steel, when permitted by the Ministry, shall be done by fabricators certified under CSA W186.

**415.72 Calibration of Measurement and Test Equipment** - All measurement and testing equipment owned by the Fabricator and used in the Quality Control Program shall be calibrated and re-calibrated at the intervals and in the manner stipulated in the current CSA-A23.4.

When the concrete testing services are contracted to a Qualified testing firm according to the latest edition of CSA A283, they shall confirm in writing to the Ministry that all their measurement and test equipment used in the testing is properly calibrated. If requested, they shall furnish copies of the calibration test data for inclusion in the contract documentation.

**415.73 Records Retention** - The Fabricator's Record File for each Contract shall contain the pertinent drawings, purchase orders, bills of material, material mill certificates, test reports, Quality Control documents, and certificates of compliance.

The Fabricator's Record File shall be made available to the Ministry's Inspectors upon request.

Items in the Fabricator's Record File shall be retained as per company policy.

The Quality Control Manager shall ensure that each file is complete in all respects before it is placed in the Company archives.



## SECTION 415

**415.74 Hold Points** - In planning the work flow, it is essential to coordinate with the Ministry Inspector to decide "hold" points for inspection. A list of hold points shall be drawn up by the Fabricator and the Ministry at a prefabrication meeting. The Ministry should be continuously informed of progress so that delays are minimized.

The "hold" points will typically include, but not be limited to, the following:

- verification of form size, quality and layout
- after stressing, rebar and hardware placement
- prior to form close up
- sampling and testing of concrete
- release cylinders
- after patching and finishing
- 28 day cylinder results
- shipping arrangements.

It must be understood that work will not proceed past a "hold" point until it has been signed off by Quality Control and Quality Assurance. Reports must be completed promptly.

(Refer to PCI Manual - Publication MNL-116 for "Sample

## MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS

Record Forms")

### MEASUREMENT

**415.81 Precast Concrete Members** – Precast Concrete members will be measured by EACH of the type specified.

### PAYMENT

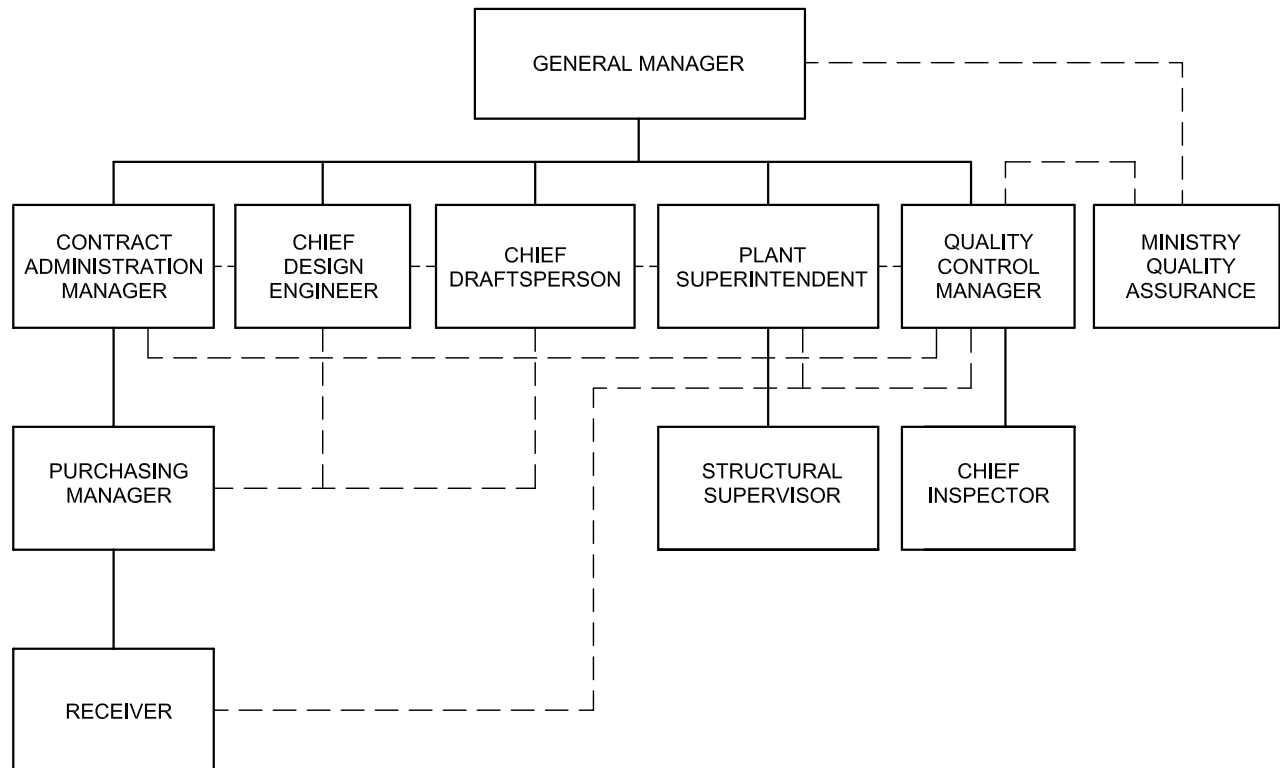
**415.91 Supply and Fabrication** – Payment for supply and fabrication of PRECAST CONCRETE MEMBERS will be made at the lump sum price bid. Payment shall be for quality control, shop drawings, supply and placing of concrete, formwork, reinforcing steel, prestressing strands and any required inserts. Payment shall also cover tensioning, curing, release, stripping of forms, patching as necessary and storage of members.

**415.92 Shipping and Erection** – Payment for shipping and erection of PRECAST CONCRETE MEMBERS will be made at the lump sum price bid. Payment shall be for quality control, erection drawings, transportation drawings, loading, shipping and unloading of members. Payment shall also cover falsework and erection of members. For box stringers, payment shall also cover the supply and placement of sealing strips between stringers.



FIGURE 1

SUGGESTED ORGANIZATION CHART



Direct Functional Reporting \_\_\_\_\_

Quality Control Reporting - - - - -

Signed \_\_\_\_\_  
General Manager

Date \_\_\_\_\_



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 416

### MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS

#### DESCRIPTION

**416.01 Scope** – This Section covers the manufacture and installation of post-tensioned concrete members.

#### 416.02 General Requirements

**416.02.01** The requirements of Section 415 and of the current CSA A23.1, Section 25, shall apply except as otherwise specified in this Section.

**416.02.02** Three weeks before post-tensioning, the Contractor shall submit to the Ministry Representative for review complete details of the proposed procedure, including jacking sequence and loads, procedure for testing grout cubes, and a list of equipment. This procedure shall be prepared and sealed by a professional engineer registered with the APEGBC.

CAN/CSA G164-M. The sheaths shall be corrugated, and chemically non-reactive with concrete, tendons, or grout. The inside cross-sectional area of the sheaths shall be at least two times the area of the prestressing steel.

Rigid steel sheaths shall have a wall thickness of at least 0.60 mm and shall be capable of bending to an inside radius of 9 m without distress. Semi-rigid steel sheaths shall have a wall thickness of at least 0.25 mm and shall be capable of bending to an inside radius of 3.50 m without distress.

The ducts shall be spliced with telescopic sleeves. The joint lines between the ducts and the sleeves shall be wrapped with tape or heat-shrink material to make the connections mortar-tight.

**416.12.02 External Tendons** - Ducts shall be either galvanized steel pipes or rigid polyethylene pipes.

#### MATERIALS

**416.11 Anchorages** - Anchorages tested in an unbonded state shall develop at least 95% of the minimum specified ultimate strength of the prestressing tendons, without exceeding anticipated set and without slippage. Test results or certificates meeting these requirements shall be supplied by the Contractor.

Anchorages shall be able to sustain the loads applied to them without slippage, distortion or other changes that will permit loss of prestress.

The anchorages shall be of such a nature that they will not kink, neck down or otherwise damage the prestressing steel.

**416.12 Ducts** - The ducts shall be provided with vents at all high points and at the anchorages, so as to facilitate grouting. Drains may be provided at low points. In any case, in cold weather, care shall be taken to prevent water from collecting and freezing in the ducts. The locations of the vents and drains shall be as shown on the drawings.

Cored and external ducts shall be watertight when tested under an internal water pressure of 0.35 MPa.

The vents and drains shall be 13 mm minimum diameter flexible tubes. The connections to the ducts shall be made with metallic structural fasteners.

**416.12.01 Internal Tendons** - The sheaths for post-tensioning ducts shall be made of galvanized steel. Galvanizing shall meet the requirements of

Galvanized steel pipes shall be spliced with threaded couplers. Galvanizing shall be in accordance with CAN/CSA G164-M.

Rigid polyethylene pipes shall conform to ASTM DD 3350 "Polyethylene Plastic Pipe and Fittings Materials" and manufactured in accordance with ASTM DD 2239 "Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter." The external diameter to wall thickness ratio shall be 21 or less.

**416.13 Condition** - Tendons, ducts, anchor assemblies and other accessories shall be free of grease, oil and other foreign matter. A light coat of rust will be permissible provided any loose rust is removed and the surface of the steel is not pitted.

**416.14 Epoxy** - Epoxy applied to match-cast segment ends shall be as specified by AASHTO Standard Specifications for Highway Bridges (1992), Division II, Section 8.13.7.

**416.15 Grout** - The Contractor shall propose a design mix for the grout and submit it for review by the Ministry Representative before grouting may begin.

The Contractor shall supply all materials for the grout.

The grout shall have a maximum water/cement ratio of 0.45 and a minimum 28-day strength of 35 MPa. The grout shall consist of a mixture of Type 10 cement, water and an approved admixture to control expansion and pumpability. The admixture shall be an aluminum powder base premixed material. Type 30 cement may be substituted for Type 10



## SECTION 416

## MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS

during low temperature periods. The Contractor shall determine the dosage of the admixture by using volume change and bleeding tests conducted before grouting commences. The Contractor shall make test grout cubes and deliver them to a testing agency approved by the Ministry.

### EQUIPMENT

#### 416.21 Stressing Equipment

**416.21.01 Supervision** - The Contractor shall provide a supervisor skilled in the use of the system of prestressing to be used.

**416.21.02 Gauges and Calibration** - The tensioning system shall be equipped with gauges that have been calibrated for the specific jacks and controls by an approved testing agency within the last 6 months. The dials of the gauges shall be at least 150 mm in diameter. Before stressing commences, certified calibration curves shall be furnished by the Contractor.

The tensioning system or tensioning devices shall be recalibrated if during the work any gauges give erratic results.

**416.22 Grout** - The grout shall be mixed in a shear type mixer with sufficient capacity to guarantee a continuous supply of grout to the pump. The accessory equipment to batch all materials shall accurately measure all materials.

The pump shall be a positive-displacement type and shall produce an outlet pressure of at least 1 MPa. The pump shall have seals to prevent introduction of oil, air or other foreign substance into the grout and to prevent loss of grout.

The grouting equipment shall utilize gravity feed to the pump inlet from a hopper attached to and directly over it. The hopper must be kept partially full of grout to prevent air from being drawn into the ducts.

The grouting equipment shall contain a screen having clear openings of 3 mm maximum to screen the grout prior to its introduction into the grout pump. A screen opening of 5 mm is satisfactory if a grout with a thixotropic additive is used. This screen shall be readily accessible for inspection and cleaning.

The Contractor shall have on site a pressure gauge with a full-scale of no greater than 2 MPa. The Ministry Representative may request the Contractor to install the gauge in the grout line between the pump outlet and the duct inlets to confirm pumping pressures.

The grouting equipment shall be capable of continuously

grouting the largest tendon on the project in 20 minutes.

### CONSTRUCTION

**416.31 Anchorages** - The spacing between anchorages shall be sufficient to allow the operation of the stressing jacks to be unimpeded by the adjacent tendons.

The axis of the tendons shall be in line with the anchorages for a minimum of 0.4 m.

The load from the anchoring devices shall be effectively distributed to the concrete.

Anchorages shall be rigidly held in position when the concrete in the section is placed. Anchorages shall hold the tensioned tendons without slip of more than 6 mm; otherwise detensioning will be required.

**416.32 Ducts** - Vents and drains in the ducts shall be mortar-tight, taped as necessary and shall provide means for injection of grout and for sealing. The ends of vents and drains shall be removed 25 mm below the concrete surfaces after grouting has been completed. If drains are used, they shall be vented downward and shall remain open until grouting commences to permit the removal of any water that may be present in the duct.

**416.33 Placement and Protection of the Tendons and Other Accessories** - The plan and profile location of the ducts shall be as shown on the Drawings. Ducts shall be securely held at intervals of 1 m or less to prevent displacement or flotation during the placement of concrete. They shall be placed with a tolerance of  $\pm 6$  mm in both the vertical and the horizontal directions. The location of the ducts shall permit the post-tensioning steel to follow the prescribed profiles.

The anchorage assemblies shall be placed so that the bearing surfaces are concentric with and perpendicular to the tendons within  $\pm 1^\circ$ .

Immediately before concrete is placed, the post-tensioning steel profile and alignment shall be checked and corrected where necessary. The ducts, grout fittings, vents and drains shall be inspected and damage shall be repaired to prevent concrete from leaking into the ducts.

The grout fittings and the ducts shall be adequately protected from collapse and other damage. Grout openings, vents and drains must be securely anchored to prevent displacement during concrete placing operations.

The ends of the ducts shall be covered to prevent the entry of water or debris after the installation in the forms.



The ducts shall be blown out with compressed, oil-free air immediately after the completion of the concrete pour. The compressed air shall be used to the extent necessary to break up and remove any mortar in the ducts before it hardens. The ducts shall be blown out clear of any water or debris again prior to the placing of the tendons.

Duct ends at match-cast segment ends shall be fitted with gaskets or other sealing devices to prevent infiltration of epoxy during assembly. A pressure of approximately 0.3 MPa, as uniform as possible, shall be applied to the joint during the epoxy curing period. The pressure may be supplied by stressing a cable to a predetermined level, or by other means.

Segmental section joints of 10 mm to 70 mm wide shall be filled with a sand-cement mortar. Joints over 70 mm wide shall be filled with concrete. The strength of the mortar or concrete used in joints shall be at least equal to the parent concrete. The Contractor shall colour the mortar or concrete to match the parent concrete. The Contractor shall submit a trial mix with a proportion of white Portland cement, if necessary, to the Ministry for its review.

All post-tensioning steel shall be installed in the ducts prior to the concreting of the cast-in-place elements.

The concrete shall be vibrated with particular care at each cast-in-place end block (push-through diaphragm) and post-tensioning anchorage location. This will ensure adequate consolidation in the anchorage zones.

The prestressing steel in each tendon shall be pulled immediately after concreting, to ensure that it is free to move and is not bonded by concrete or grout leakage.

**416.34 Stressing** - The structure shall be stressed only after the concrete has reached its transfer strength as shown on the Drawings. No tendons shall be stressed until authorized by the Ministry Representative.

Tendons shall be stressed from the end as shown on the Drawings.

The supports under the segmental sections shall be able to accommodate horizontal movements caused by the stressing.

The multiple strands composing a tendon in a common duct shall be tensioned simultaneously. Tendons shall be tensioned in sequence as specified in the reviewed procedure. The tendon force at lock-off shall be as shown in the procedure.

Before commencing the stressing operation an initial tensioning force shall be applied to each tendon to equalize

stresses and to eliminate slack. This force shall not exceed 10% of maximum jacking force.

After the initial tension forces have been applied, reference points shall be established for each tendon from which elongation by final tensioning forces will be measured.

The specified tensioning force shall be maintained steady in the strands until they are anchored. The sequence of tensioning shall be such that no undue tension stresses occur in the concrete near the ends of the members.

The tensioning force shall be determined by the calibrated gauge and by the elongation of the strands. When there is a difference of over 5% between the two means of calculation, the cause of the discrepancy shall be ascertained and corrected.

Tendons shall not be subjected to jacking forces in excess of 85% of their specified ultimate tensile strength. Any tendon subjected to such forces will be rejected.

The required tendon elongation and jacking force shall be computed, based on the required prestressing force and the estimated prestress losses.

The safety of the stressing procedure shall be in accordance with WCB Occupational Health and Safety Regulations, in particular Clauses 20.60 through 20.71.

Stressing records shall be kept. Stressing records shall clearly identify the tendons that were stressed, the sequence, the final jacking loads, the tendon elongations, the times, the temperatures and the dates. Stressing records shall be signed by the person supervising the stressing and submitted to the Ministry Representative.

**416.35 Grouting** - The temperature of grout shall be controlled by water temperature to  $15^{\circ}\text{C} \pm 5^{\circ}\text{C}$  at the pump. The grout shall be mixed for a minimum of 2 minutes. The materials shall be charged in this order: water, cement and admixture. The admixture shall be added in accordance with the manufacturer's instructions.

The grout shall be mixed to a uniform consistency of thick cream without lumps or undispersed cement. The grout shall be agitated continuously and shall be recirculated when not injecting from the line.

Water shall not be added to the grout to increase the flowability that was decreased by delayed use of the grout. The grout shall be discarded when flowability has so decreased it cannot be pumped satisfactorily.

The time between the tensioning and grouting of a tendon



## SECTION 416

shall not exceed 4 days.

Cored ducts with concrete walls shall be flushed with clean water to ensure that concrete is thoroughly wetted prior to grout injection. The ducts for external tendons shall be checked for leakage and blockage by flushing with clean water under pressure followed by oil-free compressed air immediately prior to grouting. Metal sheaths for internal ducts shall be flushed to clean out foreign materials, or oil free compressed air shall be used to check for blockages.

All grout and high point vent openings shall be open when grouting starts. Grout shall be allowed to flow from the first vent until any residual flushing water or entrapped air has been removed. The vent shall be capped or otherwise closed at that time. The remaining vents shall be closed in sequence in the same manner.

The pumping pressure at the tendon inlets shall be at least 0.7 MPa and shall not exceed 1.4 MPa.

If the pumping pressure exceeds the maximum allowable, grout may be injected at any grouted vent, as long as a one-way flow of grout is maintained. If this procedure is used the vents that are to be used for injection shall be fitted with positive shutoffs.

The grout shall be pumped through the ducts and continuously wasted at the outlet pipes until no visible slugs of water or air are ejected. The efflux rate of the ejected grout shall not be less than the influx rate of the injected grout.

To ensure that the tendons remain filled with grout, the outlets shall be closed and the pressure held for 10 seconds. The grouting ends shall then be plugged. Plugs, caps or valves shall not be removed or opened until the grout has set. Alternatively, the outlets and inlets shall be kept under a 1 m head of hydrostatic pressure. The 1 m gout head shall be maintained until the grout has hardened.

The grout shall be immediately flushed out of the ducts with water when one-way flow of grout cannot be maintained. Standby water flushing equipment, with its own source of power, shall be available in addition to the grouting equipment. It shall be capable of developing a pressure of 2 MPa, and sufficient capacity to flush out any partially grouted enclosures. After flushing, the ducts shall be blown out with oil-free compressed air and then checked for blockages. The grouting procedure shall be repeated if there are no blockages.

## MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS

The ducts shall be completely filled with grout. The presence of ungrouted lengths of duct shall be cause for nonacceptance of the members. Members with partially ungrouted duct(s) shall be replaced or repaired to the satisfaction of the Ministry at the contractor's expense.

Great care shall be taken to prevent blockages of the ducts due to grouting of nearby ducts or other causes.

All costs for investigations and for remedial measures due to blockages shall be at the Contractor's expense.

The grouting shall not be done when air temperatures are above 32°C or below 5°C, nor when freezing temperatures are predicted within the next 24 hours.

The temperature of the concrete shall be 2°C or higher from the time of grouting until site-cured cubes of grout reach a compressive strength of 6 MPa.

The grouted ducts may be subject to gamma ray radiography inspection. The cost of the inspection will be borne by the Ministry if the inspection indicates that ducts are completely filled with grout. Otherwise, the costs of inspection and the cost of reinspection shall borne by the Contractor.

**416.36 Cropping** - The cropping of post-tensioning strand shall be by a cold-cutting procedure. It shall not take place until authorized by the Ministry. Under no circumstances shall heat be applied to post-tensioning strand from cropping or other operations. The cropped strand shall be provided with a minimum concrete cover of 25 mm.

**416.37 Anchorage Recesses** - The anchorage recesses shall be cleaned and sandblasted after completion of post-tensioning and grouting. The surfaces shall be coated with an epoxy bonding agent conforming to ASTM C881, Type II, Grade 2. The Class of bonding agent shall be appropriate for the temperature at time of application. The bonding agent shall be applied in accordance with the manufacturer's applications. Wire mesh shall be placed before concreting in recesses larger than 300 mm square.

The Contractor shall fill the recesses flush with adjoining surfaces. All parts of anchorages shall have a minimum cover of 25 mm. All recesses exposed to view shall be filled with concrete coloured to match the parent concrete. If requested, the Contractor shall submit a trial mix with a proportion of white Portland cement to the Ministry Representative for review.



## SECTION 418

### CONCRETE BRIDGE DECK SEALANTS

#### SILANE SURFACE TREATMENT OF NEW PORTLAND CEMENT CONCRETE

**418.01 Scope** - This Section describes the treatment of new concrete bridge surfaces with a silane protective solution. The Specification describes surface preparation and application.

**418.02 Silane Solution** - The silane solution shall be a minimum 40% solution of alkyl trialkoxy silane (isobutyl trimethoxy silane or n-octyl triethoxy silane) dissolved in a maximum of 60% anhydrous alcohol.

**418.02.01 Delivery and Storage of Silane Solution** - The silane solution shall be delivered to the job site in unopened, sealed containers with original seals intact, also with a manufacturer's label identifying the product (including a batch number). The containers holding silane solution shall be stored in dry, enclosed structures to protect the contents from misuse, weather and excessive heat.

**418.02.02 Quality Assurance** - Only silane solution from an approved list prepared by the Ministry shall be permitted for use on the job.

Certification shall be required for each batch shipment of silane solution, prior to its use.

**418.03 Contractor's Qualification** - The applicator shall have a minimum of three years of successful and documented experience in application of liquid water repellents to concrete or masonry substrates, or else the applicator must provide documentation certifying that training approved by the manufacturer and the Ministry for applying silane solution was received.

#### **418.04 Job Site Conditions**

**418.04.01 Substrate Condition** - Prior to silane treatment:

- New concrete shall be cured for a minimum of 28 days.
- All concrete surfaces shall be fully dry.

**418.04.02 Weather Limitations** - Application of silane solution shall be undertaken only during periods when rain or snow has not occurred during the previous two days and no rain or snow is forecast by the weather office for the next two days.

Application of silane solution shall proceed only when the concrete surface temperature is above 4°C and below 32°C, and windspeed is less than 24 km/hr.

**418.05 Surface Preparation** - All concrete surfaces

prepared for treatment shall be thoroughly cleaned prior to application of the silane solution. The method of cleaning shall be capable of removing loose concrete, curing compounds, laitance, dirt, dust, salt, oil, asphalt or other foreign materials. The cleaning process shall expose concrete pores and capillaries to readily accommodate silane penetration.

The cleaning process shall not damage the concrete surface, remove or alter the existing surface finish, or expose the coarse aggregate of the concrete. The method of cleaning shall be performed in such a manner as to provide a uniform appearing surface colour.

**418.05.01 Pre-Surface Cleaning** - If necessary, pre-surface cleaning preparations may include the use of solvent and hand tools to remove materials detrimental to the silane treatment of the concrete surface.

**418.05.02 Surface Cleaning** - Suitable methods to clean the concrete surface are:

- Sand blasting
- Steel shotblasting
- Hydro blasting
- Steam cleaning
- Water pressure washing using a minimum of 3.5 MPa (500 psi) nozzle pressure.

The cleaning method used shall be capable of cleaning concrete surfaces, as specified.

**418.06 Silane Application** - Silane application shall proceed only if the condition of the cleaned concrete surface is approved by the Ministry Representative.

**418.06.01 Surface Condition** - All concrete surfaces shall be fully dry prior to silane solution application. Concrete surfaces previously steam cleaned or water washed must be allowed to dry prior to application of silane solution for:

- Minimum one day during windy or sunny days when air temperatures are over 20°C.
- Minimum two days during calm or cold days when air temperatures are between 4°C to 20°C.

**418.06.02 Silane Solution** - The silane solution shall be used as supplied by the manufacturer. It shall not be diluted or altered in any way. Water shall not be allowed to contaminate the silane solution.

**418.06.03 Application Equipment** - The silane solution shall be sprayed on the concrete surface by using low



pressure 0.1 MPa - 0.2 MPa (15 - 30 psi) positive displacement airless spray equipment. Suitable equipment is a pressurized garden sprayer or drum mounted pump. Large deck areas over 400 m<sup>2</sup> shall be sprayed using a spraybar type unit.

All spray equipment shall be fitted with fan spray nozzles and the spray adjusted to a "wet spray" condition (i.e., minimum atomization of silane solution).

**i) Cleaning of Application Equipment** - All application equipment must be clean and dry prior to use. If equipment is wet, it shall be rinsed with a small amount of methyl hydrate (methanol) prior to commencement of the actual application.

#### 418.06.04 Rate of Application

**i) Surfaces Subject to Traffic Wear** - Bridge decks and other surfaces subject to traffic wear shall be treated with silane solution at a rate of 0.40 ℓ/m<sup>2</sup>.

**ii) Surfaces not Subject to Traffic Wear** - Surfaces not subject to traffic wear (parapets, pier caps, sidewalks, etc.) shall be treated with silane solution at a rate of 0.23 ℓ/m<sup>2</sup>.

**418.06.05 Method of Application** - Silane solution shall be applied at a coverage rate according to this Specification. Horizontal surfaces shall be uniformly sprayed to saturate/flood the surface. Vertical surfaces should be treated from the bottom up and uniformly sprayed to saturate the surface.

If it is not possible to complete the silane treatment in one application, the boundary between the treated and untreated areas shall be clearly marked.

**418.06.06 Curing** - Following the application, the surface of silane treated concrete shall be cured by mist spraying with water after:

- 4-6 hrs, during days with temperatures between 25°C - 32°C
- 6-12 hrs, during days with temperatures between 15°C - 25°C
- 12-24 hrs, during days with temperatures between 4°C - 15°C

The traffic may be allowed on silane treated concrete one hour after the water wetting operation.

**418.07 Safety and Health Hazards** - Personnel exposed to silane solution and methyl hydrate shall wear personal protective equipment such as coveralls, goggles, rubber gloves and proper respirators.

No smoking, open flames, sources of heat or ignition shall be permitted during the construction operation.

Special precautions must be taken during the construction operation to prevent any over spray or spillage of materials on plants and vegetation or into fish-habitat water bodies, (Section 165, Protection of the Environment).

Manufacturer's material safety data and handling instructions shall be followed.

**418.08 Measurement and Payment** - Payment for the concrete deck sealant will be made at the unit price bid per square metre for the preparation of the concrete surfaces and the supply, application and curing of the deck sealant.



## SECTION 419

### CONCRETE BRIDGE DECK WATERPROOFING SYSTEM

#### PREFABRICATED MEMBRANE

##### DESCRIPTION

**419.01 Scope** - This Section describes the protection of concrete bridge decks with rubberized asphalt prefabricated membrane overlaid with hot mix asphalt pavement. The Section describes materials, surface preparation and application.

**NOTE:** This Section is not applicable to existing concrete with high levels of chloride contamination. Membrane and pavement overlay shall not be installed on concrete bridge decks contaminated with acid-soluble chloride ion (Cl<sup>-</sup>) in excess of 0.10% by mass of cement.

##### MATERIALS

**419.11 General** - The membrane and accessory materials shall be supplied as a package containing:

- a) full-width membrane, self-adhering internally reinforced sheet of rubberized asphalt. Membrane shall have a minimum thickness of 1.6 mm (65 mils) and shall be supplied in rolls in width between 900 mm and 1500 mm (3' to 5').
- b) detailing strip of membrane, self adhering internally reinforced sheet of rubberized asphalt. Membrane shall have thickness between 1.50 and 1.75 mm (60 to 70 mils) and shall be supplied in rolls in width between 200 and 305 mm (8" to 12").
- c) primer, rubberized asphalt dispersed in organic solvent with minimum solids of 45% (by mass), and maximum drying time of one hour.
- d) mastic, single component material, consisting of rubberized asphalt, organic solvent and fillers, supplied in caulking tubes.

**419.12 Delivery and Storage** - Membrane and accessory materials shall be delivered to the job site in unopened packages and containers with manufacturer's label identifying the product and a batch number.

The packages and containers shall be stored in a dry secured place protected from weather and excessive heat. Specific manufacturer's instructions for storage shall be followed.

**419.13 Quality Assurance** - Only membranes and materials accessories (supplied as a package) from the Recognized Products list prepared by the Ministry will be permitted for use on the job.

Certification shall be provided for each batch (package) shipment, prior to its use.

##### CONSTRUCTION

**419.31 Applicator's Qualification** - The applicator must have a minimum of three years of successful and documented experience in application of solid membranes to concrete substrates, or else the applicator must provide documentation certifying that training approved by the manufacturer or the Ministry for applying solid membranes has been received.

##### 419.32 Job Site Conditions

**419.32.01 Substrate Conditions** - Prior to application of membrane, new concrete shall be cured for a minimum of 28 days.

**419.32.02 Weather Limitations** - Application of primer and installation of membrane and pavement overlay shall be undertaken only during stable weather when precipitation has not occurred during the previous 24 hours and is not imminent, and when the minimum ambient and concrete surface temperature is 5°C and rising.

**419.33 Surface Preparation** - All concrete surfaces shall be sound, smooth, clean and free from any contamination.

- a) All defects in concrete surfaces, cracks, delamination and spalled areas shall be repaired with a suitable patching material. All patching shall be completely cured.
- b) All protrusions and sharp edges shall be removed by using hand tools or power tools.
- c) New concrete overlays on bridge decks and concrete-filled shear keys between prestressed concrete box stringers shall have smooth finish. Broom finishes are not acceptable.
- d) All loose aggregates, laitance dust, soil, oil and other debris and contaminations shall be removed from the concrete surface by one or a combination of the following methods:
  - i) high pressure clean dry air sweeping
  - ii) sand blasting



- iii) steel shotblasting
- iv) hydro blasting using a minimum of 3.5 MPa (500 psi) nozzle pressure
- v) steam cleaning.

The method used shall be capable of cleaning concrete surfaces as specified.

**419.34 Priming** - All concrete deck surfaces that are to receive membrane must be primed.

**419.34.01 Concrete Surfaces** - All concrete surfaces shall be fully dry prior to application of primer. Concrete surfaces previously steam cleaned or water washed must be allowed to dry prior to application of primer for:

- minimum 24 hours during windy or sunny days when air temperatures are over 20°C.
- minimum 48 hours during calm or cold days when air temperatures are between 5° to 20°C.

**419.34.02 Primer Material** - Primer shall be used as supplied by the manufacturer. It shall not be diluted or altered in any way.

**419.34.03 Primer Application** - Primer application shall proceed only if the condition of cleaned and repaired concrete surfaces is approved by the Ministry Representative.

All concrete surfaces to be covered with membrane shall be uniformly treated with primer at the rate of 0.15 to 0.25 ℓ/m<sup>2</sup> depending on the porosity of the substrate surface.

The primer shall be uniformly applied on substrate surface by roller or brush.

**419.34.04 Primer Curing** - Only as much surface as will be covered by membrane in the workday shall be primed. Primed concrete surfaces not covered by membrane within the workday must be reprimed immediately prior to membrane installation.

All primed areas must be tack free prior to application of the membrane.

### 419.35 Membrane Application

**419.35.01 Detail Work** - Extra attention must be given to all detail work. Detail work shall be performed first, prior to installation of the full-width membrane. The membrane shall be installed as called for on Drawings [SP419-01](#) through [SP419-08](#) and as follows:

i) curb or parapet - inside corners at curbs or parapets shall be covered using a detailing strip of membrane. The uppermost edge of the detailing strip of membrane shall be placed and extended up the face of curb or parapet to 6 mm (1/4") below the finished height of the asphalt pavement overlay. The detailing strip of membrane shall be installed in such a manner to ensure it is smooth and that it adheres strongly to the face of curb or parapet, and bridge deck without any visible defects ("tenting", "fish mouth" or "bubbles"). The first sheet of the full width of membrane shall then be applied as close as possible to the curb or parapet.

ii) bridge deck edge - on bridge decks without curbs or parapets, the full width membrane or detailing strip of membrane shall terminate 6 mm (1/4") from the outer edges of the deck. The membrane shall be heated at the edge of the deck with light flame from a torch or with a hot air gun, followed by pressing the membrane down with a roller.

iii) drains - areas around drains, basins and any other protrusions shall be double covered with membrane. First, flashing pieces of detailing strip of membrane are applied, followed by the application of the full width membrane. The membrane shall be installed in such a way as not to obstruct openings of drains and basins.

iv) weep holes - do not require detailing strip. The membrane around weep holes shall be heated with light flame from a torch or hot air gun, and pressed down to expose the opening of the hole.

v) joints and cracks - all filled cracks wider than 3 mm (1/8"), and all joints with a gap less than 6 mm (1/4"), shall be covered with a detailing strip of membrane prior to application of a full width membrane. Joints wider than 6 mm (1/4"), shall be treated as a standard expansion joint and membrane shall be terminated at expansion joint assembly.

vi) bridge ends - detailing strip of membrane shall be installed over the joint between the existing pavement and the bridge deck. At each end of the bridge deck, a full-width membrane shall extend at least 900 mm (3') over the paved bridge approaches. In the case of new construction, when the existing structure has gravel approaches, the detailing strip of membrane shall be folded over the deck edge and covered with a full width membrane.

**419.35.02 Membrane Installation** - The full width membrane shall be applied in a longitudinal direction from the low point to the high point so that laps shed water. The area along the lower edge of the deck shall be covered first.



The full width membrane shall be laid flat, avoiding wrinkles and entrapped air. Each succeeding sheet of membrane shall be applied overlapping the side laps a minimum 65 mm (2 1/2") and the end laps a minimum 150 mm (6"). The entire surface of the membrane, especially laps, and all terminations shall then be rolled with sufficient pressure to effect a bond between the membrane and the concrete surface.

**419.35.03 Mastic Application** - All membrane terminations shall be sealed with a trowelled application of mastic 12 to 25 mm (1/2" to 1") wide and 1.5 to 3.0 mm (1/16" to 1/8") thick. Mastic shall be applied along the edge of the membrane at the face of the curb or parapet, along both sides of the deck joints, around drains and at termination of the membrane on both ends of bridge approaches.

At the end of each working day, or when application is interrupted by a change in construction scheduling, all membrane terminations shall be sealed with the mastic.

**419.35.04 Inspection and Repairs** - Prior to paving over the membrane, any defective areas of the membrane shall be repaired to the satisfaction of the Ministry Representative, including:

- tears, damaged areas and inadequately lapped seams shall be patched;
- fish mouth shall be slit and repaired;
- large blisters shall be punctured and repaired; and
- if water migrates underneath the installed membrane, then the membrane covering the affected area shall be removed and replaced.

**419.35.05 Traffic On Membrane** - Traffic shall not be permitted on the membrane prior to installation of asphalt overlay with the exception of vehicles and equipment engaged in installing the asphalt overlay. Only vehicles or equipment provided with pneumatic tires or with flat tracks with rubber bonded pads, shall be permitted on the membrane. Any turning or sudden braking on the membrane shall be avoided. Any damage to the membrane resulting from the movement of vehicles or equipment shall be repaired at the Contractor's expense.

**419.36 Paving** - Asphalt overlay construction shall proceed only when the final condition of the installed waterproofing membrane is accepted by the Ministry Representative. Prior to commencing asphalt pavement construction, the weight of equipment, including loaded trucks, paver and rollers, and their maximum combined weight must be accepted by the Ministry's responsible Bridge Engineer. Only this accepted equipment and equipment combination shall be permitted on the bridge structure at the time of construction. Asphalt materials, mix design, mix production

and hot mix asphalt pavement construction shall meet the requirements of Sections 501 and 951.

**419.36.01 Asphalt Mix and Pavement Design** - Asphalt mix shall meet the requirements of Subsections 501.14 and 501.15 for Pavement Class I, Medium Mix and appropriate asphalt binder. The asphalt pavement thickness constructed over the membrane shall be not less than 50 mm and shall be constructed as indicated in Subsection 501.35.

**419.36.02 Placing The Asphalt Mix** - In addition to standard paving practice:

- i) no paving shall proceed over wet membrane;
- ii) no primer shall contaminate membrane surface;
- iii) paving operation shall commence as soon as possible after the waterproofing membrane is installed;
- iv) paving shall proceed in the direction of the end laps in the membrane (i.e., from overlap to underlap);
- v) the Contractor shall take due precautions to avoid damage to the waterproofing membrane during the paving operations by the paver and hauling trucks;
- vi) the paver shall move at a constant speed avoiding any unnecessary stopping;
- vii) hauling trucks shall maintain a steady supply of asphalt mix to the paver;
- viii) excessive accumulation of asphalt mix in the paver hopper and auger shall be avoided;
- ix) unloading of the asphalt mix from the hauling trucks onto the membrane surface will not be permitted;
- x) paver screed burners shall be set in such a way as to avoid any damage to the membrane from excessive heat;
- xi) the path in front of the screed side end plate must be kept continuously free from spilled asphalt mix. The bottom of the side end plate shall slide freely, otherwise the entrapped asphalt mix could damage the underlying membrane;
- xii) screed adjustments during paving shall be made in such a way as to achieve a uniform thickness of mat, surface texture, smoothness and designed pavement geometrics;
- xiii) the bridge deck joints, drains and other openings (except weep holes) shall be protected to avoid intrusion



of asphalt during the paving operation; and

xiv) during a "one lane at a time" construction method, as on bridges partially open to traffic, the constructed pavement mat shall terminate not less than 100 mm (4") from the edge of installed membrane in order to provide a sufficient area for lapping of the next sheet of membrane.

**419.36.03 Compaction** - In addition to standard compacting practice:

- i) drum vibration mode must not be used during compaction.
- ii) steel drum shall run as close as possible to the curb or parapet.
- iii) compaction along the expansion joints or concrete dams shall be performed transversely.
- iv) sudden stops or sharp turns by rollers shall be avoided.

**419.36.04 Hand Work** - Placing of asphalt mix in areas inaccessible to paving equipment shall be done in accordance with Subsection [501.35.10](#) and [501.36.08](#).

**419.37 Protection Of The Environment** - The Contractor shall comply with Section [165](#), appropriate environmental requirements of Fisheries and Oceans Canada, the Ministry of Environment, Lands and Parks and any related municipal

regulations.

Special precautions shall be taken during the construction operation to prevent spillage of materials into water bodies.

**419.38 Safety and Health Hazards** - Materials used in the construction of membrane and asphalt pavement overlay are flammable, toxic and hot. Personnel exposed to these materials and operations shall wear all appropriate personal protective equipment such as boots, coveralls, goggles, rubber gloves and proper respirators as specified by Worker's Compensation Board. Manufacturer's material, data and handling instructions shall be followed.

## MEASUREMENT

**419.81 General** - Rubberized asphalt membrane will be measured in SQUARE METRES installed.

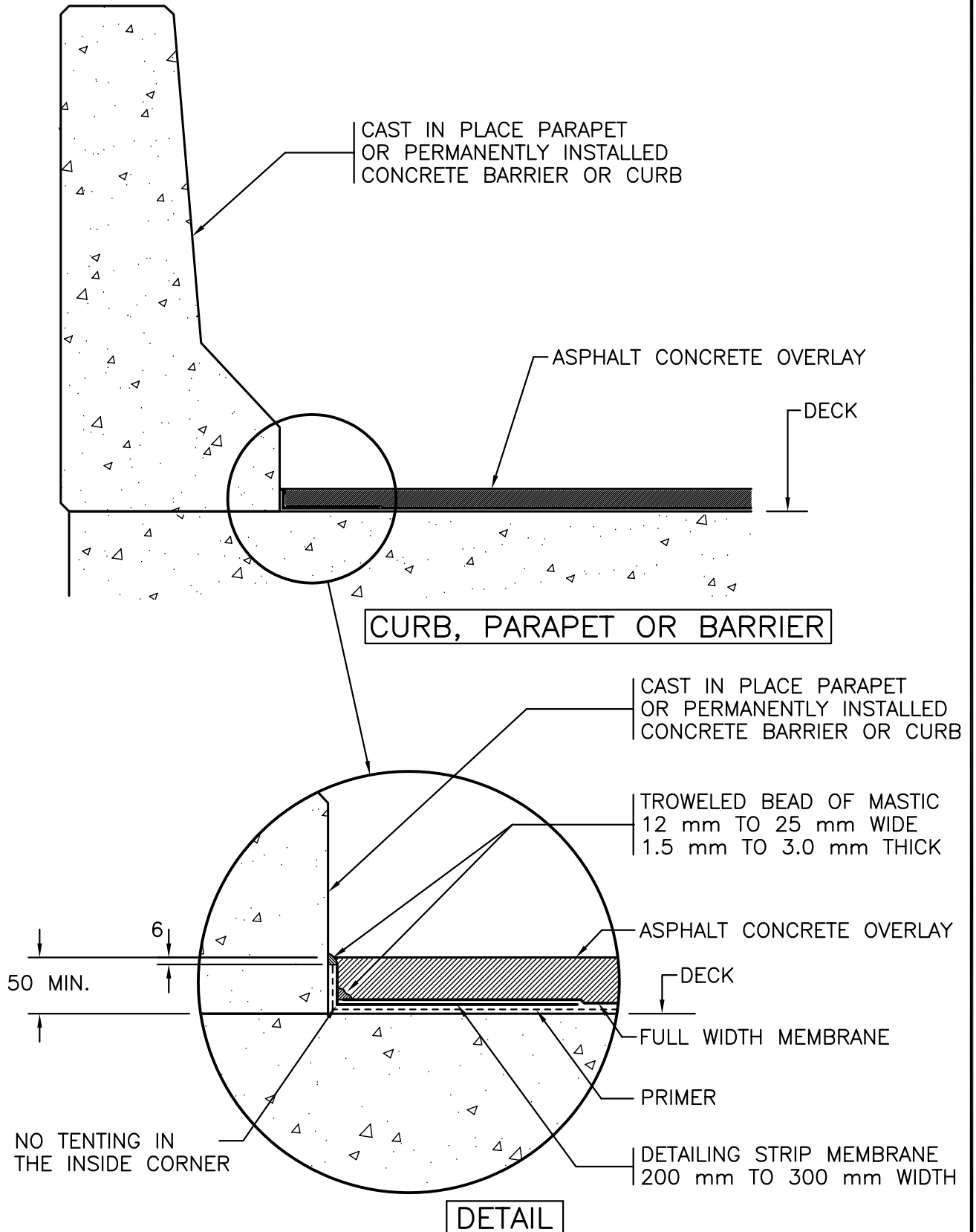
Hot mix asphalt pavement will be measured in TONNES.

## PAYMENT

**419.91 General** - Payment for the MEMBRANE installation will be made at the contract unit price bid per square metre. The unit price shall include everything done and furnished for the full completion of the waterproofing membrane installation.

Payment for the HOT MIX ASPHALT PAVEMENT OVERLAY will be made at the contract unit price bid per tonne.

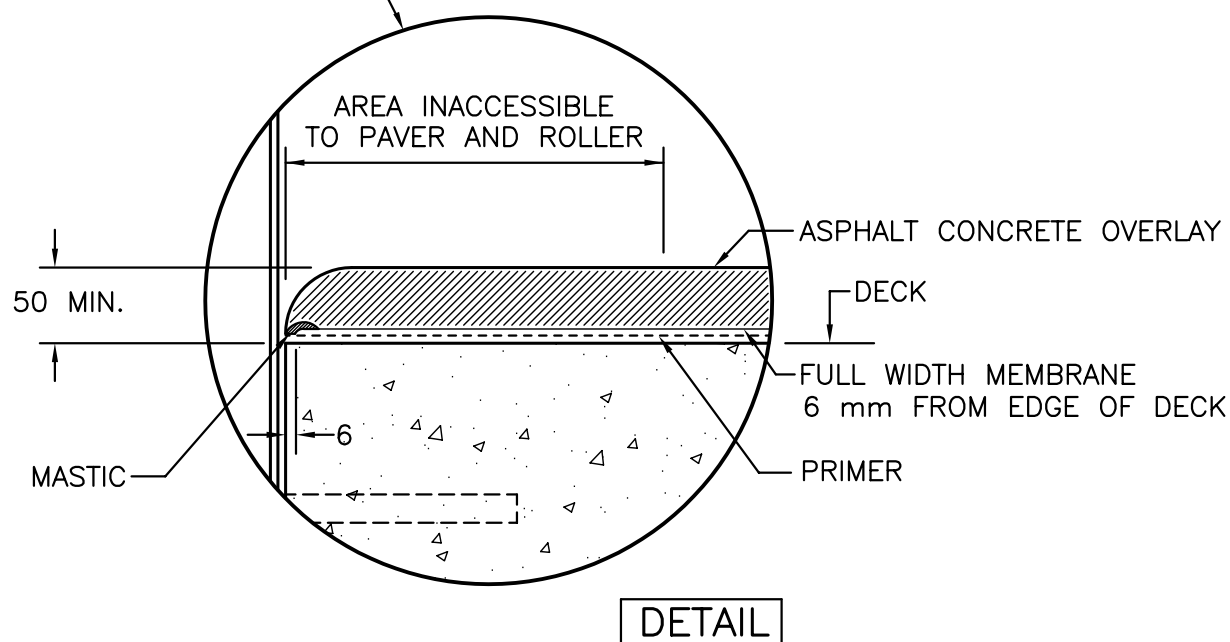
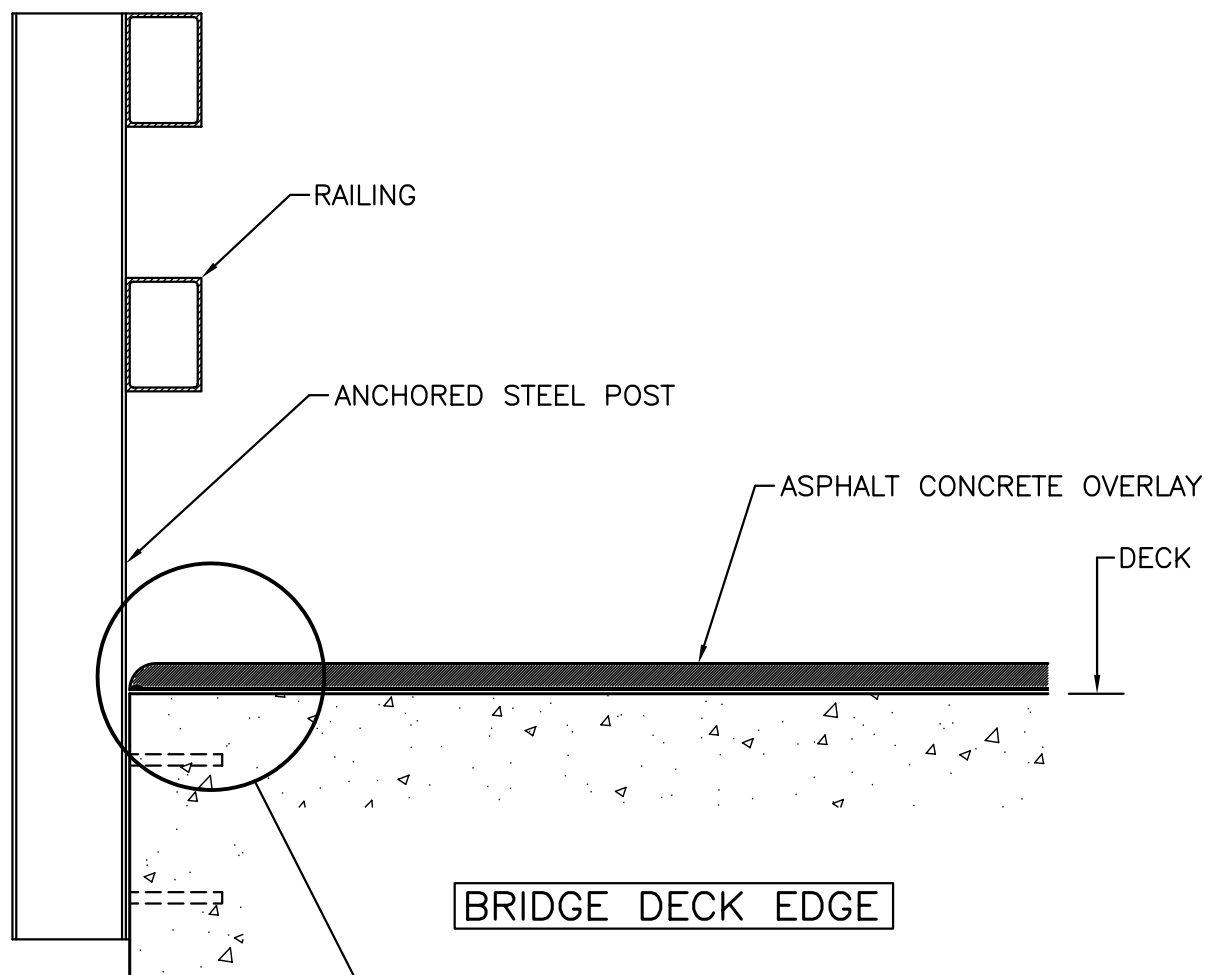




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

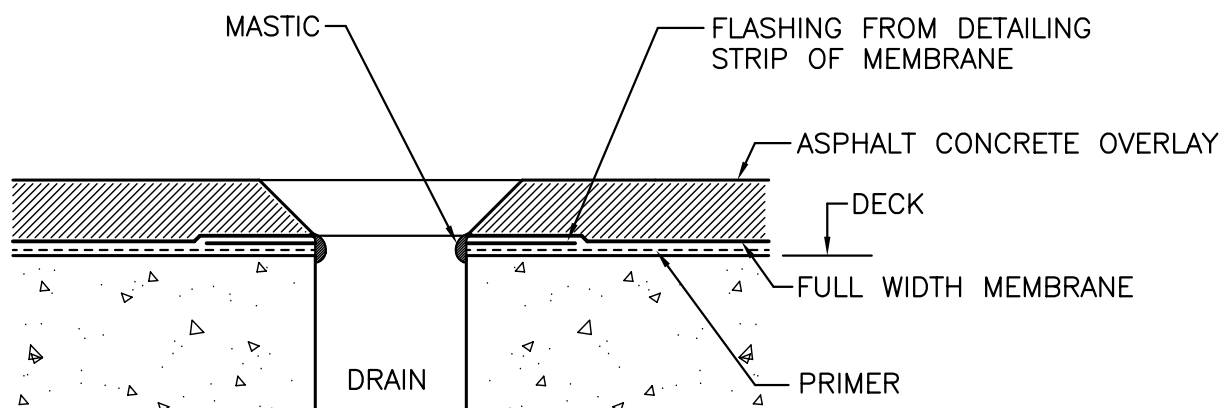




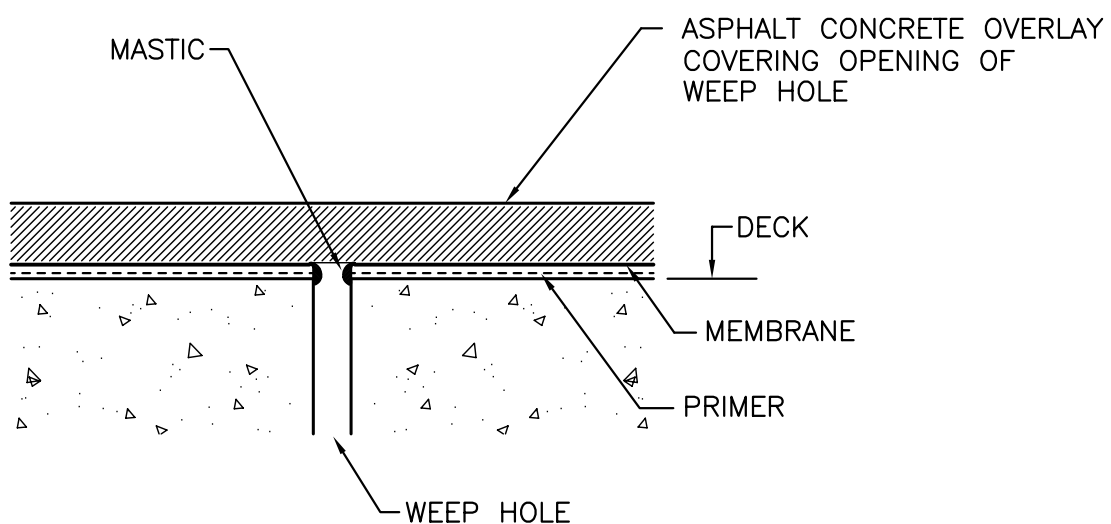
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





DRAIN

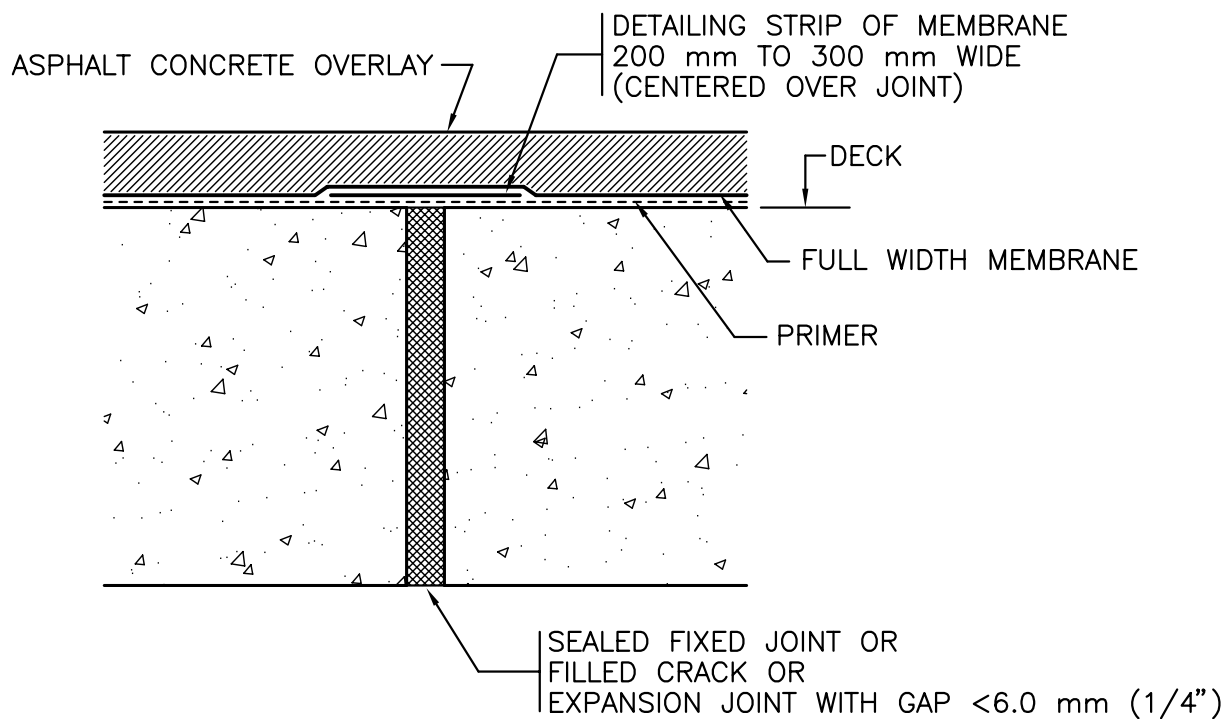


WEEP HOLE

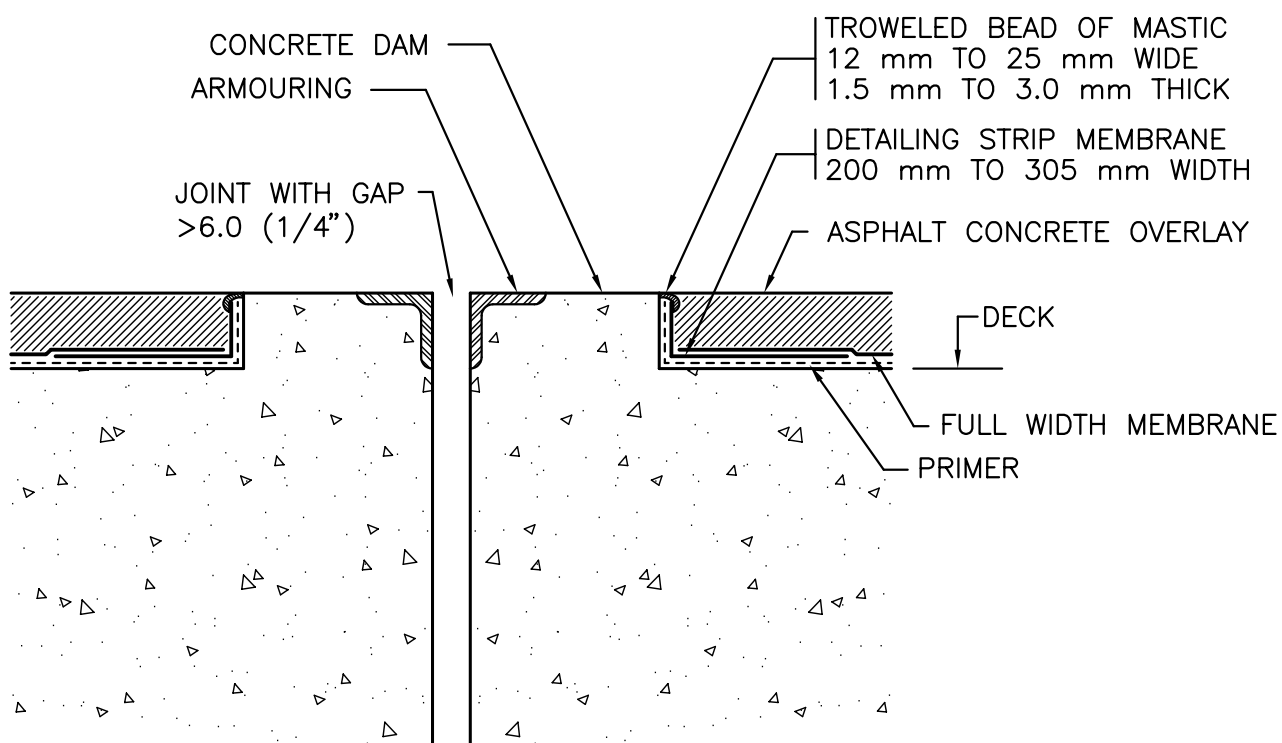
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





FIXED JOINT OR CRACK

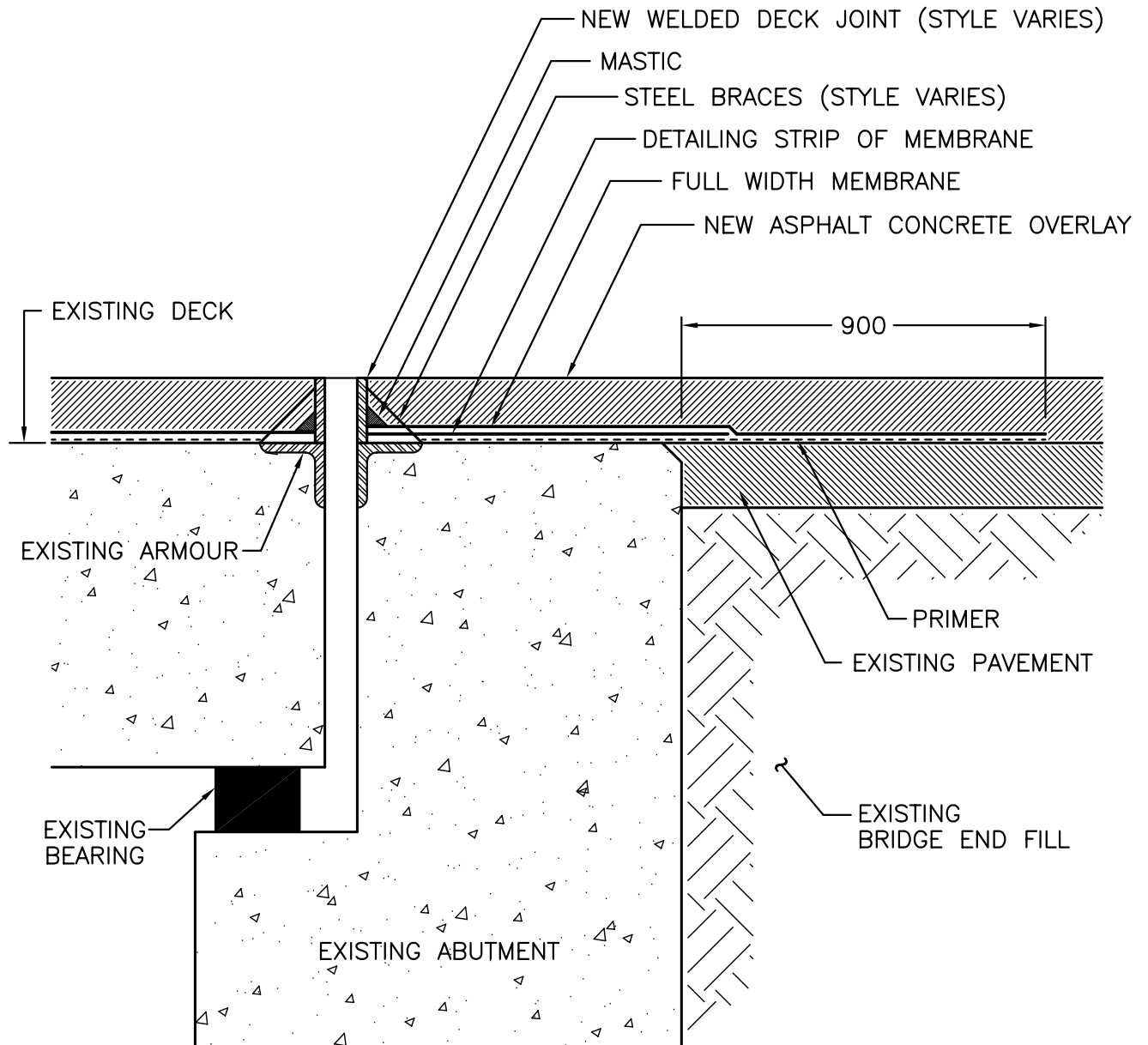


EXPANSION JOINT

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





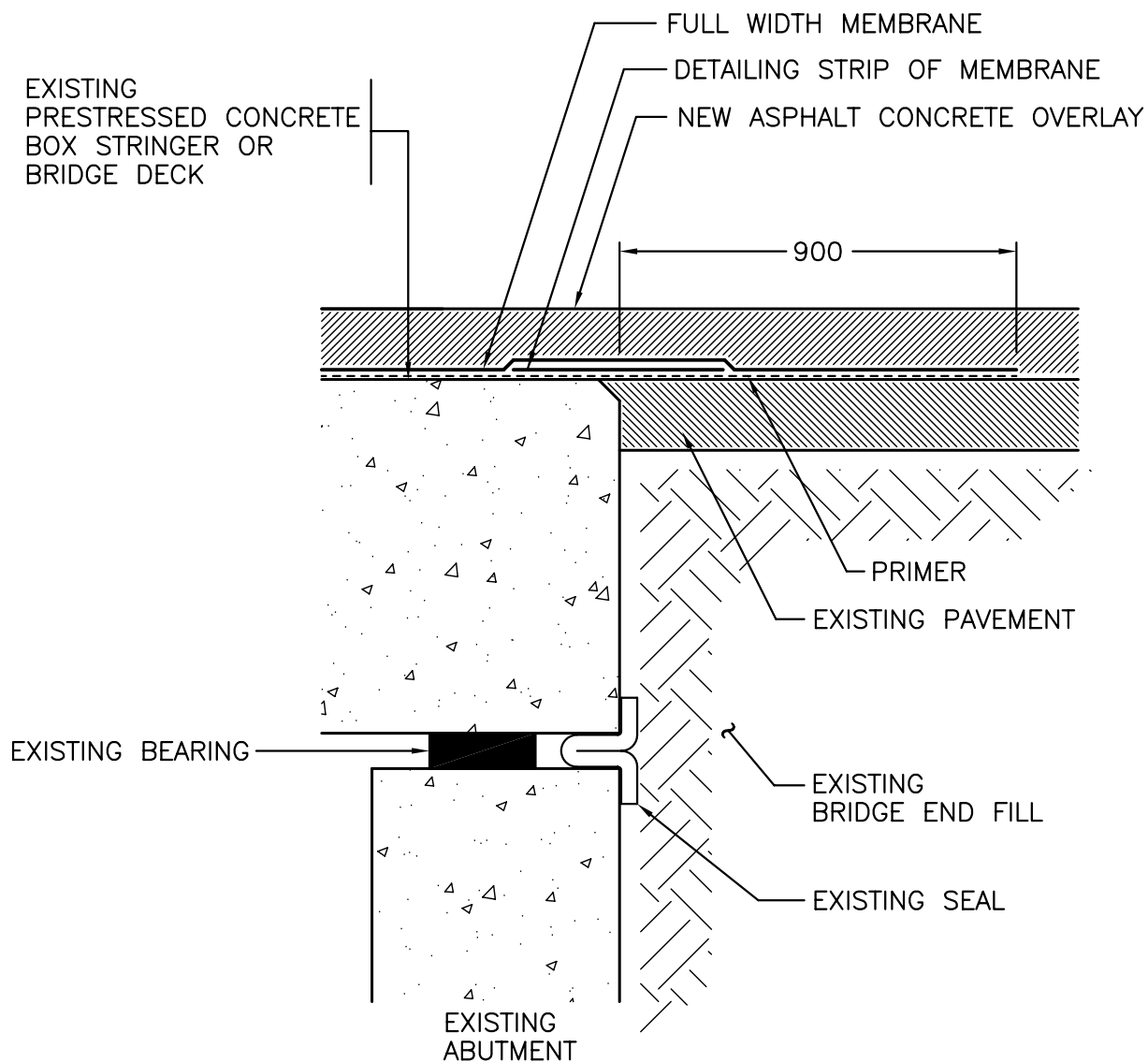
BRIDGE END

(WITH EXPANSION JOINT AND EXISTING PAVED APPROACH)

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





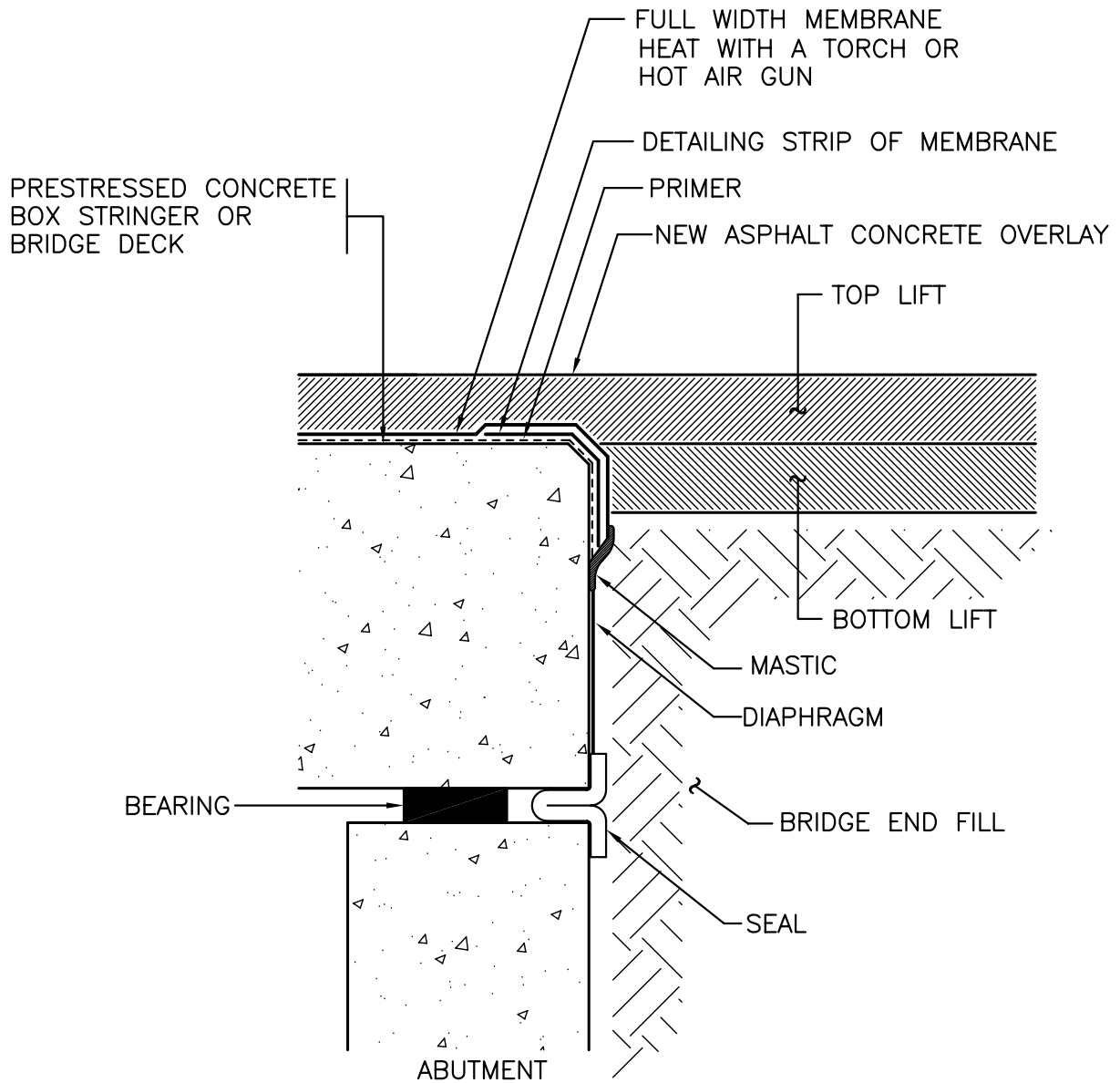
**BRIDGE END**

(EXISTING PAVED APPROACH WITHOUT EXPANSION JOINT)

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





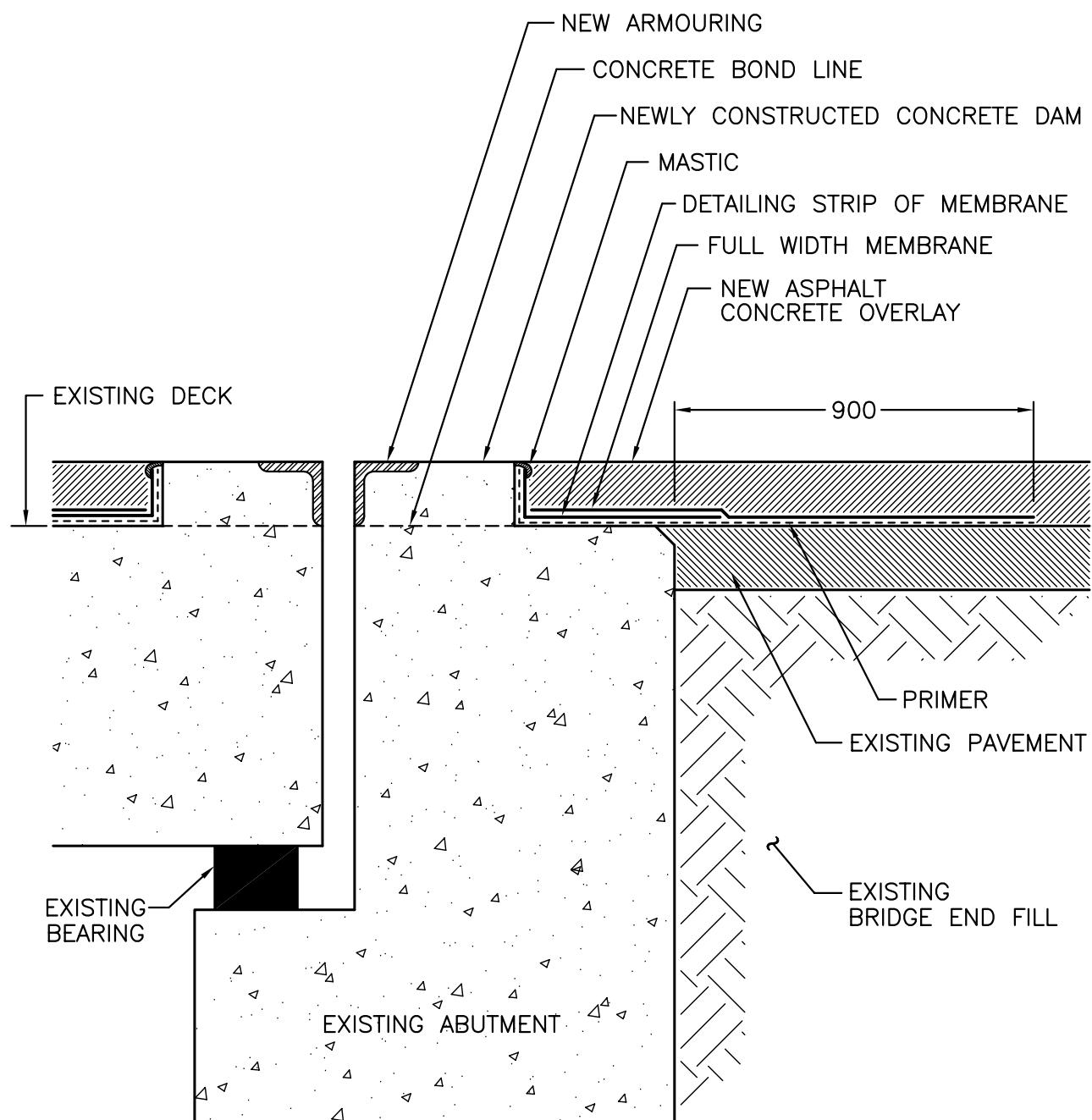
BRIDGE END

(NEW CONSTRUCTION OR EXISTING STRUCTURE WITHOUT EXISTING PAVEMENT)

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





**BRIDGE END**

(EXISTING PAVED APPROACH WITH EXPANSION JOINT)

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 421

### STRUCTURAL STEELWORK

#### DESCRIPTION

**421.01 Scope** - This Section covers the supply, fabrication, erection and quality control program of all major structural steel elements.

In general, all shop connections shall be welded, and all field connections high-strength bolted.

Except as otherwise specified herein, steelwork shall be fabricated and erected in accordance with the AASHTO Standard Specifications for Highway Bridges (1996 including interim revisions), Division II, Section 11. Welding and associated work shall be in accordance with the current edition of CSA W59-M - Welded Steel Construction.

**421.02 Prefabrication Meeting** - The Ministry will convene a prefabrication meeting with the Contractor to review procedures on quality control, welding procedures, procedures for non-destructive testing, mill certificates and heat numbers, splices, updated schedule for fabrication, and to specify the Ministry's requirements.

**421.03 Alternative Details** - All details shall, in general, conform to those shown on the Drawings. Any proposed variation shall be submitted to the Ministry in writing, with the reason for the variation, and any cost saving or extra cost. The Ministry may require the submission of Drawings prepared and sealed by a professional engineer registered with the APEGBC.

If, in the opinion of the Ministry, the variation represents a clear improvement, it may be accepted without any price adjustment.

If the variation results in a product of equivalent quality, it may be accepted at the discretion of the Ministry. In this case any saving in cost to the Contractor (as determined by the Ministry) shall be passed on as a credit to the Ministry.

**421.04 Working Drawings** - Working drawings shall consist of the following:

- Shop drawings
- Transportation details and
- Erection drawings

Transportation details and erection drawings shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC).

Shop drawings shall be prepared and sealed by a

professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) when the Contractor is responsible for the design of items that are detailed on the shop drawings.

Working drawings shall be in the same system of units as the design drawings.

Working drawings shall be on sheets approximately 600 mm by 850 mm (one drawing per sheet). Lettering for notes and dimensions shall be at least 2.5 mm and 4 mm for headings. Drawings shall be legible when half-sized or microfilmed.

**421.04.01 Shop Drawings** – Shop drawings shall show all information and details needed for the fabrication of the members including, but not limited to, such items as member shapes and dimensions, connection details, material and product standards, mark numbers and general arrangement of member locations, details of attachments, fastener details, weld details, mass of members, special tolerances, special handling instructions, coating details, lifting details and lifting locations.

**421.04.02 Transportation Details** – Transportation details shall include such items as:

- Description of hauling and handling equipment
- Weight of members
- Length and height of loads
- Location and method of member support
- Details for handling, storing, and loading of members.

**421.04.03 Erection Drawings** - Erection drawings shall show in detail the method of erection including, but not limited to, the following:

- Erection procedures
- Procedures for off loading of members upon delivery
- Details for temporary storage and support of members on site prior to erection
- Equipment to be used
- Layout or general arrangement drawing showing the layout of the members, equipment positioning, and access roads
- Crane make, model, and capacity charts, boom length(s) , crane placement, and access for transporting of members to crane(s)
- Radii and loads for crane lifts
- Rigging details
- Mass of members , rigging and special installation equipment
- Details for installation and removal of all falsework, temporary supports, temporary bearings, bracing, guys, dead-men, and lifting devices



- Attachments to the bridge members and bridge structure for temporary support and special launching equipment
- Detailed description of sequence of operations
- Details for special installation equipment such as a launching truss, launching nose, head frames, spreader beams and rollers
- Details for installation of members onto the permanent bearings
- Traffic control plan for roadway and rail traffic
- Details for protection of existing utilities affected by the erection procedures

The Contractor shall be responsible for the lateral stability of members and shall design and provide bracing as necessary until completion of the Work.

The erection drawings shall be complete in detail for all anticipated phases and conditions during erection and during the temporary support of members. The Contractor shall submit calculations, upon request, to the Ministry Representative that demonstrate that allowable stresses are not exceeded in members, falsework, temporary bracing and temporary supports and that member capacities and final geometry will be correct. The calculations shall be sealed by the professional engineer that sealed the erection drawings.

Erection drawings must also show the layout and detail of fall protection and their sequence of installation.

Falsework, temporary supports and temporary bracing shall meet the requirements of CSA Standard S269.1 –1975, “Falsework for Construction Purposes”. Falsework, temporary supports and temporary bracing shall meet all the requirements for falsework given in Clauses 20.17 to 20.26 inclusive of the WCB Occupational Health and Safety Regulations.

A professional engineer registered with APEGBC shall be responsible for any field designs and any changes made to the erection procedures. Field designs and changes to the erection procedures must be documented and sealed by the responsible professional engineer and must be available at the Site prior to the affected erection work being carried out.

Immediately before placement of loading on falsework, the Contractor must ensure that the falsework is inspected and an engineering certificate is issued by a professional engineer registered with APEGBC which:

- Indicates the specific areas inspected and
- Certifies that the falsework has been erected in accordance with the latest approved erection drawings and supplementary instructions.

The Contractor shall submit to the Ministry Representative

three sets of all working drawings. These drawings shall be submitted four weeks prior to the fabrication of the work. Any work done or materials ordered prior to the review of the working drawings shall be at the Contractor's risk. The Ministry will review the drawings for general compliance with the contract requirements.

If modifications to the drawings are required, the Ministry Representative will return one set of drawings, marked up, to the Contractor. The Contractor shall re-submit three sets of the revised drawings to the Ministry Representative.

If no exceptions are taken to the drawings, the Ministry Representative will return one set of reviewed drawings to the Contractor. The Contractor shall forward an additional four sets of the reviewed drawings to the Ministry Representative.

**SHOP DRAWINGS WILL NOT BE REVIEWED WITHOUT THE TRANSPORTATION DETAILS AND ERECTION DRAWINGS APPLICABLE TO THE MEMBERS IN QUESTION.**

Review of working drawings shall not relieve the Contractor of responsibility for carrying out the work in accordance with the contract documents.

**421.05 Quality Control** - The Contractor shall implement a quality control program to the requirements of CSA CAN3-Z299.3, or as specified in Subsections [421.61](#) through [421.75](#).

**421.06 Quality Assurance** - The Ministry will implement a quality assurance program by auditing the Contractor's quality control program and by inspection at its discretion.

The Contractor shall notify the Ministry Representative at least 14 days before fabrication has commenced. The Contractor shall allow the Ministry's representatives access to all parts of the work, and shall supply such information and assistance as is required. The Contractor shall provide samples of any materials requested by the Ministry. Inspection by the Ministry shall not relieve the Contractor from obligation to perform the work in accordance with the contract.

At its discretion and expense, the Ministry will test any weld by non-destructive testing methods, in accordance with CSA W59-M. Generally, fillet welds will be tested by the dry powder magnetic particle method and butt welds by radiography, or by any other method of testing the Ministry deems necessary.

The Ministry will attempt to schedule non-destructive testing operations so as not to interfere with the progress of



the work.

The extent of non-destructive testing will usually be as follows:

• Butt Welds	100%
• Flange/web fillet welds	100%
• Flange/stiffener fillet welds	100%
• Web/stiffener fillet welds	25%
• Bracing/stiffener fillet welds	25%

The inspection of welds shall be carried out as soon as possible after the completion of welding.

The Contractor shall be prepared to move and support the pieces being inspected. In general, inspection shall be done on the flat and a minimum of 1.25 m of headroom shall be available.

The Contractor shall bear the cost of reinspection of welds after defects are repaired.

The Ministry will inspect bolted connections in accordance with the AASHTO Specifications for Highway Bridges (1996), Division II, Section 11.

The Ministry shall be notified of any defects found in the work. No repair shall be made until agreed to by the Ministry. In the case of minor or routine corrections, approval to proceed may be given verbally by the Ministry's inspector. In such cases as repair of major cracks or a revised design to compensate for deficiencies, the means of correction shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of BC (APEGBC). It shall be submitted in writing, with adequate sketches, to the Ministry for review.

Each main member shall be audited by a Ministry quality assurance representative before it is shipped from the shop. This audit shall not relieve the Contractor of responsibility for subsequent damage or for defects which become apparent before the work is finally accepted by the Ministry.

**421.07 Quality and Details of Welds** - The quality and details of welds shall be in accordance with CSA W59-M.

Undercut at the toe of the flange to web fillet weld will not be allowed except in regions of low stress at the discretion of the Ministry.

**421.08 Design Specifications** - CAN/CSA-S6 shall be used in the design of alternative details and calculating the effect of stresses incurred in fabrication and erection.

No increase in allowable stresses due to vertical loads shall

be used for erection conditions.

## MATERIALS

### 421.11 Materials

**421.11.01 Structural Steel** - Steel shall conform to the requirements of CAN/CSA-G40.20/G40.21-M, and shall be of the grades called for on the Drawings. Plates provided from coils shall not be used. Prior to fabrication, the Contractor shall supply to the Ministry the manufacturer's mill certificates giving details of all chemical and physical properties of steel to be used in the work.

Chemical composition of steel to be galvanized shall be in accordance with Subsection 421.42.

Steel shall be supplied free of surface defects and internal discontinuities, with due regard for the end use of the steel in the work.

Edges of all plates will be subject to inspection by the Ministry. Any discontinuities will be examined and may be accepted.

The Ministry shall be supplied with a record of all observed discontinuities and repair methods.

Repairs to defective plates shall not proceed until review of the proposed repair method by the Ministry.

**421.11.02 Welding Consumables** - All electrodes shall match the base metal specified in accordance with CSA W59-M, Table 12.1. The deposited weld metal shall provide strength, ductility, impact toughness and corrosion resistance equivalent to the base metal.

Welding consumables for all processes shall be certified by the Canadian Welding Bureau (CWB) as complying with the requirements of CSA W48.01.

**421.11.03 High-Strength Bolts** - Unless otherwise specified on the drawings, high-strength bolts, nuts and washers shall conform to the requirements of ASTM A325, and as follows:

- a) for painted steelwork, Type 1, hot-dip galvanized to the requirements of CAN/CSA-G164-M.
- b) for unpainted weathering steel, Type 3.

**421.11.04 Shear Connector Studs** - Shear connector studs shall conform to the requirements of ASTM A108, Grades 1015, 1018 or 1020.



**421.12 Material Storage and Care**

**421.12.01 Steel** - Structural material, either plain or fabricated, shall be stored above the ground in an upright and shored position upon platforms, skids, or other supports. It shall be kept free from dirt and other foreign matter, and shall be protected as far as practical from corrosion. Long members shall be supported on skids placed near enough together to prevent overstress from deflection.

Prior to fabrication, all steel shall be marked for identification by heat number and specification by a marking system approved by the Ministry.

**421.12.02 Welding Consumables** - Electrodes and fluxes shall be stored and kept in condition as required by CSA W59, Section 5.2.

Gas for welding shall be stored in marked steel bottles and shall not be subjected to temperatures in excess of 50°C nor temperatures of less than 0°C.

**421.13 Fabrication** - Prior to fabrication, the welders and welding operator's qualifications, shop drawings, welding procedures, mill certificates and welding consumable certificates shall be submitted for the Ministry's review.

No fabrication or welding of steelwork shall commence until permission to do so has been received from the Ministry.

**421.14 Ministry's Plant Office** - The Contractor shall provide in the fabrication plant or nearby a suitable lock-up office for the sole use of the Ministry throughout the period of fabrication.

The office shall be at least 2.5 m x 3 m and shall be weathertight and reasonably soundproof, provided with ample window area and ventilation, furnished with a 0.75 m x 1.2 m desk, a 1 m x 2 m draughting table, a two-drawer filing cabinet, two chairs, a draughting stool and 3 m of shelves, and equipped with a telephone, which shall be operational throughout the period of fabrication. All long distance telephone calls will be paid for by the Ministry.

The Contractor shall clean, heat and light the office throughout the period of fabrication.

**EQUIPMENT****421.21 Qualifications and Equipment**

**421.21.01 Contractor** - The Contractor shall produce evidence that the plant is currently fully approved by the CWB to the requirements of CSA W47.1, Div. 2.1 or better prior to beginning work.

The Contractor shall also produce evidence of satisfactory experience in the fabrication of heavy structural steelwork.

The Contractor shall employ or retain a registered professional engineer experienced in steel bridge fabrication, to provide guidance throughout the work.

A qualified welding supervisor shall be employed on each shift where welding is done on the work.

Prior to fabrication, the Contractor shall submit to the Ministry the names of the welding engineer, the engineer experienced in steel bridge fabrication, and the welding supervisors who are to be employed on the work.

**421.21.02 Welders and Welding Operators** - The Contractor shall produce evidence that all welders and welding operators to be employed on the work are currently qualified by the CWB at the time of fabrication in the processes in which they are to be employed on the work.

The Contractor shall also produce evidence relative to each welder and welding operator, that they have been executing satisfactory welding in the required processes within the six-month period previous to the award of this contract.

**421.21.03 Welding Equipment** - All equipment to be used in the work shall be in good working order and shall be subject to the inspection of the Ministry.

For any arrangement of automatic welding, the Ministry may require that a preliminary test run of the equipment be made, without welding, over the length of the joint, to prove that the disposition of the equipment and the method and accuracy of travel are satisfactory.

**421.22 Welding Procedures** - The Fabricator shall submit copies of the proposed welding procedures for review by the Ministry. Gas metal arc welding shall not be used. Where the submerged arc or flux cored arc process is to be used, the Ministry may order that each welder and welding operator make a weld specimen not less than 1 m in length for fillet welds and 150 mm in length for butt welds. Steel of the same specifications and thickness as that to be used in the work shall be used in the specimen welds.

No welding shall be done on the work until the welders' and welding operators' qualifications are established to the satisfaction of the Ministry.

Welding procedures shall be accompanied by documentary proof that they have been qualified previously by the CWB at the plant where the work is to be carried out.

The procedures shall include the following information:



joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment, including a description of travel for automatic welding.

**421.23 Butt Joints** - Except as called for on the Drawings, butt joints will not be permitted.

The Fabricator may submit an alternative butt joint design provided that such design has been approved by the CWB.

**421.24 Assembly and Welding Sequences** - If requested by the Ministry, the Contractor shall supply full details of the proposed assembly and welding sequence of any particular weldment.

## CONSTRUCTION

### 421.31 Preparation of Material

**421.31.01 Straightening Material** - Prior to being used in fabrication, all structural steel shall be straight and free from kinks or bends. The flatness tolerance of plate in excess of 900 mm wide shall be in accordance with the tolerances of the finished product as specified in CSA W59-M. If straightening is necessary, it shall be done by methods that will not injure the metal. The steel shall not be heated unless permission is given by the Ministry.

In no case shall the temperature of the steel exceed 620°C. After straightening, the surfaces of the metal shall be carefully inspected for evidence of fracture and if necessary, the material shall be replaced or repaired to the satisfaction of the Ministry. Sharp kinks and bends will be cause for rejection of the steel.

**421.31.02 Camber** - Girders shall be cambered as shown on the drawings.

**421.31.03 Edge Preparation** - Steel may be cut to size by sawing, shearing or flame cutting. All steel before cutting shall be marked by a method agreed to by the Ministry so that its specification may be immediately identified.

All cut edges shall be smooth and regular, free from fins, cracks, tears and notches. Freehand cutting shall be done only where approved by the Ministry. Roughness of cut surfaces shall not exceed the U. S. Standards Institute B46.1 value of 1000. Roughness exceeding this value shall be removed by machining or grinding. Occasional gouges will be tolerated only at the discretion of the Ministry Representative and shall be repaired as instructed.

Sheared edges of plates more than 16 mm in thickness shall be planed to a depth of 6 mm.

Re-entrant flame cuts shall be filleted to a radius of not less than 20 mm.

All exposed sharp corners of members, which are to be painted, shall be ground to a minimum radius of 1.6 mm. All corners of oxygen-cut edges of main stress-carrying members, except unpainted bearing stiffeners and girder webs, shall be ground to a minimum radius of 1.6 mm.

Special attention shall be given to the cutting of flange plates. All flange plates prepared by flame cutting shall be preheated in accordance with Subsection 421.34.

The Brinell hardness of the edges of flange plates on fracture critical members shall not exceed 220. If greater hardness is measured, the edges shall be ground to remove the hard layer, or annealed by means of a preheating torch. The Contractor shall bear all costs for reinspection.

Surfaces to be welded shall be free from loose scale, slag, rust, grease, moisture or other material that will prevent proper welding. Mill scale that withstands vigorous wire brushing, a light film of drying oil or a thin rust inhibitive coating may remain except that all mill scale shall be removed from the surfaces on which flange-to-web welds are to be made. Surfaces within 55 mm of any weld location shall be free from any paint or other material that would prevent proper welding or produce objectionable fumes while welding.

Edges of material thicker than specified in the following list shall be trimmed if and as required to produce a satisfactory welding edge wherever a weld along the edge is to carry calculated stress:

- a) Sheared edges of material thicker than 12 mm;
- b) Rolled edges of plates (other than Universal Mill Plates) thicker than 10 mm;
- c) Toes of angles or rolled shapes (other than wide flange sections) thicker than 16 mm;
- d) Universal Mill Plates or edges of flanges of wide flange section thicker than 25 mm.

**421.31.04 Direction of Rolling** - Steel plates for main members and splice plates for flanges and main tension members shall be cut and fabricated so that the direction of rolling is parallel to the direction of the primary stresses.

**421.31.05 Bolt Holes** - Standard holes for high tensile bolts shall be either punched, sub-punched and reamed, or drilled, and shall be of a nominal diameter not more than 2 mm in excess of the nominal bolt diameter, except that the



following bolt/hole combinations will be permitted:

- a) either 3/4 inch or M20 bolts in 22 mm holes;
- b) either 7/8 inch or M22 bolts in 24 mm holes;
- c) either 1 inch or M24 bolts in 27 mm holes.

Oversize or slotted bolt holes will be allowed only in special circumstances.

Punched holes shall be clean cut, without torn or ragged edges. The diameter of the die shall not exceed the diameter of the punch by more than 2 mm. If a punched hole must be enlarged to admit a high tensile bolt, it shall be reamed.

Reamed holes shall be cylindrical and perpendicular to the member. Where practicable, reamers shall be directed by mechanical means. Reaming shall be done with twist drills or reamers.

Drilling shall be done with twist drills or core drills. Burrs on the outside surfaces shall be removed.

Poor matching of holes will be cause for rejection.

**421.31.06 Faying Surfaces** - All faying surfaces of weathering steel shall be cleaned by sand blasting in the shop. Faying surfaces of steelwork to be painted shall be given only one coat of inorganic zinc primer.

**421.32 Marking** - Prior to fabrication, all steel shall be marked for identification by heat number and specification by a marking system approved by the Ministry. Steel, which is unidentified, shall not be used in the work.

**421.33 Assembly of Weldments** - The shop assembly of the various components of the weldments shall be executed in accordance with CSA W59-M.

Tack welding shall be done by qualified welders, using the smallest size weld required to hold the components of the assembly together. Tack welds shall be incorporated in the final weld.

**421.34 Preheat and Interpass Temperatures** - No welding shall be done when the temperature of the base metal is lower than -18°C. At temperatures below 0°C, the steel shall be preheated to a temperature of at least 10°C in excess of that stated in CSA W59-M, Table 5.3.

Preheat shall be applied to all steel to be welded so that the steel within 75 mm of the weld is heated to the temperature shown in CSA W59-M, Table 5.3.

Preheat shall be applied in such a manner that moisture from the heating equipment does not penetrate the joint.

Preheat temperatures above the minimum shown in CSA W59-M, Table 5.3 may be required for highly restrained joints if designated by the Ministry.

Preheat temperature shall in no case exceed 200°C.

Preheat requirements for tack welds shall be as in the above table except that where single pass tack welds are used and are to be incorporated and consumed in a weld made by the submerged arc process, preheat is unnecessary.

**421.35 Welding** - Welding shall be done by the manual, shielded metal arc, flux-cored arc or submerged arc processes in accordance with the reviewed procedures and CSA W59-M, Section 5, Technique.

Any weld between the web and flange of a bending member shall be made by an automatic process, which provides a continuous weld throughout the length of the member.

All welding shall be done under cover and, in the case of flux-cored arc welding, shall be done in an area free from wind or draft.

Where the submerged arc process is to be used, the Contractor shall:

- a) Carry out a preliminary test run of the procedure over the length of the joint to prove that the disposition of the equipment, the handling of hoses, and the method and accuracy of travel are satisfactory.
- b) Have each operator make a weld specimen not less than 1200 mm in length for fillet welds and 150 mm in length for butt welds. Steel of the same specification and thickness as that to be used in the work shall be used in the specimen welds. No welding shall be done on the work until such a specimen is satisfactory to the Ministry.

Butt welds shall be extended beyond the edges of the parts to be joined by means of start and run-off tabs providing sufficient thickness to avoid the weld burning through and with a joint preparation similar to that on the main material. For manual shielded metal arc welding the width of the tabs shall be not less than the thickness of the thicker part being joined or 75 mm, whichever is greater. For submerged arc, welding the width of the tabs shall be not less than 75 mm. Each weld pass shall be carried far enough beyond the edge of the parts being joined to ensure sound welds in the joint. Tabs shall be removed upon completion, and the weld cooled without damage to the parent plate. The end of the weld shall be made smooth and flush with the edges of the



abutting parts.

In flux-cored arc welding the equipment shall be capable of sustaining a gas flow rate of from 0.85 to 1.25 m<sup>3</sup>/h.

**421.36 Shear Connector Studs** - Shear connector studs shall be welded in the locations shown on the drawings, to the requirements of CSA W59-M, Section 5.5.6. Shear connectors will be inspected and shall be repaired if necessary in accordance with the same standard.

**421.37 High-Strength Bolts** - Installation of high-strength bolts shall be in accordance with the AASHTO Specifications for Highway Bridges (1996), Division II, Section 11.5.6.

Galvanized bolts shall be lubricated with beeswax or other approved lubricant before installation.

Heads of bolts shall be placed on the outsides of girders and box members, and generally on the more conspicuous side, if any, of any connection.

**421.38 Bent Plates** - When bending plates, the plates shall be so taken from the stock plates that the bend line will be at right angles to the direction of rolling. The radius of the bend measured inside shall be not less than the thickness of the plate. Before bending, the corners of the plate shall be rounded to a radius of 2 mm throughout that portion of the plate at which bending is to occur.

**421.39 Shop Assembly of Bolted Connections** - Holes in girder and truss field splices shall be drilled while assembled in the shop or yard, or sub-punched or sub-drilled and reamed while assembled. Unless otherwise specified, the structure shall be progressively assembled in accordance with AASHTO Standard Specifications for Highway Bridges (1996), Division II, Section 11.5.3.1. The assembly, including camber, alignment and accuracy of holes shall be inspected by the Ministry before drilling or reaming is commenced.

Connecting parts assembled in the shop or yard for the purpose of reaming or drilling holes shall be match-marked by a method agreed to by the Ministry to indicate the location and orientation of all pieces.

Alternatively, the Contractor may drill holes full-size using automatic drilling equipment, as described in AASHTO Standard Specifications for Highway Bridges (1996), Division II, Section 11.4.8.3. In this case a check assembly will be required for the first of each major structural type, as described in AASHTO Standard Specifications for Highway Bridges (1996), Division II, Section 11.5.3.3. Reaming of holes shall be as specified in Subsection 421.47, if the bolt

holes do not line up during field assembly.

**421.40 Dimensional Tolerances** - The dimensions of completed members shall comply with the appropriate dimensional tolerances as specified in CSA W59-M.

The maximum deviation from specified length shall be  $\pm L/1000$  but not over 20 mm.

Warpage of box members shall be determined by taking measurements at any two cross-sections in a member, at opposite edges of one face of the member. Warpage is defined as the distance by which any point deviates from a plane defined by the other three points. This warpage shall not exceed 1/200 of the width of the member, or 3 mm, whichever is greater.

**421.41 Machined Surfaces** - Machine-finished surfaces, as designated on the Drawings, shall be coated with an approved protective compound.

**421.42 Galvanizing or Metallizing (if required)** - All steelwork to be galvanized shall be galvanized after complete fabrication to the requirements of CAN/CSA-G164-M. The galvanizer shall safeguard against embrittlement as required in CAN/CSA-G164-M, Appendix A. Galvanized members shall be subject, at the discretion of the Ministry, to the tests for embrittlement outlined in CAN/CSA-G164-M, Section 5.5.

The chemical composition of steel being galvanized shall be as follows:

- Carbon less than 0.25%
- Phosphorus less than 0.05%
- Manganese less than 1.35%
- Silicon less than 0.03% or between 0.15% and 0.25%

For steel not meeting these chemical composition requirements, special galvanizing techniques shall be developed by the galvanizer to ensure that the specified coating thickness and adherence is achieved. A detailed description of the special techniques shall be submitted to the Ministry Representative for review 2 weeks prior to galvanizing.

All steelwork to be metallized shall, after complete fabrication, be treated in accordance with the current CSA G189. The zinc coating shall not be less than 0.3 mm in thickness.

**421.43 Shop Painting** - The drawings or Special Provisions shall specify whether the structure is to be painted, or what parts of a structure are to be painted. This subsection applies to those parts of the steelwork which are to be painted.



Steelwork shall be given two shop coats of paint, supplied by the Contractor.

Surfaces shall be cleaned to "near-white" per SSPC-SP10 and 37.5 to 50  $\mu\text{m}$  profile.

Paint shall be applied in a covered area in accordance with the manufacturer's specifications, under the discretionary observation of the Ministry's inspector.

All edges, corners, crevices, bolts and welds (unless ground flush) shall be stripe painted by brush for a width of 50 mm with the second coat (midcoat) paint before the second coat is applied. Stripe painting shall be allowed to dry thoroughly before the second coat is applied.

The prime coat shall be applied at a thickness of 65 to 75  $\mu\text{m}$ . The stripe and midcoat shall be applied to a thickness of 100 to 150  $\mu\text{m}$ .

Unless a different coating is called for on the Drawings, the exposed steel surfaces of bearings shall be cleaned and painted as structural steelwork.

Paint shall be one of the following systems:

- a) Carboline System
  - i) Prime: Carbozinc II  
Stripe: as midcoat
  - ii) Midcoat: Carboline 893 or D801
- b) Devoe/Napko System
  - i) Prime: Cathacoat 304  
Stripe: as midcoat
  - ii) Midcoat: Bar Rust 235
- c) Ameron/General System
  - i) Prime: Dimetcoat 9  
Stripe: as midcoat
  - ii) Midcoat: Amerlock 400 or Amercoat 385
- d) Valspar/Cloverdale System
  - i) Prime: 13-F-605 (MZ-7)  
Stripe: as midcoat
  - ii) Midcoat: 76 Series

The midcoat shall be applied to all surfaces including tops and sides of the top flanges, except faying surfaces and outside faces of the splice plates. The midcoat shall not be applied until the primer coat is judged by the Ministry's inspector to be sufficiently cured.

Any surfaces inaccessible after erection, except faying

surfaces and tops and sides of top flanges, shall be given in addition to the two shop coats, one coat of the topcoat paint appropriate for the paint system being used in this Section.

**421.44 Marking and Shipping** - Each member shall be marked by a method agreed to by the Ministry with an erection mark, corresponding to the mark shown on the erection diagram. Each member with a mass of over one tonne shall also be marked with the mass.

Members shall be loaded on trucks or cars in such a manner that they can be transported to and unloaded at their destination without being damaged.

**421.45 Field Assembly** - The parts shall be accurately assembled as shown on the drawings and any matchmarks shall be followed. Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Field connections shall have one half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before final bolting. Fitting-up bolts shall be the same nominal diameter as the high tensile bolts, and cylindrical erection pins shall be 1 mm larger.

**421.46 Straightening Bent Material after Fabrication** - The straightening of plates and angles or other shapes shall be done by methods that will not produce fracture or other injury. The metal shall not be heated unless permitted by the Ministry, in which case the heating shall not be to a higher temperature than that producing a "dark cherry red" colour. After heating, the metal shall be cooled as slowly as possible.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture, and if necessary, replaced or repaired to the satisfaction of the Ministry.

**421.47 Misfits** - For all primary connections, and secondary connections having eight or more bolts, 85% of the holes shall accept bolts without reaming. The remaining 15% may be reamed to accept the designed diameter bolts. The diameter of the reamer shall be the same as the drilled hole.

Holes in plates showing more than 5 mm of offset shall be cause for rejection of that plate. New plates, if necessary, shall be field drilled using the hole pattern in the senior member as a template.

**421.48 Erection Tolerances** - Unless otherwise specified, the misalignment of members after erection shall be within the dimensional tolerances specified in CSA W59-M, but not over 50 mm.



Misalignment shall be measured from vertical lines in the case of columns or towers, and from lines joining the ends of any test length of a member.

Joints, which are required on the drawings to be milled to bear, shall have at least 75% of the entire contact area in full bearing. The separations of any remaining portions shall not exceed 0.25 mm except locally at toes of flanges where a separation of 0.60 mm is permissible.

Where joints are not milled, the opening shall not exceed 13 mm.

**421.49 Field Painting** - This section applies to those parts of the steelwork which are to be painted. After the completion of the concrete deck, steelwork shall be thoroughly cleaned of all rust, dirt, dust, oil and other foreign materials. The shop coats of paint shall be touched up as necessary, and the steelwork given one finish coat of paint, supplied by the Contractor, and applied to the manufacturer's specifications, under the discretionary observation of the Ministry's inspector. The colour of the finish coat will be selected by the Ministry.

**421.49.01 Field Touch-up** - For bare, rusty areas clean to SSPC SP3. Feather edges.

- a) Carboline System - Touch up with two coats of Carboline 893 or D801.
- b) Devoe/Napko System - Touch up with two coats of Bar Rust 235.
- c) Ameron/General System - Touch up with two coats of Amerlock 400 or Amercoat 385.
- d) Valspar/Cloverdale System - Touch up with two coats of 76 Series.

For areas where primer is intact and the intermediate coat is scarred, and for the outer surfaces of splice plates, exposed parts of bolts and nuts, clean thoroughly, feather edges and touch up with one coat of one of the above mentioned paints, appropriate to the system in use.

**421.49.02 Finish Coat** - The finish coat shall be one of the following paints, appropriate to the system in use:

- a) Carboline System - Carboline 134, 37 to 50  $\mu\text{m}$  thick;
- b) Devoe/Napko System - Devthane 369, 37 to 50  $\mu\text{m}$  thick or Devran 229, 45 to 75  $\mu\text{m}$  thick;
- c) Ameron/General System - Amercoat 450 GL, 37 to 50  $\mu\text{m}$  thick;

- d) Valspar/Cloverdale System - 40 Series, 37 to 50  $\mu\text{m}$  thick.

At the completion of the contract, all steelwork, painted or unpainted, shall be cleaned of concrete spatter, mud, oil and other foreign materials.

**421.50 Unpainted Weathering Steel** - In the case of unpainted weathering steel, the outer faces of the girders and stringers and any other surfaces mentioned in the Special Provisions shall present a uniform surface free of mill scale and, if necessary, shall be power washed and/or sandblasted prior to installation. Concrete splatter adhering to the steel surfaces after the construction of the deck shall be removed and the steel surfaces cleaned.

**421.51 Touch-up of Galvanizing and Metallizing** - All field welds and other damage in galvanized and metallized coatings shall be touched up as follows:

If the drawings or Special Provisions call for touch-up by metallizing, the damaged areas shall be locally sandblasted to "near white" per SSPC-SP10. All sandblasted areas shall be metallized in accordance with CSA G189, to provide a zinc coating not less than 0.3 mm in thickness.

Otherwise, the damaged areas shall be thoroughly cleaned and painted with two coats of Ministry-approved organic zinc-rich paint.

## **QUALITY CONTROL PROGRAM**

**421.61 Quality Control Program** - These Subsections describe the general Quality Control Program required by the Ministry for any Fabricator undertaking the fabrication of permanent steel bridges and steel bridge components.

The term "Quality Control" defines those activities that the Fabricator performs to conform to the contract.

The term "Quality Assurance" defines those activities that the Ministry performs to audit the Contractor's quality control program.

These Subsections contain statements of the Quality Objectives and Policies that the Ministry considers essential for successful and economical quality management. They also outline the Procedures and Documentation to implement and confirm that objectives are met.

The provisions of the Quality Control Program set forth in these Subsections shall apply to all steel bridges and bridge components contracted by or for the Ministry.

These Subsections require the establishment of a Quality



Organization with the responsibility for the successful and timely implementation of all necessary Quality Control activities. Some positions shown in the Suggested Organization Chart may be held by the same individual. For example, the General Manager may also be the Contract Administrative Manager and the Purchasing Manager. The Plant Superintendent may also be the Receiver and the Welding Supervisor.

#### 421.62 Quality Objectives and Policies

**421.62.01 Quality Objectives** - The Quality Objectives of the Ministry cover all steel bridges and steel bridge components produced under contract to the Ministry, as follows:

- a) Completed products shall conform fully to the governing Codes and Specifications stipulated in the contract document.
- b) The Quality Control Program shall be fully integrated into the ongoing manufacturing activities of the Fabricator.
- c) The operations of the Quality Control Program shall protect the interests of the Ministry with respect to scheduled delivery date and contracted price.

**421.62.02 Quality Policy** - The Quality Policy ensures that the product meets the Quality requirements of the contract, is delivered on time, and is produced in a cost-effective manner.

The Quality Control Program applies to all stages of the design, drafting, procurement, manufacturing and testing of the product.

A Quality Control Manager shall be appointed with defined responsibilities in resolving quality matters and shall report to a senior management level. At each hold point, the Quality Control Manager shall:

- Document the successful completion of each stage as it progresses through fabrication and erection;
- Identify and report nonconforming components;
- Initiate or recommend disposition of nonconforming components;
- Verify corrections.

Any persons assigned to perform quality control inspections shall be other than those performing or directly supervising the work and they shall not report directly to immediate supervisors responsible for producing the work.

The Quality Control Program is not subordinate to any design, drafting, procurement, manufacturing or testing

activities.

**421.63 Scope of the Quality Control Program** - The Quality Control Program governs the fabrication of steel bridges and bridge components for the Ministry of Transportation.

The General Manager shall be responsible for:

- adhering to the Quality Control Program in all respects.
- ensuring that completed bridges or bridge components shall conform fully to the applicable design, fabrication and welding codes stipulated in the Contract.
- ensuring that all required documentation is produced according to the Quality Control Program.

**421.64 Range of Capability** - The Fabricator shall provide the necessary knowledge, skill (in-house or on a contract basis) and equipment to perform the following work on steel bridges and bridge components:

- Design of connections and joints not shown on Drawings (if applicable);
- Preparation of shop fabrication drawings (if applicable);
- Preparation of bills of material;
- Preparation of material requisitions and purchase orders;
- Receiving, checking and storing materials for bridges;
- Layout, cutting, forming and fitting of parts;
- Assembly, tacking and welding;
- Dimensional checking and verification;
- Resolution of non-conformances;
- Documentation of all stages of work with capability of tracking all major components;
- Cleaning, painting, storing and shipping;
- Erection of bridges and bridge components (if applicable).

**421.65 Drawings and Specifications** - The Chief Draftsperson shall:

- obtain the latest revision of the design drawings and Specifications for the work;
- submit shop drawings and erection drawings to the Ministry for acceptance before commencement of the work;
- prepare material requisitions containing a full description of the material sizes, material specifications, and certifications required for conformance to the contract;
- deliver the material requisitions to the Purchasing Manager in ample time to permit ordering, delivery and documentation without delaying the work;
- issue requisitions for all sub-contracted drafting work



and shall ensure that all conditions of the Contract are part of such sub-contracts.

The Chief Design Engineer shall be responsible for the design of any connections or joints not shown on the design Drawings; and for the design of the erection procedures and any special erection equipment needed.

**421.66 Material Control** - All materials for bridges and bridge components shall be ordered by the Purchasing Manager in full conformance with the material requisitions provided by the Chief Draftsperson.

The Purchase Orders shall contain all information necessary to ensure that materials purchased will comply fully with the terms of the Contract. Where mill certificates and test reports are required, it shall be so stated on the Purchase Order. Instructions shall state when the certificates and reports are to be delivered to the Fabricator.

If a supplier proposes a substitute for any material, the Purchasing Manager shall refer the proposed substitution to the Chief Design Engineer for review. If the substitute is acceptable to the Ministry the Chief Draftsperson shall amend all drawings and requisitions, withdraw old issues, and issue the new versions.

The Receiver shall:

- inspect all materials on arrival for conformance with the Purchase Orders;
- confirm that mill certificates and test reports are provided and that they correctly identify the materials delivered;
- arrange with the Plant Superintendent to store all materials for the Contract in segregated areas. Clear identification with the Contract shall be provided;
- issue a non-conformance report covering overage, shortage or damage to the materials, and copies of the report shall be provided to the Purchasing Manager and the Quality Control Manager.

The Purchasing Manager shall deliver all documentation to the Quality Control Manager for inclusion in the Quality Control file for the Contract.

**421.67 In-Progress Inspection and Reporting** - The Quality Control Manager shall ensure that only documented materials are used for the Contract.

All materials intended for incorporation into bridges, girders or complex parts shall be examined after cutting to size, forming and rolling. The Chief Inspector shall ensure conformance with the detailed shop drawings, shall report any non-conformance to the Quality Control Manager and shall order all work affected by the non-conformance to

stop, pending approval of remedial action.

Before assembling any plate girders or complex parts, the surfaces of all materials shall be examined for imperfections revealed during previous fabrication operations. The joint edge preparation for all groove welds shall be verified as conforming to the Fabricator's CWB-approved welding standards and shall be within the acceptable tolerances.

After assembly of any plate girders or complex parts, and before commencing the strength welding, the assembly shall be checked for dimensional conformance. The Welding Supervisor shall ensure that the fit-up of all welded joints conforms to the approved welding standards.

The Quality Control Manager shall file a written report of verification with the General Manager and report any non-conformance.

**421.68 Correction of Non-conformance** - When a non-conformance is encountered, the Quality Control Manager shall determine a recommended disposition and obtain the Ministry's approval as quickly as possible.

If there is non-conformance to the material specification stipulated in the Purchase Order, the Purchasing Manager shall immediately find out the reasons for the delivery of non-conforming material. If the material is of a grade superior to that ordered, the Quality Control Manager and the Chief Engineer shall be notified. They shall verify that the material is an acceptable alternative in all respects, and this verification shall include consultation with the Ministry. If the material is of a grade inferior to that ordered, it shall be rejected and the correct material or a superior material shall be obtained.

If there is non-conformance of material delivery that will delay production, the Contract Administration Manager and Plant Superintendent shall be notified immediately. They

shall be given revised delivery, dated for the adjustment of production scheduling. The General Manager shall determine the alternatives available and shall notify the Ministry.

If there are non-conformities in material preparation, assembly, joint edge preparation and fit-up before strength welding, the Quality Control Manager and Welding Supervisor shall immediately review the non-conformance and notify the Chief Design Engineer who may require further investigation prior to submitting corrective action to the Ministry for approval. If the necessary corrective action will result in delay to production, the General Manager shall be notified for adjustment to the production schedule. The Plant Superintendent shall inform the Quality Control



Manager when the corrective actions are being done so that conformance can be verified and the non-conformance report cancelled.

**421.69 Welding** - All welding on structural and mechanical components shall be done by the company certified to CSA W47.1, W47.2-M (both division 2.1 or better) and W186-M as applicable, and shall be done in accordance with the Fabricator's CWB-approved welding standards.

The edge preparations for all groove welds shall conform to the dimensions established in the approved welding standards.

If the joint is to be welded from one side only without back-gouging, the root gap and root face shall be checked to ensure conformance with the required geometry so that the root pass can be successfully completed.

The strength level and chemical composition of all filler materials used in structural and mechanical assemblies shall conform to the approved shop drawings.

All welding consumables shall conform to the approved welding standards and shall be received, stored and conditioned according to the applicable welding standards.

Any preheat required before welding shall be according to the approved welding standards.

The welding procedure followed in welding any joint in a structural or mechanical component shall conform to the applicable Data Sheet in the approved welding standards.

All welders and welding operators welding on structural or mechanical contracts shall be qualified under the requirements of the CSA Standard governing certification.

**421.70 Heat Treatment** - This covers any post-weld heat treatment necessary to conform to the approved welding standards.

The Chief Design Engineer shall:

- establish whether any structural or mechanical components shall receive post-weld heat treatment to conform to the contract conditions or to the applicable Codes and Standards.
- inform the Chief Draftsperson of any such requirements so that they may be incorporated on to the approved shop drawings.

Any heat treatment stipulated on the approved shop drawings or contained in the approved welding standards shall be carried out at the appropriate time and according to the approved documents.

The Plant Superintendent shall ensure that any heat treatment stipulated is done according to the established procedures, shall obtain all documentation and reports, and shall deliver them to the Quality Control Manager.

**421.71 Non-destructive Testing** - The Ministry will test any weld by non-destructive testing methods, as described in Subsection 421.06.

The Plant Superintendent shall schedule the manufacturing operation to facilitate non-destructive testing.

If non-destructive testing of welded joints reveals imperfections that are marginally more than the acceptance standards, the Quality Control Manager shall consult with the Ministry regarding the location and nature of the imperfections. The effects of leaving minor defects in place shall be assessed in relationship to the loads carried by the joint and the possible adverse effects of making an unnecessary repair.

Weld repairs shall conform to the approved welding standards.

**421.72 Calibration of Measurement and Test**

**Equipment** - All measurement and testing equipment owned by the Fabricator and used in the Quality Control Program shall be calibrated and re-calibrated at the intervals and in the manner stipulated in the Manufacturer's Instruction Manuals. Any adjusting devices shall be sealed or otherwise protected from unauthorized adjustment or tampering.

**421.73 Records Retention** - The Fabricator's record file for each Contract shall contain the pertinent drawings, purchase orders, bills of material, material mill certificates, test reports, Quality Control documents, NDT reports and certificates of compliance.

The Fabricator's record file shall be made available to the Ministry's Inspectors upon request.

Items in the Fabricator's record file shall be retained as per company policy.

The Quality Control Manager shall ensure that each file is complete in all respects before it is placed in the Company archives.

**421.74 Hold Points** - In planning the work flow, the Fabricator shall coordinate with the Ministry Inspector to decide "hold" points for inspection or non-destructive testing. A list of hold points shall be drawn up by the Fabricator and the Ministry at a prefabrication meeting. The Ministry shall be informed of progress so that delays are



minimized.

The "hold" points will typically include some of, but not be limited to, the following:

- verification of materials
- after plate is prepared for splicing
- after splicing of plates
- after web to flange weld
- after stiffeners are applied
- camber of girders
- shop assembly
- cleaning and coating
- bearing plate attachment
- shipping arrangements
- subassemblies.

Work shall not proceed past a "hold" point until it has been signed off by Quality Control and Quality Assurance. Reports shall be completed promptly.

#### **421.75 Transportation and Installation Procedures -**

Transportation and installation procedures shall be prepared and submitted for review before any installation takes place on site. The procedures shall be sealed by a professional engineer experienced in bridge erection and registered with the APEGBC. Consideration shall be given to the following items during the preparation of the procedures:

- a) Girder Transportation**
  - i)** Brief description of hauling equipment;
  - ii)** Location of girder support points;
  - iii)** Engineering backup if supports vary from specifications.
- b) Installation Drawings**
  - i)** Bridge site plan showing piers, abutments and access roads;
  - ii)** Crane make, crane chart, boom length(s) and crane locations;
  - iii)** Mass of girder and access to crane(s);
  - iv)** Special installation equipment such as a launching truss, head frames and falsework.

#### **c) Commentary**

- i)** Brief point form description of installation sequence.

#### **d) Bearings**

- i)** Placement procedure for bearings to be included for multiple span continuous girders.

#### **e) Traffic Control**

- i)** Any arrangements that will be made for road and/or rail traffic.

#### **f) Utilities**

- i)** Safety and protection.

#### **g) Fall Protection**

- i)** Method and date of installation as required in specifications.

### **PAYMENT**

#### **421.91 Payment**

**421.91.01 Supply and Fabrication** - Payment for supply and fabrication of structural steelwork will be made at the lump sum price bid. Payment shall be for quality control, shop drawings, the supply, bending, cutting, assembly and welding of steelwork, including any galvanizing required. Payment shall also cover trial assembly and storage as necessary.

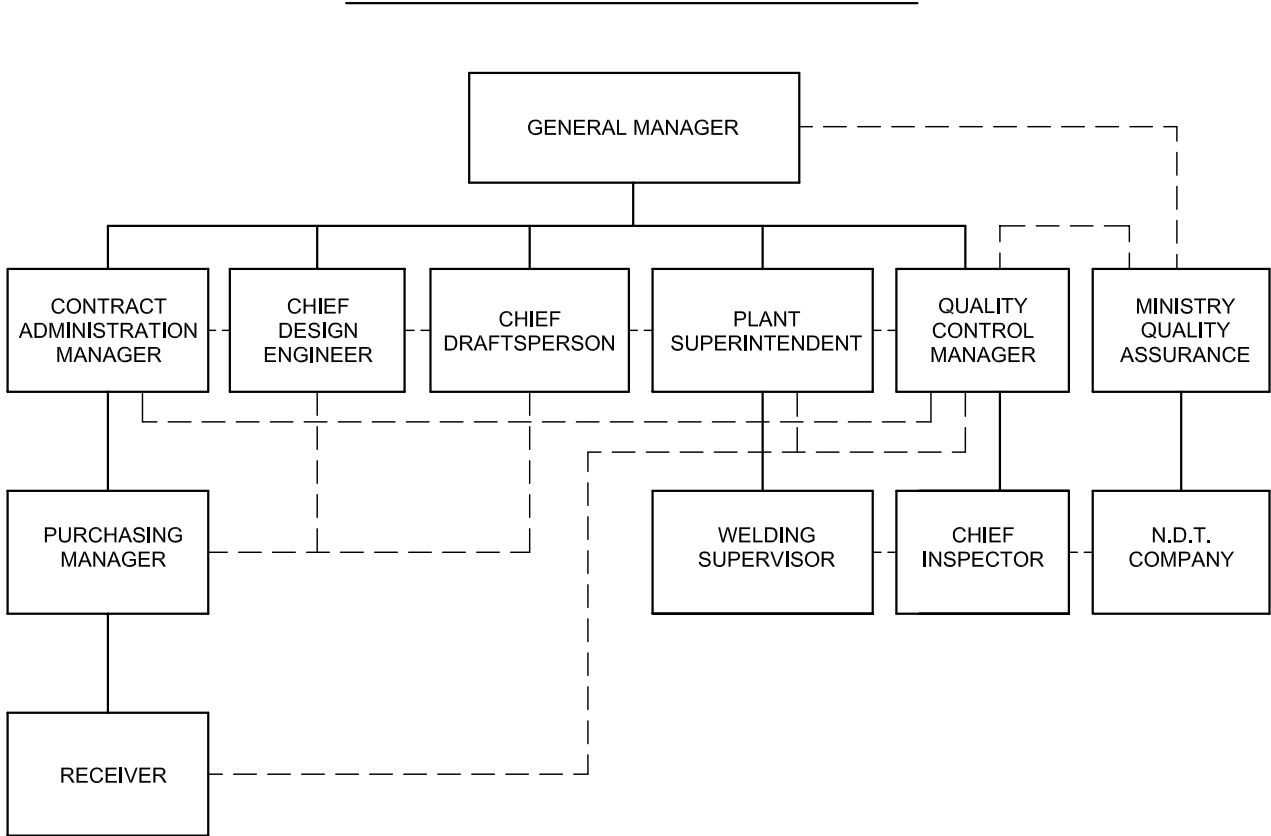
**421.91.02 Shipping and Erection** - Payment for shipping and erection of structural steelwork will be made at the lump sum price bid. Payment shall be for quality control, erection drawings and the loading, shipping and unloading of steelwork. Payment shall also cover falsework if necessary and the erection of steelwork.

**421.91.03 Painting** - Payment for painting of structural steelwork will be made at the lump sum price bid. Payment shall be for the surface preparation and the supply, application and touch-up of paint as required.



FIGURE 1

SUGGESTED ORGANIZATION CHART FOR



Direct Functional Reporting \_\_\_\_\_  
Quality Control Reporting - - - - -

Signed \_\_\_\_\_  
General Manager  
  
Date \_\_\_\_\_



SAMPLE FORM #1 - RECEIVING REPORT

RECEIVING REPORT

SUPPLIER

P.O. No.

WORK ORDER No.

INVOICE No.

DATE:

QUANTITY

DESCRIPTION

MILL CERTS.

HEAT No.

VISUAL INSPECTION

THICKNESS CHECK

HOLD MATERIAL: Describe material, problems and procedures.

QUALITY CONTROL APPROVAL:



## SAMPLE FORM #2

## NON-CONFORMANCE REPORT

BRIDGE NAME: \_\_\_\_\_ BRIDGE NUMBER: \_\_\_\_\_

JOB NUMBERS: \_\_\_\_\_

IDENTIFICATION DETAILS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

DESCRIPTION OF NON-CONFORMITY:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Date 20\_\_\_\_ Signature

CORRECTIVE ACTION:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

ACTION AGREED UPON: \_\_\_\_\_  
Quality Control Supervisor Quality Assurance InspectorDATE COMPLETED: \_\_\_\_\_ 20\_\_\_\_  
SignatureHOLD REMOVED BY: \_\_\_\_\_ 20\_\_\_\_  
DateQUALITY CONTROL SUPERVISOR: \_\_\_\_\_ 20\_\_\_\_  
DateQUALITY ASSURANCE INSPECTOR: \_\_\_\_\_ 20\_\_\_\_  
Date



## SAMPLE FORM #3

MoT

## Steel Fabrication Compliance Check List

BRIDGE NAME: \_\_\_\_\_ BRIDGE NO. \_\_\_\_\_

MARK NUMBER/S: \_\_\_\_\_

		Q.C.	Q.A.
Material:	Mill Certificates	_____	_____
	(Physicals, Chemicals, Impact Category)	_____	_____
	Identification on materials check	_____	_____
	Heat number transferred and recorded	_____	_____
Welding:	Procedures approved for each process	_____	_____
	Consumables checked	_____	_____
	Date Completed	_____	_____



## SAMPLE FORM #4

MoT

## Steel Fabrication Compliance Check List

BRIDGE NAME: \_\_\_\_\_ BRIDGE NO. \_\_\_\_\_

MARK NUMBER/S: \_\_\_\_\_

		Q.C.	Q.A.
Welding:	Weld preparation and fit up	_____	_____
	Welding within parameters	_____	_____
	Identification on materials check	_____	_____
	Shear studs	_____	_____
	Visual Inspection	_____	_____
	NDT outside agency results	_____	_____

		Q.C.	Q.A.
		Req'd	Actual
			Verified
Dimensions:	Flanges Top Width 1	_____	_____
	Width 2	_____	_____
	Flatness	_____	_____
	Tilt	_____	_____
	Bottom Width 1	_____	_____
	Width 2	_____	_____
	Flatness	_____	_____
	Tilt	_____	_____
	Web Depth	_____	_____
	Section Length	_____	_____
	Bearing Ctr. Length	_____	_____
	Sole Plate Contract	_____	_____
	Camber	_____	_____
	Sweep Tolerance (1/1000)	_____	_____
	Splicing Camber	_____	_____
	Alignment	_____	_____
	Holes	_____	_____
	Date Completed	_____	_____



## SAMPLE FORM #5

MoT

## Coating Compliance Check List

BRIDGE NAME: \_\_\_\_\_ BRIDGE NO. \_\_\_\_\_

MARK NUMBER/S: \_\_\_\_\_

		Q.C.	Q.A.
Coating:	WHMIS Safety Data Sheets	_____	_____
	Technical Spec. Sheets	_____	_____
	Surface Preparation	_____	_____
	Ambient Conditions - Req'd	_____	_____
	- Actual	_____	_____
	Application	_____	_____
	Test Results	_____	_____
	Date Completed	_____	_____



## SAMPLE TAG #6

(Front Side)

© HOLD

(Back Side)

Reason for Hold

© \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Q.C. Manager \_\_\_\_\_  
Date \_\_\_\_\_



## SECTION 422

### MISCELLANEOUS STEELWORK

#### DESCRIPTION

**422.01 Scope** - This Section covers steelwork apart from major structural steel elements (see Section 421).

**422.02 Adherence to Drawings** - Steelwork items shall be fabricated in strict accordance with the Drawings.

**422.03 Working Drawings** - The working drawings shall show all information necessary for the fabrication of the steelwork.

Working drawings shall be in the same system of units as the design Drawings.

Working drawings shall be on sheets approximately 600 mm by 850 mm (one drawing per sheet). Lettering for notes and dimensions shall be at least 2.5 mm, and 4 mm for headings. Drawings shall be legible when half-sized or microfilmed.

In the case of simple items, where the design Drawings are complete enough to be used for fabrication, the Contractor may, with approval of the Ministry, dispense with working drawings. The Contractor shall notify the Ministry Representative of such intention in writing.

The Contractor shall submit to the Ministry Representative four sets of all working drawings, for the Ministry's information only, two weeks prior to the fabrication of the steelwork.

**422.04 Inspection** - The Contractor shall notify the Ministry Representative at least 14 days before fabrication. The Contractor shall allow the Ministry's representatives access to all parts of the work, and shall supply such information and assistance as is required. When the Ministry requests, the Contractor shall provide samples of any materials. Inspection by the Ministry shall not relieve the Contractor from obligation to perform the work in accordance with the contract.

Any work found to be unacceptable shall be corrected in accordance with CSA W59-M, Section 5.10.

**422.05 Rejections** - The Ministry may reject any items which do not comply with the requirements of the contract.

#### MATERIALS

**422.11 Materials** - Structural steel, except where shown otherwise on the drawings, shall conform to CAN/CSA-G.40.21-M, Grade 260W or better.

Chemical composition of steel to be galvanized shall be in accordance with Subsection 422.36 – Galvanizing.

The quality and care of electrodes shall conform to the requirements of the latest CSA W59-M.

**422.12 Storage of Materials** - Structural material shall be stored above ground. It shall be kept free from dirt and other foreign matter, and shall be protected as far as practicable from corrosion. Long members shall be supported on skids placed near enough together to prevent injury from deflection.

#### CONSTRUCTION

**422.31 Welding** - All welding shall be done in accordance with procedures approved by the Canadian Welding Bureau (CWB) and reviewed by the Ministry.

All welded fabrication shall be done to the requirements of the latest CSA W59-M.

Welding shall be undertaken by a company approved by the CWB to the requirements of CSA W47.1, Division 3 or better.

**422.32 Welders and Welding Operators** - The Contractor shall produce evidence that all welders and welding operators to be employed on the work are currently qualified by CWB in the processes in which they are to be employed.

**422.33 Flame Cutting** - Steel may be flame cut, using a mechanical guide, provided a smooth surface is secured. Flame cutting by hand shall be done only where approved by the Ministry, and the surface shall be made smooth by planing, chipping or grinding. The cutting flame shall be so adjusted and manipulated as to avoid cutting beyond the prescribed lines. Re-entrant cuts shall be filleted to a radius of not less than 10 mm. Edges of tension members shall be ground to a radius of 2 mm.

All exposed corners of members, which are to be painted, shall be ground to a radius of 2 mm.

**422.34 Bent Plates** - Plates to be bent shall be taken from the stock plates so that the bend line will be at right angles to the direction of rolling. The inside radius of the bend shall not be less than the thickness of the plates. Before bending, the corners of the plate shall be ground to a radius of 2 mm throughout the part to be bent.

**422.35 Shop Painting** - All steelwork, which is to be painted, shall be given two shop coats of paint.



Surfaces shall be cleaned to "near white" per SSPC-SP10 and 37.5 to 50  $\mu\text{m}$  profile.

Paint shall be applied in a covered area in accordance with the manufacturer's specifications under the discretionary observation of the Ministry's inspector.

All edges, corners, crevices, bolts and welds (unless ground flush) shall be stripe-painted by brush for a width of 50 mm with the midcoat paint before the midcoat is applied. Stripe painting shall be allowed to dry thoroughly before the midcoat is applied.

The prime coat shall be applied to a thickness of 65 to 75  $\mu\text{m}$ . The stripe and midcoat shall be applied to a thickness of 100 to 150  $\mu\text{m}$ .

Paint shall be one of the following systems:

- a) Carboline System
  - i) Prime: Carbozinc II
  - Stripe: as midcoat
  - ii) Midcoat: Carboline 893 or D801
- b) Devoe/Napko System
  - i) Prime: Cathacoat 304
  - Stripe: as midcoat
  - ii) Midcoat: Bar Rust 235
- c) Ameron/General System
  - i) Prime: Dimetcoat 9
  - Stripe: as midcoat
  - ii) Midcoat: Amerlock 400 or Amercoat 385
- d) Valspar/Cloverdale System
  - i) Prime: 13-F-605 (MZ-7)
  - Stripe: as midcoat
  - ii) Midcoat: 76 Series

The midcoat shall be applied to all surfaces except faying surfaces and outside faces of splice plates. The midcoat shall not be applied until the prime coat is judged by the Ministry's inspector to be sufficiently cured.

Any surfaces inaccessible after erection shall be given one coat of the topcoat paint, in addition to the two shop coats as specified in this Section.

**422.36 Galvanizing (if required)** - All steelwork to be galvanized shall be galvanized after complete fabrication to the requirements of CAN/CSA-G164-M. The galvanizer shall safeguard against embrittlement as required in CAN/CSA-G164-M, Appendix A. Galvanized members

shall be subject, at the discretion of the Ministry, to the tests for embrittlement outlined in CAN/CSA-G164-M, Section 5.5.

The chemical composition of steel being galvanized shall be as follows:

- Carbon less than 0.25%
- Phosphorus less than 0.05%
- Manganese less than 1.35%
- Silicon less than 0.03% or between 0.15% and 0.25%

For steel not meeting these chemical composition requirements, special galvanizing techniques shall be developed by the galvanizer to ensure that the specified coating thickness and adherence is achieved. A detailed description of the special techniques shall be submitted to the Ministry Representative for review 2 weeks prior to galvanizing.

**422.37 Metallizing (if required)** - All surfaces to be metallized shall be treated after complete fabrication in accordance with CSA G189. The zinc coating shall not be less than 0.3 mm in thickness.

**422.38 Installation** - Steelwork shall be installed as shown on the Drawings.

Railings and fences shall be adjusted to produce uniform height and smooth alignment.

Field welding will be permitted only as shown on the Drawings.

**422.39 Field Painting (if required)** - All steelwork which is to be painted shall be thoroughly cleaned of all rust, dirt, dust, oil and other foreign materials. The shop coats of paint shall be touched up as necessary, and the steelwork given one topcoat applied to the manufacturer's specifications, under the discretionary observation of the Ministry's inspector. The colour of the finish coat will be selected by the Ministry.

**422.39.01 Field Touch-up** - For bare, rusty areas clean to SSPC-SP3. Feather edges.

- a) Carboline System - Touch up with two coats of Carboline 893 or D801.
- b) Devoe/Napko System - Touch up with two coats of Bar Rust 235.
- c) Ameron/General System - Touch up with two coats of Amerlock 400 or Amercoat 385.
- d) Valspar/Cloverdale System - Touch up with two



coats of 76 Series.

For areas where primer is intact and the intermediate coat is scarred, the outer surfaces of splice plates, and exposed parts of bolts and nuts, clean thoroughly, and touch up with one coat of one of the above-mentioned paints, appropriate to the system in use.

**422.39.02 Topcoat** - The topcoat coat shall be one of the following paints, appropriate to the system in use:

- a) Carboline System - Carboline 134, 40 to 65  $\mu\text{m}$  thick.
- b) Devoe/Napko System - Devthane 369, 37 to 50  $\mu\text{m}$  thick or Devran 229, 45 to 75  $\mu\text{m}$  thick.
- c) Ameron/General System - Amercoat 450 GL, 37 to 50  $\mu\text{m}$  thick
- d) Valspar/Cloverdale System - 40 Series, 37 to 50  $\mu\text{m}$  thick

**422.40 Touch-Up of Galvanizing and Metallizing** - All

field welds and other damage in galvanized and metallized coatings shall be touched up as follows:

If the contract documents call for touch-up by metallizing, the damaged areas shall be locally sandblasted to "near white" per SSPC-SP10. All sandblasted areas shall be metallized in accordance with CSA G189, to provide a zinc coating not less than 0.3 mm in thickness.

Otherwise, the damaged areas shall be thoroughly cleaned, and painted with two coats of Ministry-approved organic zinc-rich paint.

**422.41 Clean-up** - At the completion of the contract, steelwork shall be cleaned of all foreign materials.

## PAYMENT

**422.91 Payment** - Payment for miscellaneous steelwork will be made at the lump sum price(s) bid. Payment shall be for shop drawings and the supply, fabrication, galvanizing and/or painting if required and installation of the steelwork.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 501

### HOT MIXED ASPHALT PAVEMENT

#### PART A - GENERAL

**501.01 Preliminary and General** - This Section describes the materials, equipment and quality of work required for the construction of hot mixed, hot laid asphalt pavement.

**501.02 General Description of Work** - Generally, the work consists of:

- a) Supplying, screening, crushing or any other method of processing, and improving aggregate to produce asphalt mix aggregate.
- b) Priming or tack coating the prepared surface.
- c) Heating the asphalt mix aggregate and mixing it with asphalt cement to produce asphalt mix.
- d) Hauling, placing and finishing the asphalt mix to produce a high quality asphalt pavement.

**501.03 Asphalt Pavement Classifications** - The Class of asphalt pavement required under the contract will be stated in the Special Provisions and will be generally designated as follows:

- Class 1 - Highways for Heavy Traffic
- Class 2 - General Highways

Pavement Classification as Determined by ESAL

Class 1 pavements shall be utilized where the estimated Equivalent Single Axle Load (ESAL) is greater than 1,000,000 based on a twenty year life span of the pavement structure and an average 4% annual traffic growth rate.

Class 2 pavements shall be utilized where the ESALs are less than 1,000,000 based on the same premise.

#### PART B - MATERIALS

All types of hot mix material produced under this section shall be paver laid and of high quality and carefully controlled.

Asphalt mix referred to in this text means any and all of the asphalt cement bound mixes listed in this section.

##### 501.11 Definitions

**501.11.01 Hot Mix Asphalt Cement** - penetration grade asphalt used in the asphalt pavement.

**501.11.02 Cutback Asphalt** - penetration grade asphalt

which has been blended with light petroleum distillates.

**501.11.03 Emulsified Asphalt** - penetration grade asphalt that has been blended with water and emulsifying agents to form aqueous emulsions, including anionic type, cationic type and High Float type.

**501.11.04 Aggregate** - the crushed or screened gravel.

**501.11.05 Asphalt Mix Aggregate** - the processed crushed aggregate just prior to the addition of asphalt cement.

**501.11.06 Asphalt Base Course Mix Aggregate** - the processed crushed 25 mm minus aggregate just prior to the addition of asphalt cement.

**501.11.07 Recycled Asphalt Mix Aggregate** - the processed crushed aggregate for blending with reclaimed asphalt pavement just prior to the addition of asphalt cement and reclaimed asphalt pavement.

**501.11.08 Supplementary Aggregate** - a crushed or uncrushed aggregate of specified gradation, which, when added to aggregate meeting the requirements of Subsections 501.15.01 through 501.15.03 will produce asphalt mix aggregate required by the asphalt mix design.

**501.11.09 Asphalt Mix (AM)** - hot plant mixture of asphalt cement and dense graded high quality aggregate.

**501.11.10 Asphalt Levelling Course (LC)** - asphalt mix used to improve crossfall, level, and strengthen existing pavements.

**501.11.11 Asphalt Pavement (AP)** - paver laid asphalt mix compacted to uniform density.

**501.11.12 Additives** - solid or liquid materials to enhance the properties of the liquid asphalt cement or mix.

**501.11.13 Reclaimed Asphalt Pavement (RAP)** - asphalt pavement that has been milled with a cold milling machine.

**501.11.14 Asphalt Base Course Mix (ABC)** - a hot plant mix of asphalt cement and asphalt base course aggregate with lower asphalt cement content than conventional mixes.

**501.11.15 Recycled Asphalt Mix (RAM)** - a carefully controlled, hot plant mix of asphalt cement, graded high quality aggregate and reclaimed asphalt pavement.

**501.11.16 Recycled Asphalt Base Course Mix (RABC)** - a hot plant mix of asphalt cement, reclaimed asphalt pavement and asphalt base course aggregate.



**501.11.17 Reject Mix** - shall be that mix that is deemed unacceptable for use in the project by the Ministry Representative.

**501.11.18 Surplus Mix** - shall be that mix that is deemed to be surplus by the Ministry Representative through improper construction practices, poor estimating at shift end and tie-ins, truck overloads and poor operational practices.

## **501.12 Supply and Handling of Asphalt Materials**

**501.12.01 Asphalt Cement and Liquid Asphalt Cutback and Emulsion** - Unless otherwise specified, the Ministry will supply the asphalt cement and liquid asphalts required for the work f.o.b. plant site and job site, respectively.

**501.12.02 Labour and Equipment** - The Contractor shall supply all labour and equipment to remove asphalt cement and liquid asphalts from tank trucks. No separate payment will be made for taking delivery, removal, transportation within the job site and storage of said materials.

**501.12.03 Demurrage-free Unloading Period** - The demurrage-free unloading period for trucks hauling asphalt material to the job will be two hours.

**501.12.04 Demurrage Incurred** - Demurrage incurred due to the Contractor's method of operation shall be certified by the Contractor's Representative at the job site.

**501.12.05 Invoicing** - The Asphalt Supplier will invoice the Ministry directly within one month from the demurrage occurrence; and in turn the Ministry will review the charges and will recover from the Contractor the approved amount as certified in Subsection [501.12.04](#), plus a 10% surcharge to cover administration and overhead.

Freight costs resulting from the delivery and return of asphalt to the refinery will be recovered from the Contractor as specified in Subsection [951.06.03](#) without any other surcharge.

**501.12.06 Asphalt Shipments** - The Contractor shall give adequate notice to the Asphalt Supplier both to ship asphalt and to cancel ordered shipments. By agreement with the Asphalt Suppliers, notice to ship must be given:

- i) For tank truck deliveries, 24 hours before dispatch of a load.
- ii) For rail tank car deliveries, 72 hours before dispatch of a load, except that the period between 17:00 Saturday and 08:00 Monday is not included in the 72 hour notice time.

Notice of cancellation of shipments must reach the Supplier four hours before the dispatch time of a load.

The original order to ship or cancel may be given by telephone, but a confirmatory telegram, telex, or facsimile must reach the Supplier's shipper four hours before the time for dispatch of a shipment or the telephone order may be considered to be cancelled. Cancellation must also be confirmed by telegram before the dispatch time for a shipment. The cost of all telephone calls, telegrams and telexes made by the Contractor shall be to the Contractor's account.

## **501.13 Standard Tests**

**501.13.01 Asphalt Mix Aggregates** - The asphalt mix aggregates will be tested in accordance with the applicable British Columbia Ministry of Transportation (Geotechnical and Materials Engineering Branch) Manual of Test Procedures for Paving Materials and Mixes except tests BCH I - 5, I - 8, I - 9, I - 10, I - 11, and I - 12 which are in the Manual of Test Procedures Soils and Mineral Aggregates (see Table [501-A](#)).

**501.13.02 Asphalt Mix and Asphalt Pavement** - The asphalt mix and asphalt pavement will be tested in accordance with the British Columbia Ministry of Transportation (Geotechnical and Materials Engineering Branch) Manual of Test Procedures for Paving Materials and Mixes (see Table [501-B](#)).

**501.13.03 Granular Shoulder Materials and Constructed Shoulders** - The granular shoulder materials and the constructed shoulders will be tested in accordance with the British Columbia Ministry of Transportation (Geotechnical and Materials Engineering Branch) Manual of Test Procedures Soils and Mineral Aggregates (see Table [501-C](#)).

**501.14 Asphalt Mix Aggregate Requirements** - The crushing of all paving aggregate shall conform to the requirements of Subsection [202.12](#).

No asphalt mix aggregate shall have a degradation factor of less than 35 when tested in accordance with BCH test BCH I-9.

## **501.14.01 Coarse Aggregates:**

- i) shall be all mineral matter retained on the sieve designated for each individual test.
- ii) shall consist of crushed stone, crushed gravel, or combination thereof, or materials naturally occurring in a fractured condition, or materials naturally occurring of



highly angular nature or rough texture.

iii) shall be free from coating of clay, silt or other deleterious material, and shall meet the requirements listed in Table 501-D.

#### 501.14.02 Fine Aggregate:

i) shall be all mineral matter passing the sieve designated for each individual test.

ii) shall be clean, tough, durable, moderately sharp, and free from coatings of clay, silt, or other deleterious material, and shall contain no clay balls or other aggregations of fine material.

iii) shall have a maximum mass loss after five cycles of not more than 18% and 23% for pavement Classes 1 and

**TABLE 501-A TESTS FOR ALL ASPHALT MIX AGGREGATES AND SUPPLEMENTARY AGGREGATES**

TEST DESIGNATION		TITLE OF TEST
BCH	ASTM	
I - 1	C - 136	Sieve Analysis (Dry)
I - 2	C - 117	Sieve Analysis (Wash)
I - 3	C - 127	Relative Density & Absorption - Coarse Aggregate
I - 4	C - 128	Relative Density & Absorption - Fine Aggregate
I - 5	C - 88	Aggregate Soundness (Magnesium Sulphate) Tests Granular Surfacing & Base Aggregates
I - 6	D - 2216	Moisture Content Determination
	C - 566	
I - 7	-----	Clay Lumps and Friable Particles in Aggregates
I - 8	D - 2419	Sand Equivalent Test
I - 9	-----	Degradation Test
I - 10	D - 421	Preparation of Samples for Atterberg Limit
I - 11	D - 4318	Liquid Limit
I - 12	D - 4318	Plastic Limit
I - 13 Method B	-----	Fracture Count for Coarse Aggregate - by mass - retained on the 4.75 mm sieve

**TABLE 501-B TESTS FOR ASPHALT MIX AND ASPHALT PAVEMENT**

BCH	ASTM	TITLE OF TEST
II - 6	D - 2172	Quantitative Extraction of Asphalt from Bituminous Mixes
II - 7	---	Degree of Compaction of Insitu Asphalt Mix Using Cored Samples
II - 9	D - 2950	Degree of Compaction of Insitu Asphalt Mix by Nuclear Method
II - 10	---	Procedure for the Determination of the British Columbia Pavement Smoothness Rating
II - 11	---	British Columbia Segregation Rating
II - 15	---	Form Plant Briquettes

2 respectively when tested in accordance with Test BCH I-5.

iv) shall have a sand equivalent value of not less than 40 when tested in accordance with Test BCH I-8.

#### 501.14.03 Mineral Filler and Mineral Dust

i) The Mineral filler shall consist of all mineral matter passing the 0.600 mm sieve and the mineral dust shall consist of all mineral matter passing the 0.075 mm sieve.

ii) Mineral filler and mineral dust shall be free from organic matter.

iii) Mineral filler shall be non-plastic mineral filler when tested in accordance with Test BCH I-11 and BCH I-12.

#### 501.15 Asphalt Mix Design

**TABLE 501-C TESTS FOR GRANULAR SHOULDER MATERIALS AND CONSTRUCTED SHOULDERS**

BCH	ASTM	TITLE OF TEST
	D - 698	Moisture Density Relation Determination, Standard Proctor
I - 15	D - 2167	In-situ Density, using the Washington Densometer
I - 16	D - 2922 D - 3017	Field Density Test using Nuclear Gauge



**501.15.01 Gradation Limits** - The Contractor shall supply aggregates falling within the grading limits as specified in Table 501-E when tested in accordance with Test BCH I-2.

**501.15.02 Gradation Refinements** - If the gradation of the aggregate supplied by the Contractor does not fall within the gradation limits specified, such refinements will be made to the gradation as are necessary to comply with the said gradation limits at the Contractor's expense.

**501.15.03 Grading Curve** - Once the grading curve is established within the above limits, the maximum permissible variation of the mean of any four consecutive tests from the grading curve shall be within the tolerance specified in Table 501-F.

These tolerances do not waive the requirement that the running average of four consecutive tests must be maintained at all times inside the limits specified in Subsection 501.15.01. Should the Contractor be unable to maintain the grading curve within the limits specified in Subsection 501.15.01, the Contractor shall, at the Contractor's cost, carry out refinements as required to shift the grading curve away from the limits of Subsection 501.15.01 so as to ensure that a variation cushion, as specified by the maximum permissible tolerances shown in Table 501-F, is effected within the limits of Subsection

**TABLE 501-D REQUIREMENTS FOR COARSE AGGREGATES**

BCH TEST	REQUIREMENTS	PAVEMENT CLASSES	
		1	2
I - 3	Maximum water absorption: % by mass	2	2
I - 5	Maximum loss after 5 cycles	15	20
I - 7	Maximum % by mass of clay balls and friable particles	1.0	1.5
I - 13	Method B - 2 Fractured Faces: Minimum % by Mass retained on the 4.75 mm sieve	85	70

501.15.01.

**501.15.04 Asphalt Mix Design** - Unless otherwise specified, the Ministry will carry out the asphalt mix design with the aggregate supplied by the Contractor.

The asphalt mix design will establish the design grading curve which will define the proportional amounts of coarse,

**TABLE 501-E GRADATION LIMITS FOR AGGREGATES**

SIEVE SIZE (mm)	PERCENTAGE BY MASS PASSING (BCH I - 2)				
	COARSE ASPHALT MIX	MEDIUM ASPHALT MIX	FINE ASPHALT MIX	ASPHALT BASE COURSE MIX	ASPHALT BOUND OPEN GRADED BASE MIX
37.5	100	---	---	---	---
25.0	80 - 100	---	---	100	100
19.0	60 - 92	100	---	80 - 94	75 - 100
12.5	50 - 85	84 - 95	100	---	---
9.50	40 - 80	73 - 90	90 - 100	50 - 84	30 - 60
4.75	30 - 65	50 - 75	55 - 80	25 - 55	5 - 30
2.36	20 - 50	35 - 57	32 - 64	20 - 45	0 - 10
1.18	15 - 35	26 - 45	24 - 51	15 - 35	---
0.600	8 - 30	18 - 34	17 - 40	---	---
0.300	6 - 22	10 - 26	13 - 29	5 - 20	0 - 8
0.150	3 - 15	6 - 17	8 - 18	---	---
0.075	1 - 7	3 - 7	4 - 10	0 - 5	0 - 4



fine and supplementary aggregates required in the mix.

Should the Contractor, after having provided an aggregate whose gradation falls entirely within the gradation requirements as set out in Subsections 501.15.01 through 501.15.03, be directed to reject or add other aggregate(s) in order to meet the design grading curve established by the Ministry Representative, the Contractor will be compensated at the rate(s) specified in Appendix C.

**501.15.05 Transportation by Barge** - Any material transported by barge must be tested and approved by the Ministry Representative prior to loading onto the barge, and shall be rechecked prior to unloading before being accepted for use.

**501.15.06 Requirements** - All ingredients supplied by the Contractor for incorporation into the asphalt pavement shall meet all the applicable requirements of Sections 501 and 951 as determined by the Ministry Representative. The mix and finished pavement shall meet all the requirements of this section.

The asphalt mix design, meeting the appropriate Marshall Design requirements of Appendix A, will be performed by the Ministry.

The Contractor shall provide the Ministry Representative with the following at least seven days prior to commencement of the paving:

- i) A 100 kg sample of representative asphalt mix aggregate, properly bagged and labelled. The label is to show Project No., type of aggregate, source and stockpile location.
- ii) A 5 ℓ sample of asphalt cement showing refinery, batch number and date sampled.
- iii) A stockpile gradation showing daily test results and stockpile average as determined by BCH Tests I-1 and I-2.

**501.15.07** - The Ministry Representative shall further determine the need to modify the asphalt mix design for all lifts of pavement to minimize any deformation identified by the Hveem Design criteria in Appendix A. The Hveem Design will be performed by the Ministry.

Should the Contractor, having provided a mix design meeting the requirements of Appendix A, be directed to reject aggregate or add supplementary aggregate or additives to meet these modifications, the Contractor will be compensated at the rate(s) specified in Appendix C.

**TABLE 501-F MAXIMUM PERMISSIBLE TOLERANCE OF AGGREGATE FROM THE GRADING CURVE**

SIEVE SIZE(mm)	MAXIMUM PERMISSIBLE TOLERANCE % PASSING BY MASS (TEST BCH I - 1 AND 2)
25.0 and larger	± 5.0
4.75 to 19.0	± 4.5
1.18 and 2.36	± 4.0
0.600	± 3.5
0.300	± 2.5
0.150	± 1.5
0.075	± 1.0

#### 501.16 Asphalt Mix Requirements

**501.16.01 Test - Asphalt Mix Aggregate** - During all phases of the construction of asphalt pavement, the gradation of the asphalt mix aggregate will be determined in accordance with Test BCH I-1 and BCH I-2.

i) Samples for this test will be obtained at the asphalt plant prior to addition of the asphalt cement and/or after extraction of the asphalt cement from the asphalt mix, obtained from samples taken at the asphalt plant and/or at the roadway before and/or after compaction.

ii) For this test the maximum permissible variation from the design grading curve on correlation with data obtained by Test BCH I-2 from the crusher, when the aggregate is tested according to BCH I-2, shall be as detailed in Subsections 501.15.01 and 501.15.03. If a consistent variation in the gradation occurs in after production aggregate tests, the cold feed bin settings may be adjusted to produce the correct gradation at the road as directed by the Ministry Representative.

**501.16.02 Test - Asphalt Mix** - The asphalt mix will be tested in accordance with Test BCH II-6 and the measured asphalt cement content shall not vary from the design asphalt content by more than " 0.3 kg/100 kg of aggregate.

**501.16.03 Mixing Temperature** - The mixing temperature of the asphalt mix will be selected by the Ministry Representative. (It will normally be within the temperature range which corresponds to a kinematic viscosity of 150 to 300 mm<sup>2</sup>/s of the asphalt cement.)



**501.16.04 Temperature Behind Screed** - The asphalt mix temperature immediately behind the screed shall not be more than 15°C lower than the mixing temperature.

**501.16.05 Residual Moisture Content** - The residual moisture content of the asphalt mix taken in the loaded truck, at the point of loading, shall not exceed 1% by mass. Should foaming or bubbling persist, even below the allowed percentage of moisture, the Contractor shall modify the operations accordingly.

### 501.17 Asphalt Pavement

**501.17.01 In-place Density** - The in-place density of the asphalt pavement will be obtained at random locations and the Degree of Compaction will be computed from the formula:

$$\text{Degree of Compaction} = \frac{\text{In-Place Density of Sample}}{\text{Plant Briquette Density}} \times 100$$

The Degree of Compaction of the mean of any five consecutive tests shall be greater than 97%.

**501.17.02 Smoothness Rating** - The smoothness rating of the finished asphalt pavement will be determined in accordance with BCH II-10. Wherever multiple lifts are used, the top lift must meet the requirements of "A" or "B" as defined in [Appendix B](#) of this section when measured with the B.C. Smoothness Gauge. Notwithstanding the above, where multiple lift construction is carried out, no matter what method of construction is used, each lift shall have an equal or better rating than the previous course. Where single lift paving is carried out, the B.C.P.S.G. requirements shall meet the "C" rating and shall be better than the original surface rating. The ratings referred to in this section are those laid out in [Appendix B](#) of this section.

For test purposes, the B.C.P.S.G. reading will be taken at random locations throughout the length of the project, prior to the commencement of work. Testing of the newly placed surface shall utilize the same locations as the original test sections. However, should any area of the contractor work be suspect it shall be tested using the B.C.P.S.G. and the rating shall be compared to the average of the previous course's test results for acceptance or rejection purposes.

**501.17.03 Finished Pavement** - All finished pavement shall be free from depressions, bumps, or other irregularities exceeding 5 mm over a 3 m straight edge, placed in any direction.

**501.17.04 Requirements** - The pavement shall be homogeneous, free from segregation and shall be uniform with respect to surface texture, and when tested in accordance with BCH Test II-11 shall have a segregation

rating of lower than 20%.

**501.17.05 Remedial Work** - Areas failing to meet the requirements of Subsections [501.17.01](#) through [501.17.04](#) shall be corrected at the Contractor's expense. Remedial procedures may be selected by the Contractor subject to approval by the Ministry Representative.

The remedial work shall meet all specification requirements and criteria intended for the original work.

### PART C - EQUIPMENT AND PLANT

All equipment, plant and instrumentation shall be capable of performing the work in accordance with this section.

#### 501.21 Requirements for the Pressure Distributor and Liquid Asphalt Storage

**501.21.01 Pressure Distributor** - The pressure distributor shall be provided with at least the following equipment:

- i) A quick opening gate in the dome.
- ii) An external, readily visible depth gauge, indicating the quantity of asphalt in the tank to the nearest 50 ℓ and:
  - a dipstick calibrated in 20 mm increments and a calibration chart showing the volume for each 20 mm of depth, or;
  - the manufacturer's calibrated dipstick and chart.
- iii) A means of heating the asphalt material uniformly to any temperature up to 175°C and maintaining the contents constantly at any selected temperature, without any local overheating.
- iv) A heavy duty, industrial type thermometer or remote reading dial thermometer.
- v) Rear mounted spray bars and nozzles set parallel to the surface to be sprayed and capable of vertical and lateral adjustment.

The spray bars shall be capable of adjustment to provide a uniformly sprayed surface from a minimum of 0.6 m to a maximum of 6 m.

The spray bars shall be capable of producing double coverage at one pass.

The feed to the spray bars shall be so arranged that there is a constant circulation of hot asphalt material to the bars to ensure a constant pressure of the liquid asphalt at each nozzle during spraying operations.



The feed manifolds to the spray bars shall be provided with adequate filtration to prevent clogging of bars and nozzles.

Spray bar nozzles shall be of the same type, size and manufacture and set to produce uniformly fan-shaped sprays without atomization.

Spray nozzles shall be provided with valves capable of instant full opening and positive cut-off.

vi) A connection to a circulating pressure manifold to which a hose may be attached for a single nozzle hand operated outlet.

vii) A pressure pump capable of applying the asphalt material at a minimum rate of 180 ℓ per minute per metre of spray bar.

viii) A pressure gauge accurate to within 15 kPa and a meter calibrated in litres per minute, shall be readily visible.

ix) A fifth wheel tachometer, calibrated in metres per minute and readily visible.

**501.21.02 Liquid Asphalt Storage** - The Contractor shall provide a minimum 40 000 ℓ capacity of on site storage for primer materials.

## **501.22 Requirements for all Mixing Plants**

**501.22.01 Uniformity** - Plants shall be capable of producing a uniform and homogeneous asphalt mix, as specified.

### **501.22.02 Equipment - Preparation of Asphalt Cement**

i) The Contractor shall supply a minimum of two insulated tanks for the storage of asphalt cement. The tanks shall be equipped with means for heating the material under effective control at all times to the temperatures required, and shall have a total minimum storage capacity equivalent to 10 hours of plant actual maximum production capacity.

The tanks shall be connected to the circulating system such that each tank can be separately isolated from the system, without interfering with the circulation of asphalt cement to the plant.

Each tank shall be provided with its own calibrated dipstick and chart.

ii) Asphalt cement shall be supplied to the mixing plant

by a force feed pump placed at the outlet manifold from the storage tank.

iii) The asphalt circulating system shall conform to the requirements indicated on Drawings [SP501-01](#) through [SP501-03](#).

iv) All pipe lines, valve boxes, pumps, meter weigh buckets, other containers or flow lines shall be provided with a suitable means of heating or insulation to prevent heat loss and to maintain the asphalt cement at the specified temperature between storage tank and mixer.

### **501.22.03 Dust Collectors**

i) The Contractor shall provide and install such systems of dust collection as may be required to meet all existing regulations.

ii) Provisions shall be made to re-use the collected material, if required.

### **501.22.04 Asphalt Cement Control Unit**

i) Satisfactory means shall be provided to measure the amount of asphalt cement to be added to the mix with all measuring devices being accurate to  $\pm 2\%$ .

ii) A readily accessible totalizer meter shall be provided to record the total asphalt cement delivered to the mixer during mixing operations.

iii) Mix production from plants equipped with volumetric metering devices shall stop whenever the temperature of the asphalt cement passing through the devices fluctuates by more than  $\pm 5^{\circ}\text{C}$  from the temperature established by the Ministry Representative and for which the metering device has been calibrated. Mixing shall only resume when the temperature of the asphalt has been brought within the permissible operating range.

## **501.23 Requirements for Batch Plants and Continuous Plants**

**501.23.01 Screens** - Screens shall be capable of screening all aggregate to the sizes required for accurate proportioning and shall have a designed capacity slightly in excess of the full operating capacity of the mixer.

### **501.23.02 Plant Bins**

i) The plant shall be provided with hot aggregate storage bins of sufficient size to ensure uniform and continuous operation of the plant at its rated capacity. There shall



be at least three bins. All bins shall normally be utilized for gradation control of the aggregate.

A minimum number of two bins may be used, with the approval of the Ministry Representative, if the variation in the crusher gradation analyses conforms to the maximum variation allowances described in Subsection 501.15.03.

The bins shall be arranged to ensure separate and adequate storage of the required fractions of aggregate. Each bin shall be provided with an overflow chute of such size and at such location as to prevent backing up of material into other bins. Overflow material shall be wasted.

ii) An adequate additional dry storage bin shall be provided for additives when required, and satisfactory provision made for proportioning into the mix.

iii) Bins shall be provided with electronic type telltales which shall register on an indicator board plainly visible to the plant operator. When the bins empty to the lower third a red lamp shall light up and mixing shall stop immediately.

iv) Convenient means shall be provided for obtaining truly representative samples from each bin.

#### 501.23.03 Thermometric Equipment

i) An accurate multipoint continuous recording pyrometer or other approved instrument having a temperature range of 50°C to 200°C subdivided into 2°C graduations shall be centrally situated in a protected position where it is readily visible to the plant operator.

ii) Premium grade thermocouples or resistance thermometer bulbs shall be properly installed and protected at the following reference points:

- In the dryer exhaust manifold between the exhaust fan and the primary dust collector.
- In the dryer discharge chute.
- In the fine aggregate bin, not higher than the bottom quarter point of the bin and as near to the bin discharge point as practicable. The temperature reference point must protrude sufficiently into the aggregate stream flow and be protected by a small diameter tube to prevent the build up of a coat of fine material.
- In the asphalt circulating main pipe at the nearest elbow or junction to the spray bars or asphalt bucket.
- In each asphalt storage tank, to register the true temperature of the asphalt cement at the level of

the tank outlet without sensing temperature effects from the tank heating coils or external conditions.

#### 501.24 Special Requirements for Batch Plants

**501.24.01 Plant Scales** - Scales for any weigh box or hopper may be either standard beam or springless dial type accurate to 0.5% of the maximum indicated load.

Scales shall be tested as often as the Ministry Representative may deem it necessary to ensure their accuracy. The Contractor shall provide and have at hand a satisfactory number of standard weights for frequent testing of all scales. For each scale, a suitable cradle or platform shall be provided for applying the test load so that the load is uniformly distributed. The test weights shall be kept clean and stored near the scales.

**501.24.02 Time Lock and Batch Counter** - The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate after the charging of the mixer, until the closing of the mixer gate at the completion of the cycle. It shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the application of asphalt cement; the wet mixing period is the interval of time between the application of asphalt cement and the opening of the mixer gate.

The control of the timing shall be flexible and capable of being set at intervals of not more than two seconds throughout cycles up to three minutes. A mechanical batch counter shall be installed as part of the timing device and shall be designed to register only completely mixed batches.

#### 501.25 Special Requirements for Continuous Plants

##### 501.25.01 Calibration of Asphalt Pumps and Aggregate Feed

- i) The plant shall be provided with a means of calibrating gate openings and volumetric pumps by means of mass test samples.

The asphalt mix aggregate fed through individual bin orifices shall be capable of being diverted into a suitable test box with separate compartments for each aggregate size.

The test box shall be equipped to handle conveniently such test samples varying between 100 kg and 250 kg. The plant shall be equipped with an accurate revolution counter mounted on the aggregate feed apron to the



mixer.

ii) In order to calibrate the volumetric proportioning of asphalt cement, the section of the asphalt flow line between the circulating return valve and the spray bar shall be provided with a valve and outlet suitable for bypassing the flow from the volumetric proportioning device into containers capable of holding not less than 2500 ℓ. The sampling line shall be fitted with nozzles equal in type and quantity to the pugmill spray bar. The operating pressure, as registered by the gauge installed upstream of the asphalt meter, for a selected pump setting shall not vary during mixing.

iii) A platform scale shall be provided by the Contractor for determining the mass of test samples of aggregate and asphalt cement.

**501.25.02 Aggregate - Asphalt Cement Interlock -** Synchronization of aggregate and asphalt cement feeds shall be provided to allow interlocking control between the flow of aggregate from the bins and the flow of asphalt cement from the meter or other proportioning source.

**501.25.03 Asphalt Mix Aggregate Sampling -** An efficient and satisfactory method shall be provided for obtaining truly representative samples of the total aggregate being fed into the pugmill.

## **501.26 Special Requirements for Drum Mixers**

### **501.26.01 Plant Generally**

- i) The drum mixer shall be a parallel flow or counter flow type and of approved manufacture.
- ii) The drum mixer shall be used in conjunction with a hot storage silo meeting all requirements of this Section.

### **501.26.02 Cold Aggregate Feeders and Bins**

- i) The Contractor shall provide sufficient cold feed bins or feeders to allow for the accurate blending of all materials, including supplemental aggregate(s), required to meet the Marshall Mix Design. Should the Ministry wish to add additional new material to improve the gradation once the criteria for a Marshall Mix Design is met, the use of any additional bin/feeders will be paid for by the Ministry at cost. The blending of supplemental materials already being supplied by the Contractor shall not be classified as new material.
- ii) Each bin shall be equipped with a variable speed feeder, adjustable gate and other devices ensuring uniform flow of material.

iii) All feeders shall be quick adjusting and interlockable and shall maintain a constant and uniform flow throughout their range of calibration.

iv) The total flow of asphalt mix aggregate shall be metered by an electronic belt scale interlocked with a variable asphalt feed system, so that the proportions of asphalt cement and aggregate entering the drum remain constant.

v) The main feed belt shall have a vibrating scalping screen, with openings as required to prevent the feeding of oversize or deleterious material.

vi) A readily accessible approved device shall be provided for obtaining samples from the main feed belt.

vii) Feed bins shall be equipped with bin level tell-tale lights which are visible to the plant operator. When the bins empty to the lower third, a red lamp shall light up and mixing shall stop immediately.

viii) The Contractor shall provide and have at hand a satisfactory number of standard weights for frequent scale testing.

**501.26.03 Calibration -** The asphalt cement and asphalt mix aggregate feed systems shall have provisions to enable easy calibration.

**501.26.04 Monitors, Recorders and Controls -** The drum mixer control console shall have at least the following monitors, recorders and controls:

- Individual variable quantity feed belt controls which govern the output from each feed bin.
- Master variable quantity feed control which governs the combined output from the bin feeders in their proper predetermined ratios.
- Belt scale totalizer showing accumulated mass of wet aggregate delivered to the dryer drum mixer.
- Moisture content input control for changing internally the system's wet mass to dry mass.
- Indicator showing the computed total mass per hour of dry aggregate delivered to the drum mixer.
- Control for setting the required percentage of asphalt cement based on the mass of dry asphalt mix aggregate.
- Totalizer for accumulated litres of asphalt cement delivered to the drum.
- Master switch to start and stop the asphalt cement and asphalt mix aggregate feeds.

### **501.26.05 Thermometric Equipment**

- i) An accurate multipoint continuous recording



pyrometer or other approved instrument having a temperature range of 50°C to 200°C, subdivided into 2°C graduations, shall be centrally situated in a protected position where it is readily visible to the plant operator.

ii) Premium grade thermocouples or resistance bulb thermometers shall be installed:

- in the asphalt cement circulating main at the nearest elbow or junction to the supply manifold
- in each asphalt cement storage tank to measure the true temperature of the stored asphalt at the level of the tank outlet without sensing temperature effects from the tank heating coils or external conditions
- in the drum discharge chute
- in the hot storage silo, not higher than the bottom quarter point.

**501.27 Requirements for Hot Storage Silos** - Hot storage silos shall be enclosed and be of a design that will not cause segregation in the asphalt mix. The conveyor shall discharge into an automatically controlled batching device having a minimum capacity of 1.8 t, mounted on top of the hot storage silo. However, should segregation be detected, the Contractor shall modify the operation immediately.

The silo must be equipped with a remote indicator light, visible to the plant operator, indicating when silo is less than one quarter full.

The silo shall be set up so as to allow enough room for the haul trucks to pass below the discharge hopper thus allowing direct discharge into the trucks. Loading the haul trucks with the use of a conveyor system will not be allowed.

#### **501.28 Requirements for Mixing Plants Producing Sulphur Extended Asphalt Mix**

**501.28.01 General** - Equipment normally in contact with sulphur must be thoroughly heat jacketed. All those parts, which may be invaded by sulphur, should also be jacketed.

#### **501.28.02 Pipe Lines**

- i) Sulphur lines smaller than 25 mm in diameter are not permitted.
- ii) Pipe systems should be kept full of liquid sulphur all the time to prevent severe corrosion.

**501.28.03 Valves** - Steam jacketed valves, lubricated or non-lubricated plug valves are accepted. Steam jacketed gate, globe, check and relief valves are also accepted.

A sampling valve shall be installed in the emulsion feed line

immediately after the blender.

**501.28.04 Pumps** - Sulphur shall be supplied to the mixing plant by a positive displacement pump, placed at the outlet manifold from the storage tank.

#### **501.28.05 Storage Tanks**

i) Storage tanks shall be insulated. Coils shall be able to maintain the sulphur at a temperature of 127°C to 137°C. Temperature indicators and controllers shall be installed.

ii) Sulphur storage tank shall have a minimum storage capacity equivalent to 20 hours of maximum plant capacity.

iii) Storage tanks shall be grounded.

### **PART D - CONSTRUCTION**

#### **501.31 Spray Prime Coat and Tack Coat**

##### **501.31.01 Prepared Granular Bases and Old Pavements**

- All prepared granular bases or old pavements which are to be paved shall be prime coated or tack coated at specified rates and at locations as directed by the Ministry Representative.

##### **501.31.02 Liquid Asphalt - Prime Coat or Tack Coat -**

The liquid asphalt for prime coat or tack coat shall be applied when surface and weather conditions are favourable and when the air temperature is above 10°C and rising.

**501.31.03 Tack Coating - Surface** - The surface to be tack coated shall be cleaned of dirt and other foreign material by brooming or other acceptable methods. Payment for this work is considered to be included in the price bid for spray primer and tack coat.

**501.31.04 Liquid Asphalt - Spray Temperature** - The liquid asphalt shall be sprayed at a designated temperature within the temperature range which corresponds to a kinematic viscosity of 100 to 150 mm<sup>2</sup>/s.

**501.31.05 Vertical Surfaces** - The vertical surfaces of roadway appurtenances shall be hand sprayed with liquid asphalt to the top of the new pavement only. Over spraying shall be cleaned at no expense to the Ministry.

**501.31.06 Spray Overlapping** - The liquid asphalt spray shall not be excessively overlapped.

**501.31.07 Spraying Faults** - Any spraying faults resulting from the Contractor's method of operation shall be corrected as directed by the Ministry Representative at no expense to



the Ministry.

**501.31.08 Excess Liquid Asphalt** - Any excess liquid asphalt remaining unabsorbed shall be blinded with sand or fine aggregate at no expense to the Ministry.

**501.31.09 Traffic** - Traffic shall not be permitted on tack coat until it has cured and on prime coat until the primer has been absorbed into the granular surfacing.

Where it is not possible to keep the traffic off the treated surface, the surface shall be blinded with sand or fine aggregate prior to allowing traffic on same.

**501.31.10 Prime Coat and Tack Coat - Curing** - Normally prime coats shall be allowed to cure for a minimum of 24 hours prior to the placing of asphalt mix. No asphalt mix shall be placed on fresh tack coat that has not had a minimum of 30 minutes to cure or until directed to do so by the Ministry Representative.

**501.31.11 Prime Coat - Maintenance** - The Contractor shall, at the Contractor's expense, maintain the prime coat and/or tack coat except that any liquid asphalt required for such maintenance will be supplied by the Ministry.

**501.31.12 Tack Coat - Application** - Tack coat shall not be applied on sections of roadway longer than can be covered by one day of asphalt plant production.

### 501.32 Stockpiling Aggregates

**501.32.01 Aggregates** - The Contractor shall supply all aggregates for the work from approved sources. Ministry of Transportation pits may be used without charge provided they are developed and worked in accordance with Subsection 202.22 and the pit development plan. Deviation from the pit development plan will require the approval from the Ministry Representative. No guarantee is given or implied that aggregate from Ministry pits will meet the Specification requirements or provide requisite quantities.

**501.32.02 Stockpile Requirements Pre-Mixing** - Before plant mixing commences, the Contractor shall have in stockpile a minimum of 20 000 t of asphalt mix aggregate or 50% of the total quantity of asphalt aggregate required for the mix, whichever quantity is greater. These quantities shall be maintained throughout the crushing period.

**501.32.03 Stockpile Construction** - Stockpiles shall be constructed as specified in Subsection 202.28. For drum mixer or continuous or batch plant using cold feed gradation control the Contractor will be required to split the aggregate into coarse and fine stockpiles unless the requirement is waived in writing by the Ministry Representative.

The method and screen size used to split the aggregate will be subject to the approval of the Ministry Representative and the following shall govern:

- Generally, the screen size separating the coarse from the fines shall be 6.3 mm.
- Screening efficiency, when the coarse stockpile is tested according to BCH I-1, is calculated as follows:

$$E = \frac{\text{Material that Passed the Splitting Screen}}{\text{Total Aggregate Material Smaller than the Splitting Screen}} \times 100$$

- Allowable operating variation in screening efficiency shall be 5%.
- Screening efficiency shall in no case be less than 85%.
- The percentage split for each stockpile shall be provided to the Ministry Representative by the Contractor by the time that 25% of the paving aggregate is placed in stockpile(s). This information is to be provided in writing. Any surplus aggregate arising from an inaccurate split supplied will be paid for as Type 3 material. From the start of production until 25% of the material is in stockpile the contractor shall have a maximum carry-over on the splitting screen of 15% and at no time shall vary by more than  $\pm 2.5\%$ .

**501.32.04 Crushed Aggregates** - Aggregates crushed during the plant-mixing operation shall be stockpiled in such a manner as to avoid their direct feeding into the mixing plant.

**501.32.05 Stockpiles** - Stockpiles of different types of material shall be located and constructed in such a manner as to prevent intermingling of the types.

**501.32.06 Supplementary Aggregate** - Prior to the commencement of the plant mixing the total estimated quantity of supplementary aggregate shall be stockpiled at the plant site.

### 501.33 Mixing Plant Operation

#### 501.33.01 Mixers

i) With pugmill mixers the asphalt mix aggregate shall be dry mixed for a minimum period of ten seconds. The wet mixing time of the asphalt mix shall be a minimum period of 30 seconds, although this period will be increased, if required, to ensure that a uniform, evenly coated mixture is produced.

ii) With drum mixers, the mix retention period shall be dictated by the time required to ensure complete coating.



**501.33.02 Rejection and Disposal** - All asphalt mix failing to meet the requirements of this section will be rejected and shall be disposed of at the Contractor's expense as approved by the Ministry Representative and shall meet all environmental requirements.

If more than 2% by mass of total asphalt mix is rejected, the Contractor will be charged for the cost of the asphalt cement and the cost of the aggregate incorporated in that portion of the mix in excess of the 2%.

**501.33.03 Residual Coating of Particles** - Asphalt mix aggregate particles shall not be coated with residue from improper fuel combustion.

**501.33.04 Lubrication** - Lubrication of conveyor belts with diesel fuel will not be permitted.

### **501.34 Hauling the Asphalt Mix**

**501.34.01 Hauling Vehicles - General** - The hauling vehicles shall have tight smooth metal boxes cleaned of all accumulations of asphalt mix and foreign materials. Prior to loading, the truck box may be lightly lubricated with a heat resistant asphalt releasing emulsion, having a maximum silicone content of 1 part per 1000 parts of diluted emulsion. Lubrication with diesel fuel will not be permitted.

**501.34.02 Insulation** - All vertical sides of truck boxes shall be adequately insulated.

All haul vehicles shall be equipped with and use at all times an insulated tarpaulin of such size so as to completely protect the asphalt mix from the weather.

**501.34.03 Mechanical Condition** - Haul vehicles shall be in sound mechanical condition and free from oil and fuel leaks.

**501.34.04 Audible Back Up Warning Device** - See Subsection [145.30.04](#).

**501.34.05 Delivery** - Asphalt mix shall be delivered to the paver at a constant rate sufficient to allow continuous placement.

**501.34.06 Traffic Control Person** - A haul vehicle traffic control person shall be provided. This individual's sole duty during asphalt mix laydown operations shall be to ensure safe conditions and to signal and direct trucks accessing the paver lane.

### **501.35 Placing the Asphalt Mix**

**501.35.01** - When in the vicinity of an operating paver,

workers and inspectors shall stand in full view of the paver operator, clear of side arms and screed, and never in front of the machine hopper.

**501.35.02** - Asphalt mix shall only be placed on clean dry surfaces free from all foreign materials, when weather and conditions are suitable.

All lifts of asphalt mix shall only be placed on a dry surface when the ambient air temperature is 5°C and rising and in addition, the top lift shall not be placed when the average surface temperature is below 10°C. The temperature shall be taken in the centre of the travelled lane being paved.

**501.35.03 Pick-up Machines** - When the Contractor elects to utilize pick-up machines they shall be approved by the Ministry Representative. When this type of equipment is utilized, the Contractor will only place the equivalent of two tandem loads of mix on the roadway at any given time. When the legal load of a single box on a haul vehicle exceeds 20 tonnes, the full load may be spread only after the paving operation is picking up the last load spread. Further dumping will not be permitted until such time as 50% of the greater than 20 tonne load of mix has been picked up.

**501.35.04 Asphalt Levelling Course** - Prior to the placement of an asphalt pavement overlay, the Ministry Representative may require that sections of the existing pavement receive a levelling course of asphalt mix to correct superelevation and to level the roadway as required.

**501.35.05 Asphalt Levelling Course - Requirements** - Asphalt levelling course shall be the class of asphalt pavement as stated in the Special Provisions and shall meet all the requirements of this Section.

**501.35.06 Paving Machine** - The asphalt mix shall be placed by a self-propelled paving machine equipped with an activated screed and strike-off that are heated. The machine shall be capable of spreading the mix to the thicknesses and widths as indicated in the Special Provisions, or on the Drawings. A lift thickness shall be not less than 2.0 nor more than 3.5 times the designated aggregate size of the mix.

**501.35.07 Paving Machine - Equipment** - The paving machine shall be equipped with an automatic grade control device capable of controlling the spreading of the asphalt mix to the desired longitudinal grade and to the designated transverse slope within 1.5 mm/m.

### **501.35.08 Speed**

- i) The speed of the paver shall be adjusted to achieve a continuous lay-down operation producing a smooth



homogeneous mat, which meets the requirements of this section.

- ii) When paver speed is in excess of 300 m per hour, the Contractor shall be required to have two qualified joint rakers raking the joint.

**501.35.09 Processing** - During the processing of asphalt mix windrowed in front of pick-up machines the temperature loss between the haul vehicle and the paver hopper shall not exceed 8°C in any part of the windrow.

**501.35.10 Placing - Other Methods** - When it is impractical to spread and finish the asphalt mix by paving machine, it may be placed and spread by other methods consistent with prevalent construction practices.

**501.35.11 Hydraulic Screed Extension** - Hydraulic screed extension duplicating the effectiveness of the main screed may be used for narrow pavement widenings. If it is determined that the screed extension is affecting the ride of the finished pavement, the Ministry Representative will order it removed from the paving machine.

**501.35.12 Longitudinal Joints** - Longitudinal joints in the top lift of asphalt pavement will only be permitted where lane dividing lines are to be painted.

Longitudinal joints in a lift shall be offset at least 150 mm from joints in the underlying lift.

Longitudinal joints in underlying lifts shall not be offset more than 150 mm from lane dividing lines without written permission from the Ministry Representative.

**501.35.13 Traffic** - Traffic will not be permitted over an unmatched longitudinal joint except at locations designated by the Ministry Representative.

**501.35.14 Longitudinal Edge** - At places where the unprotected longitudinal edge of previously placed mat has been damaged by traffic or equipment it shall be trimmed to provide a standard abutting face against which new mix can be placed and compacted.

**501.35.15 Contact Edge** - The contact edge of abutting cooled pavements shall be thoroughly painted with a thin uniform coat of emulsified asphalt supplied by the Contractor.

**501.35.16 Paving Adjoining Parallel Mats** - When paving an adjoining parallel mat there shall be at least a 50 mm overlap onto the previously paved surface. This overlap shall be properly "raked" to form a homogeneous bond between the two mats.

**501.35.17 Raking** - Any material that is "raked" from the joint shall be placed in a wheelbarrow and deposited and immediately levelled on the shoulder where it can be covered by shoulder aggregate, for all lifts of paving, unless otherwise directed by the Ministry Representative. At no time shall "raked" material be placed in front of the paver.

**501.35.18 Discontinued Paving** - When paving is discontinued in any lane on a traffic bearing roadway, the asphalt pavement shall be tapered down at a maximum slope of 25:1. From the location of the tar paper letdown there shall be at least 1.0 m of pavement that follows the profile and grade of the pavement prior to the start of the 25:1 taper (see Drawing [SP501-04](#)).

When paving resumes and the tar paper letdown is lifted it shall be loaded out for disposal as it is removed. Disposal shall be in an environmentally sound manner.

When paving resumes, the temporary taper shall be cut back to provide a straight vertical face at the transverse joint, which shall be heated and painted as specified in Subsection [501.35.15](#).

**501.35.19 Contact Faces** - Contact faces of curbs, gutters, manholes, catchbasins, headers, etc., shall be painted as specified in Subsection [501.35.15](#) before placing the asphalt pavement.

**501.35.20 Fixed Structures** - After compaction, the pavement surface adjacent to gutters, manholes, headers or other fixed structures shall be slightly higher than the surface of such structures, but never exceeding 6 mm.

## **501.36 Compacting the Asphalt Mix**

**501.36.01 Compaction** - The asphalt mix shall be compacted to a minimum density consistent with the requirements of Subsection [501.17](#).

The Contractor shall supply compaction equipment of specific types to ensure a uniform degree of compaction and surface finish consistent with the requirements of this section. However, one rubber tired roller having a minimum mass of 15 t and capable of providing one complete coverage equal to the rolling width of the machine in one pass, will be required on every project.

Once the compacting effort required to obtain the specified degree of compaction and surface finish is ascertained, the compacting effort and procedure shall not be changed without the written permission of the Ministry Representative.

**501.36.02 Equipment** - Compaction equipment shall be



capable of producing the required density and surface finish.

**501.36.03 Wheels** - The wheels of compaction equipment in contact with the asphalt mix shall be clean. In addition, compactors shall be equipped with mats.

All wheels shall be moistened by water or by an approved diluted asphalt release agent to prevent pickup, but an excess will not be permitted.

**501.36.04 Operation** - Compaction equipment shall normally be operated with the drive roll or wheels nearest the paving machine.

**501.36.05 Longitudinal Joints** - Longitudinal joints shall be rolled immediately behind the paving operation, after which rolling shall begin longitudinally at the lower edge of the mat proceeding toward the higher edge of the mat overlapping on successive passes by at least one half of the effective roller width.

**501.36.06 Roller Speed** - The speed of the roller shall not exceed 8 km/h.

**501.36.07 Rollers** - Rollers shall not be driven on to, or off, the unprotected longitudinal edge of the unfinished mat, nor will rollers be allowed to park on the mat prior to complete cooling.

**501.36.08 Vibrating Tampers and Hand Rollers** - Along curbs, manholes, headers and similar structures which are not accessible to rollers, thorough compaction shall be obtained by use of vibrating tampers and hand rollers.

**501.36.09 Traffic** - Traffic will not be permitted on the finished pavement until it has cooled to such a temperature as to ensure that no deformation or excess flushing of the surface will occur.

**501.37 Shouldering** - The materials, equipment and work practice required for the construction of granular shoulders shall be as follows:

- a) The gradation of the crushed aggregate supplied for granular shoulders shall be within the limits set for medium mix under Subsections 501.15.01 and 501.15.02, or as specified by the Ministry Representative, and the aggregate quality shall meet all the requirements of Section 202.

The finished surface of the granular shoulder shall be true to grade and cross section, and be free from ruts, ravel, segregation or other irregularities.

- b) Shouldering machines shall comply with the

following minimum requirements:

- The machine shall travel on the adjacent asphalt pavement on pneumatic tires or rubber tracks.
- The machine may be self-propelled, towed or pushed.
- The speed of the aggregate feeder shall be adjustable and the feeder shall have sufficient power to feed required quantities of aggregate.
- The machine shall have an adjustable strike-off and cut-off plate to regulate the depth, width and cross slope of the deposited shoulder aggregate.
- The machine shall be capable of spreading material from widths of 0.5 m to 2.5 m.
- All granular shoulder materials shall be handled in such a manner that segregation does not occur.

- c) If necessary for compacting, water shall be applied to the granular shoulders.

The in-place dry density of the granular shoulders will be obtained at random locations in accordance with Test BCH I-15 or I-16, after completion of final rolling.

The maximum dry density of the granular shoulder material will be obtained in accordance with Test BCH I-14, Method C.

The Degree of Compaction of each in-place density test will be computed from the formula:

$$\text{Degree of Compaction} = \frac{\text{In-Place Dry Density}}{\text{Maximum Dry Density}} \times 100$$

The average Degree of Compaction of the granular shoulder shall be greater than 98%.

- d) If the adjacent asphalt pavement is damaged during the shouldering operation, the damage shall be repaired at the direction of the Ministry Representative, at no expense to the Ministry.

- e) For safety reasons, when a roadway with gravel shoulders is used by the travelling public, an intermediate layer of shouldering aggregate shall be placed following final rolling of levelling course or multiple lifts of asphalt pavement thicker than 50 mm, in advance of the main shouldering operation.

The additional Shouldering Work involved in the construction of this layer will be paid for at the unit price bid for Shouldering Work.

- f) Should the work extend past the completion date and be carried over to the next paving season, all shoulders shall be built up to the elevation of the adjacent asphalt



pavement, and the additional shouldering work will be considered a subsidiary obligation of the Contractor, and no additional Shouldering Work will be paid.

## PART E - PAYMENT AND DEDUCTIONS

### 501.41 General

**501.41.01 Payment** - Payment for the work will be at the unit price bid for each respective item as listed in the Schedule of Approximate Quantities and Unit Prices, and at the fixed unit prices as detailed in [Appendix C](#).

**501.41.02 Contractor: Cost to – Crusher Reject within Ministry Pits** - If the Contractor is required, prior to the asphalt plant feed operation, to reject a portion of the aggregate or add supplementary aggregate to comply with the requirements of Subsections [501.14](#) and [501.15](#), the Contractor shall bear all costs associated with these improvements, save that the ensuing rejected materials will be paid for as crusher reject - surplus aggregate Type 3 within [Appendix C](#) when produced in Ministry pits only.

### 501.41.03 Contractor: Payment to

i) If the Contractor, having provided an aggregate whose gradation falls entirely within the gradation requirements as set out in Subsections [501.15.01](#) through [501.15.03](#), is required to blend supplementary aggregate or an additive at the crusher or at the plant to meet the design grading curve, the Contractor will be paid for the blending at the actual cost under [Appendix C](#) and in accordance with Subsections [501.44](#) and [501.45](#).

ii) If the Contractor, having provided an aggregate whose gradation falls entirely within the gradation requirements as set out in Subsections [501.15.01](#) through [501.15.03](#), is required by the Ministry Representative to reject a portion of the aggregate at the crusher or at the plant in order to meet the design grading curve, the Contractor will be paid the fixed unit price for all surplus aggregate (Type 1) arising from the rejecting operation.

### 501.41.04 Transportation by Barge

i) If the Contractor elects to transport material(s) by barge, the Contractor shall provide facilities at the off-loading site which meet the requirements of Subsection [145.18.04](#).

ii) Payment for material(s) barged will only be made for acceptable materials actually incorporated in the works.

**501.42 Schedule Items** – Contrary to Section [202](#), Base Aggregates will be paid in stockpile only for projects

classified by the Ministry as Rehabilitation Projects.

**501.42.01** Payment for items in Subsections [501.42.01 \(i\)](#) through [501.42.01 \(iii\)](#) shall be at the unit price bid per tonne.

**i) Crushed Aggregates into Stockpile** - The Contractor shall be responsible for determining that there is enough material in stockpile to cover each contract material type. Payment for crushed aggregates in stockpile shall be full compensation for pit development, crushing, screening and stockpiling of all aggregates required. Upon completion of crushing, the Contractor shall be paid for the quantity of material for each item estimated on the Schedule of Approximate Quantities and Unit Prices. The Ministry Representative shall estimate the quantity of aggregate in stockpile, for monthly progress estimate purposes. These payments do not infer that the crushed aggregate in stockpile will be accepted for use. Should the aggregate(s) not meet the requirements for which it is intended all previous payment(s) for this aggregate(s) will be deducted from monies owed to the Contractor. Upon the completion of the work, the actual quantity used of each aggregate type shall be determined in accordance with Subsection [501.43.03](#). If the quantities are greater than those estimated and the Contractor has crushed sufficient to cover the overage then payment shall be for the actual quantity used. If it has been determined that less than the required quantity was placed into stockpile, there shall be a deduction under the appropriate Schedule Item equal to the shortfall in quantity.

**ii) Placing Base Aggregates** - Payment for the placing of base aggregate(s) shall be full compensation for loading, weighing, hauling, placing, grading and compacting of the aggregate to the required grades and crossfall. This item may or may not include the supply of water for compaction and/or dust control.

**iii) Placing Asphalt Mixes** - Payment for all L.C., A.P., A.B.C., R.A.M., and R.A.B.C. shall be full compensation for loading the aggregate into the feeders, drying the aggregate, taking delivery of; heating and storing the asphalt cement and any other additives required, mixing, loading, weighing, hauling, dumping, spreading, compacting and finishing the asphalt pavement.

**501.42.02 Asphalt Mix f.o.b. Plant** - Payment for Asphalt Mix f.o.b. Plant will be at the unit price bid per tonne.

The unit price shall be full compensation for loading the aggregate into the feeders, drying the aggregate, taking delivery of; heating and storing the asphalt cement and any



other additives required, mixing, loading and weighing the mix into trucks at the plant.

#### **501.42.03 Payment for Spray Primer, Tack Coat and Blinding Sand**

- i) Payment for Spray Primer and Tack Coat will be at the unit price bid per litre of liquid asphalt/diluted emulsion actually sprayed. The asphalt volume shall be that measured at 15°C.
- ii) Payment for Blinding Sand will be by Work Order, if its use is necessary due to conditions beyond the control of the Contractor, other than weather.

**501.42.04 Shouldering** - Payment for Shouldering will be at the unit price bid per tonne or cubic metre to the neat lines, whichever is specified in the Schedule of Approximate Quantities and Unit Prices. The price bid shall be full compensation for loading, weighing, hauling, placing, spreading and compacting the aggregate to the required grades and crossfall. This item may or may not include the supply of water for compaction and/or dust control.

**501.42.05 Shouldering Work** - Payment for Shouldering Work will be at the unit price bid per shoulder kilometre of the road. The price bid shall include blading, shaping, compacting and finishing granular shoulders. Water will be paid for as detailed in Subsection 202.40. If the Schedule of Approximate Quantities and Unit Prices does not contain an item for water, a unit price will be negotiated and added to the Schedule.

**501.43 Surplus Aggregate in Stockpile** - At the discretion of the Ministry Representative, the Ministry may or may not purchase surplus aggregate in stockpile in a private pit. Generally, the Ministry will purchase surplus aggregate in stockpile in Ministry Pits only. However, should the Contractor produce surplus aggregate in a private pit, and the Ministry intends to purchase these surplus aggregates, the Contractor shall be required to provide a written agreement with the owner of the property that the Ministry will have free access to and use of the surplus aggregate in stockpile for a period of 12 months after the completion of the contract work. If the Contractor undertakes private work from within the private pit, measurements for surplus aggregate in stockpile will not be taken until the completion of the private work, ensuring that the Ministry does not pay for aggregate used on private works.

**501.43.01 General - Types** - All surplus aggregate shall be properly stockpiled.

There shall be three types:

i) **Type 1** - all surplus aggregate in stockpile which is produced as a result of rejecting material in order to meet the design grading curve after the Contractor has provided aggregate meeting the requirements of Subsections 501.15.01 through 501.15.03.

ii) **Type 2** - surplus aggregate, in split or unsplit stockpiles, which singly or when combined will give the gradation as supplied by the Contractor to meet Subsection 501.15.01 through 501.15.03.

iii) **Type 3** - aggregate in stockpile of whatever kind not included in Subsection 501.43.01 (i) or 501.43.01 (ii), except for private pits.

**501.43.02 Ministry Purchase of Surplus Aggregates** - If the Ministry is proceeding with the purchase of surplus aggregates as per Subsection 501.43, upon completion of the contract, the Ministry will purchase all the surplus paving mix aggregate as per Subsection 501.43.02 (i) through 501.43.02 (iv) and all surplus crushed base and/or shoulder aggregates as per Subsection 501.43.02 (v) and 501.43.02 (vi) at the unit price bid in the Schedule of Approximate Quantities and Unit Prices or under Appendix C, whichever applies.

i) The Ministry will purchase the surplus Type 2 aggregate up to the estimated quantity required by the contract at the Contract Unit Price per tonne for crushing for each aggregate type.

ii) Surplus Type 2 aggregate from the estimated contract requirement to 105% of the contract requirement will be paid for as specified in Appendix C for Type 2. Should more than the estimated quantity be utilized for the work, the calculation for the surplus material will be based on the original estimated quantity unless an official quantity change has been reflected within the Schedule of Approximate Quantities and Unit Prices.

iii) Any remaining surplus Type 2 aggregate will be purchased at the rate specified in Appendix C for Type 3.

iv) Any remaining surplus aggregate in stockpile not meeting the requirements of surplus Type 2 aggregate as per Subsection 501.43.02 (ii) and 501.43.02 (iii) will be paid for as surplus Type 3 aggregate as specified in Appendix C.

v) When crushed base and/or shoulder aggregate(s) are required in the contract and are specified to meet the requirements of Subsection 202.05 and Subsection 501.37 (a) respectively, the Ministry will purchase the surplus aggregate(s) up to the estimated quantity



required by the contract at the Contract Unit Price per tonne.

**vi)** All remaining surplus crushed base and/or shouldering aggregates, beyond the contract requirements, will be purchased at the rate specified in [Appendix C](#) for Type 3.

**vii)** Any excess aggregate produced from Ministry Pits and taken to a private pit shall be returned to the Ministry Pit prior to its being purchased by the Ministry.

**viii)** The Ministry may purchase surplus aggregate, in accordance with Subsections [501.43.02 \(i\)](#) through [501.43.02 \(vi\)](#), in private pits at the rates listed in [Appendix C](#).

**501.43.03 Measurement** - To determine the quantity of Asphalt Mix Aggregate used in the production of asphalt mix the following formula will be applied:

$$\frac{\text{Tonnes of Asphalt}}{\text{Mix Aggregate}} = \frac{\text{'tonnes of mix' } \times 100}{100 + \text{average calculated asphalt content}}$$

When the Ministry has supplied supplementary aggregate, the percentage incorporated into the Asphalt Mix Aggregate shall be recorded. When determining the quantity of surplus material that meet specifications, and is to be paid for under Subsections [501.43.02 \(i\)](#) through [501.43.02 \(iii\)](#), the quantity of Ministry supplied supplementary aggregate shall be determined and deducted from the total. Payment will be made for only that portion of the remaining piles required to meet specifications.

**i)** Measurement for payment under Subsections [501.43.02 \(i\)](#) through [501.43.02 \(vi\)](#) will be determined by digital terrain models and/or cross-sectioning and average end area computation and converted to mass using the conversion factor of 2.0 tonnes per cubic metre. The Ministry Representative will authorize payment for surplus aggregate in stockpile at the rates specified in Subsections [501.42.01](#) and [501.43.02](#).

**ii)** The quantity of crusher reject aggregate in stockpile will be determined by digital terrain models and/or cross-sectioning and average end area computation and converted to mass using a factor of 2.0 tonnes per cubic metre.

**iii)** All reject mix shall be weighed in tonnes prior to disposal. Calculation of the quantity of Aggregate incorporated in the mix shall be determined by the formula in [501.43.03](#). The quantity of asphalt cement shall be calculated by subtracting the quantity of

aggregate incorporated in the mix from the total quantity of mix.

**501.43.04 Payments/Deductions** - Payment for Surplus Aggregate in Stockpile will be at the fixed rate per tonne as listed in [Appendix C, Item 7](#).

The fixed unit price shall be full compensation for pit development; supplying, crushing, screening and stockpiling the surplus aggregate.

A deduction will be made for any reject mix in excess of 2% of the quantity of mix placed on the roadway. This deduction will be divided into two sections as specified in [Appendix C, Item 18](#).

**i) Asphalt Mix Aggregate Incorporated in the Mix:** The deduction for this aggregate will be at the Contract Unit Price for paving aggregate in stockpile.

**ii) Asphalt Cement Incorporated in the Mix:** The quantity of asphalt cement will be calculated as per Subsection [501.43.03 \(iii\)](#). The deduction for the asphalt cement will be at the purchase order price plus PST.

**501.44 Supplementary Aggregate** - The need for supplementary aggregate will be determined by the Ministry Representative.

**501.44.01 Ministry-Controlled Sources** - All Ministry controlled supplementary aggregate sources shall be developed and worked in accordance with Subsection [202.11](#).

**501.44.02 Supplementary Sources** - All supplementary aggregate sources will be developed as directed; the work, including loading out, will be performed on a Work Order and payment will be made under [Appendix C, Item 1](#).

**501.44.03 Screening** - If required by the Ministry Representative, the supplementary aggregate will be screened, and payment will be by a Work Order.

**501.44.04 Payment - Hauling Supplementary Aggregate**

**i)** Payment for hauling supplementary aggregate will be at the fixed rate per tonne-kilometre as described in [Appendix C, Item 4](#). The rates shown are not accumulative and therefore only one rate shall apply for all kilometres hauled, appropriate to the total hauling distance listed in [Appendix C, Item 4](#). The quantity used for payment for hauling supplementary aggregate will be the actual quantities of supplementary aggregate weighed into stockpile at the plant site, in accordance with Subsection [501.32.05](#).



ii) When the crusher or mixing plant is located in a private pit, and at the end of production the Contractor is required to haul processed aggregate and/or Reclaimed Asphalt Pavement from the private pit to a Ministry Pit, they shall be reimbursed for haul at the rates indicated under [Appendix C, Item 4](#). For payment purposes, the material shall be accurately weighed over an approved scale, into stockpile.

#### **501.44.05 Payment - Blending Supplementary**

**Aggregate** - The quantity used for payment for blending supplementary aggregate will be the computed quantities added at the plant, increased to include the actual moisture content, determined at the time of stockpiling at the plant site.

Payment for blending supplementary aggregate will be at the actual cost under [Appendix C, Item 5](#).

The price under [Appendix C](#) shall be full compensation for excavating, loading and blending the supplementary aggregate at the plant.

#### **501.44.06 Deductions**

i) Should the Contractor be required to purchase supplementary aggregate, either processed or unprocessed, the Contractor will be reimbursed the actual costs of that aggregate, less a deduction equal to the fixed price for Type 2 Surplus Aggregate in Stockpile, for each tonne of supplementary aggregate actually incorporated in the asphalt mix.

ii) The above deductions will also be effected when the supplementary aggregate is paid for by the Ministry under Subsections [501.44.01](#) through [501.44.05](#).

**501.45 Blending Additives** - The need for additives will be determined by the Ministry Representative.

**501.45.01 Ministry-Supplied Additives** - If the Contractor has provided aggregate whose gradation falls entirely within Subsections [501.15.01](#) through [501.15.03](#), and is required to blend additives, the Ministry will supply the additives f.o.b. the asphalt plant site.

**501.45.02 Payment** - Payment for blending additives will be at the actual cost incurred by the Contractor.

This price will be full compensation for unloading, handling, storing and blending the additive through a separate feeder.

**501.46 Adjustment for Haul** - To compensate for variation in haul caused by an order of the Ministry Representative changing the application rate to differ from that specified in

the Special Provisions or on the Drawings, an adjustment will be made for each applicable item. The difference between the average haul cost per tonne of the quantities at the specified application rate and the average haul cost of the quantities at the changed application rate, based on the haul from the Contractor's selected source(s), shall be calculated using the rate specified in [Appendix C, Item 8](#). The adjustment, equal to the calculated difference, times the number of tonnes actually placed, may result in an addition or a deduction. This adjustment applies to all items in the Schedule supplied by the tonne.

**501.47 Extra Handwork** - Where letdowns extend more than the minimum requirement of 1 m from the edge of the paver-laid pavement or immediately behind the concrete curb, the Contractor will be compensated at the rate specified in [Appendix C, Item 9](#) for mix laid beyond the 1 m or immediately behind the concrete curb to compensate for extra handwork. This rate shall also apply to the lift used in capping traffic islands.

No additional compensation over the price bid per tonne of asphalt mix for the appropriate items in the Schedule of Approximate Quantities and Unit Prices will be made for intersection work; acceleration and deceleration tapers; miscellaneous widening work; handwork around manholes, catch basins and water valves, and/or long letdowns placed by a paving machine.

**501.48 Single Stockpile** - Should the requirement of Subsection [501.32.03](#) be waived, and the Contractor is allowed to place all aggregate for the mix in a single stockpile, a monetary deduction as specified in [Appendix C, Item 10](#) will be made. This deduction will not be effected on mixing plants equipped with and utilizing hot screening decks.

**501.49 Reducing of Top Size of Aggregate** - If the Contractor, having supplied an aggregate meeting all the requirements of Subsections [501.14](#) and [501.15](#), is required by the Ministry Representative to reduce the top size, the Contractor will be compensated at the negotiated price under [Appendix C, Item 11](#) for all tonnage of aggregate so produced.

**501.50 Accommodation for Inspection Trailer including Supply of Water and Electricity** - The Contractor shall provide prepared site(s) for inspection trailer(s), if required by the Ministry Representative, at the plant site. The site must be made available upon commencement of crushing, or as directed by the Ministry Representative. The trailer will require a constant supply of water and will be on 100A demand.

The water tank will be supplied by the Ministry.



Payment for this work will be at the fixed rate set in [Appendix C, Item 12](#) and shall cover only the time that the Contractor's activities on actual project work are in effect. Heating fuel for the inspection trailer will be supplied by the Ministry.

Regardless of whether accommodation for inspection trailer is requested by the Ministry Representative as above, the Contractor will be required to provide material testing facilities at the crusher and plant as described in Subsection [145.18.02](#), the cost of which is considered to be included in

the unit prices bid.

**501.51 Surplus Mix** - The cost of any mix that has been deemed to be surplus by the Ministry Representative will be deducted under [Appendix C, Item 15](#) per tonne. This shall include all costs incurred by the Ministry and shall include but shall not be limited to the following: the cost of crushing, if applicable, royalties on the aggregate, and the cost of the asphalt cement incorporated into the surplus mix. The Contractor shall be responsible for the disposal of said surplus materials in a sound environmental manner.



## APPENDIX A

## 1) MARSHALL DESIGN CRITERIA

(See Subsection 501.15.06)

PROPERTY OF LABORATORY COMPACTED PAVING MIXTURE	A.M. or R.A.M. PAVEMENT CLASS		A.B.C. or R.A.B.C. PAVEMENT CLASS	
	1	2	1	2
ESALs	$>10^6$	$<10^6$	$>10^6$	$<10^6$
Number of blows each face of test specimens	75	75	75	75
Minimum % Voids in mineral aggregate for maximum particle size: 25.0 mm	---	13	13	13
Minimum % Voids in mineral aggregate for maximum size: 19.0 mm	14	14	---	---
Minimum % Voids in mineral aggregate for maximum size: 12.5 mm	14	14	---	---
Minimum % Voids in mineral aggregate for maximum size: 9.5 mm	16	16	---	---
Percentage of air voids in laboratory compacted mixture for: Coarse Mix	---	3 to 8	4 to 6	3 to 8
Percentage of air voids in laboratory compacted mixture for: Medium Mix	3 to 5	3 to 5	---	---
Percentage of air voids in laboratory compacted mixture for: Fine Mix	4 to 6	3 to 8	---	---
Minimum Marshall Load, N @ 60°C for 80 - 100	9000	7000	8000	7000
Minimum Marshall Load, N @ 60°C for 150 - 200 and 200 - 300	7000	6000	7000	6000
Flow index, units of 0.25 mm	8 to 14	8 to 16	8 to 14	8 to 16
Minimum Index of Retained Stability after immersion in water at 60°C for 24 hours	85%	75%	---	---

## 2) HVEEM DESIGN CRITERIA

(See Subsection 501.15.07)

	CLASS 1	CLASS 2
Minimum Hveem Stability for 80 - 100	37	35
Minimum Hveem Stability for 150 - 200 and 200 - 300	35	33
Minimum Cohesion	120	100



## APPENDIX B

## B. C. P. S. G.\*

**TABLE OF STANDARDS FOR NEW PAVEMENT**  
(See Subsection [501.17.02](#))

INTERVAL/ CLASSIFICATION (mm)	A	B	C	D	E
- 0.50 to + 0.50	44	34	30	20	15
- 1.00 to + 1.00	50	47	45	35	29
- 1.50 to + 1.50	---	50	49	44	39
- 2.00 to + 2.00	---	---	50	48	45
- 2.50 to + 2.50	---	---	---	49	47
- 3.00 to + 3.00	---	---	---	50	48
- 3.50 to + 3.50	---	---	---	---	49
- 4.00 to + 4.00	---	---	---	---	50

\* Using BCH Test II-10

## APPENDIX C

## SCHEDULE OF MONETARY ADJUSTMENTS

1	Pit Development for Supplementary Aggregates and Loading	W.O.	<a href="#">501.44.02</a>	---
2	Screening Supplementary Aggregates	W.O.	<a href="#">501.44.03</a>	---
3	Purchasing Supplementary Aggregates	Actual Cost	<a href="#">501.44.06</a>	Actual Cost
4	Hauling Supplementary Aggregates: 0 - 1 km	tonne/km	<a href="#">501.44.04</a>	\$0.61
	Hauling Supplementary Aggregates: 1 - 2 km			\$0.79
	Hauling Supplementary Aggregates: 2 - 3 km			\$0.98
	Hauling Supplementary Aggregates: 3 - 4 km			\$1.16
	Hauling Supplementary Aggregates: 4 - 5 km			\$1.34
	Hauling Supplementary Aggregates: 5 - 6 km			\$1.48
	Hauling Supplementary Aggregates: 6 - 7 km			\$1.59
	Hauling Supplementary Aggregates: 7 - 8 km			\$1.70
	Hauling Supplementary Aggregates: 8 - 9 km			\$1.80
	Hauling Supplementary Aggregates: 9 - ? km			add \$0.10/km

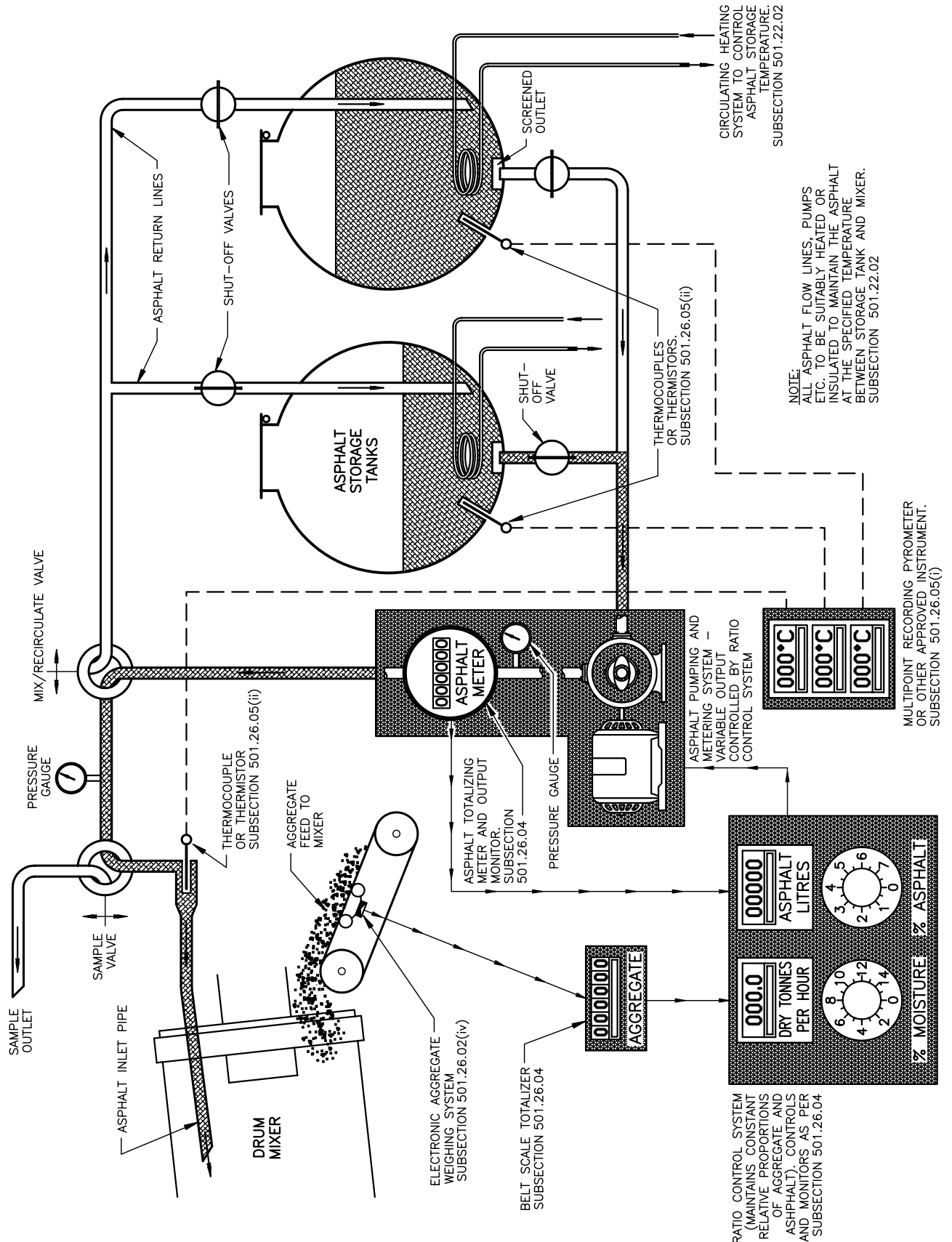


5	Blending Supplementary Aggregate: Coarse and Fine	tonne (t) Actual Cost	501.41.03 (i) 501.44.05	Actual Cost
	Blending Supplementary Aggregate: Mineral Fillers		501.44.05	Actual Cost
6	Blending Additives: Mineral Dust, Commercial Fillers and Crushed Limestone	tonne (t) Actual Cost	501.41.03 (i) 501.45.02	Actual Cost
	Blending Additives: Chemicals, Fibre, etc.	ℓ Actual Cost	501.41.03 (i) 501.45.02	Actual Cost
7	Surplus Aggregate in Stockpile: Type 1	tonne (t)	501.41.03 (ii) 501.15.01	\$3.00
	Surplus Aggregate in Stockpile: Type 2		501.43.02 (ii) 501.43.02 (iii)	\$1.50 \$0.40
	Crusher Reject – Surplus Aggregate: Type 3		501.41.02	\$0.40
	Surplus Aggregate in Stockpile: Type 3		501.43.02 (iv) 501.43.02 (vi)	\$0.40 \$0.40
8	Adjustment for Haul	tonne/kilometre (t/km)	501.46	\$0.15
9	Extra Handwork	m <sup>2</sup>	501.47	\$4.75
10	Single Stockpile (Drum Mixers)	tonne (t)	501.48	\$0.25 Deduction
11	Reducing Top Size	tonne (t)	501.49	Negotiated Unit Price
12	Accommodation for Inspection Trailer	trailer/month	501.50	\$500.00
13	Supplementary Aggregate Supplied or Paid for by the Ministry	tonne (t)	501.44.06 (i) & 501.44.06 (ii)	\$1.50 Deduction
14	Not Used			
15	Surplus Mix Deduction	Tonne	501.51	Calculated Cost
16	Further to the provision of Section 202.23, should the Contractor be instructed to move out from their chosen gravel pit due to reasons other than the ones mentioned in said clause, the Contractor will be paid, on completion of the move, a lump sum of \$2,500.00 for a normal crushing complex and a further sum of \$500.00 if any additional primary unit is involved, which will be deemed to be full compensation for all costs and expenses incurred by the Contractor as a result of the authorized move.			
17	Supply of additional bins/feeders	Substantiated Actual Cost	501.26.02 (i)	Substantiated Actual Cost
18	Reject Mix Asphalt Mix Aggregate	tonne	501.33.02	Crushing Cost Deduction
	Reject Mix Asphalt Cement		501.33.02	Actual Cost Deduction



# DIAGRAMATIC ASPHALT CIRCULATING AND PROPORTIONING SYSTEM – DRUM MIX PLANTS

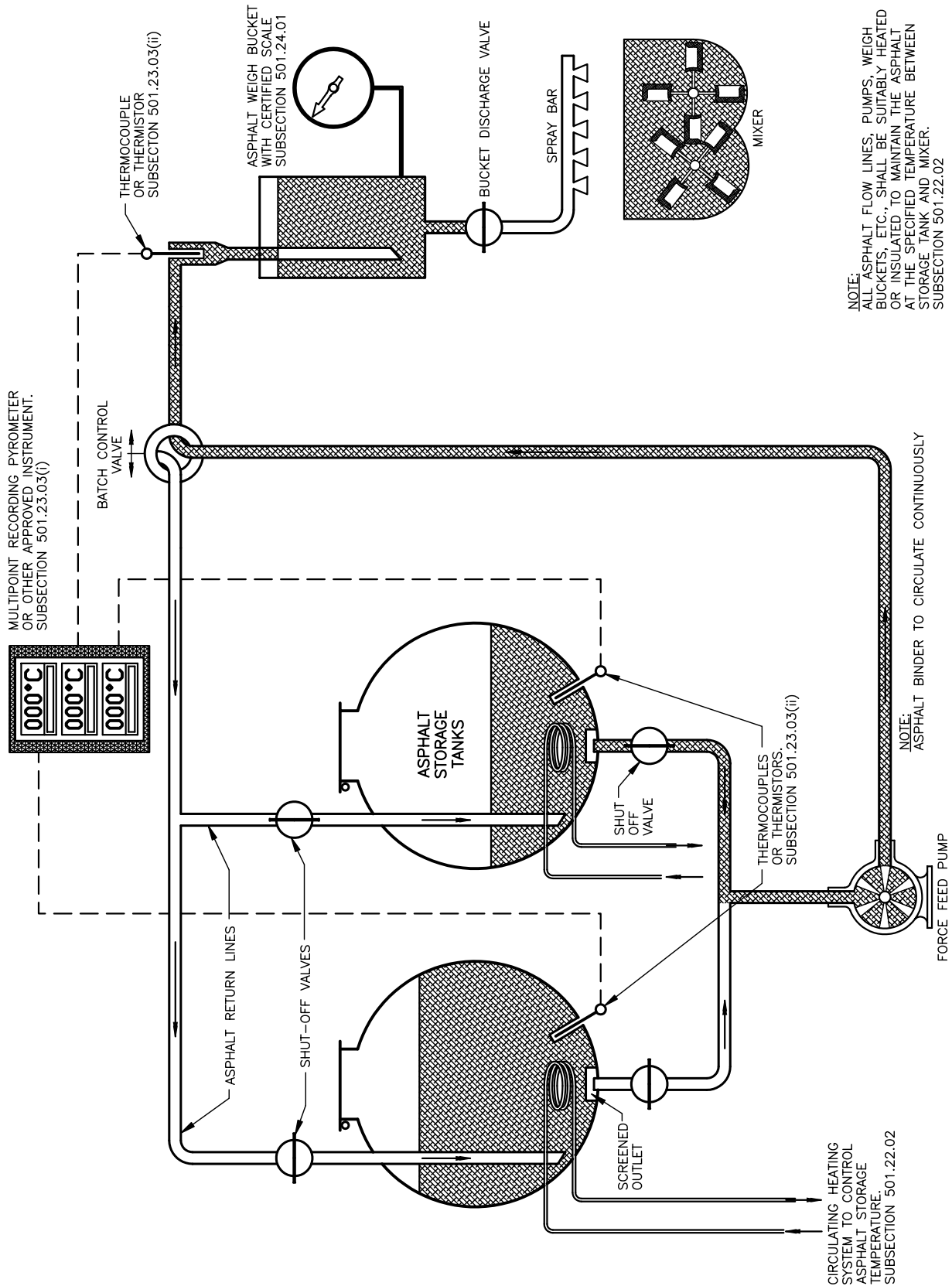
SP501-01





# DIAGRAMATIC ASPHALT CIRCULATING AND PROPORTIONING SYSTEM — BATCH TYPE MIXING PLANTS

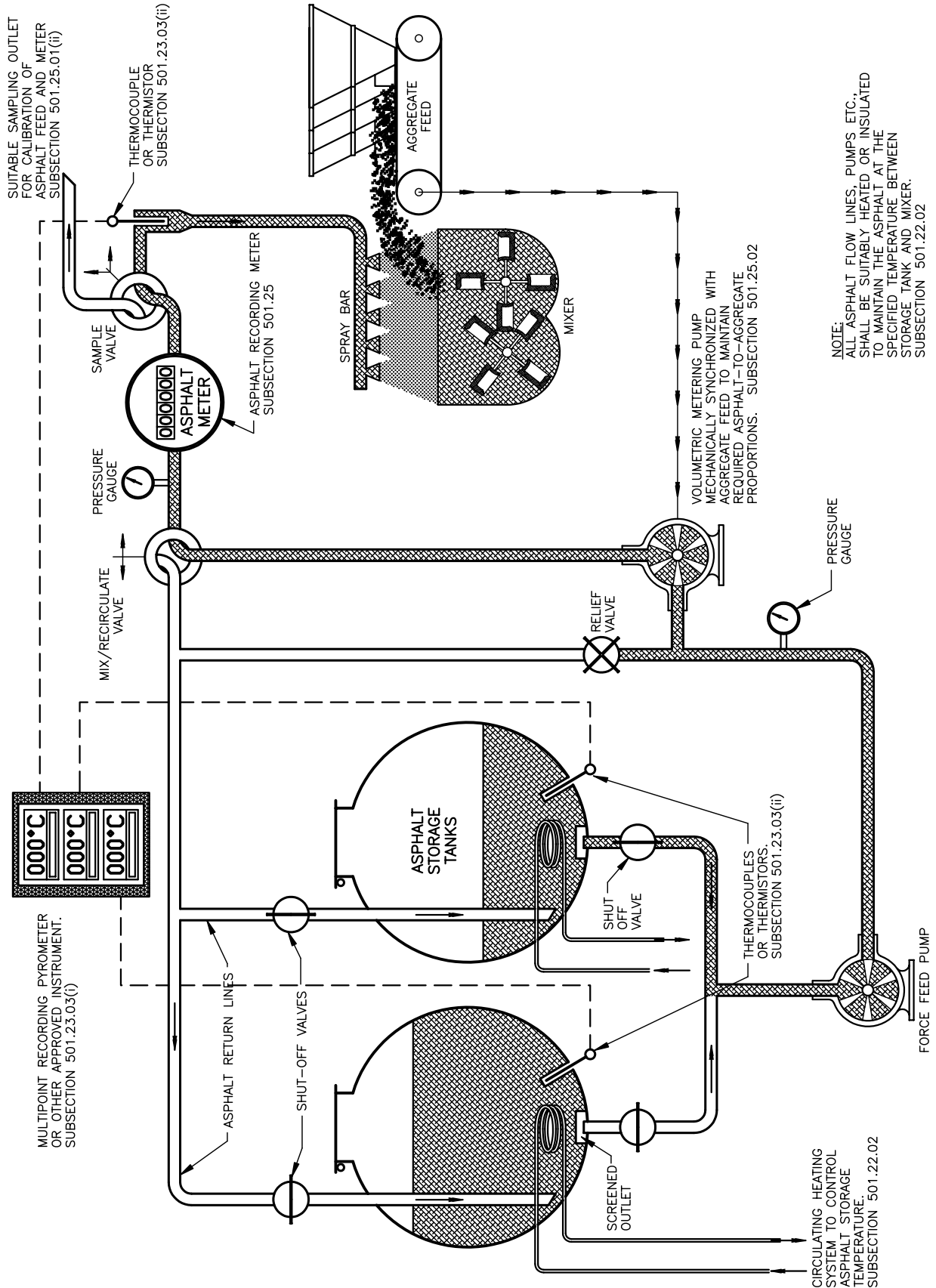
SP501-02



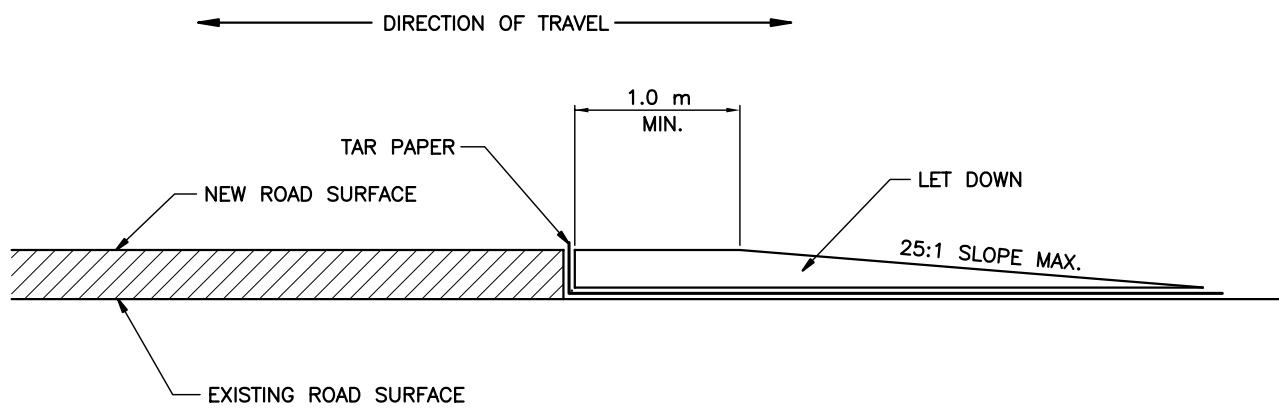


# DIAGRAMATIC ASPHALT CIRCULATING AND PROPORTIONING SYSTEM – CONTINUOUS MIX PLANTS

SP501-03





**NOTES:**

1. LEVEL SECTION OF LET DOWN TO FOLLOW SAME PROFILE AND CROSS FALL AS MAT ABUTTING THE TAR PAPER.
2. MATCHING PROFILE AND CROSS FALL SECTION TO BE AT LEAST 1 m IN LENGTH
3. 25:1 SLOPE CAN BE ALTERED IN SPECIAL PROVISIONS, DEPENDENT UPON LOCATION AND TRAFFIC.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 502

### END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

#### PART A - GENERAL

**502.01 Preliminary and General** – This Section describes the materials, equipment, professional standards and end product requirements for the construction of hot mixed hot laid asphalt pavement.

End Product Specifications contain the acceptance and payment criteria based on the results of specified sampling and testing. Payment of the contract Unit Prices for the asphalt pavement product is subject to adjustments upward and downward in accordance to the provisions provided in End Product Specifications (EPS).

**502.02 General Description Of Work** - Generally, the work associated with the construction of asphalt pavement by EPS consists of the following:

- Preparing a Quality Control Plan for evaluation before commencing the Work and providing at the production site a testing facility to provide the data needed to implement that plan.
- Supplying, screening, crushing, processing and improving aggregate to produce asphalt mix aggregate.
- Supplying and delivering asphalt cement and spray primer meeting the requirements of [Section 952](#).
- Preparing mix designs which, once verified by the Ministry Representative, become the basis for the accepted Job Mix Formula.
- Heating the asphalt mix aggregate and mixing it with asphalt cement to produce asphalt mix that meets the Job Mix Formula.
- Hauling, placing, compacting and finishing the asphalt mix.

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the contract. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice and those identified in [Section 501](#). Payment is subject to adjustments based on quality acceptance tests performed by the Ministry Representative and calculations performed by the Contractor with respect to application rate.

#### **502.03 Definitions Relevant To End Product Specification**

**502.03.01 End Product Specification (EPS)** - A specification whereby the Contractor is entirely responsible for quality control of the construction processes, and

whereby the Ministry performs the specified quality assurance sampling and testing of the end product for the purpose of determining acceptance/rejection and payment.

**502.03.02 Job Mix Formula** - The Job Mix Formula establishes the aggregate proportions, gradation, and the asphalt content to be used for production of asphalt mix. The Job Mix Formula is based on a Ministry reviewed asphalt mix design, in accordance with [Subsection 502.05.07](#), or on an accepted variation in accordance with [Subsection 502.05.09](#). In either case, each Job Mix Formula requires the evaluation of the Ministry Representative.

**503.03.03 Asphalt Content** - Asphalt Content means the quantity of asphalt cement in the mix expressed as a percentage by weight of the total dry aggregate in the mix.

**Design Asphalt Content** - The asphalt content upon which the Job Mix Formula is initially established.

**Approved Asphalt Content** - The design asphalt content or subsequent adjustment to it, embodied in a Job Mix Formula or revised Job Mix Formula which has been evaluated in writing by the Ministry Representative.

**Actual Asphalt Content** - Actual asphalt content is the amount of asphalt cement in the mix as determined by the Ministry's Quality Assurance Program.

**502.03.04 Smoothness** - Smoothness is a measure of the longitudinal profile of the pavement surface. The unit for measurement is the International Roughness Index (IRI).

**502.03.05 Sample Mean** - The Sample Mean is the arithmetic mean of a set of test results constituting the sample.

**502.03.06 Stratified Random Sample** - A Stratified Random Sample is a set of test measurements taken one each from a number of separate (stratified) areas or Sub-Lots within a Lot in an unbiased way.

**502.03.07 Lot** - A Lot is a portion of the work being considered for acceptance and for the determination of payment. A Lot is defined as follows.

For the application of the contract requirements for:

- Density,
- Asphalt Content,
- Aggregate Gradation, and
- Material Application Rate,



## SECTION 502

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

A Lot shall be one day's scheduled production of at least 7 hours plant production where no changes have occurred to criteria such as but not limited to:

- accepted Job Mix Formula,
- the specific lift that is being placed,
- the required material application rate.

A change in any above criteria may require a new Lot designation.

One day's production of less than 7 hours will be dealt with as follows:

- the material will be added to the next Lot that has the same criteria, as described above, except that if a test indicates that this production is subject to a payment adjustment or to rejection, or if no further material will be produced with the same criteria, this production will be designated as a separate Lot,

A Lot shall be no more than two days total production even if the above criteria have not changed or been met.

For application of the contract requirements for:

- segregation, and
- smoothness,

A Lot shall be one kilometre length of top lift pavement for each driving lane.

**502.03.08 Sub-Lots for Density, Asphalt Content, Gradation, and Smoothness** - For the application of the contract requirements for:

- density, asphalt content, and gradation, each Lot shall be divided into three equal Sub-Lots, defined by lineal metres of production.
- smoothness, each Lot shall be divided into 100 metre Sub-Lots.

**502.03.09 Driving Lane** - A driving lane shall mean a single lane in any area of the pavement other than a shoulder or a barrier flare.

**502.03.10 Surplus Aggregate** - Surplus aggregate is aggregate surplus to the works, in split or un-split stockpiles which singly or combined will meet the asphalt mix aggregate gradation. Surplus aggregate will be paid for as indicated in [Subsection 502.32.01](#). There will be no payment for reject aggregate.

### 502.04 Quality Control

**502.04.01 General** - Quality Control, by the Contractor, is the sum total of activities by the Contractor to ensure that a

product meets contract specification requirements. Quality Control includes material handling and construction procedures, calibration and maintenance of equipment, production process control and any sampling, testing and inspection that is done for these purposes.

The Contractor is responsible for all Quality Control under this specification. The Ministry Representative will audit and monitor the Contractor's operations and the implementation of the Contractor's Quality Control Plan.

The Ministry will not take samples for quality control testing and will in no manner assist in any degree or in any aspect of the Contractor's operation in the production of asphalt pavement, beginning from the production of aggregate through the compaction of asphalt mix.

The Ministry Representative may issue a Stop Work Order to the Contractor if the Contractor fails to adhere to the Quality Control Plan. The Ministry Representative will not issue a Resume Work Order until the Contractor has given the Ministry Representative satisfactory assurance that it has in place adequate capacity to fulfil the requirements of the Quality Control Plan. Further to Major Works General Condition 37.00 of the Construction Agreement, such action by the Ministry Representative is specifically excluded from the definition of "Reimbursable Delay".

**502.04.02 Quality Control Plan** - The Contractor shall prepare a detailed written Quality Control Plan that fulfils or exceeds the requirements of [Appendix I](#). The Contractor's Quality Control Plan shall be submitted to the Ministry Representative not less than five working days before the production of paving aggregate is started. The Ministry Representative will review the plan for approval based on whether or not it meets the Quality Control Requirements and Guidelines, and will respond, in writing, within five days. Any subsequent change to the Contractor's Quality Control Plan must also be submitted to the Ministry Representative, for approval, not less than twenty-four hours before such change is implemented.

The Contractor's Quality Control Plan shall include a description and schedule of the intended sampling, testing and reporting. The Quality Control Plan must also include a detailed description of the means by which the Contractor shall use the quality control test results to ensure that the asphalt materials, aggregate, mix production, paving and pavement compaction processes will be controlled to keep the end product within the specified limits. The Quality Control Plan must clearly show the flow of information from the quality control laboratory to the individuals who shall make the actual adjustments to the processes and equipment to effect this control. The plan will show time allowance for each step, the names and positions of all the people



involved, and a clear description of the responsibilities of each.

**502.04.03 Quality Control Testing and Inspection** - The Contractor shall provide and maintain equipment and qualified personnel to perform all laboratory testing, field testing and inspection necessary to determine and monitor the characteristics and properties of all the materials produced and incorporated into the work. They shall also monitor the workmanship of the final product in accordance with the Quality Control Plan as most recently submitted.

The Contractor's Quality Control testing and inspection shall utilise a qualified registered member of the Association of Professional Engineers and Geoscientists of British Columbia or a qualified, registered member of the Applied Science Technologists and Technicians of British Columbia who shall oversee all aspects of the Quality Control testing and inspection. This person shall be designated as the Quality Control Manager for the purposes of these specifications. The Quality Control Manager shall be responsible for preparation and sign off of the Quality Control Plan, approving all quality control staff, all Quality Control testing and inspections and for the signing and the submission, within 5 working days, of all Quality Control testing and inspection records to the Ministry.

The Contractor shall provide a testing facility(s) that meets the requirements necessary to carry out all the test procedures listed within this Section. The facility(s) must have the equipment specified under the appropriate test designation to perform the tests. The Ministry shall have access at all times to the quality control facility(s).

**502.04.04 Quality Control Records** - The results from quality control testing shall be reported on test logs and plotted on charts immediately after each test is completed. The Contractor shall report all test results on Ministry supplied forms available from the Ministry Representative. Reports and charts shall be available for viewing to the Ministry Representative, within 24 hours of the end of each shift.

For the purposes of confirming delivery of asphalt mix to the road and the calculation of material application rates, the Contractor shall provide to the Ministry Representative a copy of the Road Checker's Summary and the weigh tickets for each load received at the paving operation at the end of each shift. The Road Checker's Summary shall include, but not be limited to, the following information:

- a) Truck Number
- b) Weigh Ticket Number and Net Weight of load
- c) Time and location by station of delivery
- d) Material Application Rate Dimensions and Calculations. Calculation frequency minimally shall be for every 10 loads.
- e) Notes pertaining to the paving of any appurtenances (letdowns, intersections, tapers, etc.)

ASTM test procedures are to be followed.

**TABLE 502-A-1 – STANDARD SAMPLING AND TESTING PROCEDURES FOR AGGREGATES**

All aggregate tests shall use the following sieve sizes:

37.5mm, 25mm, 19mm, 16mm, 12.5mm, 9.5mm, 4.75mm, 2.36mm, 1.18mm, .600mm, .300mm, .150mm, and .075mm.

Item	Procedure	Test Reference No.
1	Sieve Analysis of Fine And Coarse Aggregates	ASTM C-136
2	Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing	ASTM C-117
3	Specific Gravity and Absorption of Coarse Aggregate	ASTM C-127
4	Specific Gravity and Absorption of Fine Aggregate	ASTM C-128
5	Determining the Percentage of Fractured Particles in Coarse Aggregate	ASTM D-5821
6	Total Moisture Content of Aggregate by Drying	ASTM C-566
7	Standard Practices for Sampling of Aggregates	ASTM D-75



**TABLE 502-A-2 – STANDARD SAMPLING AND TESTING PROCEDURES FOR ASPHALT CEMENT**

Item	Procedure	Test Reference No.
1	Penetration of Bituminous Materials	ASTM D-5
2	Viscosity of Asphalt by Vacuum Capillary Viscometer	ASTM D-2171

**TABLE 502-A-3 – STANDARD SAMPLING AND TESTING PROCEDURES FOR ASPHALT MIX AND PAVEMENT**

Item	Procedure	Test Reference
1	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures	ASTM D-2726
2	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin Coated Specimens	ASTM D-1188
3	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	ASTM D-1559
4	Effect of Water on Compressive Strength of Compacted Bituminous Mixtures	ASTM D-1075
5	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures	ASTM D-2041
6	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures	ASTM D-3203
7	Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture	ASTM D-4469
8	Sampling Compacted Bituminous Mixtures for Laboratory Testing	ASTM D-5361
9	Determining Asphalt Content by Ignition Method	ASTM D-6307
10	Combining Loose Mix for the purpose of Determining Asphalt Content and Gradation	ATTACHMENT 2

**TABLE 502-A-4 – TEST SAMPLE SOURCE LOCATIONS**

Test	Sample Source:
Density	100mm dia. road cores; 150mm dia. Road cores for Superpave
Asphalt Content	Loose Mix Samples
Smoothness	Driver's Wheel-path
Aggregate Gradation	Loose Mix Samples
Segregation	Roadway Pavement

All equipment and the laboratory shall be well maintained and in good working condition. All testing equipment shall be calibrated and evidence of the calibration shall be

provided when requested by the Ministry Representative. For the purpose of obtaining accurate and consistent results between the Contractor's Quality Control testing and the



Ministry's Quality Acceptance testing, correlation of the Marshall hammer and ignition ovens to be used on the project shall be performed during the verification of the Job Mix Formula.

**502.04.05 Final Quality Control Testing Reports** - Prior to the issuance of a Completion Certificate, in accordance with [Article 26.00 of Section 115](#), the Contractor shall provide the Ministry Representative with:

- a summary of all aggregate quality control test results;
- copies of all quality control test results for asphalt mix properties and compaction; and
- copies of all quality control charts.

**502.04.06 Minimum Acceptable Construction Practices** - Good construction practices shall be considered as standard construction procedures to be followed and shall include but not be limited to the procedures described below.

**Tack Coating** - The surface to be tack coated shall be cleaned of dirt or other foreign material.

**Vertical Surfaces** - Vertical surfaces of roadway appurtenances shall be hand sprayed to the top of the new pavement only.

**Tack Coat – Application** - Tack coat shall not be applied on sections of roadway longer than will be covered by one day of asphalt plant production.

**Stockpiles** - Stockpiles of different types of material shall be located and constructed in such a manner as to prevent intermingling of the types and to prevent segregation.

**Haul Vehicles** - Lubrication of the truck boxes with diesel fuel will not be permitted. All vehicles shall have adequately insulated truck boxes and shall be equipped with an insulating tarpaulin of such size as to completely protect the asphalt mix.

**Longitudinal Joints** - Longitudinal joints in the top lift of asphalt pavement will only be permitted where lane dividing lines are to be painted. Longitudinal joints in a lift shall be offset at least 150 mm from joints in the underlying lift.

**Longitudinal Edge** - Where an unprotected longitudinal edge has been damaged by traffic or equipment it shall be trimmed to provide a vertical abutting face.

**Contact Edge** - The contact edge of abutting cooled asphalt pavement shall be thoroughly painted with a uniform coat of emulsified asphalt.

**Paving Adjoining Mats** - When paving an adjoining

parallel mat there shall be at least a 50-mm overlap onto the previously paved surface. This overlap shall be properly constructed to form a homogeneous bond between the two mats.

**Raking** - Any material that is raked from the joint shall not be placed on the new mat or placed in or in front of the paver. The Contractor shall dispose of the material in an environmentally acceptable manner.

**Discontinued Paving** - When paving is discontinued in any lane on a traffic bearing roadway, the asphalt pavement shall be tapered down at a minimum slope of 25:1. When paving resumes this letdown shall be cut back so as to form a vertical face that matches the required depth being paved. Material removed from the taper shall be disposed of in an environmentally friendly manner.

**Rollers** - Rollers shall normally operate with the drive wheel nearest the paver and at a speed not in excess of 8 km/h. They shall not be driven on to or off, the unprotected longitudinal edge of the unfinished mat and shall not be allowed to park on the mat prior to complete cooling.

#### **502.05 Supply Of Aggregates, Asphalt Materials, Asphalt Mix Design And Job Mix Formula**

**502.05.01 Work in Ministry Pits or Quarries** - When operating in a Ministry pit or quarry, the Contractor shall comply with all provisions of [Subsection 145.26](#).

Variations to the code are available from the District Manager, Transportation.

**502.05.02 Supply of Aggregates, Aggregate Production and Characteristics** - The Contractor shall not produce paving aggregate until the Contractor has received written notification that their Quality Control Plan is in accordance with [Subsection 502.04.02](#), and has in place testing facilities for aggregate production that are in accordance with the Quality Control Plan.

For the production of Asphalt Mix Aggregate, within Ministry pits, the Contractor shall provide crushing equipment such that all aggregate which will pass through 375 mm x 450 mm slotted openings shall be used for the production of crushed aggregate. Rocks, which will not pass through these openings, shall be stockpiled as directed by the Ministry Representative. Crushing and screening equipment shall be provided with adequate facilities and capacity to be able to bleed off reject aggregate and remove any excess fine aggregate, dust or objectionable aggregate coatings, to make it generally acceptable for use. No portion of the products from crushing or screening plants that can be used shall be wasted, but shall be stockpiled or used as



## SECTION 502

directed by the Ministry Representative.

Where the Ministry has available any test result information on the properties shown in [Table 502-B](#), for a Ministry pit or other source, the Ministry Representative will upon request, provide that information to the Contractor. Otherwise, sampling and testing to determine and demonstrate the compliance of paving aggregate with the requirements of this Section shall be the responsibility of the Contractor.

Paving aggregates shall meet the following requirements:

### a) Coarse Aggregates

- i) shall be all mineral matter retained on the sieve designated in the test procedures for each individual test.
- ii) shall consist of crushed stone, crushed gravel, or combination thereof, or materials naturally occurring in a fractured condition, or materials naturally occurring of highly angular nature or rough texture.
- iii) shall be free from coating of clay, silt or other deleterious material, and shall meet the requirements listed in [Table 502-B](#).

### b) Fine Aggregate

- i) shall be all mineral matter passing the sieve designated in the test procedure for each individual test.
- ii) shall be clean, tough, durable, moderately sharp, and free from coatings of clay, silt, or other deleterious material, and shall contain no clay balls or other aggregations of fine material.
- iii) shall have a maximum mass loss after five

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

cycles of not more than 18% and 23% for pavement Class 1 and 2 respectively when tested in accordance with ASTM Test C-88.

iv) shall have a sand equivalent of not less than 40 when tested in accordance with ASTM Test D-2419

v) shall have a minimum value of 45 when tested according the AASHTO Test T 304, Method "A", - Uncompacted Void Content of Fine Aggregate when determining Fine Aggregate Angularity.

### c) Mineral Filler and Mineral Dust

i) Mineral filler shall consist of all matter passing the 0.600-mm sieve and mineral dust shall consist of all mineral matter passing the 0.075-mm sieve.

ii) Mineral filler and mineral dust shall be free from organic matter.

iii) Mineral filler shall be non-plastic when tested in accordance with ASTM Test D-4318.

iv) determination of aggregate properties and gradation for superpave

d) For the purposes of the mix design for Superpave, the gradation of the design mix and the subsequent Job Mix Formula, shall be of the properties and the gradation limits as specified below and in accordance with the SHRP Standards for a Superpave Level I Mix Design contained in the Asphalt Institute's Superpave Series Publication - Superpave Level I Mix Design SP-2. Changes and/or variations from these limits shall be outlined within the Contract Special Provisions.

i) 90% fractured aggregate with a 12.5mm nominal maximum size, including sufficient

**TABLE 502-B – REQUIREMENTS FOR COARSE AGGREGATES**

TEST REF. #	PROCEDURES	PAVEMENT CLASSES		
		Super pave	1	2
ASTM C-127	Maximum Water Absorption: % by mass	2	2	2
ASTM C-88	Soundness of Aggregate Maximum loss after 5 cycles	15	15	20
ASTM C-142	Maximum % by mass of clay balls and friable particles	1.0	1.0	1.5
BCH 1-9	Minimum Degradation Factor	35	35	35
ASTM D-5821	2 Fractured Faces: Minimum % by Mass retained on the 4.75 mm sieve	90	85	70



manufactured fines to provide fine aggregate angularity. The aggregates must meet all the requirements for angularity, toughness, soundness, deleterious materials, clay content and thin, elongated particles. Design ESALs will be 10 – 30 million.

ii) A dense graded gradation with a 19.0mm maximum size aggregate restricted to the following:

1) Passing below the following boundaries of the aggregate restricted zone:

SIEVE SIZE	MIN/MAX PERCENT PASSING BOUNDARIES FOR 12.5mm Nominal Max. Aggregate Size
2.36mm	39.1/39.1
1.18mm	25.6/31.6
0.600mm	19.1/23.1
0.300mm	15.5/15.5

2) The design gradation shall be within the following specified control points:

CONTROL POINT (PERCENT PASSING)		
SIEVE SIZE	Minimum	Maximum
0.075mm	2.0	10.0
2.36mm	28.0	58.0
9.5mm	-	90.0
Nominal Maximum (12.5mm)	90.0	100.0
Maximum (19.0mm)	100.0	-

**502.05.03 Supply of Asphalt Cement and Spray Primers**

- The Contractor shall supply the types and grades of asphalt cement and spray primers as specified in the Special Provisions and in accordance with [Section 952](#). The supply of these materials includes, but is not limited to, ordering, scheduling delivery of, receiving, handling, storing, sampling, and testing of the materials and other related work.

The Contractor shall supply the Ministry Representative with copies of the asphalt supplier's weigh-bill and records of all asphalt materials received on a daily basis.

**502.05.04 Responsibility for Asphalt Mix Design -**  
Preparation and submission of the project asphalt mix

designs for Ministry review is the responsibility of the Contractor. All costs incurred in mix design formulation are the responsibility of the Contractor.

The Contractor shall utilise a qualified registered member of the Association of Professional Engineers and Geoscientists of British Columbia or a qualified, registered member of the Applied Science Technologists and Technicians of British Columbia who shall sign off the asphalt mix design. The Contractor shall also utilise a qualified testing laboratory meeting the requirements of [Subsection 502.04.03](#) and acceptable to the Ministry, to assess the aggregate material proposed for use and to carry out the asphalt mix designs.

**502.05.05 Requirements for Asphalt Mix Design -** The asphalt mix design for Class 1 and Class 2 pavements shall be carried out under the design criteria for Marshall design using the designated equipment and procedures as contained in the Asphalt Institute's Mix Design Methods for Asphalt Concrete MS-2, latest edition.

Asphalt mix designs, Job Mix Formulas and field adjustments made in accordance with [Subsection 502.05.09](#), must all be based on an aggregate gradation meeting the requirements of [Table 502-C-1](#).

The divergence limits, as defined in [Table 502-G](#), when applied to the gradation of the Job Mix Formula, shall not result in a gradation that is outside of the limits as shown in [Table 502-C-1](#).

The Superpave asphalt mix design shall be carried out in accordance with the Superpave Level I Mix Design contained in the Asphalt Institute's Superpave Series Publication - Superpave Level I Mix Design SP-2.

Asphalt mix designs shall be performed using asphalt cement of the penetration grade described in the Special Provisions and which is from the same refinery contracted to supply the asphalt cement for the duration of the project.

Any subsequent change in the asphalt cement supplied by the Contractor will require a new asphalt mix design unless permitted otherwise by the Ministry Representative.

Marshall asphalt mix designs shall be performed to meet the criteria specified in [Table 502-C-2](#) for the class of pavement specified in the Special Provisions.

**502.05.06 Asphalt Mix Design Submittals -** The Contractor shall submit each asphalt mix design to the Ministry Representative for review that it complies with the requirements of the Contract, and shall not proceed until the review is received in writing from the Ministry Representative. The Contractor's submissions shall include



## SECTION 502

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

the following information:

- The gradation of each aggregate to be used in each mixture.
- The percentage by mass of each aggregate to be used

in each mixture.

- The design gradation of the combined aggregate for each mixture.
- All asphalt mix design data used in arriving at the

**TABLE 502-C-1 – AGGREGATE GRADATION LIMITS**

SIEVE SIZE (mm)	PERCENTAGE BY MASS PASSING		
	COARSE ASPHALT MIX	MEDIUM ASPHALT MIX	FINE ASPHALT MIX
37.5	100	---	---
25.0	80 - 100	---	---
19.0	60 - 92	100	---
12.5	50 - 85	84 – 97	100
9.50	40 - 80	73 – 90	90 - 100
4.75	30 - 65	50 – 75	55 - 80
2.36	20 - 50	35 – 57	32 - 64
1.18	15 - 35	26 – 45	24 - 51
0.600	8 - 30	18 – 34	17 - 40
0.300	6 - 22	10 - 26	13 - 29
0.150	3 - 15	6 - 17	8 - 18
0.075	1 - 7	3 - 7	4 - 10

**TABLE 502-C-2 – MARSHALL DESIGN CRITERIA**

PROPERTY OF LABORATORY COMPACTED PAVING MIXTURE	PAVEMENT CLASS	
	1	2
Number of blows each face of test specimens	75	75
Minimum % Voids in mineral aggregate for maximum particle size: 25.0 mm	--	13
Minimum % Voids in mineral aggregate for maximum particle size: 19.0 mm	14	14
Minimum % Voids in mineral aggregate for maximum particle size: 12.5 mm	15	15
Minimum % Voids in mineral aggregate for maximum particle size: 9.5 mm	16	16
Percentage of air voids in laboratory compacted mixture for: Coarse Mix	--	3 to 6
Percentage of air voids in laboratory compacted mixture for: Medium Mix	2.5 to 4.5	2.5 to 4.5
Percentage of air voids in laboratory compacted mixture for: Fine Mix	4 to 6	3 to 6
Minimum Marshall Load, N @ 60°C for 80 – 100 Pen.	9000	7000
Minimum Marshall Load, N @ 60°C for 150 – 200 and 200 – 300 Pen.	7000	6000
Flow index, units of 0.25 mm	8 to 14	8 to 16
Asphalt Film Thickness	Min. 7.5 microns	Min. 7.5 microns
Minimum Index of Retained Stability after immersion in water at 60°C for 24 hours	85%	75%



final mix designs.

- The design asphalt content expressed as a percentage of the dry weight of the aggregate.

**502.05.07 Review of Asphalt Mix Design** - The Ministry Representative will require up to 5 calendar days from the time of receipt of the asphalt mix design for review. The mix design must be reviewed prior to commencement of pavement construction.

When the Ministry Representative has confirmed in writing that the Contractor's asphalt mix design has been accepted, the accepted asphalt mix design becomes the Job Mix Formula for the start of production.

**502.05.08 - Verification of Job Mix Formula -**

Verification of the Job Mix formula will be carried out by the Contractor during the course of production of the first Lot. The Contractor will provide a Job Mix Formula with supporting verification data, which shall include all the information, but not limited to, the requirements of [Subsections 502.05.05 and 502.05.06](#).

**502.05.09 Field Adjustment of Job Mix Formula** - A field adjustment to the Job Mix Formula is defined as a change in the asphalt cement content of the mix, aggregate gradation and/or proportioning of various aggregate sizes, within the specified limits as shown in [Table 502 - D](#) without review and acceptance of a new asphalt mix design.

The proposed field adjustment shall be submitted in writing together with supporting documentation to the Ministry Representative. Within four hours of receipt of the proposed field adjustments, the Ministry Representative will review the field adjustment for conformance with the contract requirements and notify the Contractor whether or not it is acceptable.

The Contractor's field adjustment to the Job Mix Formula must comply with the Asphalt Mix Design requirements of

Subsections [502.05.05](#) and [502.05.06](#). The Contractor shall provide all supporting verification data

After the Job Mix Formula has been established in accordance with [Subsection 502.05.09](#), no field adjustment to that Job Mix Formula will be permitted without prior written acceptance by the Ministry Representative. The Ministry Representative will limit the number of field adjustments to the Job Mix Formula originally derived from the laboratory mix design, to two.

No field adjustment will be acceptable if it results in a change from the Job Mix Formula, for any property, in excess of the maximum adjustment for that property permitted in the following table:

**PART B - PAYMENT ADJUSTMENTS**

**502.11 Density**

**502.11.01 Coring** - The Contractor shall be responsible for providing all core samples for quality assurance and payment adjustment purposes. The randomly selected locations for the cores shall be supplied by the Ministry Representative to the Contractor. The Contractor shall provide 100mm diameter cores for these purposes. For projects utilizing a Superpave product, 150mm diameter cores shall be required. The Contractor shall prepare the cores prior to the submission by removing all material not representative of the pavement lift to be tested. The Contractor shall deliver these cores to the Ministry Representative on site, within 24 hours of being provided the locations for the coring.

The Contractor shall fill and compact the core holes immediately after the extraction of the cores.

All costs associated with the obtaining the cores, including the filling and compaction of the core holes are considered

**TABLE 502-D – FIELD ADJUSTMENT OF JOB MIX FORMULA**

Job Mix Formula Property	Maximum Field Adjustment
Asphalt cement content	± 0.2
Percentage passing 25.0 mm and 19.0 mm, sieves	± 2.0
Percentage passing 12.5 mm, and 9.5 mm sieves	± 2.0
Percentage passing 4.75 mm, 2.36 mm	± 1.5
Percentage passing 1.18mm, .600mm,	± 1.5
Percentage passing .300mm and .150mm sieves	± 1.5
Percentage passing .075 mm sieve	± 0.50



## SECTION 502

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

incidental to the contract and are the responsibility of the Contractor.

**502.11.02 Percent Density** - The average in-place density will be determined from core samples of the completed lift of pavement.

One random core sample will be obtained from each Sub-Lot and the test results for the three Sub-Lots will be averaged to determine the percent density for the Lot.

### Marshall Mixes

$$\text{Marshall Percent Density} = \frac{\text{In-Place Density of Sample}}{\text{Plant Briquette Density}} \times 100$$

For the determination of Mix Briquette Density, the Contractor shall obtain the samples as outlined in [Appendix 2](#) for each Sub-lot. The samples shall be obtained from the road using a sampling tray to be picked up immediately after placement by the paver. The samples will not be taken from the inside wheel path area. All handwork to replace material from the sampling tray area shall be performed expediently by the Contractor and all costs associated with sampling, and subsequent handwork shall be the Contractor's responsibility.

From each Sub-lot sample, the Contractor will form three briquettes as per the procedure identified in [Table 502-A-3](#) and tested, and the test results will be averaged to obtain the test value for that sample.

The Mix Briquette Density for a Lot is the average of the test results from the three Sub-lots. The Mix Briquette Density value for the Lot shall be provided to the Ministry Representative prior to the provision of the coring locations to the Contractor.

At the discretion of the Ministry Representative, the Ministry may at any time, perform and use the Ministry results in accordance with procedures as outlined above, to obtain the value for Mix Briquette Density which will replace the values achieved under the Quality Control Testing.

Should the initial test results in any Sub-Lot be lower than 92.0%, one additional core will be taken and tested, and that result shall replace and be averaged with the initial result to determine the percent density for the Sub-Lot.

### Superpave Mixes

$$\text{Superpave Percent Density} = \frac{\text{In-Place Density of Sample}}{\text{Maximum Theoretical Density (ASTM D-2041)}} \times 100$$

The average in-place density will be determined from 150mm diameter core samples of the completed lift of pavement.

The Maximum Theoretical Density for a Lot is the value calculated defined as the average of the test results from the three sub lots. The Maximum Theoretical Density value for the Lot shall be provided to the Ministry Representative prior to the provision of the coring locations to the Contractor.

**502.11.03 Payment Adjustments** - The payment adjustment for percent density will be the amount shown in [Table 502-E-1](#) and [502-E-2](#) for the Sample Mean of the test results for the Lot.

**502.11.04 Rejection Limit** - The rejection limit for percent density is the limiting value of the Sample Mean as shown in [Table 502-E-1](#) and [502-E-2](#), beyond which the Sub-Lot is rejected and not paid for.

Acceptance or rejection will be determined for each Sub-Lot. One opportunity will be provided to the Contractor, using non-destructive test methods, to isolate the area of low density and conduct additional compaction providing no damage is incurred to the new pavement. One additional core will be taken randomly in the area of low density and will replace the core with previous low density and a new value will be calculated. The Ministry Representative shall be advised as to the scheduling of the re-compaction effort prior to the work taking place.

Where the Lot average density is less than 96%, the Contractor shall either overlay or remove and replace the previously placed mix. If the test result for density of a Sub-Lot is outside the acceptance limits, the Sub-Lot is rejected automatically regardless of the values of other acceptance parameters. To minimize the cost of rejection to the Contractor, the Contractor will be provided the opportunity to isolate the area of low density within the Sub-lot. The limits of the low density area must be verified and approved by the Ministry Representative before remedial work proceeds.

Where the Lot average density is less than 91%, the Contractor shall either overlay or remove and replace the previously placed mix.

**502.11.05 Payment for Rejected Work Made Acceptable** - The payment adjustment for density will be based on testing of the replacement or overlay material where applicable. Where replacement or overlay material does not cover the entire Lot or Sub-Lot, prior tests of the uncovered area will be averaged with new tests on the corrective work.



**TABLE 502-E-1 – PAYMENT ADJUSTMENTS FOR DENSITY – MARSHALL**

% Density Lot Average	Payment Adjustment (\$ Per Tonne) for Design Lift Thickness
98.6 Plus	+\$1.00
98.1 – 98.5	+\$0.75
97.6 – 98.0	+\$0.50
97.0 – 97.5	+\$0.25
96.6 – 96.9	-\$0.50
96.0 – 96.5	-\$1.00
95.9 or less	Reject

If any Sub-Lot has a density below 96%, the Sub-Lot shall be considered rejectable, and, subject to the Contractor's opportunity to increase the density as described in [Subsection 502.11.04](#), shall be rejected.

**TABLE 502-E-2 – PAYMENT ADJUSTMENTS FOR DENSITY - SUPERPAVE**

% Density Lot Average	Payment Adjustment (\$ Per Tonne) for Design Lift Thickness
95.0 Plus	+\$1.00
94.0 – 94.9	+\$0.75
93.0 – 93.9	+\$0.50
92.0 – 92.9	+\$0.25
91.6 – 91.9	-\$0.50
91.0 – 91.5	-\$1.00
90.9 or less	Reject

If any Sub-Lot has a density below 91%, the Sub-Lot shall be considered rejectable, and, subject to the Contractor's opportunity to increase the density as described in [Subsection 502.11.04](#), shall be rejected. Percent Density is based on a comparison to the Maximum Theoretical Density.

## 502.12 Asphalt Content

**502.12.01 Determination of Asphalt Content** - The asphalt content of the asphalt mix will be determined from loose mix samples obtained from each Sub-Lot (3 per Lot) and tested in accordance with ASTM test procedures listed in [Table 502-A-3](#).

One random sample will be obtained from each Sub-lot as per [Appendix 2](#). The asphalt content of the asphalt mix will be determined using the average of the results obtained from all of the Sub-lot samples. The Actual Asphalt Content of the Lot will be compared to the Job Mix Formula Asphalt Content and the deviation will be used for payment adjustment purposes.

**502.12.02 Payment Adjustments** - The payment adjustment for asphalt content will be the amount shown in [Table 502-F](#).

**502.12.03 Rejection Limit** - Rejection limits for asphalt content are the limiting values of the Sample Mean as shown in [Table 502-F](#), beyond which the Lot is rejected and not paid for.

If the asphalt content of a Lot is outside the acceptance limits, the Lot is rejected automatically regardless of the values of other acceptance parameters.

**502.12.04 Payment for Rejected Work Made Acceptable** - The payment adjustment for Asphalt Content will be based on testing of the replacement or overlay material where applicable. Where replacement or overlay material does not cover the entire Lot or Sub-Lot, prior tests of the uncovered area will be averaged with new tests on the corrective work.



## SECTION 502

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

### 502.13 Aggregate Gradation

**502.13.01 Determination of Aggregate Gradation - Table 502-C-1**, Aggregate Gradation Limits specifies the aggregate gradation limits which asphalt mix design, Job Mix Formulas, and field adjustments made in accordance with **Subsection 502.05.09**, must be based.

**Table 502-G** shows the limiting values for acceptance and for the determination of payment adjustments. These limits are expressed as departures, on each specified sieve size, from the percentage of material passing that sieve according to the Job Mix Formula. Aggregate gradation will be determined for each Lot from loose mix samples of the completed lift of pavement. One random sample will be obtained from each Sub-lot, and the aggregate gradation for the Lot will be determined by using the average of the 3 sub-lot tests to determine the Sample Mean.

Divergence from the job mix formula gradation shall not vary outside of the limits identified in **Table 502-C-1**.

#### 502.13.02 Payment Adjustments -

- a) Where the Sample Mean for every specified sieve size falls within the applicable limiting value prescribed in Column 3 of **Table 502-G**, the Lot will be accepted with a payment adjustment of + \$0.75 per tonne.
- b) Where the Sample Mean for every specified sieve size falls within the applicable limiting value prescribed in Column 2 of **Table 502-G**, but the Lot is not eligible

under (a) above, the Lot will be accepted with no payment adjustment.

- c) Where the Sample Mean for every specified sieve size falls within the applicable limiting value prescribed in Column 1 of **Table 502-G**, but the Lot is not eligible under either (a) or (b) above, the Lot will be accepted with a payment adjustment of - \$1.50 per tonne.

**502.13.03 Rejection Limit** - Rejection limits for aggregate gradation are the limiting values of the Sample Mean for any one, or more, of the specified sieve sizes, as shown in Column 1 of **Table 502-G**.

If the Sample Mean value for any specified sieve size exceeds the values shown in **Table 502-G**, or the divergence of the job mix formula gradation is outside the limits of **Table 502-C-1**, the Lot will be rejected and not paid for, regardless of the values of other acceptance parameters.

#### 502.14 Material Application Rate

**502.14.01 Determination of Material Application Rate** - Asphalt mix shall be applied to the roadway at the rate or rates specified in the Special Provisions, on the Drawings or as otherwise directed by the Ministry Representative. Material Application Rates will be determined by the tonnage delivered to the paver as recorded by weigh tickets generated by automated scales, divided by the area covered by the Lot after allowance has been made for entrance letdowns and/or intersections. The Contractor shall provide the material application rate calculations to the Ministry

**TABLE 502-F – PAYMENT ADJUSTMENTS FOR ASPHALT CONTENT**

Deviation of the Actual Asphalt Content from the Approved Asphalt Content (either above or below) kg/100kg of Dry Aggregate	Payment Adjustment for Asphalt Content \$ per tonne	
	Top Lift	Lower Lift
From 0 to 0.15	\$0.50	\$0.50
From 0.16 to 0.30	\$0.00	\$0.00
From 0.31 to 0.35	-\$1.00	-\$1.00
From 0.36 to 0.40	-\$2.00	-\$2.00
From 0.41 to 0.45	-\$3.00	-\$3.00
From 0.46 to 0.50	-\$4.00	-\$4.00
From 0.51 to 0.55	Reject	-\$5.00
0.56 and greater	Reject	Reject
For top lift deviations of more than 0.50 the Contractor shall either overlay or remove and replace the Lot.		
For lower lift deviations of more than 0.55, no payment will be made and the Ministry Representative will determine whether removal and replacement is necessary.		



TABLE 502-G – ACCEPTANCE AND PAYMENT ADJUSTMENTS FOR AGGREGATE GRADATION

Sieve Size mm	Divergence from job mix formula grading curve Percentage passing by mass ASTM C-117 and C-136		
	COLUMN 1 Limiting Values for Acceptance Conditional Upon a Payment Adjustment of \$1.50 per Tonne of mix	COLUMN 2 Limiting Values for Acceptance with No Payment Adjustment	COLUMN 3 Limiting Values for Acceptance with a Payment Adjustment of + \$0.75 per Tonne of mix
12.5	±7.0	±4.5	±3.5
4.75	±6.0	±4.5	±3.0
0.600	±4.0	±3.5	±2.0
0.075	±1.5	±1.0	±0.75

Any material with a gradation outside the limits set out in Column 1 is reject and the Contractor shall either overlay or, remove and replace the previously placed mix. Reject Bottom Lift shall remain in place, however no payment will be made for this material under the applicable Items

Representative at the end of each shift.

**502.14.02 Payment Adjustments** - The payment adjustment for material application rate will be applied as shown in [Table 502-H](#).

**502.14.03 Acceptance and Rejection Limits** - The acceptance limit for material application rate is the limiting value of the actual material application rate, expressed as a percentage of the specified material application rate, for the Lot, below which the Lot is rejected, as shown in [Table 502-H](#).

If the application rate of a Lot is outside the acceptance limit, the Lot is rejected automatically regardless of the values of other acceptance parameters.

## 502.15 Surface Segregation

**502.15.01 Determination of Surface Segregation** - The finished pavement shall be homogeneous, free from segregation and shall be uniform with respect to surface texture. A segregated area is defined as an area within the driving lanes of the pavement wherein the texture differs visually from the texture of the surrounding pavement.

Due to the nature of variation in asphalt mixes and their compactive characteristics, the definition of degrees of segregation will be established on a project by project basis. The Contractor and the Ministry Representative shall establish through the use of photographs or other mutually agreed tools, the definition of slight, moderate and severe segregation. The Ministry Representative and the

Contractor shall evaluate the first two Lots upon completion of the second Lot, after opening to traffic, to confirm the “agreed to” guidelines. Segregation will then be evaluated only when all paving is complete.

The Ministry Representative, with the Contractor’s Representative, will observe the finished pavement to evaluate the existence, severity and extent of segregation and other surface defects. The evaluation will be completed prior to the issuance of the Completion Certificate

The rating system for categorizing the severity of top lift surface segregation, and repair methodology is shown in [Table 502-I-1](#).

**502.15.02 Payment Adjustments** - The payment adjustment for top lift segregation will be the applicable amount shown in [Table 502-I-2](#).

**502.15.03 Repair** - On the final driving pavement surface, all segregation shall be repaired according to [Table 502-I-1](#). The Lot will not be re-evaluated for segregation payment adjustments. The Lot will be re-evaluated for acceptance. Repair shall be to the neat lines and dimensions of the segregated area using a sand cement slurry. The Ministry Representative shall provide the formula for the slurry to the Contractor.

The Contractor shall be responsible for all costs associated with the repair of segregated areas.

Remedial work is required for any occurrences of segregation.



TABLE 502-H – PAYMENT ADJUSTMENTS FOR MATERIAL APPLICATION RATE

Actual Application Rate Expressed as % of Specified Application Rate	Assessment for Application Rate \$ per tonne	
	Bottom Lift or Single Lift	Top Lift of Multiple Lifts
110 +	-\$6.00 for all material between 100.0% and 110.0% and no payment for product in excess of 110.0%)	
106.0 – 109.9	-\$4.00 for all material between 100.0% and 109.9%	-\$6.00 for all material between 100.0% and 106.0% and no payment for product in excess of 106.0%
105.0 – 105.9		-\$4.00 for all material between 100.0% and 105.9%
104.0 – 104.9	\$0.00	-\$2.00 for all material between 100.0% and 104.9%
96.0– 103.9	+\$0.50	+ \$0.50
94.0 - 95.9	-\$1.00	-\$1.00
92.0 - 93.9	-\$2.00	-\$2.00
90.0 - 91.9	-\$3.00	-\$3.00
85.0 – 89.9	-\$5.00	-\$5.00
84.9 or lower	Rejected, Mill and Fill, and/or rejected with no remedial work required at the discretion of the Ministry Representative	Rejected, Mill and Fill, Overlay, and/or rejected with no remedial work required at the discretion of the Ministry Representative

TABLE 502-I-1 – SEGREGATION – TOP LIFT ONLY – REMEDIATION METHODOLOGY

Segregation Severity	Visual Appearance	Repair Procedures
None	Completely uniform surface texture	N/A
Slight	Matrix of asphalt binder, coarse and fine aggregate exists; visually increased presence of stone sizes	sand cement slurry
Moderate	Significantly more stone than surrounding pavement; matrix of asphalt binder and coated sand particles is reduced	seal coat or sand cement slurry patch or neat hot mix patch or mill and fill patch
Severe	Appears as an area of very stony mix - stone against stone - little or no matrix	remove and replace or overlay to limits defined by Ministry Representative

**502.16 Smoothness**

for each Sub-Lot.

**502.16.01 Determination of Pavement Smoothness** - The finished pavement surface shall be tested using a Class I precision rolling profile measuring instrument, to determine the longitudinal profile and compute the International Roughness Index (IRI) in each driving lane. Profiles shall be measured and the IRI calculated in the driver's wheel-path

For any Sub-Lot between 50 m and 100 m in length, the IRI value shall be considered representative of a complete Sub-Lot. For any Sub-Lot less than 50 m in length, the IRI value will be combined with the proceeding Sub-Lot IRI value.

The profile shall be measured over the entire length of the



pavement exclusive of structures and shoulder areas. Acceleration, deceleration and turning lanes are considered part of the driving lanes and shall be tested in accordance with this provision. For the measuring process, the Contractor shall provide the Ministry Representative a chalk guide line in the driver's wheelpath immediately prior to measurement.

**502.16.02 Auxiliary Lanes** - For smoothness testing, sections of the driving lanes that do not fall within the continuous through lanes, such as acceleration lanes, deceleration lanes and turning lanes, and lanes which are less than 1 km in length, shall be treated as follows. The ratio of the section length to the standard Lot length of 1 km shall be determined and the payment adjustment shall be pro-rated on this basis as in the following example:

*Length of segment, i.e. 565 metres = 0.565 times the  
Standard Lot Length of 1000m.*

Hence the applicable payment adjustment is 0.565 times the payment adjustment for a 1-km Lot as determined from [Table 502-J](#).

**502.16.03 Acceptance Limits** - The acceptance limit for smoothness is the limiting value as shown in Table 502-J, beyond which corrective work is required. Payment adjustments are shown in Table 502-J. The International Roughness Index (IRI) value, calculated for each Sub-Lot, will be used to determine if the Lot will be accepted, and if so whether it will be subject to any payment adjustment.

**502.16.04 Payment Adjustments** - Acceptance of any Lot for payment will occur if it contains no obvious defects as

per Subsection 502.22 and in the case of top lift pavement only, the pavement smoothness, as reported by the International Roughness Index (IRI) meets the following requirements:

- No sub-lots shall have a value  $\geq 1.8$

**502.16.05 Rejection Limit** - When there are one or more Sub-Lots with an IRI  $\geq 1.8$ , the sub-lot or sub-lots is rejected, subject to [Subsection 502.16.06](#). A Sub-Lot for calculation of smoothness is defined in [Subsection 502.03.08](#).

**502.16.06 Remedial Work** - If the test results on a Sub-Lot of pavement indicate a payment reduction or rejection because of smoothness, the Contractor may propose remedial work to improve the smoothness. Such proposals are subject to the approval of the Ministry Representative, but such approval does not imply that the proposed remedy will be successful, and does not reduce the Contractor's responsibility for meeting the acceptance requirements. Grinding may be acceptable, but an overlay may be required. Only one attempt may be made to improve smoothness, and this must be completed within ten (10) calendar days from the time the Contractor receives notification from the Ministry Representative of the original smoothness test results for that Sub-Lot.

Following any attempt to improve the smoothness of a Sub-Lot or Sub-Lots, the Ministry Representative will retest the Sub-Lot or Sub-Lots, and the new results will replace the previous data for the purposes of determining acceptance and payment.

No payment will be made for any material, equipment or

**TABLE 502-I-2 – SEGREGATION – TOP LIFT ONLY – PAYMENT ADJUSTMENTS**

Payment Adjustment	Category		
	Slight	Moderate	Severe
+\$1,000 per lane km. (If the criteria in all three adjacent columns are met)	0 - 3	0	0
+\$500 per lane km. (If the criteria in all three adjacent columns are met)	4-5	0	0
No payment adjustment	6 – 10	0 – 1	0
-\$500 per lane km. (If the criteria in any one or more of the adjacent columns applies)	11 - 15	2 – 5	0 – 1
-\$1,000 per lane km. (If the criteria in any one or more of the adjacent columns applies)	16+	6+	2+



**TABLE 502-J – LOT ASSESSMENT AND  
PAYMENT ADJUSTMENTS FOR SMOOTHNESS**

For the final surface course only, the following payment adjustments shall apply to each Lot.

Lot IRI (m/km)	Payment Adjustment
≤ 0.80	+\$2,000
0.81 to 0.90	+\$1000
0.91 to 1.00	+\$500
1.01 to 1.10	+\$200
1.11 to 1.20	0
1.21 to 1.30	-\$100
1.31 to 1.40	-\$250
1.41 to 1.50	-\$600
1.51 to 1.60	-\$1,400
1.61 to 1.70	-\$2,000
1.71 to 1.80	-\$3,000
≥ 1.80	Reject and corrective work required

The Lot IRI is the average IRI value calculated for the Sub-Lots within the Lot.

manpower used to improve, or attempt to improve, smoothness.

**502.16.07 Smoothness Deficiencies** - Smoothness deficiencies (bumps and dips) less than 8mm over 3m will not have remedial work required. Individual deficiencies between 8mm and 12mm over 3m will result in a \$200.00 penalty. Deficiencies exceeding 12mm over 3m will require remedial work.

## PART C - ACCEPTANCE AND REJECTION

**502.21 Acceptance At Reduced Or Adjusted Payment** - Acceptance of any Lot at reduced payment will occur if it contains no obvious defects as per [Subsection 502.22](#), and if:

- the test results for acceptance parameters are such that the Lot or Sub-Lot meets the requirements for acceptance at a reduced payment; and
- the Lot or Sub-Lot is approved in respect of all other requirements; and if
- the Contractor has not notified the Ministry Representative in writing that it will exercise its option to either repair or remove and replace the work, at its own cost, with work meeting the requirements for acceptance at full or increased payment.

**502.22 Rejection For Workmanship Defects** - The finished surface of any lift shall have a uniform "closed" texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Ministry Representative such as, but not limited to the following, will be cause for automatic rejection of asphalt pavement regardless of the values of any other acceptance parameter:

- individual bumps and dips that exceed 12mm over 3m;
- areas of excess or insufficient asphalt;
- improper matching of longitudinal and transverse joints;
- roller marks;
- tire marks; or
- cracking or tearing.

When asphalt pavement is rejected by reason of obvious defects, the minimum area of rejection will be the actual length of the defect for the full width of the driving lane in which the defect exists.

Rejected work shall be promptly repaired, remedied, overlaid, or removed and replaced in a manner acceptable to the Ministry Representative. The Contractor shall be responsible for all costs including materials.

No payment will be made for work in any Lot or Sub-Lot, which has been rejected, until the defects have been remedied.

## 502.23 Appeal Testing

**502.23.01 Density, Asphalt Content and Gradation** - The Contractor may appeal the results of acceptance testing for density, asphalt content and/or aggregate gradation for any Lot only once. Appeals will only be considered if quality control results support an appeal and can be presented.

Quality control test results for density which are provided to the Ministry Representative subsequent to the Contractor's receipt of the quality assurance test results for that Lot will not be considered (when evaluating evidence) for an appeal. The appeal shall be for all tests within the Lot, and there will be no appeal allowed for single tests within a Lot.

Any attempt to improve density on the appealed Lot after the Ministry Representative has tested the Lot for acceptance shall void the appeal and the original test results will apply.

The following procedures will apply for an appeal:

- For Density, Gradation and Asphalt Content, the Contractor shall serve notice of appeal to the Ministry Representative, in writing, within two working days



of receipt of the test results;

- The Ministry Representative will arrange for an independent testing laboratory to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality control testing on the project will not be used for appeal testing;
- The Contractor will sample the pavement and provide the core samples to the independent testing laboratory. The Ministry Representative shall observe the sampling process.
- For density appeals, the original core test results will be discarded and a new sample mean will be obtained from 5 random cores. The appeal agency shall prepare new briquette densities from the previously taken companion samples as per Appendix 2.
- For asphalt content and gradation, the original test results will be discarded. A new sample mean for three new test results will be determined using the companion samples and will be used for acceptance and payment adjustments.

**502.23.02 Smoothness** - The Contractor may appeal acceptance test results of a Lot only once.

The Ministry Representative will perform, and the Contractor will be given the opportunity to witness, the appeal testing and the new results will be binding on the Contractor and the Ministry.

**502.23.03 Segregation** - Appeals of segregation ratings will first be handled by a joint review with the Contractor. If consensus cannot be reached then the Ministry Representative shall engage the Joint Committee, comprised of representatives from the Ministry and B.C. Roadbuilders, to assess the area(s) in question.

**502.23.04 Application of Appeal Testing Results** - For density, gradation and asphalt content appeals, the original test results will be discarded.

For density, five (5) new random cores will be tested within the next three (3) site occupancy days to establish a new Sample Mean and used for acceptance and payment adjustment.

For gradation and asphalt content appeals, companion samples prepared as per Appendix 2 shall be used to establish a new Sample Mean and used for acceptance and payment adjustment.

The new values, thus determined, in all cases, will be binding on the Contractor and the Ministry.

**502.23.05 Payment for Appeal Testing** - If the new results indicate a change in the payment adjustment in the

Contractor's favour, then sampling and testing costs incurred during the appeal procedures for that Lot will be borne by the Ministry.

If the new results verify that any payment reduction or rejection remains valid for that Lot, then the costs of testing (plus 10% mark-up) incurred during the appeal procedure will be charged to the Contractor.

**502.23.06 Time Limits For Appeal Of Test Results** - All appeals shall be in writing and submitted within three (3) site occupancy days of receipt of the applicable test results.

**502.24 Overlays As A Corrective Measure** - If an overlay is used as a corrective measure on a defective Lot or Sub-Lot, the overlay thickness will be subject to the approval of the Ministry Representative, but shall not be less than 40mm. In all other respects, the whole overlay will be subject to the same specifications as the pavement being overlaid. Where an overlay is used as a corrective measure in any lane, adjacent lanes shall also be overlaid whether acceptable or not.

Whether the overlay is applied as a corrective measure or is placed over otherwise acceptable pavement in order to match an adjacent lane, acceptability and payment will be determined as follows:

- acceptability, and eligibility for either positive or negative payment adjustment, will be determined entirely on the results of testing and observations conducted on the overlay, regardless of test results that have been obtained on the underlying, overlaid lift of pavement; but
- the payment quantity, for application of the Unit Prices for asphalt pavement, and the quantity, to which any payment adjustment is to be applied, will be derived from the tonnage of mix in the underlying, overlaid lift.

## **PART D - PAYMENT**

**502.31 General** - Payment at the Unit Prices for the supply of primer/tack coat materials, the application of the spray primer/tack coat, the supply of paving aggregates into stockpile, and the construction of asphalt pavement including the supply of asphalt cement, shall be full compensation for completing the supply and installation of asphalt pavement on prepared surfaces in accordance with the contract requirements. Applicable payment adjustments (Additions or subtractions as applicable) shall be applied in accordance with Part B of this Section.

The first 1,000 tonnes of asphalt mix production and placement will not be subject to bonus/penalty payment



## SECTION 502

## END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION

adjustments but will be required to meet minimum Specification requirements for quality and workmanship. The location where this material is to be placed shall be defined in the Special Provisions or by the Ministry Representative.

[Section 501](#), including the monetary adjustments set out in Appendix C thereof, shall not apply to these payments, and the cost of all work listed in Appendix C shall be considered incidental to the Unit Prices for asphalt pavement.

### 502.31.01 Primer

**Supply of Spray Primer and Tack Coat** - Payment to Supply Spray Primer and Tack Coat shall be at the Unit Price per litre for the quantity of material actually sprayed onto the roadway measured prior to any additional diluting by the Contractor where applicable. The measured quantity shall not be greater than the total of the bills of lading.

Such payment shall be full compensation for supplying, handling, storing, sampling and testing of the material and all other related work.

**Application of Spray Primer and Tack Coat** - Payment for the application of Primer and Tack Coat will be at the Unit Price per litre of primer actually sprayed onto the roadway. In the case of an emulsion the payment quantity shall include any water added by the Contractor with the approval of the Ministry Representative. Such payment shall be full compensation for diluting the material when required and spraying it on the surfaces to be paved, and for all incidental costs arising from priming and tack coating.

**502.31.02 Paving Aggregate into Stockpile – EPS** - Payment for Paving Aggregate into Stockpile - EPS shall be at the Unit Price per tonne for the quantity of paving aggregate placed into stockpile accordance with the following:

- The paving aggregate quantity will be identical to (100%) of the asphalt mix quantity. As the aggregate is crushed into stockpile, progress payments will be made against the bid item, up to the quantity shown in the “Approximate Quantity” column of the Schedule of Approximate Quantities and Unit Prices.

Such payment shall be full compensation for all work including but not limited to the production, supply and stockpiling of all paving aggregates, and shall include all costs of quality control.

**502.31.03 Asphalt Pavement – EPS** - Payment for Asphalt Pavement - EPS constructed in place shall be at the Unit Price per tonne for the quantity of mix placed in accordance with the Contract requirements.

Subject to the exception noted below, only acceptable asphalt pavement will be included in the payment quantity.

Where overlays are used as a corrective measure, in accordance with [Subsection 502.24](#):

- the overlay quantity will not be included in the payment quantity, but
- the quantity of asphalt pavement covered by the overlay will be included in the payment quantity, whether or not it was acceptable.

Such payment shall be compensation in full for all work including but not limited to: loading the aggregate into the feeders; drying the aggregate; supplying, metering, and adding the asphalt cement; mixing, loading, weighing, hauling, dumping, spreading, compacting and finishing the asphalt pavement; and shall also include all costs of quality control.

**502.31.04 Payment for Acceptable Work** - The following end product properties of asphalt pavement will be measured for acceptance:

- Density
- Asphalt Content
- Aggregate Gradation
- Smoothness
- Material Application Rate
- Segregation

**502.31.05 Payment for Rejected Work Made Acceptable** - When defects have been remedied in Lots or Sub-Lots which had been rejected, payment for the original quantity of material in those Lots or Sub-Lots will be made subject to payment adjustments and penalty assessments and subject to [Subsection 502.24](#).

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed entirely at the Contractor's expense.

**502.31.06 Payment Adjustment** - Payment adjustments resulting from the application of this Section will be effected on each progress payment as follows:

- a) For each Lot paid for by the tonne (t), the applicable payment adjustment derived from [Tables 502-E](#) (Density), [502-F](#) (Asphalt Content), and [502-G](#) (Gradation), in dollars per tonne; will be expressed as positive in the case of increases and negative in the case of decreases. The algebraic sum of these unit adjustments will then be applied to the payment quantity for the Lot. The resulting amount, in dollars, will be the net payment adjustment, positive or negative, for that Lot.



- b) Payment Adjustments from [Table 502-H](#) (Application Rate) shall be computed for each Lot.
- c) The algebraic sum of the net payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for density, asphalt content, aggregate gradation, and material application rate for the current progress payment.
- d) For each Lot (km) with payment adjustments based on kilometre, the applicable unit adjustment derived from [Table 502-I-2](#) (Segregation) and [Table 502-J](#) (Smoothness), in dollars per Lot (\$/lane km), will be expressed as positive in the case of increases and negative in the case of decreases, and will be the payment adjustment, positive or negative, for that Lot.
- e) The algebraic sum of the payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for segregation for the current progress payment.
- f) The algebraic sum of the total payment adjustments for density, asphalt content, aggregate gradation, material application rate, segregation and smoothness, derived in accordance with 1 and 2 above, shall be the total payment adjustment, positive or negative, in dollars, for all attributes for the current progress payment. This amount shall be added, if positive, or subtracted, if negative, by a single entry in computing the current progress payment.
- g) The process set out in 1) to 3) above will be used in computing each progress payment to which it is applicable.

**502.32 Surplus Aggregate In Stockpile -** At the discretion of the Ministry Representative, the Ministry may or may not purchase surplus aggregate in stockpile in a private pit.

Generally the Ministry will provide payment for the processing costs of surplus aggregate in stockpile in Ministry Pits only, and only to a limited quantity. However, should the Contractor produce surplus aggregate in a private pit, and the Ministry intends to purchase these surplus aggregates, the Contractor shall be required to provide a written agreement with the owner of the property. This document shall indicate that the Ministry will have free access to and use of the surplus aggregate in stockpile for a period of 12 months after the completion of the contract work. If the Contractor undertakes private work from within the private pit, measurements for surplus aggregate in stockpile will not be taken until the completion of the private work, ensuring that the Ministry does not pay for aggregate used on private works. All surplus aggregate shall be properly stockpiled.

**502.32.01 Ministry Purchase of Surplus Aggregate -**

Should the Ministry proceed with the purchase of surplus aggregate, upon completion of the contract, the Ministry will purchase surplus paving mix aggregate as indicated herein. Surplus crushed base and/or shoulder aggregates shall be paid for according to the Standard Specifications [Section 501](#).

If the quantity of Asphalt Pavement actually incorporated into the works is less than the estimated quantity, as stated in the Schedule of Approximate Quantities and Unit Prices, the Ministry will purchase surplus aggregate up to 100% of the quantity required by the contract. The surplus aggregate must, when singly or combined, meet the gradation requirements set out in the Job Mix Formula. The maximum total surplus aggregate to be purchased will be the quantity of aggregate required to produce the quantity of mix as stated in the Schedule of Approximate Quantities and Unit Prices minus the quantity of aggregate actually incorporated in the works.

No payment shall be made for any surplus paving aggregate remaining at contract completion in excess of the contract requirement. Material remaining in the pit is the property of the Ministry.



## APPENDIX 1

## QUALITY CONTROL REQUIREMENTS AND GUIDELINES

## 1.01 GENERAL

The Contractor's guidelines for preparing, submitting and adhering to a Quality Control Plan are specified in [Subsection 502.04](#). This Appendix titled "Quality Control Requirements and Guidelines" sets out the requirements and guidelines for the Contractor's Quality Control Plan, in addition to those set out in [Subsection 502.04](#).

## 1.02 QUALITY CONTROL PLAN

The Contractor shall prepare and submit a Quality Control Plan for evaluation. The Plan may be operated wholly or in part by a qualified Subcontractor or an independent organization/agency. However, the Quality Control Plan, including compliance with the Plan and its modifications, must remain the responsibility of the Contractor.

The Plan shall address all elements that affect the quality of the hot mix, hot laid asphalt pavement, including but not limited to the following:

- Supply of Asphalt Materials
- Identification of source and proof of quality of aggregates to be supplied;
- Aggregate production and its gradation control;
- Quality of aggregate components;
- Stockpile management;
- Mix Design(s);
- Asphalt plant calibration and proportioning of aggregate components;
- Mixing including asphalt cement content control;
- Process temperature controls;
- Material application rates, placing and finishing;
- Joints;
- Compaction;
- Smoothness;
- Segregation;

The plan shall also include the following:

- The name of the Quality Control testing agency and its proven capability to provide the specific services required for the project.
- The list of dedicated technical staff, if available, (including names, qualifications and relevant experience) and their proposed roles.
- The list of testing equipment available for project work.

The Quality Control Plan shall include the designation of specific personnel to be responsible for specific quality control duties.

- There shall be a Quality Control Manager (QCM) who will be responsible for the development and management of the Quality Control Plan. This person shall be qualified as per the requirements identified in [Subsection 502.04.03](#). This individual shall also be responsible for the signing off of Quality Control Testing and Inspection records. This individual shall also be responsible for approving all quality control staff, implementing and documenting any changes or improvements to the Quality Control Plan.
- There should be a designated Process Control Technician (PCT), with 5 years of related experience, who will ensure that laboratory test results and other quality control practices are used to control the quality of aggregates and other mix components, and to adjust and control mix proportions to meet the mix design(s). The PCT is responsible for ensuring that testing equipment, utilized for proportioning and mixing are calibrated and in good working order. The Plan shall describe how the PCT's duties, including sampling methods and responsibilities are to be accomplished and documented. The Plan should also describe the criteria to be used by the PCT to correct or reject unsatisfactory materials.
- There should also be a Pavement Quality Control Technician (PQT), with 5 years of related experience, who will ensure that delivered materials meet the requirements of the specifications. In addition, the PQT shall be responsible for periodically inspecting all equipment used in placing, finishing, and compacting to assure its proper operating condition and to assure that placing, application rate, finishing, joint construction, and compaction is in conformance with this specification and the contract requirements.

## 1.03 CONTRACTOR'S RECORD OF QUALITY CONTROL TESTING

Test results should be made on specified forms or charts immediately after completion of each test. These test results are to be made available to the Ministry Representative upon request.

Records of gradation control, both during aggregate production and also during the asphalt mixing operation, should be kept on the form H-295 - Mechanical Analysis of Aggregates.

## 1.04 MATERIAL APPLICATION RATE

The Contractor shall control the Material Application Rate by monitoring the amount of asphalt mix delivered to the road against the area covered by checking the application



rate minimally every ten loads.

The Contractor shall advise the Ministry Representative in writing on an ongoing basis of the application rate.

### 1.05 DENSITY

The Contractor should take core samples to determine actual pavement density. At the start of paving, the Contractor should take a minimum of two pavement cores from each Sub-Lot. The Contractor may employ a nuclear densometer to ensure intermediate density control. Two nuclear densities may be determined for each Sub-Lot, based on job

mix densities obtained from the most recent plant briquettes.

### 1.06 OTHER QUALITY CONTROL PROCEDURES

The Contractor may initiate other Quality Control procedures as necessary for ensuring production of a quality product and include them in the Quality Control Plan. Procedures may also be introduced after the start of work as necessary as amendments to the Quality Control Plan.

### 1.07 QUALITY CONTROL TESTING FREQUENCY

Recommended test frequency requirements for Quality Control are described in the following table:

**TABLE 1 – TEST FREQUENCY GUIDELINES**

	Test	*Minimum Frequency
Tests During Aggregate Production	ASTM C-136, Dry Sieve Analysis of Aggregate	<ul style="list-style-type: none"> <li>- Split Stockpiles: 1 for each stockpile for every 2 hours of production.</li> <li>- One main stockpile: for every 300 tonnes.</li> <li>- Blend Sand: 1 for every 100 tonnes during stockpiling.</li> <li>- Natural filler: 1 for every 50 tonnes during stockpiling.</li> </ul>
	ASTM D-5821 Determining the Percentage of Fractured Particles in Coarse Aggregate	Every second coarse aggregate sieve test.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	1/shift on reduced sample obtained from combined samples from the crusher
Tests During Asphalt Plant Mixing	ASTM 136, Dry Sieve Analysis of Aggregate	1 of combined aggregate (off the belt) every 300 tonnes.
	ASTM C-566 & D-2216, Moisture Content	Aggregate: 2 tests/Lot Asphalt mix: 1 on first Sub-Lot and every second day.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	1/shift on reduced sample obtained from combined samples from the plant cold feed
	ASTM D-5581), Resistance to Plastic Flow Using Marshall Apparatus.	One set of three briquettes for 1,200 tonnes or Lot, whichever is less.
	Asphalt Extraction Test ASTM D-6307 Ignition Method	One/Lot.
	Penetration of Bituminous Materials ASTM D-5	One per Manufacturer's Batch. Samples should be taken for every 3000 tonnes of mix production
	Viscosity ASTM D-2171	Contractor's Option
Asphalt Products Tests	Tack and Prime	Contractor's option.
Test During Asphalt Paving for Density Testing	BCH II-15 Test to obtain Briquettes from Asphalt Mix	One 15 kg sample for every Sub-Lot or minimum 1/day for field testing
	Core Samples	At start, two cores for each Sub-Lot. After rolling pattern established, only one core for each Sub-Lot. All cores to be a minimum of 100mm diameter; Superpave mixes shall require minimum 150mm diameter cores

\* These are the recommended minimum frequencies and the Contractor is responsible to assess the need to increase testing frequency, where aggregate source is not uniform or any other condition exists that may warrant it.



## APPENDIX 2

## LOOSE MIX SAMPLE PREPARATION

1. 3 samples shall be obtained from behind the paver screed per subplot at random locations.

- I. Quality Control sample (Contractor)

- II. Quality Acceptance sample (MoT)

- III. Appeal sample

2. The samples shall be taken from an area between the center of the screed and the outside (shoulder) edge of the mat.

3. The samples shall be obtained by use of an approximate size sampling tray (25.4cm x 25.4cm) that shall provide a sample meeting the requirements of ASTM D-979 Sampling Bituminous Mixtures, Table 1, Size of Sample. Cleaning all mix from within the framework of the sampling tray shall be accomplished by use of a trowel.

4. The sample size shall be reduced to required laboratory sample size for Marshall and Superpave gyratory briquettes, asphalt content and hot mix gradation determination as outlined below:

- I. The sample shall either be reduced using a Riffle splitter or shall be quartered into four approximately equal portions. The two diagonally, opposite quarters shall be combined resulting in two samples. Identify and designate one of the samples as the Quality

Companion Sample and set aside. Identify and designate the other resulting sample as the Quality Control Sample. Use the Quality Control Sample for testing.

- II. The Quality Control Sample shall be weighed to ensure that the sample so obtained meets the minimum mass required for the ignition test. If the sample does not meet the minimum mass requirements, then the additional materials will be obtained and added to the Quality Control Sample from the Companion Sample. This will be achieved by quartering the Quality Companion sample and adding one quarter of the Quality Companion Sample to the Quality Control Sample.

- III. This process is to be repeated for each tray sample to provide the Quality Acceptance and Appeal Samples.

5. The third sample for appeal purposes shall be set aside and retained in a Contractor-supplied, suitable container labeled with sample location, date sampled, and project information. These shall be delivered to the Ministry Representative for storing.

6. The areas sampled shall be filled with mix immediately after sampling, and shall receive the same compactive effort as the rest of the mat.



## SECTION 503

### BASE PREPARATION AND BASE PROCESSING

**503.01 Base Preparation** - The work shall consist of shaping and compacting the existing granular base course to the designated grade and cross-section.

The existing base course material shall be watered, graded and compacted to provide a non-segregated, tightly-knit surface which conforms to the line, grade and cross sections shown on the Drawings or staked by the Ministry Representative to an accuracy of  $\pm 10$  mm.

If necessary, the existing surface shall be scarified and bladed to achieve this. No imported materials are to be incorporated into the work, except where failed areas have to be backfilled.

**a) Failed Areas** - Where a failed area is present in the existing base, the Contractor shall excavate and dispose of the material, all as directed by the Ministry Representative. The area shall be backfilled using crushed granular base or surfacing aggregate or road-mix as directed by the Ministry Representative and compacted to the same density as the rest of the base course.

**b) Compaction** - If watering is required to attain compaction or for any other reason, it shall be applied uniformly from a distributor of the pressure type, equipped with a spray bar mounting nozzles similar to those used on asphalt distributors. Splash plate type distributors or those equipped with spray bars that eject fine streams of water will not be permitted. The distributor must be provided with a satisfactory means for accurately measuring the quantity of water sprayed. If the Ministry Representative so requires, the measuring equipment shall be calibrated under the Ministry Representative's inspection.

The final surface of the base course shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698.

**c) Surplus Aggregate** - All surplus loose aggregate arising from the base preparation shall be bladed clear into windrows on the shoulder for later incorporation into the shouldering aggregate or bladed to the side slope and trimmed, as directed by the Ministry Representative.

**d) Payment** - Payment for Base Preparation will be at the unit prices bid in the Schedule of Approximate Quantities and Unit Prices per square metre for the area actually prepared and shall be full compensation for scarifying done to a maximum depth of 40 mm, blading, shaping, trimming, compacting, finishing and maintaining the granular base to the required line, grade, cross-section and density.

Payment for supply of material used for backfilling and compaction of failed areas will be at the unit price bid in the Schedule for the material used. Payment for excavating and disposing of the material from the failed areas will be by Order for Extra Work.

Payment for Water Applied to Roadway will be at the unit price bid per kilolitre for the actual quantity applied to the road and shall be full compensation for everything furnished and done to supply, haul and apply water.

**503.02 Base Processing** - Where, in the opinion of the Ministry Representative, the base is so deformed, rutted or unsuitable, that it cannot be adequately prepared for priming under the provisions for base preparation, the Ministry Representative shall order in writing how it shall be processed. This work shall be carried out on an Order for Extra Work basis.

Payment will not be made for superintendence, provision or placement of barriers, lights or other equipment which should normally be provided and available for the general performance of the contract.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 504

### PAVEMENT DRAINAGE

#### DESCRIPTION

**504.01 Scope** - This Section covers the provision of pavement drainage with the construction of necessary asphalt curbing and drainage outlets using cast iron catch basins or asphalt spillways together with pipe or paved outfalls. Concrete curbs, concrete and corrugated steel catch basins, cast iron grates and frames where applicable are specified by Section 582.

#### MATERIALS

##### 504.11 Materials

a) Unless otherwise specified the Ministry will supply f.o.b. the Contractor's job site yard or the Ministry's yard or other location as indicated in the Special Provisions or Purchase Order the following materials:

- Cast Iron Catch Basin Box and Adaptor plate (Drawing SP582-02.05).
- Cast Iron Catch Basin Grates (Drawing SP582-05.02).
- 200 mm Nominal diameter Corrugated Galvanized Steel Pipes, Bends and Connectors (Section 320).

b) The Contractor shall provide and/or fabricate as required:

- i) All strap iron binding hoops, angle iron pipe supports, brackets, bolts and studs or other hardware not provided by the Ministry.
- ii) All other building or construction materials that may be required to construct the outlets according to the intent of this Section.
- iii) Asphalt mix required for the work with payment to be made in accordance with Subsection 504.93.

#### CONSTRUCTION

##### 504.31 Asphalt Curbs

**504.31.01 Integral Asphalt Curb** - Where specified in the Contract Documents, asphalt concrete curb integral with the asphalt concrete highway pavement shall be constructed to the dimensions indicated on Drawing SP504-01.

**504.31.02 Machine-Laid Asphalt Curb** - Where specified, machine laid (extruded) asphalt concrete curbs shall be constructed in accordance with Drawing SP504-01 and as follows:

i) The type of curb to be placed (Type "A" or Type "B") will be as specified or as determined by the Ministry Representative.

ii) Prior to construction of the curb, the affected pavement area shall be dry and cleaned of loose or deleterious materials. A tack coat of liquid or emulsified asphalt determined by the Ministry Representative or specified in the Special Provisions or Purchase Order shall be uniformly applied at a rate of 0.25 to 0.5  $\ell/m^2$ , to a width 0.1 m wider than the proposed curb.

iii) The production and transportation of asphalt mix for curb construction shall be in accordance with Sections 501 and 951 and shall meet the requirements for Class 1 Fine Mix.

iv) The machine for constructing the curb shall be self-propelled extrusion-type equipment with a material hopper, distributing screw and adjustable curb forming devices capable of placing and compacting the asphalt mix to the required alignment, grade and cross-section in an even homogeneous manner free of surface defects. The asphalt concrete mix shall be handled to provide a curb meeting the applicable density requirements of Section 501 and the curbing equipment shall be operated in a manner that ensures a smooth, uniform finished curb alignment. Where handforming of curb is required, the finished curb shall conform to all dimension, alignment, density and finish requirements for machine-laid curb.

**504.32 Location of Drainage Outlets** - On completion of pavement and curb construction and in conjunction with the installation of any precast concrete barriers, the Contractor shall install or construct drainage outlets at the low point of curves in the vertical alignment and at such other locations designated by the Ministry Representative.

**Note:** The exact low point on the pavement may be determined by allowing water to flow along the surface to the actual lowest point on the pavement adjacent to the curb or barrier. This low point shall be clearly marked on the pavement.

**504.33 Excavation** - At the locations designated by the Ministry Representative, the asphalt pavement and any curbing shall be accurately cut away and the highway shoulder excavated to the dimensions consistent with the installation of Cast Iron Catch Basins (Drawing SP504-03) or the construction of Asphalt Spillways (Drawing SP504-02). The excavation shall, as nearly as possible, have vertical sides and shall be so done as to cause minimum disturbance of the adjacent compacted base and pavement structures. The outside dimensions of the excavation shall



be the smallest compatible with the efficient construction of the drainage facility, as any excess or irregular excavation will be required to be repaired with asphalt mix.

Where applicable, appropriate trench excavation shall be performed to permit the installation and embedment of outlet pipe and associated fittings. Excavation for installation and embedment of outlet pipe shall be considered incidental to the rate bid for pipe installation.

#### 504.34 Drainage Outlets

**504.34.01 Cast Iron Catch Basins** - Bedding and surrounding mortar for catch basins shall be composed of one part Portland cement to three parts clean well-graded fine aggregate mixed to proper consistency.

Bedding shall be minimum of 125 mm thick to permit accurate setting of the catch basin in mortar at the correct level true to alignment with curbing, barrier or pavement edge as shown on Drawing [SP504-03](#). After securely fixing the adaptor, watertight gasket and connecting pipe, the catch basin shall be surrounded with mortar to the full perimeter of the excavation, and the mortar well tamped and worked around the connecting pipe for 300 mm from the side of the catch basin.

The mortar shall be allowed to set prior to backfilling and further work.

**504.34.02 Asphalt Spillways** - Asphalt spillways shall be constructed to the general dimensions shown on Drawing [SP504-02](#) with the necessary handforming in accordance with Subsection [504.31.02 \(iv\)](#).

**504.34.03 Pipe Outfalls General** - Except where paved outfalls are specified, corrugated galvanized metal outlet pipes of the required diameter shall be installed, as shown generally on Drawing [SP504-03](#). Should the fill material preclude pipe embedment, the pipe shall be secured to the slope by dual angle iron posts placed at 3 m intervals, as shown. The pipe shall be similarly secured at the bend at the base of the slope and at a point approximately 150 mm from its outlet.

The pipe trench shall be backfilled with excavated material as may be directed by the Ministry Representative and the fill thoroughly compacted.

Riprap of 200 mm minimum dimension shall be placed at the pipe outlet as shown on Drawing [SP504-03](#).

**504.35 Dishing, Spillways and Completion** - The asphalt pavement adjacent to the drainage outlet shall be constructed

to the profile and cross-sections indicated for the type of outlet being installed. The asphalt pavement surface shall be so shaped as to channel all collected water to the outlet orifice and no ridges or other obstructions shall be left which may impede the flow of water to the drainage outlet.

The asphalt paving mix shall be compacted to the density specified by the Ministry Representative to provide an integral and impervious drainage area. Where the asphalt pavement abuts a cast iron catch basin box, the contact face of the box shall be painted with liquid or emulsified asphalt as specified in Subsection [501.23.15](#) prior to placing the asphalt concrete.

On completion, the area shall be cleared and cleaned up to the satisfaction of the Ministry Representative.

### MEASUREMENT

**504.81 Pavement Drainage Outlets** - Pavement drainage outlets will be measured per EACH of the type specified.

**504.82 Corrugated Metal Pipe** - Corrugated metal pipe will be measured by the METRE along its centre line as installed.

**504.83 Asphalt Concrete Mix** - Unless otherwise specified, asphalt concrete mix used to form drainage aprons, curbs, spillways and outfalls will be measured by the TONNE.

**504.84 Asphalt Curb** - Asphalt curb will be measured by the METRE.

### PAYMENT

**504.91 Pavement Drainage Outlets** - Payment for the installation of PAVEMENT DRAINAGE OUTLETS will be at the Contract Unit Price for each complete outlet of the type specified. The Contract Unit Price shall be full compensation for taking delivery of cast iron basins, boxes and grates; excavation (see Subsection [504.33](#)); provision of all materials required for setting basins to correct grade including cement mortar; backfill and compaction; spreading, shaping and compaction of asphalt concrete aprons and spillways; provision and setting of riprap at the outfall and all labour, materials, tools, warning signs, barriers and superintendence required to complete the installation of the drainage outlet.

**504.92 Corrugated Metal Pipe** - Payment for CORRUGATED METAL PIPE will be at the Contract Unit Price per metre. The Contract Unit Price shall be accepted as full compensation for taking delivery and installation including all necessary transport of components, excavation



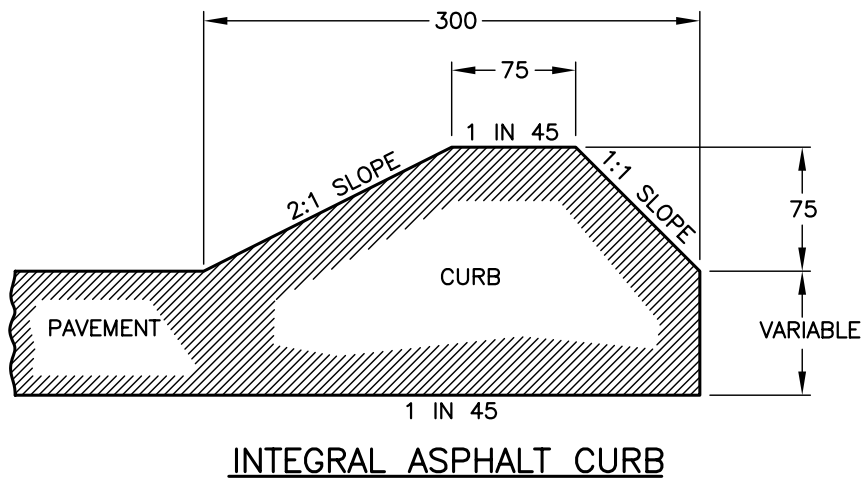
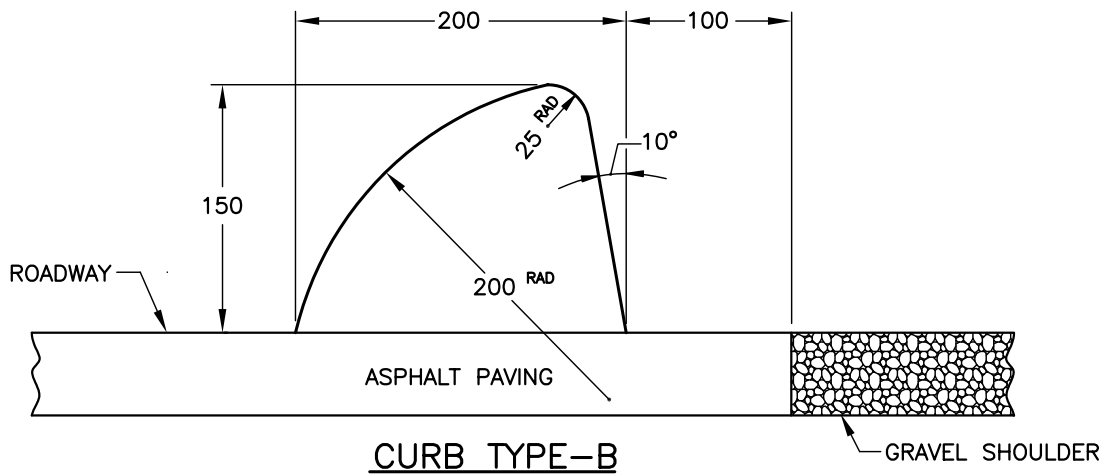
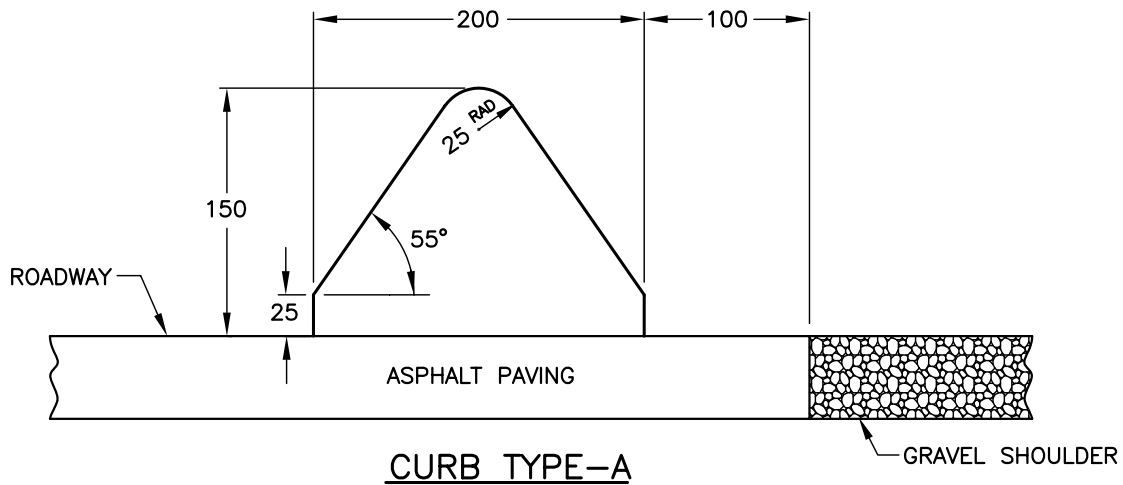
and backfilling; provision of posts, brackets, hoops and hardware; labour for connecting and securing pipe fittings, compaction, superintendence, lights, warning signs, barriers and all other things or services necessary for the proper installation of the pipe.

**504.93 Asphalt Concrete Mix** - Unless otherwise specified, payment for ASPHALT CONCRETE MIX used

to form drainage aprons, curbs, spillways and outfalls will be at the Contract Unit Price per tonne.

**504.94 Asphalt Curb** - Payment for ASPHALT CURB will be at the Contract Unit Price per metre of the appropriate curb type placed. The Contract Unit Price shall include the formation of offset curb alignment at drainage outlets in accordance with Subsection [504.31](#).

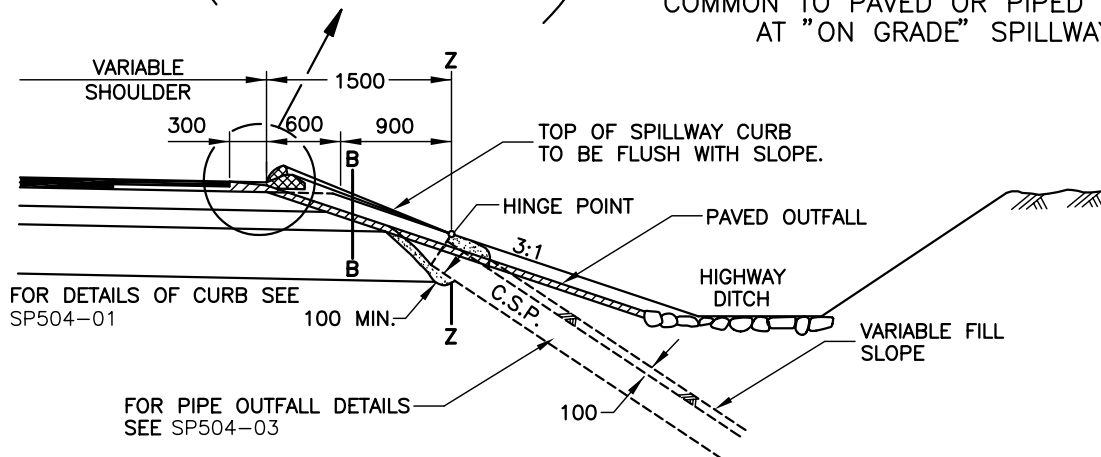
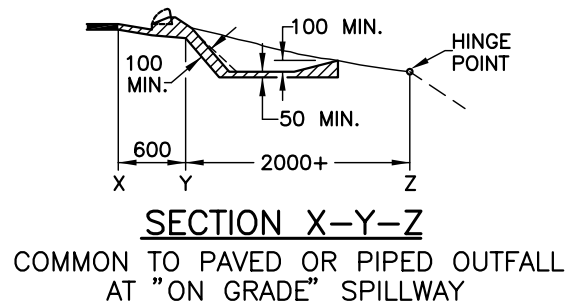
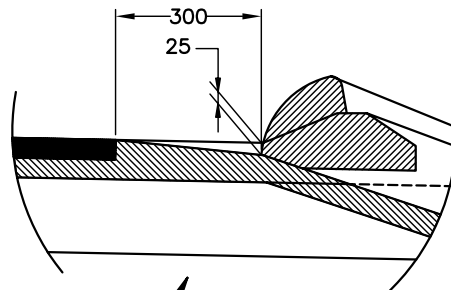
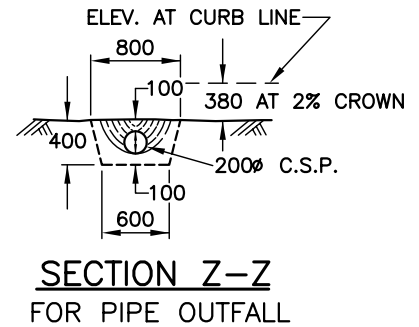
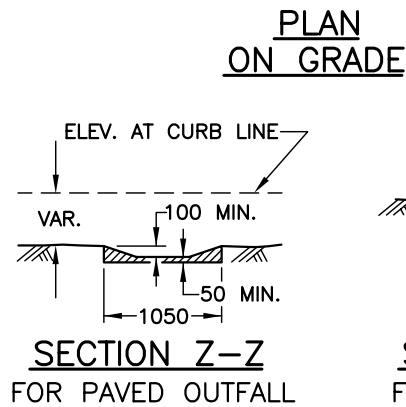
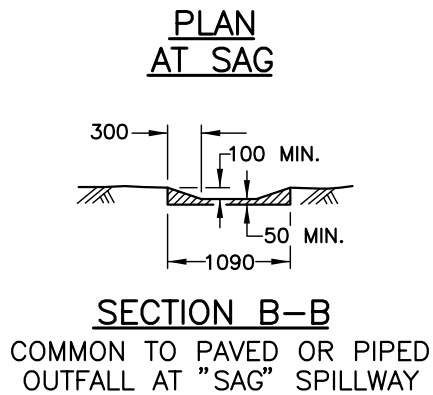
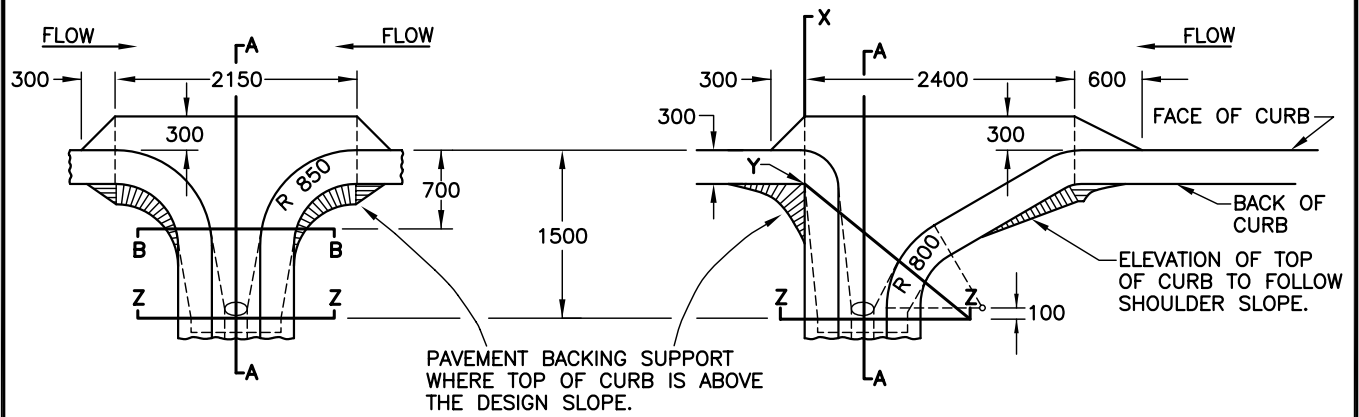




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



# INSTALLATION OF CURB, BARRIER AND CAST IRON CATCH BASIN

SP504-03

690 mm CONCRETE BARRIER  
SEE SP941-01.02.01 & SP941-01.02.02

NARROW SHOULDER  
INSTALLATION

CONSTRUCTION  
GRADE

MORTAR

FOR DETAILS  
SEE SP582-02.05

USE INTEGRAL ASPHALT CURB OR  
TYPE-B CURB (SEE SP504-01)

CATCH BASIN AND CURB INSTALLATION  
FOR NARROW SHOULDERS

LANE EDGE

BARRIER

**CATCH BASIN AT BARRIER**

PLACEMENT OF CATCH BASIN  
WHERE SHOULDER WIDTH IS  
1.9 m OR GREATER

LANE EDGE

IRREGULAR ELBOWS

SLOPE	LENGTH
1.5:1	300/600
2:1	300/750
3:1	300/900

MIN. 1%  
SLOPE

100

200

150

900

300

SPLASH PAD

TYPICAL INSTALLATION

OUTLET PIPE TO BE BURIED WITH  
100 mm OF COVER. HOWEVER, SHOULD  
THE FILL MATERIAL BE SUCH AS TO  
PRECLUDE BURYING THE PIPE; IT MAY  
BE LAID ON THE SURFACE AND  
ANCHORED WITH BRACKETS.

50 mm ANGLE IRON BRACKET, GALVANIZED  
50 mm STRAP IRON, GALVANIZED  
50 mm ANGLE IRON POST, GALVANIZED

50 mm ANGLE IRON BRACKET  
WELDED TO POST WHICH  
SUPPORTS AND ANCHORS PIPE

**DETAIL OF PIPE, ANCHOR BRACKETS AND POSTS**

LANE  
EDGE

SHOULDER  
VARIABLE

150

400

450

CONSTRUCTION  
GRADE

**POST AND BEAM GUIDE RAIL**

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

504 (6 of 6)

2004

BC - MOT



## SECTION 507

### PRODUCTION AND STOCKPIILING OF ASPHALT MIX

**507.01 General** - This Section covers the supply of aggregate, mixing it with a specified asphalt material in a central plant and placing the produced mix in a stockpile.

#### 507.02 Aggregate

a) The Contractor shall supply aggregate with gradation wholly within the limits listed in Table 507-A when tested in accordance with BCH Test I-2 (Wash Test).

Once a crushed aggregate gradation has been accepted, the maximum permissible variation of the mean of any four consecutive tests from the accepted gradation curve shall be within the limits specified in Table 507-B.

Should there be a substantial change in the type of aggregate exposed as the work proceeds, the Ministry Representative may authorize a change in the mean gradation.

b) A minimum of 50% by count of all aggregate particles retained on the 4.75 mm sieve shall have at least one fractured face or shall be naturally angular with sharp edges (BCH Test I-13 Method A). If this requirement cannot be met for a specified crushed aggregate type then the Contractor shall, at no additional charge, crush aggregate to the next smaller size or such intermediate size as the Ministry Representative may direct in order that the crushed granular aggregate shall meet the requirement.

c) All aggregates shall be free from coatings of clay, silt or other objectionable matter and shall contain no clay lumps or other aggregations of fine-grained materials.

d) Crushed aggregate shall conform to the following requirements:

- The sand equivalent value in accordance with BCH Test I-8 shall not be less than 40.
- The degradation factor in accordance with the Ministry's procedure shall not be less than 20.
- In the absence of satisfactory performance records for a particular source of aggregate, its soundness shall be tested according to BCH Test I-5. Aggregate so tested shall be considered unsatisfactory if the loss after five cycles exceeds 20% for coarse aggregate or 25% for fine aggregate.

e) For testing purposes, fine aggregate shall be all mineral matter passing the 4.75 mm sieve including mineral fillers. It shall consist of natural and/or manufactured material derived by crushing stone, slag or gravel.

f) Mineral filler shall:

- consist of all mineral matter passing the 0.425 mm sieve.
- be dry, free from organic matter, clay particles or lumps.
- be non-plastic when tested in accordance with Test BCH I-11 (ASTM D 423) and BCH I-12 (ASTM D 424).

g) Mineral dust shall consist of all mineral matter passing the 0.075 mm sieve.

**TABLE 507-A GRADATION REQUIREMENTS FOR AGGREGATE**

SIEVE SIZE (mm)	PERCENT PASSING (BY MASS)	
	PATCH MIX	PAVING MIX
19.0	---	100
16.0	---	100 - 92
13.2	---	100 - 80
9.5	100	90 - 65
4.75	85 - 55	75 - 45
2.36	65 - 40	60 - 30
1.18	50 - 25	45 - 20
0.300	30 - 15	25 - 10
0.150	18 - 8	17 - 5
0.075	12 - 5	9 - 2

**TABLE 507-B MAXIMUM PERMISSIBLE VARIATION OF CRUSHED AGGREGATE GRADATION FROM THE GRADATION CURVE**

SIEVE SIZE	VARIATION LIMITS % PASSING
4.75 mm and larger	± 5
1.18 mm to 4.75 mm	± 3.5
0.300 mm to 1.18 mm	± 2
0.075 mm to 0.300 mm	± 1



**507.03 Asphalt Material**

- a) The type of asphalt material to be used will be specified in the Contract's Special Provisions.
- b) Normally the Ministry will supply the Liquid Asphalts or High Float Emulsified Asphalts f.o.b. the Contractor's Plant site.
- c) Should the Contractor be required to supply a particular type of asphalt material, such shall meet the requirements of Section 951.

**507.04 Mix Design**

- a) Unless otherwise specified, the Ministry will carry out the Asphalt Mix design with the aggregate supplied by the Contractor.
- b) At least seven days prior to commencement of mixing, the Contractor shall submit the following to the Ministry Representative:
  - A 50 kg sample of aggregate which is representative of the aggregate to be used on the project.
  - If available, a 30 kg sample of plant produced asphalt mix whose gradation is deemed to be representative of the gradation of the aggregate to be used on the project.
  - When the Contractor is to supply the asphalt material, a 5 ℓ sample of the type of asphalt to be used on the project.
- c) Once the design grading curve is established, the maximum permissible variation will be as specified under Subsection 507.02 (a).

**507.05 Mixing Requirements**

- a) Mixing operations shall be performed in a mixing plant capable of producing the asphalt mix within the required specifications.
- b) The maximum moisture content of the aggregate immediately prior to mixing with a liquid asphalt (MC or SC) shall not be over 2% by mass of dry aggregate.
- c) Temperatures of the mix shall be generally in accordance with the limits specified in Table 507-C. Mix temperatures may be lowered to reduce the emission of "blue smoke" from the discharge chute.
- d) The asphalt content in the mix shall not vary from the design asphalt content by more than 0.3 by mass of total aggregate.

- e) The asphalt mix shall not contain more than 1% moisture by mass at the discharge from the plant.
- f) The asphalt mix shall be uniform in appearance with all particles thoroughly coated. The mixing time will be increased if the mix is not completely coated with asphalt.
- g) The Ministry reserves the right to adjust the asphalt content in the mix up to the maximums listed in Table 507-D.

**507.06 Hauling** - When the haul distance from the mixing site to the stockpile is greater than 1 km, the hauling vehicles shall be equipped with and use a tarpaulin of such size as to completely protect the asphalt mix from the weather and inhibit premature curing of the mix by aeration.

The tarpaulin shall be double quilted canvas or other approved material treated to prevent absorption of the asphalt.

**507.07 Stockpiling**

- a) The exact location of the stockpile site will be determined by the Ministry. The Contractor shall place the cold mix within the boundaries of the designated

**TABLE 507-C MIX TEMPERATURES**

TYPE OF ASPHALT	ASPHALT STORAGE TEMPERATURE RANGE °C	MIX TEMPERATURE RANGE °C
SC - 250	65 - 80	60 - 80
MC - 250	65 - 80	60 - 80
HF - 500M	55 - 65	100 - 120*
HF - 1000M	55 - 65	100 - 120*
* High temperatures are used when the mix is hauled directly to the road and when dictated by high moisture in the aggregate.		

**TABLE 507-D MAXIMUM PERCENT BY MASS**

ASPHALT TYPE	MAXIMUM PERCENT BY MASS OF DRY AGGREGATE
SC - 250	6.0
MC - 250	6.0
HF - 500M	7.3
HG - 1000M	7.3



stockpile site.

- b)** The Contractor shall prepare the stockpile site, which shall be shaped to a uniform smooth surface and graded to ensure good drainage.
- c)** Temporary stockpiling of the mix on the ground or in storage bins will be allowed, however, the Contractor will be required to minimize the handling of the mix to prevent premature curing of the mix.
- d)** If conveyor belts are used for temporary stockpiling or final stockpile construction, the free fall distance from the conveyor belt to the stockpile shall not exceed 2 m.
- e)** If the stockpile is constructed using a front end loader or end dumping by truck, the mix shall be deposited in layers of approximately 1 m in depth.
- f)** Plank or protected runways shall be provided for operating equipment on stockpiles when the Ministry Representative deems them necessary to prevent

contaminants being tracked onto the stockpile and to minimize consolidation of the mix.

- g)** The final stockpile shall be constructed in such a manner that height is not more than 4 m.

- h)** Mixing, hauling or stockpiling will not be permitted during periods of atmospheric precipitation.

**507.08 Measurement** - The asphalt mix will be measured in TONNES and the asphalt material(s) in LITRES, corrected to 15°C.

**507.09 Payment** - Payment for ASPHALT MIX in stockpile will be at the contract unit price per tonne, and per litre of asphalt material(s) added to the asphalt aggregate as specified in the tender form.

The unit price will be full compensation for preparing the stockpile site; supplying and heating the aggregate; heating and storing the asphalt material; mixing, hauling and stockpiling the mix.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 508

### END PRODUCT SPECIFICATION FOR GRADED AGGREGATE SEAL COAT

#### PART A – GENERAL

**508.01 Preliminary and General** - This section describes the materials, equipment, professional standards and the end product requirements for the construction of graded aggregate seal coats.

This section shall be read and construed together with all applicable Standard Specifications for Highway Construction.

Should this Section conflict with any other Section, this Section shall be take precedence unless otherwise stated in the Special Provisions.

**508.02 General Description of Work** - Surface treatment shall consist of the application of a selected asphalt emulsion and embedment of the selected aggregate so as to provide a new, uniformly textured surface. This surface shall be impervious to moisture, be skid-resistant and have good riding qualities. There are five classes of Graded Aggregate Seal, as specified in Subsection 531.17. These include but are not limited to chip seal, graded aggregate seal, a coarse sand seal or any other surface treatment outlined in the Special Provisions of the Contract.

#### PART B - SUPPLY OF MATERIALS

**508.11 Asphalts** - The Contractor shall supply the asphalt emulsion as specified in the Special Provisions that shall meet the requirements of Section 951.

#### 508.12 Aggregates

**508.12.01 Ministry Supply** - The Ministry will supply the graded aggregate seal aggregates, which are necessary for the completion of the application of the seal. The Ministry will perform all quality control tests. The test results will be available to the Contractor upon request.

**508.12.02 Contractor Supply** - The Contractor shall be responsible for the supply of blinding material meeting the requirements of Table 531-H.

**508.13 Graded Aggregate Seal Design** - The contractor shall provide a graded aggregate seal coat design, professionally prepared by qualified and experienced personnel. This design shall include the asphalt emulsion application rate in litres per square metre, spray temperature and the aggregate spread rate in kilograms per square metre. It shall be presented to the Ministry Representative for their approval, at least three (3) days prior to the commencement of work.

The Contractor shall inform the Ministry Representative of the intended emulsion application rate and aggregate spread rate three days prior to the commencement of work and at any time subsequent changes are made to these rates. These rates shall be expressed in litres and kilograms per square metre respectively.

The Contractor shall submit to the Ministry Representative one litre of a representative sample of the emulsion(s) and a twenty kilogram sample of the aggregate(s) intended for use on the project. These samples shall be supplied at least three days prior to the commencement of the work.

#### PART C – EQUIPMENT

While the specifics of Subsections 531.21 to 531.29 are not a requirement of this Specification, reference is made to these sections for the Contractor's consideration.

#### PART D – CONSTRUCTION

While the specifics of Subsections 531.31 to 531.38.03 are not a requirement of this Specification, reference is made to these sections for the Contractor's consideration.

#### 508.31 Requirements

**508.31.01 Daylight Hours Only** - Construction shall be carried out during daylight hours only.

**508.31.02 Traffic Control and Signing** - The Contractor shall submit, for the approval of the Ministry Representative, a Traffic Control Plan at least three days prior to the pre-construction meeting.

Traffic Control on Seal Coat projects shall be in accordance Section 194 and Subsection 531.32, as well as the Ministry's publication "Traffic Control for Work on Roadways". The supply of traffic control and accommodation is to be included in the unit price bid per square metre for Graded Aggregate Seal Coat.

The Traffic Control shall be maintained at all times when in the opinion of the Ministry Representative, the risk of damage to the mat is likely to become a safety issue or to result in unnecessary vehicular damage from loosened rock. Additional traffic control to protect the quality of the product is also the responsibility of the Contractor.

Extending traffic control beyond the end of the shift, in order to maintain safety and reduce vehicular damage risks, will not preclude the Contractor from providing and applying blinding material to further reduce these risks.



The Contractor shall, after discontinuing the application of product for the day, continue to maintain flag-person assisted traffic control over the extent of the day's production, for a minimum of two hours. Longer periods of traffic control and/or the application of blinding sand will be required where safety and vehicular damage concerns need to be addressed.

**508.31.03 Temperature and Weather** - Asphalt emulsion and aggregate shall only be applied when the air shade temperature is at least 6°C and rising.

No application shall take place when the weather is misty or rainy.

**508.31.04 Grade Preparation** - Immediately prior to the application of the graded aggregate seal coat on a previously constructed granular surface, the surface shall be watered, graded and compacted and/or broomed to provide a non-segregated, tightly knit surface free from loose rock. Unless otherwise specified in the Special Provisions, the price bid per square metre to supply graded aggregate seal coat shall include this grade preparation.

## **PART E - QUALITY CONTROL AND QUALITY ASSURANCE**

**508.41 Quality Control by the Contractor** - The contractor shall be responsible for providing all resources required to carry out the quality control on all the constituent materials within the construction of the seal coat and the quality of the end product except for the quality control on the aggregate production.

**508.41.01 Quality Control Plan** - The Contractor shall prepare and submit a Quality Control Plan at least seventy-two hours prior to the pre-construction meeting. The plan shall detail the Contractor's proposed program of sampling, testing and observation. The plan shall detail who is responsible for performing and reporting test and observation data and those responsible for interpreting the data. The plan shall also detail who is responsible for and initiating corrective measures when test and observation data do not meet quality and quantity requirements.

The Ministry Representative may issue a Stop Work Order to the Contractor if the Contractor fails to adhere to the Quality Control Plan. The Ministry Representative will not issue a Resume Work Order until the Contractor has given the Ministry Representative satisfactory assurance that it has in place adequate capacity to fulfil the requirements of the Quality Control Plan. Further to Article 36.00 of the Construction Agreement, such action by the Ministry Representative is specifically excluded from the definition of "Reimbursable Delay".

**508.41.02 Sampling, Testing and Observing** - The contractor shall provide properly maintained equipment, qualified personnel and shall maintain access to a qualified laboratory so that quality control tests and observations are performed, and the results reported to the Ministry Representative, in a timely manner.

### **508.42 Quality and Quantity Control Records**

**508.42.01 Emulsion Quality** - The Contractor is referred to tests performed on asphalt emulsion (Appendix A). Quality control tests results for each batch of emulsion supplied to the job site must be made available to the Ministry Representative on Form H-539 (Appendix B).

### **508.42.02 Aggregate Quality**

The Contractor shall assess the supplied aggregate to determine and satisfy themselves as to its suitability for the intended application. Any modifications deemed necessary to ensure a quality product shall be made at the Contractor's expense.

**508.42.03 Emulsion Usage** - Daily emulsion usage shall be made available to the Ministry Representative on the Form "Emulsion Usage" (Appendix C). The subsequent days work shall not progress until the Ministry Representative has received this report.

**508.42.04 Aggregate Usage** - The Contractor shall monitor the aggregate spread rate on a production day basis and make the results available, in an acceptable format, to the Ministry Representative.

**508.42.05 Daily Activity Log** - The Contractor's Superintendent or designate shall complete and make available to the Ministry Representative the "Daily Activity Log" (Appendix D) on a daily basis. This form shall be completed and submitted for all calendar days from the first day of mobilization to the last day of demobilization. The subsequent day's works shall not progress until the Ministry Representative has received this report.

### **508.42.06 Emulsion Sampling**

i) The Contractor shall, at the request of the Ministry Representative, procure and store a four litre sample of the emulsion for the Ministry's use.

These samples shall be obtained, handled and stored in accordance with ASTM procedure D140 "Standard Practice for Sampling Bituminous Materials" and also with the manufacturer's recommendations

ii) The samples shall be identified and retained by the



Contractor for at least ten working days after which time permission may be granted by the Ministry Representative to discard them in an environmentally friendly manner.

iii) The Ministry Representative may provide the Contractor with a copy of the test results from the Quality Assurance Testing. The Contractor shall not utilize these tests in place of their own Quality Control Program.

iv) The absence of Ministry test results shall not relieve the Contractor's obligation to remedy any defect in materials or construction.

**508.42.07 Final Quantity Usage Report** - The Contractor shall supply to the Ministry Representative, prior to final acceptance of the work, the total amount of emulsion and graded aggregate seal aggregate used on the project.

**508.43 Quality Assurance** - The Contractor is responsible for Quality Control under this specification. The Ministry Representative will monitor the Contractor's Quality Control program to assure that the Quality Control program is being followed. In addition, the Ministry will undertake a Quality Assurance Program. The Contractor is advised that the Ministry's Quality Assurance Program does not relieve the Contractor of carrying out the Quality Control Program.

## PART F - END PRODUCT ASSESMENT

**508.51 General** - The Contractor shall provide an end product conforming in accuracy and detail as specified herein. Payment is based on end product assessment by the Ministry Representative.

### 508.52 Surface Deficiency Definitions

**508.52.01 Blackening** - Blackening is the emergence of excess asphalt onto the finished surface whereby the finished surface becomes discoloured but the coarse surface texture remains. Under this condition, the effective cover stone can still be seen to protrude above the level of the asphalt binder's upward migration. (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for an example).

**508.52.02 Effective Cover Aggregate** - Effective Cover Aggregate is the effective friction course of aggregate contained and visible on the road surface. For graded aggregate classes A, B, C and D (Re. 531.16.03, Table 531-E), this aggregate size is the material retained on the 9.5mm sieve (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for examples).

**508.52.03 Flushing and Bleeding** - Flushing and bleeding is the emergence of excess asphalt and fines onto the finished surface and the significant loss of coarse surface texture, leaving little or no effective cover aggregate visible. (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for an example).

**508.52.04 Pock Marks** - Pock Marks are indentations in the mat texture, normally less than the thickness of the graded seal layer, evidenced by the absence of effective cover aggregate in a small area.

**508.52.05 Pot Holes** - Pot Holes are the loss of all cover aggregate and base material(s) into the underlying asphalt or gravel base. Pot Holes may develop because of seal and/or base weakness. (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for examples).

**508.52.06 Ravelling** - Ravelling is a general term for loss of cover aggregate, which can include numerous "pock marks". (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for an example).

**508.52.07 Streaking** - Streaking is a continuous visible absence of effective cover aggregate often seen paralleling a 'ridge' of excess cover aggregate, characterized by the narrowness of its width and the significant extent of its length. Where streaking displays an absence of effective cover aggregate, the condition is unlike ravelling in that there was originally little or no effective aggregate in the area. (See Appendix E "Catalogue of Graded Aggregate Seal Coat Deficiencies" for an example).

**508.52.08 Washboard** - Washboard is a condition of non-uniform surface texture caused by the buildup of transverse ridges within the graded seal layer itself, and characterized by a very rough, vibratory or chattering ride.

### 508.53 End Product Evaluation

**508.53.01 Lot Definition** - The Ministry will divide each uni-directional single, double or multiple-lane road/highway within the Project consecutively into one-kilometre, sections. These will be numbered and referenced to a convenient landmark/intersection. These sections will be considered LOTS for evaluation purposes. Sections of any road/highway remaining which are less than one-half (0.5) kilometres in length, will be included in the previous lot. Sections remaining which are 0.5 kilometres or greater, but less than one kilometre will receive a lot designation unique for the road/highway. Adjoining lanes being sealed constitute an application width. (Re. Appendix F, Note\*\*\*)

**508.53.02 Rating Time Criteria** - The Ministry Representative will rate each lot, within thirty (30) days of



final brooming.

**508.53.03 Performance Rating Criteria** - Performance rating will be in accordance with the two tables in Appendix F: *The Surface Defect Parameters Table* and the *Surface Defects Frequency Definitions*.

**508.54 Deficiency Repair and Replacement** - Any 'Lot' of sealed surface which is found unacceptable shall be remedied in accordance with the (Appendix F) "Surface Treatment Repair/Replacement Criteria", until the whole project has been repaired or replaced as necessary and accepted by the Ministry Representative. On double seal applications both the lower and upper lifts must be free of deficiencies prior to being accepted. The sealing contractor will not be responsible for deficiencies attributed to base work done by others. These may be repaired under a provisional sum item provided for that purpose, or as ordered by the Ministry Representative.

**508.55 Attention to Potential Safety Hazards** - If in the opinion of the Ministry Representative remedial work is required to correct a potential safety hazard it shall be undertaken immediately.

## PART G - MEASUREMENT AND PAYMENT

**508.61 Payment for Acceptable End Product** - Payment will be made at the unit price bid, per square metre. Payment in a double pass application will be for final top lift surface area only. Payment will be full compensation for grade preparation, pre-cleaning the surface; supplying,

storing, handling and applying the asphalt emulsion; loading, hauling, placing and compacting the aggregate; brooming the finished surface; quality control and traffic control.

No extra payment will be made for any additional equipment, tools or labour employed to satisfy special brooming requirements.

No extra payment will be made for any additional equipment, tools, labour or material used to replace, repair or overlay unacceptable work. The supply of extra aggregate, required to repair or overlay unacceptable work, will be the Contractor's responsibility. Where sufficient aggregate quantities exist, the Ministry will make these available to the Contractor at the Ministry's production cost.

**508.62 Claims for Vehicular Damage** - Without in any way limiting the Contractor's obligations or liabilities herein, during construction and up until final acceptance of the whole project by the Ministry Representative, the Contractor shall be fully responsible for all claims for damages caused by the work and shall address and deal with each claim submitted.

**508.63 End Product Warranty** - All work shall be warranted, on a lot by lot basis, against defects for a period of one year from the time of acceptance of the lot. Payment for the work does not imply acceptance of the work. If a defect becomes apparent and is noticed by the Ministry Representative within this period, the Contractor will be notified and the Contractor, at the Contractor's expense, shall undertake the repair.



**APPENDIX A****Quality Control Tests for High Float Emulsified Asphalts**

<u><b>Test Designation</b></u>		<u><b>Test Name</b></u>
	ASTM D140	Standard Practice for Sampling Bituminous Materials
BCH IV-3	ASTM D88	Saybolt Furol Viscosity
BCH IV-2	CAN2-16.5-M84	Residue by Distillation
BCH IV-2	CAN2-16.5-M84	Penetration of Asphalt Materials
BCH IV-2	CAN2-16.5-M84	Absolute Viscosity of Asphalts
BCH IV-2	CAN2-16.5-M84	Method of Float Tests for Bituminous Materials



## APPENDIX B

**HIGH FLOAT EMULSIFIED ASPHALT REPORT (H-539)**

Project No: \_\_\_\_\_

Refinery: \_\_\_\_\_

Contract: \_\_\_\_\_

Asphalt Grade: \_\_\_\_\_

Location: \_\_\_\_\_

Batch No: \_\_\_\_\_

Sampling Date: \_\_\_\_\_

Testing Date: \_\_\_\_\_

REQUIREMENTS	RESULTS	SPECIFICATIONS	
		MAXIMUM	MINIMUM
Residue by Distillation % by mass			
Oil Distillation % by volume			
Saybolt Furol Viscosity (SFS) 50°C			
Penetration 5 s/100 g/25° C			
Viscosity, mK or CM (Pa•s) 60° C			
Float Test (s) 60° C			



## APPENDIX C

## **EMULSION USAGE**

Project No: \_\_\_\_\_  
Product: \_\_\_\_\_

Date: \_\_\_\_\_  
Supplier: \_\_\_\_\_

**Contractor:** \_\_\_\_\_

**Supplier Lading No:** \_\_\_\_\_

[illegible]



**APPENDIX D**  
**DAILY ACTIVITY LOG**

**1. General**

Contractor \_\_\_\_\_ Address \_\_\_\_\_

Superintendent \_\_\_\_\_ Phone \_\_\_\_\_ Fax \_\_\_\_\_

Project No. \_\_\_\_\_ Hwy/Road \_\_\_\_\_

Project Description \_\_\_\_\_

Emulsion Manufacturer \_\_\_\_\_ Emulsion Type \_\_\_\_\_

Aggregate Source(s) \_\_\_\_\_ Aggregate Class \_\_\_\_\_

**2. Equipment** (e.g.: type, make and model of chip spreader)

---



---



---



---

<b>3. Weather</b>	<b>at start-up</b>	<b>at shut-down</b>
-------------------	--------------------	---------------------

Ambient Temperature: \_\_\_\_\_

Road Surface Temp.: \_\_\_\_\_

General Conditions: \_\_\_\_\_

<b>4. Traffic Control</b>	<b>Number/Type</b>	<b>Duration (From/to)</b>
---------------------------	--------------------	---------------------------

Pilot Vehicles \_\_\_\_\_

T.C.P.'s \_\_\_\_\_

Signs (specify) \_\_\_\_\_

**5. General Remarks** (e.g.: weather, dust, traffic volumes, mechanical, materials)

---



---



---

(Contractor's Representative)

(Date)



## APPENDIX E

## CATALOGUE OF GRADED AGGREGATE SEAL COAT DEFICIENCIES

[illegible]



## APPENDIX F

**SURFACE DEFECT PARAMETERS TABLE AND TREATMENT REPAIR/REPLACEMENT  
CRITERIA**

SURFACE DEFECTS	SEVERITY	RATING PARAMETERS	REPAIR/REPLACEMENT METHOD
Loss of cover aggregate (Ravelling)	Very good	No noticeable aggregate loss	None
	Good	A few pock marks, less than 5 per 0.09m <sup>2</sup>	None
	Fair	Frequent pock marks closely spaced, more than 5 per 0.09m <sup>2</sup>	Reseal of affected area***
	Poor	Extensive pock marks or few surface disintegrations	Reseal of affected area***
	Very poor	Disintegration with potholes	Reseal of affected area***
Potholes	Very good	Few minor potholes, only involves graded aggregate seal	All potholes to be filled with asphaltic patching material at contractor's expense
	Good	Few deep potholes, involves granular base	All potholes to be filled with asphaltic patching material.(see subsection 508.54)
	Fair	Intermittent potholes	Patch potholes and reseal affected area*** (see subsection 508.54)
	Poor	Frequent potholes	Patch potholes and reseal affected area*** (see subsection 508.54)
	Very poor	Extensive or potholes throughout	Patch potholes and reseal affected area*** (see subsection 508.54)
Flushing / bleeding	Very good	No/very faint colour change in wheel path	None
	Good	Few sections with asphalt on surface	None
	Fair	Intermittent sections with asphalt on surface	Application of sand blotter
	Poor	Frequent sections with asphalt on surface, has wet look or asphalt on surface throughout	Reseal of affected area. Removal of initial surface treatment at contractor's option***
	Very poor	Wet look with noise like a wet pavement	Reseal of affected area. Removal of initial surface treatment at contractor's option***
Total failure	Any	Any condition where the asphalt material softens or disintegrates under traffic and aggregate is picked up or "kicked off" by traffic	Remove and dispose of failed surface treatment in its entirety and apply new surface treatment
Streaking (see raveling)	Any	Absence of cover aggregate caused by too little binder - characterized by long, narrow sections of little or no stone cover	Reseal of affected area
Washboard	Any	Any condition of repetitive build-up across the travel lane	Remove and reseal affected area

NOTE:\*\*\* Reseal shall consist of a new graded aggregate surface treatment, single pass application. Area of the reseal repair/replacement shall not be less than one application width multiplied by 10 metres in length. If there is less than 10 metres between two sections in the application pass designated for repair/replacement, the repair/replacement shall be continuous.



**APPENDIX F (Continued)****SURFACE DEFECTS FREQUENCY DEFINITIONS**

DENSITY OF SURFACE DEFECTS**			
UNITS	RAVELLING (% LENGTH)	POTHOLES (NUMBER)	FLUSHING/BLEEDING (% LENGTH)
Few	<5%	<5	<5%
Intermittent	>5%, <20%	>5, <15	>5%, <20%
Frequent	>20%, <50%	>15, <30	>20%, <50%
Extensive	>50%, <80%	>30, <50	>50%, <80%
Throughout	>80%	>50	>80%

Note: \*\* Based on number of surface defects or percent of surface affected by defect, per lot. (see 508.53.01, Lot Definition).

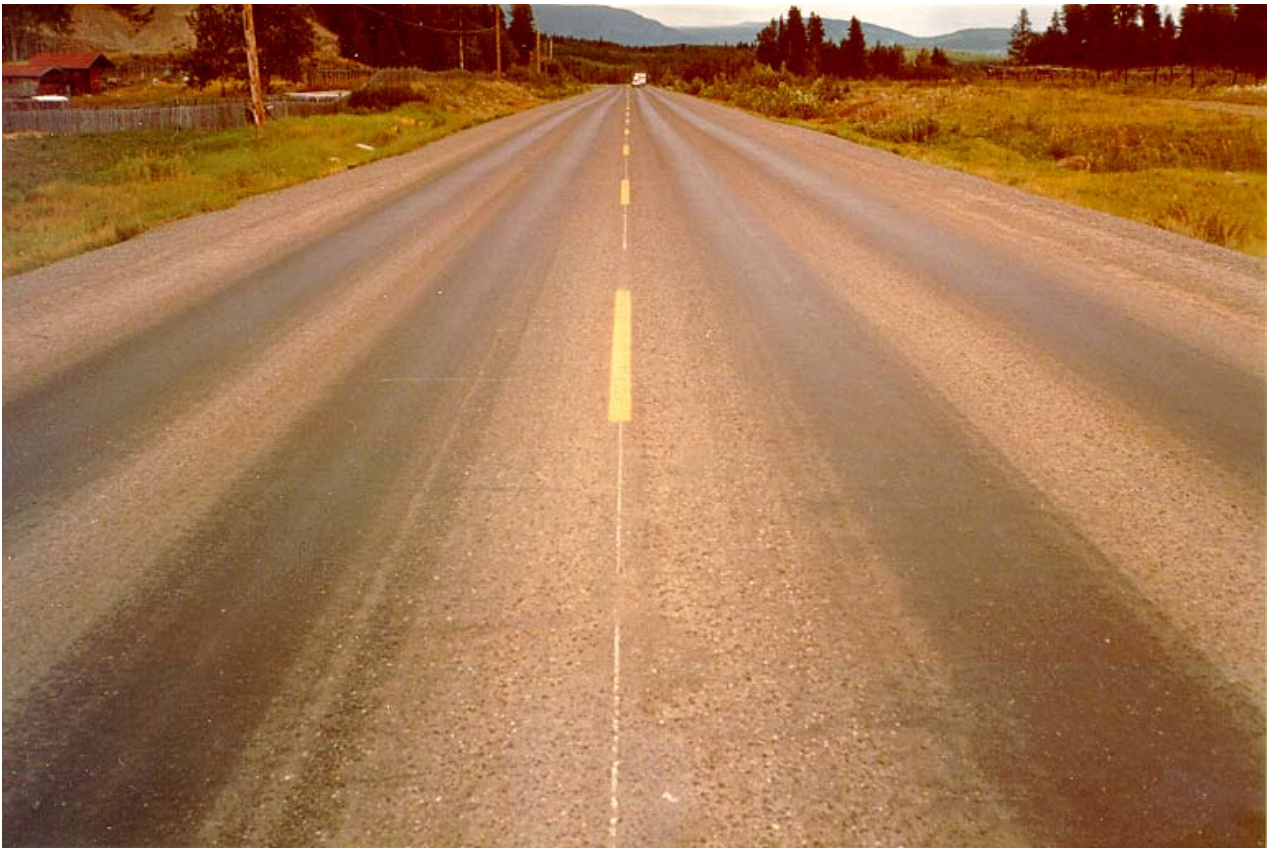




Blackening







Flushing or Bleeding







Pot Hole





Raveling or Stripping







Streaking



## SECTION 511

### COLD MILLING

#### DESCRIPTION

**511.01 Scope** - This work consists of preparing a foundation for placement of new surfacing by cold milling the existing pavement surface to the depth and width as indicated in the Special Provisions and/or drawings.

#### EQUIPMENT

**511.21 Milling Machine** - The milling machine shall be self-propelled and shall be equipped with automatic longitudinal and transverse grade control, which shall be used when directed by the Ministry Representative. A profiling ski or boom of a minimum 4 m length, approved by the Ministry Representative, must be used. No substitute equipment will be permitted. The cutting drum shall be a minimum of 1.8 m in width, totally enclosed and with replaceable cutting teeth. There shall be an effective means of removing the loosened material from the surface and for preventing dust from escaping into the air.

**511.22 "Kill" Switch** - All pavement milling machines shall be equipped with a "kill" switch installed or approved by the manufacturer of the milling machine. This "kill" switch shall be automatically actuated whenever the operation of the machine is so impeded that a hazardous situation, such as "kick back", would result were that operation to continue. When so actuated the "kill" switch shall instantly shut down the operation of the milling machine.

**511.23 Audible Back Up Warning Device** - See Subsection [145.30.04](#).

#### CONSTRUCTION

**511.31 Traffic Control Person** - A haul vehicle traffic control person shall be provided during cold milling operations. This individual's sole duty shall be to signal and direct hauling vehicles to exit, back into and pull away from the milling machine, and to re-enter the traffic stream in a safe manner in accordance with existing requirements.

**511.32 Pavement Removal** - The existing pavement shall be removed to the depth and width as specified in the Special Provisions, on the drawings or as directed by the Ministry Representative to provide a surface that is free of longitudinal and transverse irregularities. The use of a heating device to soften the pavement will not be permitted.

At all times, during the milling operation, the traveled roadway shall be kept clean of all loose materials.

At the end of the milling shift or at the end of each section to be milled, prior to reopening the road to traffic, the pavement shall be cleaned and swept so that all loose material is removed. Also, the transition from the milled surface to the existing paved surface shall be tapered at a maximum slope of 25:1, or as directed by the Ministry Representative. The Ministry Representative shall indicate whether the taper is to be milled or a tar paper letdown shall be constructed using asphalt mix.

On extensive milling projects no more than one milling shift shall be carried out in any one lane so as to minimize the length of the grade difference between the lanes. At no time, at the end of a shift, shall there be a grade difference that is not at lane dividing lines, centre line or at locations indicated by the Ministry Representative. When the milling operation traverses intersecting roads or on and off ramps, the transition from the milled surface to the existing pavement shall be at a maximum slope of 25:1 or as directed by the Ministry Representative. This transition can be done with the milling machine or by using tar paper letdowns as approved by the Ministry Representative.

If, due to delays between the milling and paving operations, the milled surface starts to pothole or deteriorate, repairs shall be carried out at once using asphalt mix. At no time shall there be a grade difference between lanes of more than 50 mm at the end of a shift. If the milling is carried out to a depth greater than 50 mm, the full width of the driving surface shall be milled or a lift of leveling course shall be constructed to maintain a maximum depth of 50 mm.

At those locations where milling is conducted the Contractor shall cut drainage channels as required to prevent water from collecting in the milled area.

If washouts occur at any time during the milling operations, they shall be immediately repaired by the Contractor, at the Contractor's own expense, with approved materials and as directed by the Ministry Representative.

**511.33 Disposal of Materials** - The disposal of materials removed under this section which are not recycled and used on the project shall become the property of the Contractor at the point of removal, unless otherwise specified. Materials shall be disposed of outside the limits of the project in a manner satisfactory to the Ministry Representative and shall meet all environmental requirements. The procurement of a disposal site, if required, shall be the Contractor's responsibility.



**MEASUREMENT**

**511.81 General** - Cold Milling will be measured by the SQUARE METRE or the TONNE. The area quantities will be determined by measurement of the actual surface area from which the materials have been removed and computed to the nearest square metre. Measurement of material by mass shall be done in accordance with Subsections [145.18.04](#) and [145.19](#) before moving to stockpile.

**PAYMENT**

**511.91 General** - Payment for COLD MILLING will be at the unit price bid per square metre or tonne as specified in the Special Provisions. The unit price shall be for all things furnished and done including servicing all equipment, replacing teeth on the cutting drum, performing all work to remove the existing pavement by milling, and the provision

for a traffic control person as set out in Subsection [511.31](#). No additional payment will be made to load, haul and place the material in stockpile.

**511.92 Asphalt Mix** - Asphalt mix required to repair the milled surface as set out in Subsection [511.32](#) shall be paid for as set out in the Special Provisions.

**511.93 Contractor** - The Contractor will be advised of the existence of manholes, catch basins, valves, boxes and other utilities on the project. Care must be taken not to disturb or damage any such structures or devices. Damage to visible, referenced, or plan-indicated manholes, catch basins, valves, valve covers and concrete/asphalt curb, or any other infrastructure shall be repaired at the Contractor's expense. All metal and concrete faces must be cleaned of old pavement and painted with primer, at the Contractor's expense, prior to repaving.



## SECTION 514

### HOT IN-PLACE RECYCLE

#### DESCRIPTION

**514.01 Scope** - This Specification describes the equipment, work practice and materials required for carrying out Hot In-Place Recycle operations.

#### MATERIALS

**514.11 Rejuvenating Agent-Requirements** - The Contractor shall supply only a Ministry of Transportation approved rejuvenating agent meeting the requirements as shown in Table 514-A.

**514.12 Asphalt Mix** - When the Special Provisions require the addition of virgin mix to be incorporated into the recycled asphalt mix, it shall meet the requirements as shown in the Special Provisions. The Ministry Representative shall be advised five working days in advance of commencement of work of the source of Virgin Mix for testing purposes.

When the Contractor is required to supply asphalt mix for repair work, the Ministry Representative is to be advised of the mix source so that it may be tested and approved prior to being required.

#### EQUIPMENT

**514.21 General** - All equipment and instrumentation shall be capable of performing the work in accordance with these specifications.

**514.22 Processing Equipment** - The equipment shall have the capability to process the existing pavement to a minimum depth of 50 mm yielding an average mass of 120 kg/m<sup>2</sup> of existing pavement being processed.

The equipment shall be capable of heating the existing pavement to a width 100 to 200 mm wider than the width to be processed and to a temperature, behind the screed, of not less than 110°C. The equipment shall be regulated so that excessive heating and burning of the existing asphalt cement does not occur. This will generally require the existing surface to be radiantly heated and no open flame will be permitted.

The scarifying tines or cutting drum(s) shall mill to the specified cross-section and shall be set so as to produce a fully homogenous recycled mixture free of lumps.

The equipment shall have an activated heated screed complete with augers and strike-off device, in accordance with Section 501, capable of distributing and placing the reprocessed mix to the full width of the pavement being recycled.

**TABLE 514-A SPECIFICATIONS**

BCH Test	ASTM Test	TITLE OF TEST	SPECIFICATION
II-1	D-2726	Bulk Relative Density of Compacted Bituminous Mixtures using Saturated Surface Dry Method	
II-2	D-1188	Bulk Relative Density of Compacted Mixes Using Paraffin Coated Method	
II-3	D-1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	
III-4	D-2170	Kinematic Viscosity @ 60°C	200-500 mm <sup>2</sup> /sec
III-7	D-70	Specific Gravity	0.98-1.02
III-11	D-92	Flash Point by Cleveland Open Cup	204°C Min.
	D-1160 (10 mm Hg)	Volatility - IPB - 2%v. - 6%v.	150°C min. 190°C min. 210°C min.
	D-2007	Saturates, %w	28 max.
	D-2006-70	Asphaltenes, %w	1.5 max.
	D-2006-70	Chemical Composition (PC+A <sub>1</sub> )/(S+A <sub>2</sub> )	0.4-0.8



The equipment shall have a minimum production rate of 500 m<sup>2</sup> per hour except between June 1st and September 8th when the minimum rate shall be 700 m<sup>2</sup> per hour.

Rejuvenating agents that contain water will not be permitted.

The hot recycling unit shall be equipped and capable to add and homogeneously blend any specified proportion of virgin Asphalt Mix into the reclaimed material and shall be equipped with a means to introduce a rejuvenating agent homogeneously into the reclaimed mixture.

The Contractor's compaction equipment shall conform to Subsection [501.36](#) in its entirety.

Individual pre-heating and reprocessing units shall be equipped in such a way that the operator and other workers are not exposed to any hazardous fumes or gases produced from the equipment operation, the heated pavement or from the addition of the rejuvenating agent, in accordance with all applicable regulations.

**514.23 Rejuvenating Agent Equipment** - To accurately proportion the rejuvenating agent into the scarified mixture the equipment shall comply with the following requirements:

- a) positive feed and shut off of the rejuvenating agent, governed by the movement of the reprocessing machine
- b) control of the quantity of rejuvenating agent to  $\pm 0.05$   $\ell/\text{m}^2$  of surface reprocessed with an agent application range of 0.0  $\ell/\text{m}^2$  to 1.0  $\ell/\text{m}^2$
- c) measurement of the rejuvenating agent applied by means of a metering device, which is capable of recording accumulated litres to the accuracy of  $\pm 2\%$ , and which is fully visible to both the operator and the Ministry Representative
- d) mechanically or electronically controlled application of the rejuvenating agent relative to and variable with the processing rate of the equipment
- e) a mechanical or electronic metering device capable of supplying an accurate indication of the quantity of rejuvenating agent being applied per square metre
- f) a mechanical, electronic or manual method of measuring the quantity of rejuvenating agent in the tank
- g) heating of the agent to within  $\pm 5^\circ\text{C}$  of the application temperature established by the manufacturer and/or the Ministry Representative.

## CONSTRUCTION

**514.31 Preliminary** - If required, prior to starting work, as directed by the Ministry Representative, the existing paved surface shall be cleaned to avoid contamination of the recycled pavement. It shall be swept back at least 20 cm wider than the area to be processed.

Prior to proceeding with the road work, the Contractor shall ensure that all catch basins and manholes, which are within the operating area of the heating units, are clear of any flammable liquids or otherwise hazardous fumes/gases. The local Fire Authority may be of assistance in this regard.

**514.32 Recycling** - The existing highway pavement shall be heated, planed, reprocessed, with or without the addition of a rejuvenating agent or virgin mix as specified, remixed, replaced and compacted using a heater scarification or hot milling process and rollers.

The recycled material shall not be heated over an average of  $150^\circ\text{C}$  in order to avoid excessive oxidation and hardening of the recycled Asphalt Cement.

At locations where reprocessing operations begin and end, the Contractor shall ensure that the transition between the processed and unprocessed surface is smooth and without irregularities. If any irregularities occur resulting from the reprocessing operation, the Contractor shall repair these areas with fresh asphalt mix and/or additional reprocessing, at the Contractor's own expense, as directed by the Ministry Representative.

At all times the Contractor shall ensure that the appropriate cross slopes for safety and positive pavement drainage are maintained.

The Contractor shall ensure that the longitudinal edges of the recycled pavement are blended to conform in elevation with the adjacent pavement unless this surface is scheduled to be recycled.

Generally, the outer edge of each lane will be tapered to a 12:1 slope.

Excess materials shall be removed and deposited in a location such that they can be reincorporated into the recycled mixture. At no time shall excess material be cast across the newly processed surface or incorporated into the granular shoulders.

**514.33 Compaction and Finishing** - Immediately behind the reprocessing operation, the Contractor shall supply roller compaction to obtain a minimum of 97% laboratory density. The laboratory density will be the specimen density (Test



BCH II-1 or 2) that results from heating a representative sample of the existing pavement, or rejuvenated and blended mixture, as applicable, to a temperature of 130°C and producing a compacted laboratory specimen using the procedure for 75 blow Marshall method. (Sample preparation shall be in accordance with applicable portions of Test BCH II-3).

The mix for compaction testing shall be obtained behind the screed of the laydown machine, and the roadway shall be marked at that location for subsequent drilling of the core. The core shall be cut at the specified heater recycling thickness prior to obtaining its density.

The reprocessed mat shall have a uniform appearance. Any deficiencies shall be corrected, at the Contractor's expense, to the satisfaction of the Ministry Representative.

The completed Hot In-Place Recycled surface shall conform to all requirements of Subsection [501.10](#).

### MEASUREMENT

**514.81 General** - Hot In-Place Recycle will be measured by the SQUARE METRE of finished product. The area will be determined by measurement of the reprocessed mat and computed to the nearest square metre.

**514.82 Rejuvenating Agent** - Rejuvenating agent will be measured by the LITRE.

**514.83 Additional Virgin Mix** - Additional Virgin Mix will be measured by the TONNE.

### PAYMENT

**514.91 General** - Payment for HOT IN-PLACE RECYCLE of asphalt pavement will be at the Contract Unit Price per square metre. The Contract Unit Price shall be for all things furnished and done including sweeping, processing, compacting, and patching as necessary to complete the work. There shall be no additional payment for areas of "overlap" such as at tapers and joints.

**514.92 Rejuvenating Agent** - Payment for REJUVENATING AGENT will be at the Contract Unit Price per litre. The Contract Unit Price shall be to supply, store, heat, apply and blend with the asphalt pavement mixture reclaimed from the roadway.

**514.93 Additional Virgin Mix** - Payment for adding VIRGIN MIX at the recycling train will be at the Contract Unit Price per tonne. The Contract Unit Price shall be for all things furnished and done to produce the mix, haul and add the mix to the recycling operation.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 515

### END PRODUCT SPECIFICATION FOR HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT

#### PART A - GENERAL

**515.01 General** – This Section describes the materials, equipment, professional standards and end product requirements for the construction of Hot In Place Recycled Asphalt Pavement.

End Product Specifications contain the acceptance and payment criteria based on the results of specified sampling and testing. Payment of the contract Unit Prices for the hot in place asphalt pavement product is subject to adjustments upward and downward in accordance to the provisions provided in End Product Specifications (EPS).

**515.02 General Description Of Work** - The Contractor will be responsible for the following work associated with the construction of hot in place asphalt pavement by EPS:

- Preparing a Quality Control Plan for evaluation before commencing the Work and providing at the production site a testing facility to provide the data needed to implement that plan.
- Supplying, screening, crushing, processing and improving aggregate to produce virgin asphalt mix aggregate.
- Supplying and delivering asphalt cement meeting the requirements of [Section 952](#).
- Supplying and delivering rejuvenating agents meeting the requirements of [Subsection 514.11](#) and [Subsection 514.23](#).
- Heating the virgin asphalt mix aggregate and mixing it with asphalt cement to produce asphalt admix that meets the Job Mix Formula.
- Hauling, and adding the asphalt admix into the recycling process.
- Recycling the existing highway pavement by heating, milling, reprocessing, with or without the addition of rejuvenating agents or admix (virgin mix) as specified, re-mixing, replacing and compacting using a multi-stage, hot milling process and rollers.

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the contract. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice and those identified in [Section 514](#). Payment is subject to adjustments based on quality assurance tests performed by the Ministry Representative.

The Ministry shall provide information pertaining to the gradation of the admix, asphalt content, addition rates for rejuvenating agents and the percentage of admix to be incorporated.

#### 515.03 Definitions Relevant To End Product Specification

**515.03.01 End Product Specification (EPS)** - A specification whereby the Contractor is entirely responsible for quality control of the construction processes, and whereby the Ministry performs the specified quality assurance sampling and testing of the end product for the purpose of determining acceptance/rejection and payment.

**515.03.02 Job Mix Formula** - The Job Mix Formula, supplied by the Ministry, establishes the virgin aggregate proportions, gradation, the asphalt content and type of asphalt to be used for production of asphalt admix. The Job Mix Formula is based on an asphalt mix design, in accordance with [Subsection 515.05.06](#), or on a variation in accordance with [Subsection 515.05.07](#).

**515.03.03 Asphalt Admix** - The Asphalt Admix is virgin asphalt mix added to the recycled mix. The Asphalt Admix is project specific designed and is blended homogeneously within the recycling process. The Asphalt Admix becomes an integral component of the recycled pavement structure.

**515.03.04 Asphalt Content** - Asphalt Content means the quantity of asphalt cement in the virgin admix expressed as a percentage by weight of the total dry aggregate in the mix.

**Design Asphalt Content** - The asphalt content upon which the Job Mix Formula is initially established.

**Approved Asphalt Content** - The design asphalt content or subsequent adjustment to it, embodied in a Job Mix Formula or revised Job Mix Formula.

**Actual Asphalt Content** - Actual asphalt content is the amount of asphalt cement in the admix as determined by the Contractor's Quality Control Testing.

**515.03.05 Smoothness** - Smoothness is a measure of the longitudinal profile of the pavement surface. The unit for measurement is the International Roughness Index (IRI).

**515.03.06 Sample Mean** - The Sample Mean is the arithmetic mean of a set of test results constituting the sample.

**515.03.07 Stratified Random Sample** - A Stratified Random Sample is a set of test measurements taken one each from a number of separate (stratified) areas or Sub-Lots within a Lot in an unbiased way.

**515.03.08 Lot** - A Lot is a portion of the work being considered for acceptance and for the determination of



payment. A Lot is defined as follows.

For the application of the contract requirements for:

**- Density,**

A Lot shall be one day's scheduled production of at least 7 hours of pavement recycling where no changes have occurred to criteria such as but not limited to:

- approved Job Mix Formula,
- the specific thickness to be processed,
- the required materials addition rate,
- change in the ratio of the components making up the Hot In Place Recycled Pavement.

A change in any above criteria may require a new Lot designation.

One day's production of less than 7 hours will be dealt with as follows:

- the material will be added to the next Lot that has the same criteria, as described above, except that
- if a test indicates that this production is subject to a payment adjustment or to rejection, or if no further material will be produced with the same criteria, this production will be designated as a separate Lot,

A Lot shall be no more than two days total production even if the above criteria have not changed or been met.

For application of the contract requirements for:

**- Smoothness,**

A Lot shall be one kilometre length of recycled pavement for each driving lane.

**515.03.09 Sub-Lots for Density and Smoothness** - For the application of the contract requirements for:

- Density, each Lot shall be divided into three equal Sub-Lots.
- Smoothness, each Lot shall be divided into 100 metre Sub-Lots.

**515.03.10 Driving Lane** - A driving lane shall mean a single lane in any area of the pavement other than a shoulder or a barrier flare.

**515.03.11 Surplus Aggregate** - Surplus aggregate is aggregate surplus to the works, in split or un-split stockpiles which singly or combined will meet the virgin asphalt mix aggregate gradation. Surplus aggregate will be paid for as indicated in [Subsection 515.32.01](#). There will be no payment for reject aggregate.

**515.03.12 Hot In Place Recycled Pavement** - Hot In Place Recycled Pavement shall be the result of the process where recycling, the addition of admix and/or rejuvenating agents, the spreading, compacting and finishing of the asphalt pavement have taken place to form a quality finished product. The Hot In Place Recycled Pavement may be comprised of the following components: existing asphalt pavement, admix, and/or rejuvenating agents.

**515.04 Quality Control**

**515.04.01 General** - Quality Control, by the Contractor, is the sum total of activities by the Contractor to ensure that a product meets contract specification requirements. Quality Control includes material handling and construction procedures, calibration and maintenance of equipment, production process control and any sampling, testing and inspection that is done for these purposes.

The Contractor is responsible for all Quality Control under this specification. The Ministry Representative will audit and monitor the Contractor's operations and the implementation of the Contractor's Quality Control Plan.

The Ministry will not take samples for quality control testing and will in no manner assist in any degree or in any aspect of the Contractor's operation in the production of asphalt pavement, beginning from the production of aggregate through the compaction of asphalt mix. The only exception shall be in accordance with the provisions of [Subsection 515.05.07](#), where the Ministry shall have the ability to adjust the ratio of the components of the Hot In Place Recycled Pavement based upon the Contractor's Quality Control Results and visual inspections.

The Ministry Representative may issue a Stop Work Order to the Contractor if the Contractor fails to adhere to the Quality Control Plan. The Ministry Representative will not issue a Resume Work Order until the Contractor has given the Ministry Representative satisfactory assurance that it has in place adequate capacity to fulfil the requirements of the Quality Control Plan. Further to Article 42.00 of the Construction Agreement, such action by the Ministry Representative is specifically excluded from the definition of "Reimbursable Delay".

**515.04.02 Quality Control Plan** - The Contractor shall prepare a detailed, written Quality Control Plan, based on the guidelines as shown in [Appendix 1](#). The Contractor's Quality Control Plan shall be submitted to the Ministry Representative not less than five working days before starting the production of paving aggregate. The Ministry Representative will evaluate the Contractor's Quality Control plan and will respond, in writing, within five days. Any subsequent changes to the Contractor's Quality Control



Plan must also be submitted to the Ministry Representative for evaluation.

The Contractor's Quality Control Plan shall include a description and schedule of the intended sampling, testing and reporting. The Quality Control Plan must also include a detailed description of the means by which the Contractor shall use the quality control test results to ensure that the asphalt materials, aggregate, mix production, recycling and pavement compaction processes will be controlled to keep the end product within the specified limits. The Quality Control Plan must clearly show the flow of information from the quality control laboratory to the individuals who shall make the actual adjustments to the processes and equipment to effect this control. The plan will show time allowance for each step, the names and positions of all the people involved, and a clear description of the responsibilities of each.

**515.04.03 Quality Control Testing and Inspection** - The Contractor shall provide and maintain equipment and qualified personnel to perform all laboratory testing, field testing and inspection necessary to determine and monitor the characteristics and properties of all the materials produced and incorporated into the work. They shall also monitor the workmanship of the final product in accordance with the Quality Control Plan as most recently submitted.

The Contractor shall use a qualified registered member of the Association of Professional Engineers and Geoscientists of British Columbia or a qualified, registered member of the Applied Science Technologists and Technicians of British Columbia. This person shall be designated as the Quality Control Manager for the purposes of these specifications. The Quality Control Manager shall be responsible for preparation and sign off of the Quality Control Plan, shall be responsible for all Quality Control testing and inspections and shall be responsible for the signing of all Quality Control testing and inspection records and submissions to the Ministry.

The Contractor shall provide a testing facility(s) that meets the requirements necessary to carry out all the test procedures listed within this Section. The facility(s) must have the equipment specified under the appropriate test designation to perform the tests.

All equipment and the laboratory shall be well maintained and in good working condition. All testing equipment shall be calibrated and evidence of the calibration shall be provided when requested by the Ministry Representative.

**515.04.04 Quality Control Records** - The results from quality control testing shall be reported on test logs and

plotted on charts immediately after each test is completed. These test results, reports and charts shall be available, within 24 hours of the end of each shift, to the Ministry Representative and at all times during the progress of the work.

For the purposes of confirming delivery of asphalt mix to the road and the calculation of material application rates, the Contractor shall prepare and provide to the Ministry Representative, a copy of the Road Checker's Summary and the weigh tickets for each load received at the recycling operation at the end of each shift. The Road Checker's Summary shall include, but not be limited to, the following information:

- a) Truck Number
- b) Weigh Ticket Number and Net Weight of load
- c) Time and location by station of delivery
- d) Admix and Rejuvenator Material Application Rate Calculations
- e) Processed Depth, Lengths and Widths
- f) Temperatures (behind screed, windrow, ambient and admix)
- g) Notes pertaining to the paving of any appurtenances (intersections, tapers, etc.)

**515.04.05 Final Quality Control Testing Reports** - Prior to the issuance of a Completion Certificate, in accordance with Article 35.00 of the Construction Agreement, the Contractor shall provide the Ministry Representative with:

- a summary of all virgin aggregate quality control test results;
- copies of all quality control test results for asphalt admix properties, Hot In Place Recycled Pavement and compaction; and
- copies of all quality control charts.

**515.04.06 Minimum Acceptable Construction Practices** - Good construction practices shall be considered as standard construction procedures to be followed and shall include but not be limited to the procedures described below.

**Stockpiles** – Stockpiles of different types of material shall be located and constructed in such a manner as to prevent intermingling of the types and segregation of material.

**Haul Vehicles** – Lubrication of the truck boxes with diesel fuel will not be permitted. All vehicles shall have adequately insulated truck boxes and shall be equipped with an insulating tarpaulin of such size as to completely protect the asphalt mix.



**TABLE 515-A-1 STANDARD SAMPLING AND TESTING PROCEDURES FOR VIRGIN AGGREGATES**

All virgin aggregate tests shall use the following sieve sizes:

37.5mm, 25mm, 19mm, 16mm, 12.5mm, 9.5mm, 4.75mm, 2.36mm, 1.18mm, .600mm, .300mm, .150mm, and .075mm.

Item	Procedure	Test Reference
1	Sieve Analysis of Fine And Coarse Aggregates	ASTM C-136
2	Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing	ASTM C 117
3	Specific Gravity and Absorption of Coarse Aggregate	ASTM C-127
4	Specific Gravity and Absorption of Fine Aggregate	ASTM C-128
5	Determining the Percentage of Fractured Particles in Coarse Aggregate	ASTM D-5821
6	Total Moisture Content of Aggregate by Drying	ASTM C-566

**TABLE 515-A-2 STANDARD SAMPLING AND TESTING PROCEDURES FOR ASPHALT CEMENT**

Item	Procedure	Test Reference.
1	Penetration of Bituminous Materials	ASTM D-5
2	Viscosity of Asphalt by Vacuum Capillary Viscometer	ASTM D-2171

**TABLE 515-A-3 STANDARD SAMPLING AND TESTING PROCEDURES FOR VIRGIN ASPHALT ADMIX AND HOT IN PLACE RECYCLED PAVEMENT**

Item	Procedure	Test Reference
1	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures	ASTM D-2726
2	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures	ASTM D-2041
3	Sampling Compacted Bituminous Mixtures for Laboratory Testing	ASTM D-5361
4	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	ASTM D-1559
5	Determining Asphalt Content by Ignition Methods for Admix.	ASTM D-6307

**TABLE 515-A-4 TEST SAMPLE SOURCE LOCATIONS**

Test	Sample Source:
Density	150mm diameter. road cores
Smoothness	Driver's wheel-path

**Existing Paved Surfaces** – Existing paved surfaces shall be clean to avoid contamination of the recycled pavement. The existing surfaces shall be swept back at least 20cm wider than the area to be processed.

**Existing Utility Structures** – The Contractor shall ensure all catch basins and manholes, which are within the operating area of the heating units are clear of any flammable liquids or otherwise hazardous fumes/gases.

**Heating of Recycled Material** – The recycled material shall not be heated over an average of 150°C in order to avoid excessive oxidation and hardening of the recycled Asphalt Cement.

**Minimum Admix Temperature** – Based on the most recent Temperature Viscosity Curve supplied by the Asphalt Cement Supplier. This information will be used to set



minimum and maximum mixing temperatures.

**Longitudinal Joints** – Longitudinal joints in the top lift of asphalt pavement will generally only be permitted where lane dividing lines are to be painted.

**Longitudinal Edges** – Are to be blended to conform in elevation with the adjacent pavement unless this surface is scheduled to be recycled.

**Minimum Temperature** – Minimum Temperature behind the paver screed of the recycled material shall not be less than 110°C.

**Metering of Rejuvenating Agents** – To accurately proportion the rejuvenating agent into the hot milled material, the equipment shall control the quantity of the rejuvenating agent to  $\pm 0.05 \text{ } \ell/\text{m}^2$  of surfaced reprocessed with an agent application range of  $0.0 \text{ } \ell/\text{m}^2$  to  $1.0 \text{ } \ell/\text{m}^2$ . The measurement of the rejuvenating agent applied by means of a metering device shall be capable of recording accumulated litres to the accuracy of  $\pm 2\%$ , and be fully visible to both the operator and the Ministry Representative.

**Outer Edges** – The outer edge of each lane shall generally be tapered to a 12:1 slope.

**Recycling Adjoining Mats** – When recycling an adjoining parallel mat there shall be at least a 50-mm overlap onto the previously recycled surface. This overlap shall be properly “raked” to form a homogeneous bond between the two mats.

**Raking** – Any material that is raked from the joint shall not be placed on the new mat or placed on or in front of the paver. This material may be introduced at a point of the operation where the material shall be reheated and remixed with the Hot In Place Recycled Pavement.

**Discontinued Paving** - At locations where reprocessing operations begin and end, the Contractor shall ensure that the transition between the processed and unprocessed surface is smooth and without irregularities. If any irregularities occur resulting from the reprocessing operation, the Contractor shall repair these areas with fresh asphalt mix and/or additional reprocessing, at the Contractor’s own expense.

**Pavement Drainage** – The Contractor shall at all times ensure that the appropriate cross slopes for safety and positive pavement drainage are maintained.

**Rollers** – Rollers shall normally operate with the drive wheel nearest the paver and at a speed not in excess of 8 km/h. They shall not be allowed to park on the mat prior to complete cooling.

**515.05 Supply Of Virgin Aggregates, Asphalt Materials, Asphalt Admix Design And Job Mix Formula**

**515.05.01 Work in Ministry Pits or Quarries** - When operating in a Ministry pit or quarry, the Contractor shall comply with all provisions of [Subsection 145.26](#).

Variations to the code are available from the District Manager, Transportation.

**515.05.02 Supply of Virgin Aggregates, Aggregate Production and Characteristics** - The Contractor shall not produce paving aggregate until the Contractor has received written notification that the Quality Control Plan is in accordance with [Subsection 515.04.02](#), and has in place testing facilities for aggregate production that are in accordance with the Quality Control Plan.

For the production of virgin Asphalt Mix Aggregate, within Ministry pits, the Contractor shall provide crushing equipment that will permit all aggregate, that passes through 375 mm x 450 mm slotted openings, to be used for the production of crushed aggregate. Rocks, which will not pass through these openings, shall be stockpiled or disposed of as directed by the Ministry Representative. Crushing and screening equipment shall be provided with adequate facilities and capacity to be able to bleed off reject aggregate and remove any excess fine aggregate, dust or objectionable aggregate coatings, to make it acceptable for use. All products from crushing or screening plants, that can be used shall not be wasted, and shall be stockpiled or used as directed by the Ministry Representative.

Where the Ministry has available any test result information on the properties shown in [Table 515-B](#), for a Ministry pit or other source, the Ministry Representative will upon request, provide that information to the Contractor. Otherwise, sampling and testing to determine and demonstrate the compliance of paving aggregate with the requirements of this Section shall be the responsibility of the Contractor.

Paving aggregates shall meet the following requirements:

**a) Virgin Coarse Aggregates;**

- i)** shall be all mineral matter retained on the sieve designated in the test procedures for each individual test.
- ii)** shall consist of crushed stone, crushed gravel, or combination thereof, or materials naturally occurring in a fractured condition, or materials naturally occurring of highly angular nature or rough texture.
- iii)** shall be free from coating of clay, silt or other deleterious material, and shall meet the requirements listed in [Table 515-B](#).



**b) Virgin Fine Aggregate**

- i) shall be clean, tough, durable, moderately sharp, and free from coatings of clay, silt, or other deleterious material, and shall contain no clay balls or other aggregations of fine material.
- ii) shall have a maximum mass loss after five cycles of not more than 23% when tested in accordance with ASTM Test C-88.
- iii) shall have a sand equivalent of not less than 40 when tested in accordance with ASTM Test D-2419
- iv) shall have a minimum value of 45 when tested according to the AASHTO Test T 304, Method "A", - Uncompacted Void Content of Fine Aggregate when determining Fine Aggregate Angularity.

**c) Virgin Mineral Filler and Mineral Dust**

- i) Mineral filler shall consist of all matter passing the 0.600-mm sieve and mineral dust shall consist of all mineral matter passing the 0.075-mm sieve.
- ii) Mineral filler and mineral dust shall be free from organic matter.
- iii) Mineral filler shall be non-plastic when tested in accordance with ASTM Test D-4318.

**515.05.03 Supply of Asphalt Cement and Rejuvenating Agents** - The Contractor shall supply the types and grades of asphalt cement and rejuvenating agents as specified in the Special Provisions. The supply of these materials includes, but is not limited to, ordering, scheduling delivery of, supply of Temperature Viscosity Curve information, receiving, handling, storing, heating, blending, sampling, and testing of the materials and other related work.

The Contractor shall supply the Ministry Representative with copies of the supplier's weigh-bill and records of all asphalt and rejuvenating materials received on a daily basis. The amount of asphalt cement used will be calculated based on the Contractor's Quality Control testing results.

The supply of asphalt cement and rejuvenating agents shall be at the Unit Price bid for asphalt cement and rejuvenating materials.

**515.05.04 Responsibility for Asphalt Admix Design** - As the Ministry is responsible for all pre-engineering for the project, preparation of the asphalt admix design is the responsibility of the Ministry. The Ministry shall provide to the Contractor, pre-engineering information related to the Asphalt Admix. All costs incurred in admix design formulation are the responsibility of the Ministry.

**515.05.05 Evaluation of Asphalt Admix Materials** - The Ministry Representative will require up to 5 calendar days upon notification from the Contractor to evaluate the Contractor's Asphalt Admix materials.

**515.05.06 Samples Required for Asphalt Admix Evaluation** - At the discretion of the Ministry Representative, the Ministry may request samples of the Admix materials and Quality Control results and documentation for evaluation. Shipping costs for samples delivered to the Ministry Representative are the responsibility of the Contractor.

**515.05.07 Field Adjustment of the Job Mix Formula and/or Recycled Pavement** - During construction, the Ministry may require field adjustments to the job mix formula and/or recycled pavement. A field adjustment to the Job Mix Formula is defined as a change in the asphalt cement content of the admix, aggregate gradation, rejuvenating agent and/or proportioning of various aggregate sizes.

**PART B - PAYMENT ADJUSTMENTS****515.11 Density**

**515.11.01 Coring** - The Contractor shall be responsible for providing all core samples for quality assurance and payment adjustment purposes. The location of the cores shall be randomly selected and provided to the Contractor by the Ministry Representative. The Contractor shall

**TABLE 515-B – REQUIREMENTS FOR VIRGIN COARSE AGGREGATES**

Test Reference	Requirements	
ASTM C-127	Maximum Water Absorption: % by Mass	2
ASTM C-88	Soundness of Aggregate Maximum Loss After 5 Cycles	20
ASTM C-142	Maximum % by Mass of Clay Lumps and Friable Particles	1.5
BCH I - 9	Minimum Degradation Factor	35
ASTM D-5821	2 Fractured Faces: Minimum % by Mass Retained on the 4.75 mm sieve	85



provide 150 mm diameter cores for these purposes. The minimum core thickness shall be 37 mm. The Contractor shall prepare the cores prior to submission by removing all material not representative of the pavement lift to be tested. The Contractor shall deliver these cores to the Ministry Representative on site, within 24 hours of being provided the locations for the coring.

In the case of a core sample location falling in an obvious non representative area, such as a previously patched area, at the sole discretion of the Ministry Representative, a new random core location will be chosen for that sample.

All costs associated with obtaining the cores, including the filling and compaction of the core holes are considered incidental to the contract and are the responsibility of the Contractor.

**515.11.02 Percent Density** - One random core sample will be obtained from each Sub-Lot and tested. The test results for the three Sub-Lots will be averaged to determine the percent density for the Lot.

$$\text{Hot-In-Place \% Density} = \frac{\text{In Place Density of Sample}}{\text{Maximum Theoretical Density}} \times 100$$

(ASTM D-2041)

The Maximum Theoretical Density for the lot will be determined by combining the Sub-Lot cores. Prior to testing to determine the maximum theoretical density, the cores should be prepared in accordance with the procedure outlined in [Appendix 3](#).

**515.11.03 Payment Adjustments** - The payment adjustment for percent density will be the amount shown in [Table 515 C](#) for the Sample Mean of the test results for the Lot.

**515.11.04 Rejection Limit** - The rejection limit for percent density is the limiting value of the Sample Mean as shown in [Table 515 C](#).

If the test result for density of a Sub-lot is outside the acceptance limits, the Sub-lot is rejected automatically regardless of the values of other acceptance parameters. To minimize the cost of rejection to the Contractor, the Contractor shall isolate the area of low density within the Sub-lot and perform the necessary corrective measures to ensure specifications are met. The limits of the low density area must be verified and approved by the Ministry Representative before remedial work proceeds.

**515.11.05 Payment for Rejected Work Made Acceptable** - The payment adjustment for density will be based on testing of the reprocessed, replaced, or overlaid material

where applicable. Where replacement or overlay material does not cover the entire Lot or Sub-Lot, prior tests of the uncovered area will be averaged with new tests on the corrective work.

## **515.12 Smoothness**

**515.12.01 Determination of Pavement Smoothness** - The finished pavement surface shall be tested using a Class I precision rolling profile measuring instrument, to determine the longitudinal profile and compute the International Roughness Index (IRI) in each driving lane. Profiles shall be measured and the IRI calculated in the driver's wheel-path for each Sub-Lot. IRI values will be recorded to a precision of 0.01 m/km for each Sub-Lot. The Lot IRI value is the average of the IRI values calculated for the Sub-Lots within the Lot.

For any Sub-Lot between 50 m and 100 m in length, the IRI value shall be considered representative of a complete Sub-Lot. For any Sub-Lot less than 50 m in length, the IRI value will be combined with the proceeding Sub-Lot IRI value.

The profile shall be measured over the entire length of the pavement exclusive of structures and shoulder areas. Acceleration, deceleration and turning lanes are considered part of the driving lanes and shall be tested in accordance with this provision. For the measuring process, the Contractor shall provide the Ministry Representative a chalk guide line in the driver's wheelpath immediately prior to measurement.

**515.12.02 Auxiliary Lanes** - For smoothness testing, sections of the driving lanes that do not fall within the continuous through lanes, such as acceleration lanes, deceleration lanes and turning lanes, and lanes which are less than 1 km in length, shall be treated as follows. The

**TABLE 515 C PAYMENT ADJUSTMENTS FOR DENSITY**

<b>% MAXIMUM THEORETICAL DENSITY LOT AVERAGE</b>	<b>PAYMENT ADJUSTMENT (\$ PER m<sup>2</sup>) FOR DESIGN LOT</b>
95.6 Plus	+ \$0.25
95.0 – 95.5	+ \$0.15
94.0 – 94.9	+ \$0.10
93.0 – 93.9	0.00
92.6 – 92.9	- \$0.10
92.0 – 92.5	- \$0.25
91.9 or less	Reject



ratio of the section length to the standard Lot length of 1 km shall be determined and the payment adjustment shall be pro-rated on this basis as in the following example:

$$\begin{array}{l} \text{Length of segment,} \\ \text{i.e. 565 metres} \end{array} = \frac{0.565 \text{ times the Standard Lot}}{\text{Length of 1000m.}}$$

Hence the applicable payment adjustment is 0.565 times the payment adjustment for a 1-km Lot as determined from [Table 515-D](#).

**515.12.03 Acceptance Limits** - The acceptance limit for smoothness is the limiting value as shown in [Table 515-D](#), beyond which corrective work is required. Payment adjustments are shown in [Table 515-D](#). The International Roughness Index (IRI) value, calculated for each Sub-Lot, will be used to determine if the Lot will be accepted, and if so whether it will be subject to any payment adjustment.

**515.12.04 Payment Adjustments for Full or Increased Payment** - Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects as per [Subsection 515.22](#) and in the case of top lift pavement only, the pavement smoothness, as reported by the International Roughness Index (IRI) meets the following requirements:

- All Sub-Lots shall have an IRI value  $\leq 2.0$

**515.12.05 Rejection Limit** - If a Sub-Lot has an IRI  $\geq 2.0$ , the Sub-Lot is rejected.

**515.12.06 Remedial Work** - If the test results on a Sub-Lot of pavement indicate a payment reduction or rejection because of smoothness, the Contractor may propose remedial work to improve the smoothness. Such proposals

are subject to the approval of the Ministry Representative, but such approval does not imply that the proposed remedy will be successful, and does not reduce the Contractor's responsibility for meeting the acceptance requirements. Reprocessing may be acceptable, but cold milling and repaving may be required. Only one attempt may be made to improve smoothness, and this must be completed within ten (10) calendar days from the time the Contractor receives notification from the Ministry Representative of the original smoothness test results for that Sub-Lot.

Following any attempt to improve the smoothness of a Sub-Lot or Sub-Lots, the Ministry Representative will retest the Sub-Lot or Sub-Lots, and the new results will replace the previous data for the purposes of determining acceptance and payment.

No payment will be made for any material, equipment or manpower used to improve, or attempt to improve, smoothness.

**515.12.07 Smoothness Deficiency Repairs** - Smoothness deficiencies (bumps and dips) less than 8 mm over 3 m will not have a fix or remedial work requirement. Individual Smoothness deficiencies between 8 mm and 12 mm over 3 m will result in a \$200.00 penalty per deficiency and Smoothness deficiencies over 12 mm over 3 m will require remedial work. (see [Subsection 515.22](#)).

## PART C - ACCEPTANCE AND REJECTION

**515.21 Acceptance At Reduced Or Adjusted Payment** - Acceptance of any Lot at reduced payment will occur if it contains no obvious defects as per [Subsection 515.22](#), and if:

- the test results for acceptance parameters are such that the Lot or Sub-Lot meets the requirements for acceptance at a reduced payment; and
- the Lot or Sub-Lot is approved in respect of all other requirements; and if
- the Contractor has not notified the Ministry Representative in writing that it will exercise its option to either repair or remove and replace the work, at its own cost, with work meeting the requirements for acceptance at full or increased payment.

**515.22 Rejection For Workmanship Defects** - The finished surface of any lift shall have a uniform "closed" texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Ministry Representative such as, but not limited to the following, will be cause for automatic rejection of asphalt pavement regardless of the values of any other acceptance parameter:

**TABLE 515-D – LOT ASSESSMENT AND PAYMENT ADJUSTMENTS FOR SMOOTHNESS**

For the final surface course only, the following payment adjustments shall apply to each Lot.

Lot IRI (m/km)	Payment Adjustment
$\leq 0.80$	+\$2,000
0.81 to 1.0	+\$1000
1.01 to 1.10	+\$500
1.11 to 1.40	0
1.41 to 1.6	-\$250
1.61 to 1.7	-\$500
1.71 to 1.99	-\$1,000
$\geq 2.00$	Reject and corrective work required



- individual bumps and dips that exceed 12 mm over 3 m.;
- areas of excess or insufficient asphalt;
- improper matching of longitudinal and transverse joints;
- roller marks;
- tire marks; or
- cracking or tearing.

When asphalt pavement is rejected by reason of obvious defects, the minimum area of rejection will be the actual length of the defect for the full width of the driving lane in which the defect exists.

Rejected work shall be promptly repaired, remedied, or removed and replaced in a manner acceptable to the Ministry Representative. The Contractor shall be responsible for all costs including materials.

No payment will be made for work in any Lot or Sub-Lot, which has been rejected, until the defects have been remedied.

### **515.23 Appeal Testing**

**515.23.01 Density** - The Contractor may appeal the results of acceptance testing for density for any lot only once. Appeals will only be considered if quality control results can be presented to support the appeal.

Quality control test results for density which are provided to the Ministry Representative subsequent to the Contractor's receipt of the quality assurance test results for that Lot will not be considered (when evaluating evidence) for an appeal. The appeal shall be for all tests within the Lots, and there will be no appeal allowed for single tests within the Lot.

The following procedures will apply for the appeal:

- The Ministry Representative will arrange for an independent testing laboratory to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality control testing on the project will not be used for appeal testing.
- The original quality assurance results will not be considered in the appeal. The Contractor will sample the pavement at locations randomly re-selected by the Ministry within three site occupancy days following receipt of the appeal such that a total of (5) new core specimens are extracted throughout the Lot. The Ministry Representative will observe the sampling process. The procedures used to determine the test results shall be consistent with the original acceptance testing methods.

**515.23.02 Smoothness** - The Contractor may appeal smoothness acceptance test results of any rejected or penalised Lot, once. The appeal shall be in writing and submitted within the next three site occupancy days following receipt of the test results.

Any attempt to improve smoothness on the appealed Sub-Lot after the Ministry Representative has tested the Lot for acceptance shall void the appeal and the original test results will apply.

The Ministry Representative will perform, and the Contractor will be given the opportunity to witness, the appeal testing and the new results will be binding on the Contractor and the Ministry.

**515.23.03 Application of Appeal Testing Results** - For density appeals, the original test will be discarded. A new Sample Mean for the five new test results will be determined and used for acceptance and payment adjustment.

The new values, thus determined, in all cases, will be binding on the Contractor and the Ministry.

**515.23.04 Payment for Appeal Testing** - If the new results indicate a change in the payment adjustment in the Contractor's favour, then sampling and testing costs incurred during the appeal procedures for that Lot will be borne by the Ministry.

If the new results verify that any payment reduction or rejection remains valid for that Lot, then the costs of sampling and testing (plus 10% mark-up) incurred during the appeal procedure will be charged to the Contractor.

**515.23.05 Time Limits for Appeals of Test Results** - All appeals shall be in writing and submitted within the next three site occupancy days of receipt of the test results.

**515.24 Cold Milling And Re-Paving As A Corrective Measure** - If cold milling and re-paving is used as a corrective measure on a defective Lot or Sub-Lot, the thickness will be subject to the approval of the Ministry Representative, but shall not be less than 40mm. In all other respects, the re-paving will be subject to the same specifications as the pavement being replaced.

Whether the cold milling and re-paving is applied as a corrective measure, acceptability and payment will be determined as follows:

- acceptability, and eligibility for either positive or negative payment adjustment, will be determined entirely on the results of testing and observations conducted on the re-paving, regardless of test results



that have been obtained on the hot-in-place recycled pavement;

- the payment quantity, for application of the Unit Prices for asphalt pavement, and the quantity, to which any payment adjustment is to be applied, will be derived from the square meters of recycled pavement affected by the re-paving.

## PART D - PAYMENT

**515.31 General** - Payment at Unit Prices for the supply of virgin aggregates, the supply of asphalt cement, the supply of rejuvenating agents, the supply of virgin asphalt mix and the Hot In Place recycling construction of asphalt pavement, shall be full compensation for completing the supply and installation of Hot In Place asphalt pavement on prepared surfaces in accordance with the contract requirements.

Applicable payment adjustments (Additions or subtractions as applicable) shall be applied in accordance with Part B of this Section

The first 4,000 m<sup>2</sup> of hot in place asphalt pavement recycling production will not be subject to bonus/penalty payment adjustments but will be required to meet minimum Specification requirements for quality and workmanship.

### 515.31.01 Rejuvenating Agent and Asphalt Cement -

**Rejuvenating Agent** - Payment to Supply Rejuvenating Agent shall be at the Unit Price per litre for the quantity of material actually metered into the recycling process.

Such payment shall be full compensation for supplying, handling, storing, heating, sampling, testing and blending the material and all other related work.

**Asphalt Cement** - Payment for Supply of Asphalt Cement for admix shall be at the Unit Price per tonne for the payment quantity determined from:

$$\text{Payment Quantity of Asphalt Cement} = \frac{\text{Av. Actual Asphalt Content} \times \text{Payment Quantity of Asphalt Admix}}{\text{Average Actual Asphalt Content} + 100}$$

Where: **-Payment Quantity of Asphalt Admix** is the quantity determined in accordance with [Subsection 515.31.03](#),  
**-Actual Asphalt Content** is as defined in [Subsection 515.03.04](#),

The actual asphalt content shall be determined on a Lot by Lot basis by averaging the values obtained from the Quality Control tests from each Lot. This average will be used to determine the tonnage of Asphalt Cement used for payment

purposes for the Asphalt Cement for the Lot.

The quantity of asphalt cement so determined shall be used for payment purposes regardless of any discrepancy that may be noted between it and any quantity calculated using delivery quantities, tank dips, or other data. No payment will be made for asphalt cement used in reject mix.

Such payment shall be full compensation for supplying the material to the project, handling, storing, heating, sampling, and testing of the material, and other related work.

**515.31.02 Paving Aggregate into Stockpile – EPS** - Payment for Paving Aggregate into Stockpile - EPS shall be at the Unit Price per tonne for the quantity of paving aggregate placed into stockpile accordance with the following:

- The paving aggregate quantity will be identical to (100%) of the asphalt admixture quantity. As the aggregate is crushed into stockpile, progress payments will be made against the bid item, up to the quantity shown in the “Approximate Quantity” column of the Schedule of Approximate Quantities and Unit Prices. At contract completion, the final payment quantity for asphalt admix aggregate in accordance with the following calculation:

$$\frac{\text{Tonnes of Asphalt Admix Aggregate}}{100} = \frac{\text{'tonnes of mix x 100'}}{100 + \text{actual calculated asphalt content as per Subsection 515.03.04}}$$

Such payment shall be full compensation for all work including but not limited to the production, supply and stockpiling of all paving aggregates, and shall include all costs of quality control.

**515.31.03 Asphalt Admix – EPS** - Payment for Asphalt Admix - EPS constructed in place shall be at the Unit Price per tonne for the quantity of admix placed in accordance with the Contract requirements.

Subject to the exception noted below, only acceptable asphalt admix will be included in the payment quantity.

Where cold milling and re-paving is used as a corrective measure, in accordance with [Subsection 515.24](#);

- the overlay quantity will not be included in the admix payment quantity, but
- the admix used in quantity of recycled pavement removed by the cold milling and re-paving will be included in the admix payment quantity, whether or not it was acceptable.

Such payment shall be compensation in full for all work



including but not limited to: loading the aggregate into the feeders, drying the aggregate, metering and adding the asphalt cement, mixing, loading, weighing, hauling, dumping, spreading, compacting and finishing the asphalt pavement, and shall also include all costs of quality control.

**515.31.04 Hot In Place Recycled Asphalt Pavement – EPS** - Payment for Hot In Place Recycled Asphalt Pavement - EPS constructed in place shall be at the Unit Price per square meter for the quantity of recycled pavement in accordance with the Contract requirements.

Subject to the exception noted below, only acceptable recycled asphalt pavement will be included in the payment quantity.

Where cold milling and re-paving is used as a corrective measure, in accordance with [Subsection 515.24](#);

- the overlay quantity will not be included in the admix payment quantity, but
- the admix used in quantity of recycled pavement removed by the cold milling and re-paving will be included in the admix payment quantity, whether or not it was acceptable.

Such payment shall be compensation in full for all work including but not limited to: recycling, metering adding the rejuvenating agent, adding, spreading, compacting and finishing the asphalt pavement, and shall also include all costs of quality control.

**515.31.05 Payment for Acceptable Work** - The following end product properties of recycled asphalt pavement will be measured for acceptance:

- Density
- Smoothness

**515.31.06 Payment for Rejected Work Made Acceptable** - When defects have been remedied in Lots or Sub-Lots which had been rejected, payment for the original quantity of material in those Lots or Sub-Lots will be made subject to payment adjustments and penalty assessments and subject to [Subsection 515.24](#).

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed entirely at the Contractor's expense.

**515.31.07 Payment Adjustment** - Payment adjustments resulting from the application of this Section will be effected on each progress payment as follows.

1. For each Lot paid for by the square metre (m<sup>2</sup>), the applicable payment adjustment derived from [Table](#)

[515-C](#) (Density), in dollars per square metre will be expressed as positive in the case of increases and negative in the case of decreases. The algebraic sum of these unit adjustments will then be applied to the payment quantity for the Lot. The resulting amount, in dollars, will be the net payment adjustment, positive or negative, for that Lot.

The algebraic sum of the net payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for density for the current progress payment.

2. For each Lot, the applicable payment adjustment derived from [Table 515-D](#) (Smoothness), in dollars per Lot, will be expressed as positive in the case of increases and negative in the case of decreases, and will be the payment adjustment, positive or negative, for that Lot.

The algebraic sum of the payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for smoothness for the current progress payment.

3. The algebraic sum of the total payment adjustments for density and smoothness, derived in accordance with 1 and 2 above, shall be the total payment adjustment, positive or negative, in dollars, for all attributes for the current progress payment. This amount shall be added, if positive, or subtracted, if negative, by a single entry in computing the current progress payment.
4. The process set out in 1 to 3 above will be used in computing each progress payment to which it is applicable.

**515.32 Surplus Aggregate In Stockpile** - At the discretion of the Ministry Representative, the Ministry may or may not purchase surplus aggregate in stockpile in a private pit. Generally the Ministry will provide payment for the processing costs of surplus aggregate in stockpile in Ministry Pits only, and only to a limited quantity. However, should the Contractor produce surplus aggregate in a private pit, and the Ministry intends to purchase these surplus aggregates, the Contractor shall be required to provide a written agreement with the owner of the property. This document shall indicate that the Ministry will have free access to and use of the surplus aggregate in stockpile for a period of 12 months after the completion of the contract work. If the Contractor undertakes private work from within the private pit, measurements for surplus aggregate in



stockpile will not be taken until the completion of the private work, ensuring that the Ministry does not pay for aggregate used on private works.

All surplus aggregate shall be properly stockpiled.

**515.32.01 Ministry Purchase of Surplus Aggregate -**

Should the Ministry proceed with the purchase of surplus aggregate, upon completion of the contract, the Ministry will purchase surplus paving mix aggregate as indicated herein. Surplus crushed base and/or shoulder aggregates shall be paid for according to [Section 501](#).

If the quantity of Asphalt Pavement actually incorporated into the works is less than the estimated quantity, as stated in

the Schedule of Approximate Quantities and Unit Prices, the Ministry will purchase surplus aggregate up to 100% of the quantity required by the contract. The surplus aggregate must, when singly or combined, meet the gradation requirements set out in the Job Mix Formula. The maximum total surplus aggregate to be purchased will be the quantity of aggregate required to produce the quantity of mix as stated in the Schedule of Approximate Quantities and Unit Prices minus the quantity of aggregate actually incorporated in the works.

No payment shall be made for any surplus aggregate remaining at contract completion in excess of the contract requirement. Material remaining in the pit is the property of the Ministry.



## APPENDIX 1

### QUALITY CONTROL REQUIREMENTS AND GUIDELINES

#### 1.01 GENERAL

The Contractor's responsibilities for preparing, submitting and adhering to a Quality Control Plan are specified in Subsection 515.04. This Appendix provides requirements and guidelines for the Contractor's Quality Control Plan, in addition to those set out in [Subsection 515.04](#).

#### 1.02 QUALITY CONTROL PLAN

As a requirement, the Contractor shall prepare and submit a Quality Control Plan for evaluation. The Plan may be operated wholly, or in part by a qualified Subcontractor or an independent organization/agency. However, the Quality Control Plan, including compliance with the Plan and its modifications, is the responsibility of the Contractor.

The Plan shall address all elements that affect the quality of the hot in place recycled asphalt pavement, including but not limited to the following:

- Supply of Asphalt Materials
- Supply of rejuvenating agents
- Identification of source and proof of quality of virgin aggregates to be supplied;
- Virgin aggregate production and its gradation control;
- Quality of virgin aggregate components;
- Stockpile management;
- Asphalt plant calibration and proportioning of aggregate components;
- Mixing including asphalt cement content control;
- Process temperature controls;
- Admix Material and Rejuvenating Agent application rates and processed dimensions, placing and finishing;
- Joints;
- Density;
- Smoothness;
- Segregation;

The plan shall also include the following:

- The name of the Quality Control testing agency and its proven capability to provide the specific services required for the project.
- The list of dedicated technical staff, if available, (including names, qualifications and relevant experience) and their proposed roles.

The list of testing equipment available for project work.

The Quality Control Plan shall include the designation of specific personnel responsible for specific quality control duties.

- There shall be a designated Quality Control Manager, as per [Subsection 515.04.03](#). The Quality Control Manager shall be qualified as per [Subsection 515.04.03](#). The Quality Control Manager shall be responsible for the preparation and sign off of the Quality Control Plan, responsible for all Quality Control testing, and inspections, responsible for the sign off of all quality control testing and inspection records and responsible for all quality control submissions to the Ministry. The individual shall be identified and named in the Quality Control Plan submission. If the Contractor requests a change in the Quality Control Manager, then a formal request to the Ministry representative shall be made and the Ministry will review the request for approval.
- There may be a designated Process Control Technician (PCT) who would be responsible to ensure that laboratory test results and other quality control practices are used to control the quality of aggregates and other mix components and to adjust and control mix proportions to meet the mix design(s). The PCT is responsible for ensuring that testing equipment, utilized for proportioning and mixing are calibrated and in good working order. The Plan may describe how the PCT's duties, including sampling methods and responsibilities are to be accomplished and documented. The Plan should also describe the criteria to be used by the PCT to correct or reject unsatisfactory materials.
- There may also be a Pavement Quality Control Technician (PQT) who would be responsible to ensure that delivered materials meet the requirements of the specifications. In addition, the PQT shall be responsible for periodically inspecting all equipment used in recycling, placing, finishing, and compacting to assure its proper operating condition and to assure that recycling, placing, application rate, finishing, joint construction, and compaction is in conformance with this specification and the contract requirements.

#### 1.03 CONTRACTOR'S RECORD OF QUALITY CONTROL TESTING

Test results shall be made on specified forms or charts



immediately after completion of each test. These test results are to be made available to the Ministry Representative upon request.

Records of gradation control, both during aggregate production and also during the asphalt mixing operation, should be kept on the form H-295 - Mechanical Analysis of Aggregates.

**1.04 MATERIALS APPLICATION RATE**

The Contractor shall control the Material Application Rate by monitoring the amount of asphalt admix delivered to the road against the area covered by checking the application rate every five loads.

The Contractor shall monitor the addition of rejuvenating agents by calculating the application rate, through comparing the metered amount with the total area processed every one-half hour.

The Contractor is to advise the Ministry Representative on an ongoing basis of the application rates.

**1.05 DENSITY**

The Contractor shall take core samples to determine actual pavement density. At the start of paving, the Contractor may take a minimum of two pavement cores from each Sub-Lot. The Contractor may employ a nuclear densometer to ensure intermediate density control.

**1.06 OTHER QUALITY CONTROL PROCEDURES**

The Contractor may initiate other Quality Control procedures as necessary for ensuring production of a quality product and include them in the Quality Control Plan. Procedures may also be introduced after the start of work as necessary as amendments to the Quality Control Plan.

**1.07 QUALITY CONTROL TESTING FREQUENCY GUIDELINES**

Test frequency guidelines for Quality Control are described in TABLE 1:



**TABLE 1 –TEST FREQUENCY GUIDELINES**

	Test	Minimum Frequency
Tests During Crushing (Virgin Aggregate)	ASTM C-136, Dry Sieve Analysis of Aggregate	Split Stockpiles: One for each stockpile for every 2 hours of production. One main stockpile: for every 300 tonnes. Blend Sand: One for every 100 tonnes during stockpiling. Natural filler: One for every 50 tonnes during stockpiling.
	ASTM D-5821 Determining the Percentage of Fractured Particles in Coarse Aggregate	Every second coarse aggregate sieve test.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	One per day on reduced sample obtained from combined samples from the crusher
Tests During Asphalt Plant Mixing (Admix)	ASTM C-136, Dry Sieve Analysis of Aggregate	One of combined aggregate every 100 tonnes.
	ASTM C-566 & D-2216, Moisture Content	Aggregate: 2 tests/Lot Asphalt mix: 1 on first Sub-Lot and every second day.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	One per shift on reduced sample obtained from combined samples from the plant cold feed
	Asphalt Extraction Test ASTM D-6307 Ignition Method	One per Lot.
	Penetration of Bituminous Materials ASTM D-5	One per Manufacturer's Batch
	Viscosity ASTM D-2171	Contractor's Option
Rejuvenating Agents Tests	Rejuvenating Agent	Contractor's option.
Test During Asphalt Paving for Density Testing (Hot In Place Recycled Pavement)	ASTM D-1559, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	Contractor's Option
	ASTM D-2726 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures (Briquette or Cores)	One per Sub-lot
	ASTM D-2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures	One (see Appendix 3 for Combining Cores)
	Core Samples	One core for each Sub-Lot. All cores to be 150mm diameter.



## APPENDIX 2

## REQUIREMENT FOR PRODUCTION OF ADMIX AGGREGATES

## 2.01 GRADATION MAXIMUM PERMISSIBLE VARIATION LIMITS:

Sieve Size	
19.0 mm or 16.0 mm	0%
12.5 mm	+/-3.5%
9.5 mm	+/-3.5%
4.75 mm	+/-3.0%
2.36 mm	+/-3.0%
1.18 mm	+/-2.0%
0.600 mm	+/-2.0%
0.300 mm	+/-1.5%
0.150 mm	+/-1.0%
0.075 mm	+/-0.75%

The variation limits, when applied to the Ministry specified design Admix gradation, shall not result in a gradation that is outside of the limits as specified by the Ministry.



### APPENDIX 3

#### METHOD TO COMBINE ROAD CORES INTO A SINGLE COMBINED SAMPLE FOR THE DETERMINATION OF MAXIMUM THEORETICAL DENSITY.

##### 3.01 INTRODUCTION

After the individual Density for each core has been determined, the Sub-lot road cores shall be combined into one single sample for the determination of maximum theoretical density.

##### 3.02 SAMPLE PREPARATION

The upper re-cycled portion of the cores shall be separated from other pavement layers by sawing or other effective methods.

The minimum combined sample size required shall be 2000 grams and 2500 grams for 19.0 mm and 25.0 mm maximum aggregate size respectively.

Select a core trimmer to ensure that the minimum sample size is obtained depending on the thickness of the samples. 100 mm, 114 mm, or 127 mm core trimmers may be used.

Place the core samples in a pan and heat to  $130^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for about 20 minutes to allow the specimens to be easily trimmed. Do not overheat. The cores can be stacked on top

of each other and trimmed together or individually.

Select a core trimmer to attain the minimum combined sample size. Heat the base of the trimmer by placing on a burner for a few minutes.

Centre the heated trimmer on the heated cores (allow equal clearance on all sides of the core).

Hold the trimmer vertically by its handle, then press it down through the core until it reaches the bottom of the pan. Apply a slight twist if the heated cores(s) are difficult to penetrate.

Remove the outside cut rock mix by means of a spatula spoon and discard.

Thoroughly mix the resultant combined sample prior to testing to ensure uniform aggregate coating.

The complete combined sample must be tested. If the resultant sample size exceeds the available capacity of the container used for vacuum saturation, it may be tested a portion at a time.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**

**NEW SECTION**



## SECTION 521

### ASPHALT STABILIZED BASE COURSE MIXED IN PLACE

#### DESCRIPTION

**521.01 Scope** - This Section describes the materials, plant, equipment and work practice required for the in place stabilization of granular base course material mixed with selected bituminous binder.

#### EQUIPMENT

##### 521.21 General Condition of Plant and Equipment

**521.21.01** The Contractor, when submitting the bid for work under this contract shall at the same time submit a list of equipment available and ready for use on the contract, and shall further certify that the equipment listed meets the requirement of this Section in every respect.

**521.21.02** Before any work is permitted to commence, the Contractor's equipment and plant will be carefully inspected; should any of it fail to meet the required standards, work will not be permitted to commence until such deficiency is corrected.

**521.21.03** All equipment and plant shall be in good mechanical condition and adjustment and be capable of efficiently performing the work required of it.

**521.21.04** Once the Contractor's bid has been accepted, provision and maintenance of all equipment listed shall become an essential part of the contract and no equipment or plant may be released from the contract work for use elsewhere until completion, except by the express written permission of the Ministry Representative.

**521.21.05** The Ministry Representative shall have access at all times to any plant, equipment or machinery to be used on this contract in order to check calibration, control or operating adjustments. Where adjustment appears necessary, it shall be done by a competent technician or instrument repair laboratory.

**521.21.06** Plant, machinery and equipment specified hereafter shall represent a minimum requirement for the type of machine described and does not represent a comprehensive list of equipment to be supplied by the Contractor, who shall supply whatever plant and equipment may be necessary to the proper and efficient completion of the work.

**521.21.07** All plant and equipment shall be under the control of experienced and skilled operators.

**521.22 Pressure Distributor** - The pressure distributor

used for applying bituminous materials shall consist of a fully insulated tank with a minimum capacity of 5000 ℓ permanently and rigidly mounted on a truck or trailer provided with pneumatic tires and propelled by a power unit capable of maintaining a constant and uniform speed. In order to be acceptable, the distributor shall be provided with the following minimum equipment:

- a) quick opening gate in the dome.
  - b) a measuring dipstick calibrated in 100 ℓ increments or in 20 mm gradations and provided with a calibration chart indicating the number of litres for each 20 mm in depth of contained bituminous material for accurate checking of the distributor contents. In addition an external and readily visible depth gauge or levelometer indicating the asphalt content of the tank to the nearest 100 ℓ and having an accuracy of  $\pm 50 \ell$ .
  - c) an efficient and positive means of heating the bituminous contents uniformly to any temperature up to 175°C and maintaining the contents constantly at any selected temperature without any local overheating.
  - d) an approved industrial type thermometer so situated that its face shall always be readily visible to the spray bar operator. The sensing element of the thermometer shall be placed either directly in contact with the hot bituminous material or enclosed in a thin walled well of approved manufacture, so placed as to accurately measure the temperature of the material in the tank. The thermometer shall have a minimum range of 10° to 175°C subdivided into 1°C graduations and be accurate to  $\pm 0.5^\circ\text{C}$
  - e) rear mounted spray bars and nozzles set parallel to the surface to be sprayed and capable of vertical and lateral adjustment. The spray bars shall be capable of adjustment to provide a minimum spraying width of 1.8 m and a maximum spraying width of 7.5 m.
- The feed to the spray bars must be so arranged that there shall be a constant circulation of hot bituminous material to the bars such as will ensure a uniform viscosity and constant pressure of the bituminous material at each nozzle, both before and during spraying operations. Feed manifolds to spray bars shall be provided with strainers to prevent clogging of bars and nozzles.
- f) rotary adjustable, spray bar nozzles which shall be so designed and set as to ensure a uniformly fan shaped spray without atomization, overlapping on the surface to be sprayed, such that there shall be produced a uniformly sprayed surface to clearly defined edges of the sprayed



lane without any reduction of the rate of application adjacent to the edges of the lane. Spray nozzles shall be provided with valves capable of instant full opening or positive cut-off.

g) a connection to a circulating pressure manifold to which a hose may be attached for a single nozzle, hand operated outlet.

h) a pressure gauge accurate to 15 kPa and calibrated pressure pump, equipped with a tachometer registering litres per minute and driven by an independent mechanically governed power unit, so designed as to be capable of applying through the spray nozzles fitted, accurately measured quantities of bituminous material at a minimum rate of 900 ℓ per minute.

Both pressure gauge and tachometer shall be mounted so as to be readily visible to the operator.

i) a fifth wheel tachometer, registering metres per minute and so calibrated and mounted as to be readily visible to the driver of the distributor, to enable the operator to maintain the constant speed required for application of bituminous material to the road at the specified rate.

**521.23 Blade Graders** - Self-propelled blade graders mounted on pneumatic tires shall be of approved modern type, either four wheel drive or tandem type having sufficient capacity to efficiently perform all work that may be required on the contract. Unless otherwise approved by the Ministry Representative, all graders shall meet the criteria listed in Table 521-A.

**521.24 Pulverizing and Rotary Mixing Machines** - Pulverizing and rotary mixing machines to be used on the work shall be standard machines, factory produced by a reputable manufacturer, so designed and constructed as to satisfactorily break up all base aggregations into constituent particles and capable of thoroughly and uniformly mixing the granular base material and applied asphaltic binder so as to produce a uniformly coated mix free from lumps, balls or segregation. The Contractor may use any machine of the Contractor's choice, subject to the approval of the Ministry Representative.

**521.25 Compaction Equipment** - Compaction equipment shall consist of approved steel wheel rollers, pneumatic tired rollers, vibrating rollers or tampers.

**521.25.01 Self Propelled Steel Rollers** - Self propelled steel rollers may be three-wheel rollers or tandem rollers. These rollers shall be equipped with power units of not less than four cylinders unless otherwise approved by the

**TABLE 521-A CRITERIA FOR BLADE GRADERS**

Minimum Weight	7.25 t
Minimum Blade Length	3.6 m
Minimum Wheel Base	5.5 m
Minimum Cubic Displacement of Pistons: 4 Cycle Motors	7.0 ℓ
Minimum Cubic Displacement of Pistons: 2 Cycle Motors	4.0 ℓ

Ministry Representative, and under working conditions shall be capable of developing a compression in the rear wheels of not less than 4.0 kg/mm<sup>2</sup> over a minimum roller width of 500 mm. At least one roller on each job shall be capable of developing a roll pressure of 4.5 kg/mm<sup>2</sup> of width. Rollers shall be in good working condition and free from backlash, faulty steering mechanism or worn parts. Rollers shall be equipped with adjustable scrapers to keep the rolls clean and with an efficient means of keeping the wheels wet to prevent mixes from sticking to the rolls. Rolls shall be free of flat areas, dents, openings or projections which will mar the surface of the pavement.

**521.25.02 Pneumatic Tire Rollers** - Pneumatic tire rollers shall be either self-propelled or towed type, single or double axle, having a minimum effective rolling width of 1.2 m. The rollers shall be equipped with smooth tread pneumatic tires of equal size and diameter. The wheels of the roller shall be so spaced that two passes of a single axle roller or one pass of a two axle roller will accomplish one complete coverage equal to the rolling width of the machine. There shall be a minimum 6 mm overlap of the tracking wheels of a double axle roller. The wheels of towed rollers to be used on granular base preparation may wobble. The roller shall be so constructed that the contact pressure shall be uniform for all wheels and the tire pressure of the several tires shall not vary more than 35 kPa. Pneumatic tire rollers shall be constructed with ample ballast space to provide an operating weight of 4.5 to 8 kg/mm<sup>2</sup> of tire track width. The total operating weight of the roller may be varied by the Ministry Representative. The towing vehicle for towed type roller shall be equipped with smooth tread pneumatic tires.

**521.25.03 Vibrating Tampers** - Vibrating tampers to be used for the compaction of bituminous base in places inaccessible to rollers, shall be of a type suitable for the work to be performed and shall be subject to the approval of the Ministry Representative.

**521.25.04 Vibrating Compaction Equipment** - The Contractor may use vibrating compaction equipment to compact the stabilized base, provided that such equipment produces compaction and surface finish equal to that



obtainable by using a steel wheel finish roller having a minimum compression roll pressure of 4.5 kg/mm<sup>2</sup>.

## CONSTRUCTION

**521.31 Method I** - When the roadway has been completed in its entirety by others, the following method shall apply:

a) The granular base shall be regraded to true line, grade and cross-section; the top 65 mm of the base shall be loosened by means of scarifying. The lumps of bonded material are to be broken to constituent gravel by harrowing, blading or rotary tilling. The loose material is to be bladed into a windrow, approximately 10 cm in height on both sides of the road. This windrow will act as a dam in case of spillage or the occurrence of rain after the spraying has taken place.

b) The prepared gravel surface shall be primed on the side not obstructed by the windrow, to the outside width required at a rate of 1 to 1.5 ℓ/m<sup>2</sup> or as may be ordered, employing the bituminous binder selected by the Ministry Representative within a spraying temperature range which corresponds to a kinematic viscosity of 150 to 200 mm<sup>2</sup>/s in the binder.

Priming shall be applied only when the surface is dry or slightly damp, and unless otherwise permitted by the Ministry Representative, when the air temperature in the shade is not less than 10°C rising or 12°C falling. When the prime has been completely absorbed by the prepared surface, blade the windrow of loose surface course onto the primed half of the road and prime the untreated half of the surface in a like manner.

Generally, this work shall be governed by the applicable provisions of Subsection [501.31](#).

c) Immediately prior to application of the bituminous binder, the windrow of loose gravel shall be bladed across the road to a full width uniform cross section. If wet or damp, it shall be first bladed back and forth until dry unless an emulsion is to be used. Cutback bituminous binder shall not be applied until the moisture content has been reduced to 1.5%. In the case of emulsions, mixing may commence when the moisture content of the gravel has been reduced to 4%. No asphaltic binder shall be sprayed on the granular aggregate unless the average temperature of the aggregate on the road is 13°C or higher and such temperature can be maintained in the aggregate until the full mixing cycle has been completed.

Upon the layer of graded aggregate, the bituminous binder shall be applied uniformly at a rate of 1.35 ℓ/m<sup>2</sup>,

at application temperature required to produce a kinematic viscosity of 150 to 200 mm<sup>2</sup>/s in the binder.

A disc harrow or rotary type mixer shall immediately follow the distributor after the application of the bituminous binder and shall continue to operate on the treated strip until all free bituminous material has been mixed into the mineral aggregate. The treated mixture shall then be further mixed with a blade grader until a thoroughly uniform mixture results.

The mixture shall then be spread uniformly across the road once more, a second uniform application of bituminous binder at a rate of 0.9 to 1.8 ℓ/m<sup>2</sup> as may be directed by the Ministry Representative shall be sprayed at application temperature so as to give a final asphalt content of 4 to 6% of the mix. The second application of bituminous binder shall be mixed with the mineral aggregate in a similar manner to the first application, taking care that during the blade mixing none of the untreated base below the prime or shoulder material is brought into the mix. Blade mixing shall be continued until the bituminous binder and mineral aggregates are thoroughly mixed to uniform colour, free from fat spots, balls and uncoated particles. If the mixture should become wet before the mixing process is complete, the mixing operations shall be continued until it has dried out. After final mixing, the mixture shall be brought to a single windrow.

d) Before the finished mixture is finally spread for compaction, a triangular cut shall be made with a blade at each edge of the base course to provide for a thickened edge of bituminous mixture. The cut shall be approximately 50 mm deep at the outer edge and slope to zero, 0.6 m in toward the centre. In making the cut, the excavated material shall be thrown to the shoulder in a small windrow against which the mixture shall be spread. The bituminous mixture shall be spread for compaction from the large windrow. It shall be bladed from this windrow in a succession of thin layers to correct thickness and a uniform cross section with a camber of 1 in 45 (except at curves, where the correct superelevation originally set for base shall be followed).

After the mixture has been spread as specified, it shall be compacted by means of rollers, which operation shall begin at the edges of the course and progress toward the centre parallel to the centreline of the roadway, overlapping in successive passes by at least one-half the width of the roller. Initial breakdown compaction may be obtained by use of steel or rubber tired rollers until no appreciable surface movement or roller marks are visible and the surface has been satisfactorily sealed. Final rolling to eliminate rubber tire or other marks and irregularities shall be carried out



using an approved steel wheel finish roller or steel wheel vibrating rollers or other satisfactory equipment.

Compaction shall be carried out to the satisfaction of the Ministry Representative.

Should unsatisfactory areas develop during compaction, they shall be corrected as directed by the Ministry Representative.

**521.32 Method II** - When the granular base and base stabilization are included in the contract, Method II shall apply as described hereunder:

- a) The first lift of granular base, 90 mm, shall be hauled to the roadway, spread, graded to line, grade and cross-section, compacted to 100% of the density as obtained in the laboratory following BCH Test 1-14 (ASTM Designation 0698) Method D.

On completion of the above roadways, as described in the foregoing, priming may be commenced.

On completion of priming and curing the second lift, 60 mm of granular base may be hauled to the primed roadway and spread in a uniform windrow and mixing commenced as described in Subsection 521.31(c).

On completion of base stabilization, the remaining granular base may be applied, i.e., from the edge of the stabilized base to the shoulder.

### MEASUREMENT

**521.81 Spray Asphalt** - Spray asphalt will be measured by the LITRE sprayed on the road.

**521.82 Process Base Gravel** - Process base gravel will be measured by the SQUARE METRE of completed surface,

constructed to dimensions ordered.

### PAYMENT

**521.91 Payment** - Payment for asphalt stabilizing granular base course in place will be made as follows:

- a) **Spray Asphalt** - Payment for SPRAY ASPHALT will be at the Contract Unit Price per litre for the actual number of litres sprayed on the road converted to its volume at 15.6°C. The rate for spraying asphalt shall cover acceptance of asphalt at points of delivery, storing, heating, transport, spraying, traffic control, labour superintendence, equipment and machinery required to carry out all asphalt spraying work including priming described in this Section.

- b) **Process Base Gravel** - Payment for PROCESSING BASE GRAVEL will be at the Contract Unit Price per square metre of measured completed surface, constructed to dimensions ordered. Payment will not be made for extra width of surface mixed or compacted beyond the limits specified.

The rate for processing base gravel shall cover provision of all tools, labour, equipment and services required to cut, shape, dry, pulverize, mix and lay out the base; all compaction; warning signs, barriers, lights, traffic control and superintendence required to thoroughly mix and compact the asphalt and aggregate in place on the road.

Payment of measured quantities at the bid rates for the above two items shall be full compensation for all work and services performed and materials and equipment supplied to complete asphalt stabilization of granular base course material according to the description and intent of this Section.



## SECTION 531

### ASPHALT SURFACE TREATMENTS

#### DESCRIPTION

**531.01 Scope** - This Section specifies the materials, plant, equipment and quality of work required for the construction of asphalt surface treatments with cover aggregates.

**531.02 Description of Work** - Surface treatment shall consist of the application of a selected asphalt binder material to a previously constructed bituminous pavement, or a well compacted crushed granular surface followed by the application and embedment of a course(s) of selected aggregate to provide a new surface which shall be impervious to moisture, have a non-skid texture, high luminosity and good riding qualities. This normally would be a chip seal, graded aggregate seal or a coarse sand seal or any other surface treatment outlined in the Special Provisions for the Project work of the Contract.

**531.03 Types of Chip Seals** - There are five types of chip seals characterized by the principal size of the cover aggregate. Unless specifically described otherwise in the Special Provisions, an asphalt chip seal shall be constructed using medium cover aggregate as defined in Subsection [531.16](#).

**531.04 Types of Graded Aggregate Seals** - There are six types of graded aggregate seals as characterized by the maximum and minimum gradations of the cover aggregate as defined in Subsection [531.17](#).

asphalt; medium curing cutback asphalts; or anionic or cationic emulsions including high float emulsified asphalts meeting the requirements of Section [951](#). Types and grades of asphalt binder proposed for use on the Project will be specified in the Special Provisions.

**531.12 Coating and Anti-Stripping Additives** - For general use or for experimental or trial purposes, the Ministry Representative may direct the use of surface active "coating and anti-stripping additives" or any other materials formulated to improve the coating and adhesive properties of the asphalt binder to the selected cover aggregate. In such cases, instructions concerning the type of additive to be supplied and the method of incorporation with the asphalt binder will be specified in the Special Provisions or, if the work has commenced, will be the subject of supplementary written instructions to the Contractor.

**531.13 Mineral Aggregate Supply** - Mineral cover aggregate meeting the requirements described hereunder shall be supplied by the Contractor unless specifically described otherwise in the Special Provisions.

**531.14 Mineral Aggregate - Method of Test** - Mineral Aggregate will be tested in accordance with the standard British Columbia Ministry of Transportation (BCH) and ASTM tests listed in Table [531-A](#).

#### 531.15 Mineral Aggregate - Physical Requirements

**531.15.01 Composition** - Mineral cover aggregate shall consist of clean, sound, hard, durable particles or fragments of sand, gravel or crushed stones or combination thereof; containing a minimum of thin elongated or flaky pieces such

#### MATERIALS

**531.11 Asphalt Materials** - Asphalt(s) to be used on surface treatment may be standard rapid curing cutback

**TABLE 531-A TEST METHODS FOR MINERAL AGGREGATE**

BCH TEST	ASTM DESIGNATION	NAME OF TEST
	D 75	Sampling stone, slag, gravel, sand, and stone block for use as Highway materials
I - 1		Sieve Analysis of Aggregates
I - 2		Wash Test of Aggregates
I - 7		Clay Lumps and Friable Particles in Aggregates
I - 3		Bulk Relative Density and Absorption of Coarse Aggregates
I - 4		Bulk Relative Density and Absorption of Fine Aggregates
I - 5		Soundness of Aggregates by use of Magnesium Sulphate
I - 9		Degradation Test
I - 13		Fracture Count on Coarse Aggregate
I - 6		Moisture Content of Aggregate by Drying
I - 11 & 12		Liquid Plastic Limit Determination



as may cause the height constant of the particles to be less than 0.6 (refer to BC Highways Paving Branch Manual of Test Procedures BCH-VI). It shall be substantially free from loosely bonded aggregations, clay lumps or other objectionable matter and shall not, in the Ministry Representative's opinion, be markedly hydrophilic in character.

**531.15.02 Test Requirements** - For the purpose of testing, the mineral cover aggregate shall be considered to be divided into coarse and fine (sand) fractions. Fine aggregates shall consist of all material passing through a 4.75 mm standard sieve, unless some other boundary shall be specifically described under the respective Method of Test. The mineral cover aggregate, when tested by the methods listed in Subsection 531.14, shall meet the following criteria:

- a) Clay Lumps** - Coarse aggregate shall not contain more than 0.5% by mass of clay lumps or other aggregation of fine material.
- b) Absorption** - maximum 1.0% by mass for coarse aggregate; maximum 1.5% by mass for fine aggregate.
- c) Soundness** - When tested for soundness by BCH Test I-5, the aggregate shall not show a weighted loss for five cycles in excess of 12% when Magnesium Sulphate is used (or have a satisfactory record of service).
- d) Degradation** - No individual test shall have a degradation factor of less than 40.

### 531.16 Chip Seal Aggregates - Requirements

**531.16.01 Screen Analysis** - Chips shall be subjected to a washed screen analysis. The result will be shown on a chart, with the total percent passing each screen plotted against the logarithm of the screen opening. Sufficient screens of suitable size shall be used to result in a reasonably well-defined and smooth curve. The values on the screen opening scale at which this curve intersects the 5%, 10%, 50%, 90% and 100% lines on the percentage scale shall be noted; likewise, the percentage passing the 0.075 mm mesh screen. The screen opening corresponding to the 50% point will hereafter be referred to as the Principal Size.

**531.16.02 Aggregate Size** - The variation in Principal Size for each of the described aggregate grades shall be as tabulated in Table 531-B.

While the grade description for the project may have been stated, the acceptance of the corresponding size range in any aggregate not described or previously approved in order to make the most economic use of the aggregate resources,

shall be at the discretion of the Ministry Representative, since the shape and other characteristics of the aggregate determine its suitable principal size in use.

**531.16.03 Gradation** - The size openings determined as described in Subsection 531.16.01 shall meet the requirements stated in Table 531-C, the ratio in each case being that of the screen opening corresponding to the percentage specified to the Principal Size or 50% opening.

Grading Chart Drawing SP531-01 illustrates the grading requirements.

In addition, the percentage of material passing the 0.075 mm mesh sieve shall not exceed the amounts stated in Table 531-D for the various grades.

### 531.17 Graded Aggregate Seal - Requirements

**531.17.01 Gradation** - Gradations shall meet the limit stated in Table 531-E for each Class of graded aggregate seal.

**a) Fracture** - When tested according to BCH Test I-13 Method B-2 fractured faces, the minimum % by mass on course aggregate shall be as follows:

- Classes A & B = 70%
- Classes C, D, & E = 85%

**b) Variation Limits** - Once the grading curve is established within the above limits, the maximum permissible variation of the mean of any five consecutive tests from the grading curve shall be within the tolerance specified in Table 531-F

These tolerances do not waive the requirement that the running average of five consecutive tests must be maintained at all times inside the limits specified in Subsection 531.17.01. Should the Contractor not be able to maintain the grading within the variation limits

**TABLE 531-B VARIATIONS IN PRINCIPAL SIZES FOR VARIOUS AGGREGATE GRADES**

GRADE DESCRIPTION	PRINCIPAL SIZE (mm)	
	MINIMUM	MAXIMUM
Fine Cover Sand	0.7	2.0
Coarse Cover Sand	2.0	3.5
Small Cover Aggregate	3.5	6.5
Medium Cover Aggregate	5.0	11.0
Large Cover Aggregate	11.0	19.0



specified above they shall be required to construct a second stockpile. This does not alleviate the Contractor from consistently maintaining the grading curve within the tolerances indicated in the gradation curves.

**c) General Usage**

- Class A & B - Double seals on gravel highways
- Class B - Low traffic paved roads
- Class C & D - Major Highway
- Class E - Residential areas & Second seals

**531.17.02 Coarse Aggregate**

**a)** will be defined as all material retained on the 4.75 mm sieve.

**b)** shall consist of crushed stone or gravel, or a combination thereof; or materials naturally occurring in a fractured condition; or materials naturally occurring of highly angular nature or rough texture with a minimum degradation factor of 40.

**c)** shall be free from coating of clay, silt or other deleterious material and shall meet the applicable tests requirements of Subsections 531.14 and 531.15.

**531.17.03 Fine Aggregate**

**a)** will be defined as all materials passing the 4.75 mm sieve and shall meet the applicable test requirements of Subsections 531.14 and 531.15.

**b)** shall be clean, hard, durable, moderately sharp, and free from coatings of clay, silt or other deleterious material and shall contain no clay balls or other aggregations of fine material.

**531.17.04 Mineral Filler and Mineral Dust**

**a)** Mineral filler shall consist of all mineral matter passing the 0.600 mm sieve and the mineral dust shall consist of all mineral matter passing the 0.075 mm sieve.

**b)** Mineral filler and mineral dust shall be free from organic matter.

**c)** Mineral filler shall be non-plastic when tested in accordance with BCH Test I-11 and BCH Test I-12.

**531.18 Presealing Sand** - Sand required for use as a fine aggregate in connection with presealing operations conducted under Subsection 531.36 shall meet the physical requirements of Subsection 531.15, but unless otherwise specified by the Ministry Representative, shall have a grading as specified in Table 531-G.

All aggregate passing the 0.425 mm sieve shall be non-plastic.

**531.19 Blinding Sand** - Sand required for use as blinding material applied on the completed chip seal as described in Subsection 531.37.04 (b), shall meet the physical requirements of Subsection 531.15.02 (a) for Clay Lumps and shall, in addition, meet the grading requirements shown in Table 531-H.

All aggregate passing the 0.425 mm sieve shall be non plastic. In the event that the Contractor is unable to provide blinding material within this gradation, payment shall be made only for the proportion of material applied to the road which falls within the gradation curve.

**EQUIPMENT**

**531.21 General**

**531.21.01** When submitting the bid for work under the Contract, the Contractor shall, at the same time, submit a list of equipment available and ready for use on the Project.

**531.21.02** Before any work is permitted to commence, the Contractor's equipment and plant will be carefully inspected and should any of it fail to meet the required standards, work will not be permitted to commence until such deficiency is corrected.

**TABLE 531-C REQUIREMENTS FOR SIZE OPENINGS**

PERCENTAGE PASSING	LIMITING RATIO	
	MINIMUM	MAXIMUM
5%	0.4	---
10%	0.6	---
90%	---	1.50
100%	---	2.00

**TABLE 531-D PERCENT OF MATERIAL PASSING VARIOUS GRADES**

GRADE OF AGGREGATE	MAXIMUM PERMISSIBLE % PASSING 0.075 mm SIEVE
Fine Cover Sand	2.0
Coarse Cover Sand	1.5
Small Cover Aggregate	1.0
Medium Cover Aggregate	0.5
Large Cover Aggregate	0.5



**531.21.03** Once the Contractor's bid has been accepted, provision of all equipment listed shall become an essential part of the contract and no equipment or plant may be released from the Project work for use elsewhere until completion, except by the express written permission of the Ministry Representative.

**531.21.04** The Ministry inspectors shall have access at all times to any plant, equipment or machinery to be used on the Project in order to check calibration, control or operating adjustments. Where adjustment appears necessary, it shall be done by a competent operator or mechanic or instrument repair technician, as required.

**531.21.05** Plant, machinery and equipment specified hereafter shall represent a minimum requirement for the type of machine described and does not represent a comprehensive list of equipment to be supplied by the Contractor who shall supply whatever plant and equipment may be necessary to the proper and efficient completion of the work.

**531.21.06** All plant and equipment shall be under the control of experienced and skilled operators.

**531.22 Pressure Distributor** - The pressure distributor used for applying asphalt materials shall consist of a fully insulated tank with a minimum capacity of 5000 ℓ, permanently and rigidly mounted on a truck or fifth wheel trailer provided with pneumatic tires and propelled by a power unit capable of maintaining a constant and uniform speed.

The pressure distributor, to be acceptable, shall be provided with at least the following equipment:

- a) A quick opening gate in the dome.
- b) A dipstick calibrated in 20 mm increments and a calibration chart showing the volume for each 20 mm of depth, or provide the manufacturer dipstick and chart. Readily visible external depth gauge indicating the quantity of asphalt in the tank to the nearest 50 ℓ.
- c) A means of heating the asphalt material uniformly to any temperature up to 175°C and maintaining the contents constantly at any selected temperature without any local overheating.
- d) A heavy duty, industrial-type thermometer and a remote reading dial thermometer.
- e) Rear-mounted spray bars and nozzles set parallel to the surface to be sprayed and capable of vertical and lateral adjustment. The spray bars shall be capable of

**TABLE 531-E GRADATION LIMITS FOR GRADED AGGREGATE SEAL**

Sieve size (mm)	CLASS				
	Mass Percent Passing				
A	B	C	D	E	
19	100	-	-	-	-
16	-	100	100	-	-
13.2	60 - 90	60 - 90	-	100	-
9.5	40 - 80	35 - 75	30 - 70	30 - 80	100
4.75	20 - 60	15 - 50	25 - 45	25 - 45	0 - 30
0.600	0 - 25	0 - 15	5 - 20	5 - 20	0 - 10
0.075	0 - 7	0 - 5	0 - 3	0 - 3	0 - 2

adjustment to provide a uniformly sprayed surface from a minimum of 0.6 m to at least 4 m width.

The spray bars shall be capable of producing up to triple coverage at one pass. The feed to the spray bars must be arranged so that there is a constant circulation of hot asphalt material to the bars to ensure a uniform viscosity and constant pressure of the liquid asphalt at each nozzle both before and during spraying operations.

**f)** The feed manifolds to the spray bars shall be provided with positive filtration to prevent clogging of bars and nozzles.

**g)** Rotary adjustable spray bar nozzles shall be of the same type, correct size and manufacture; and set to produce uniformly fan-shaped sprays without atomization. Nozzles shall be inspected daily and any nozzle having nicked or damaged edges shall be replaced.

**h)** Spray nozzles shall be provided with valves capable

**TABLE 531-F VARIATION LIMITS**

Sieve Size (mm)	Maximum Permissible Tolerance % Passing by Mass (Test B.C.H. I-1 & I-2)
4.75 to 19.0	± 4.5
1.18 and 2.36	± 4.0
0.600	± 3.5
0.300	± 2.5
0.150	± 1.5
0.075	± 1.0



of instant full opening and positive cut-off.

- i) A connection to a circulating pressure manifold to which a hose may be attached for a single nozzle hand-operated outlet.
- j) A pressure pump capable of applying the asphalt material at a minimum rate of 180 ℓ per minute, per metre of spray bar.
- k) A pressure gauge accurate to within 15 kPa and a metre calibrated in litres per minute, shall be readily visible.
- l) A fifth wheel tachometer, calibrated in metres per minute and readily visible to the operator of the distributor.
- m) Vehicle spring "tie-downs" to prevent the change in height of the spray bars due to the reduction of the asphalt load during spraying.
- n) Electronic distance measuring device, with print out connected to the transmission, that is capable of measuring each spray length and the total length sprayed during the day.

**531.23 Mechanical Spreader** - Cover aggregate shall be spread by means of an efficient, self-propelled spreader mounted on pneumatic tires and capable of continuously and uniformly spreading closely regulated quantities of crushed aggregates at the application rates selected. The loading hopper shall be of such a capacity as to ensure continuous operation between dumps of aggregate. Aggregate shall be transferred from the loading hopper to the front spreading device in such a manner as to ensure a uniform flow and prevent segregation of particles.

The spreading mechanism shall be so designed as to distribute and spread aggregate across the selected width without segregation. Aggregate shall be applied to the freshly sprayed surface by use of a screen so that the largest particles are first placed on the road with the smaller fractions falling on top. The approved screen is to be mounted beneath the discharge openings of the spreader mechanism in such a manner that the angle of the screen relative to the road surface can be easily and quickly changed.

Suitable provision shall be made to prevent aggregate from rolling on the freshly sprayed surface. The cover aggregate shall be applied ahead of the spreader wheels, with sharply defined, straight edges and without any lateral movement of the aggregate after initial application.

**TABLE 531-G PHYSICAL REQUIREMENTS FOR SAND IN A FINE AGGREGATE**

SIEVE SIZE (mm)	PERCENTAGE PASSING
4.75	100
2.36	80 - 100
1.18	60 - 90
0.300	25 - 70
0.150	10 - 40
0.075	2 - 12

A walkway with protective railings, conforming to the applicable W.C.B. Regulations, shall be provided at the front of the spreader so that the hopper operator has safe access to the individual gate control levers.

The spreader shall be designed to apply aggregate at any application width between 2 m and 4.12 m. (Note: a 4.26 m hopper is required.)

**531.24 Rollers** - Self-propelled pneumatic tired rollers (mass range from 13 600 kg to 19 000 kg) shall be used on the work. The rollers shall have a minimum effective rolling width of 1.83 m. The rollers shall be equipped with smooth, wide-tread compaction tires of equal size and diameter. The wheels of the roller shall be spaced so that one pass of the roller shall accomplish one complete coverage equal to the rolling width of the machine. There shall be a minimum overlap of 6 mm of the tracking wheels of the roller. The wheels shall be so mounted as to oscillate in pairs. The roller shall be provided with ample ballast space and be so constructed that the specified wheel load can be uniformly applied to all the wheels, to provide similar contact pressure under all wheels when rolling on a level pavement.

The tires shall have a minimum of 16 ply and their inflation pressure shall not normally exceed the specified pressure by

**TABLE 531-H PHYSICAL REQUIREMENTS FOR SAND IN A BLINDING MATERIAL**

SIEVE SIZE (mm)	PERCENTAGE PASSING
4.75	100
2.36	50 - 90
1.18	30 - 80
0.300	10 - 55
0.150	5 - 25
0.075	0 - 3



more than 35 kPa and shall at no time be less than specified. Inflation pressure of all of the tires shall be controlled from a central location while the machine is in motion and capable of varying the tire pressure from 206 kPa to 827 kPa. Rollers shall be ballasted and operated to the manufacturers recommended specifications.

The Ministry Representative may approve the use of compactors equal to but differing from the above requirements provided the Ministry Representative is satisfied that equally effective compaction will be obtained by use of the alternative equipment.

The Ministry Representative may approve the use of rubber-covered, vibrating drum rollers (minimum width of 1.52 m and mass of 3000 kg) or tandem steel wheel rollers in the static mode provided the drum or drums can contact the road surface over the entire width of the drums (no bridging). On shoulder seals, the use of pulled wobbly wheel rollers may be used at the discretion of the Ministry Representative. They also may be used on graded aggregate seal on gravel surfaces, where the road is wide enough to permit units to turn without damage to the road surface, sealed or otherwise.

All rollers shall be provided with equipment for spraying water continuously on all tires or wheels, while rolling is in progress, and also be provided with such means as may be required to keep the tires clean and free of adhering asphaltic binder.

**531.25 Power Brooms** - Brooming work shall be carried out using rotary power brooms mounted on self-propelled, pneumatic tired tractor units. The brooms shall be capable of vertical and horizontal angular adjustment and must be provided with equipment for spraying water, as required, on the surface to be broomed while the equipment is in operation. The brooms shall have sufficient power and brushing capacity to completely clean the surface of the standard lane to be treated or which has been treated within three coverages.

This Subsection is to be read in conjunction with Subsection 145.19 and Section 165.

**531.26 Blade Graders** - Self-propelled blade graders mounted on pneumatic tires shall be of approved modern type, either four wheel drive or tandem type, having sufficient capacity to efficiently perform all work that may be required on the contract.

**531.27 Water Truck** - Water trucks shall have a minimum capacity of 9000 ℓ. Water shall be applied from a distributor of the pressure type, equipped with a spray bar mounting nozzles similar to those used on asphalt distributors and

capable of applying the water accurately and uniformly. Splash plate type of distributors or those equipped with spray bars that eject fine streams of water will not be permitted.

The distributor must be provided with a satisfactory means for accurately measuring the quantity of water sprayed. If the Ministry Representative so requires, measuring equipment shall be calibrated under the Ministry Representative's inspection. The Contractor shall make all necessary arrangements for obtaining water at the Contractor's own expense. In addition, the water truck shall be equipped so that it may be used as a flush truck with front-mounted, adjustable spray nozzles that produce a fan-shaped spray in the horizontal mode and can be adjusted in vertical or horizontal direction (ball-mounted). The delivery of water should be variable to single or multiple nozzles so that the desired flushing can be achieved. The water truck shall be equipped with a loading pump capable of pumping 1360 ℓ or more of water per minute.

The spraying and flushing controls must be in the cab and accessible to the driver while the unit is in motion. The minimum spray bar width will be 2.40 m. Gravity single jet or drip bar equipment unit will not be permitted.

**531.28 Sign Truck** - Truck(s) of sufficient capacity to store and transport all necessary signs, stands, barriers, flashing lights, batteries, flood lights, generators, high-level warning devices, project signs, etc., is required.

**531.29 Tanks, Mobile Asphalt Heating, & Storage** - Insulated liquid asphalt storage tanks should meet the following minimum criteria:

- a) A positive high-low heating system, 10° to 200°C, with a hot oil/steam circulation system.
- b) Automated heating and control system with safety shutdown.
- c) Intake/Outlet, two, each with screens installed.
- d) Positive locking valve on discharge line.
- e) Sampling valve or spigot.
- f) Pyrometer; Multi point 20° - 200°C.
- g) Direct reading levelometer.
- h) Manholes, at each end, with ladders.
- i) Tank(s) with sufficient capacity to hold one day's production requirements.



## CONSTRUCTION

**531.31 Temperature and Weather** - Asphalt binder and aggregate shall be applied only during the hours of daylight when the shade air temperature is at least 10°C for graded aggregate seals and 15°C for chip seals and is rising; and when the surface of the road is dry and at a minimum temperature of 20°C and rising. Operations shall cease when the temperature falls below 20°C for chip seals and 15°C for graded aggregate seals. No application shall take place when, in the opinion of the Ministry Representative, the weather or roadbed conditions are unfavourable, i.e., weather is misty or rainy, precipitation is predicted for the construction area within 12 hours or the atmospheric temperature at the construction area of less than 12°C is predicted within 24 hours. No chip seal shall be effected before June 1 or after August 15.

**531.32 Traffic Control** - Traffic control shall meet the requirements of Section 194 and the following:

**531.32.01 Signs and Barriers** - The Contractor shall provide all warning and instructional signs, barriers, lights, electronic communicating devices and flagpersons required to properly and safely control all traffic around or through the work in accordance with Section 194, and as may be specially required below.

**531.32.02 Detours** - Where conditions indicate that traffic may be detoured, the Contractor shall arrange to close off the section of road to be sealed and erect detour and route signs. After the completion of the sealing operations traffic shall not be allowed onto the closed sections after the completion of the sealing operations, for the periods specified in Subsections 531.32.04, 531.36.06 and 531.37.04, unless otherwise directed by the Ministry Representative.

**531.32.03 Shoulder Detours** - Where shoulders are wide and firm enough to accommodate traffic that cannot be detoured along an alternative route, the Ministry Representative may direct that traffic be detoured onto the shoulder. If required, and approved by the Ministry Representative, the shoulder shall be made up, rolled and graded on a force account basis. A designated liquid asphalt shall be sprayed from the edge of the road to the edge of the shoulder, as required, and allowed to cure before traffic is detoured off the road to be sealed and onto the shoulders.

The Contractor shall provide sufficient pilot cars and barriers to maintain traffic movement at a maximum speed of 40 km/h solely on the shoulders, during the course of work. Once a section has been sealed, traffic will be regulated as indicated in Subsection 531.32.04.

**531.32.04 Traffic Through Work** - Where it is not possible to detour traffic, sealing work shall normally be carried out in lane widths and traffic shall be regulated by pilot cars on the opposite traffic lane to that on which construction is in progress. Traffic travelling on the old road surface may be permitted to travel up to a maximum speed of 50 km/h consistent with safety requirements. Traffic shall only be allowed to travel on the newly-sealed lane under control of a pilot car or cars which shall enforce a 20 km/h speed limit up to 4 hours and a 30 km/h speed limit for a period of up to 24 hours, as determined by the Ministry Representative, after completion of the sealing operations; except in the case of pre-seal construction when the period of control shall be up to 4 hours after completion of the pre-sealing operation.

In the event of prolonged inclement weather, traffic control will be maintained as long as the Ministry Representative deems necessary to protect newly laid surface seals.

**531.32.05 Pilot Cars** - Sufficient pilot cars shall be provided so that the delay to traffic shall be no greater than 20 minutes. They shall be equipped in accordance with Section 194.

**531.32.06 Communications** - The flagpeople, pilot car or cars, sign truck, spreader and supervisor's vehicle shall have an effective electronic means of communication so that instructions and information can be quickly and accurately relayed over the total length of the control area.

**531.32.07 Flood Lights** - During periods when headlights must be used, including during daytime periods of poor visibility and high dust condition, two self-contained floodlights shall be used to illuminate each of the flagging stations. These floodlights shall be of at least 1000 watts and be complete with reflector, lens and adjustable stand at least 2.15 m high. The light, reflector and lens must be mounted so that they are capable of both vertical and horizontal adjustment. The stands are to be sufficiently sturdy so that they can withstand a 30 km/h wind without the use of ballast. The generators shall have a full capacity sufficient to enable them to run one shift under full load.

**531.32.08 Flag Personnel** - Flag personnel shall be equipped in accordance with Section 194 and provided as required to safely control and conduct traffic through the job.

**531.33 Preparation of Roadway** - The patching and levelling of the pavement to be sealed may be part of a sealcoating contract or may be effected by others.



**531.34 Sweeping** - Sweeping shall meet the requirements of Section 145, Section 165, and Subsection 531.27 regarding equipment for watering and the following:

- Immediately prior to the commencement of the sealing operations, all loose aggregates, dust, dirt, caked clay or foreign materials shall be removed from the width of the surface to be treated by brushing with power brooms supplemented by hand push brooms, shovels or the use of a power grader, and where necessary by flushing.
- Particular care shall be taken to thoroughly clean to outside edges of the strips to be treated and to ensure that the sweepings are not so deposited on the shoulder as to permit subsequent contamination of the treated surface.

**531.35 Patching** - In order to avoid delays to the Contractor, any patching not done, and in the opinion of the Ministry Representative required before sealing operations begin, may be done by the Contractor as directed by the Ministry Representative with materials supplied by the Ministry and paid for under an Order for Extra Work.

### 531.36 Pre-Seal Treatment

**531.36.01 Description** - Wherever the pavement is in a worn, open, dry or porous condition, or on gravel surfaces which, in the opinion of the Ministry Representative, would result in high absorption of the asphalt binder, the surface shall be pre-sealed. All pre-sealing work on a Contract shall, unless otherwise ordered by the Ministry Representative, be fully completed prior to the commencement of seal coat work.

**531.36.02 Application of Asphalt Pre-Seal** - After the surface has been prepared in accordance with Subsections 531.33 and 531.34, a selected asphalt binder shall be sprayed, at such application rates as directed, so that just sufficient asphalt material shall be applied to the most absorptive sections of the mat, avoiding an excess elsewhere. The asphalt binder shall be applied at the temperature at which the Saybolt-Furol Viscosity of the material is in the range of 50 - 75 seconds.

### 531.36.03 Application of Sand Cover

- a) Application of sand in sufficient quantity to completely blot up all excess unabsorbed asphalt material shall follow within five minutes or as may be directed by the Ministry Representative.
- b) At the time of spreading, the sand shall not contain more than 5% moisture by mass.

**531.36.04 Rolling** - Rolling shall commence immediately after the application of cover sand and shall be completed within 15 minutes. Sufficient pneumatic tired rollers shall be used to ensure that the entire surface of the treated road receives complete coverage within the specified time, at a rolling speed not in excess of 8 km/h.

**531.36.05 Bleeding** - Bleeding spots or areas shall receive a further application of sand blotter and be re-rolled. This process shall be repeated until no further bleeding occurs.

**531.36.06 Traffic** - No traffic shall be permitted on pre-sealed sections for up to four hours or as the Ministry Representative may direct.

**531.36.07 Curing Time** - No seal coating work shall be carried out on the pre-sealed surface until 24 hours after completion of the pre-seal or as the Ministry Representative may direct.

**531.36.08 Sweeping** - Prior to commencement of the main seal-coat treatment all loose, unbonded sand shall be swept from the pre-sealed surface in accordance with Subsection 531.34.

### 531.37 Single Pass Surface Treatment

**531.37.01 Application of Asphalt Material** - The selected asphalt material shall be uniformly sprayed on the properly prepared surface at a rate of 0.5 to 2.75  $\ell/m^2$ , or as may be directed, and at such temperature as shall cause the Saybolt Furol Viscosity of the material to be within 50 - 75 seconds.

Wherever it is possible to detour traffic, the surface may be sprayed full width at one pass of the distributor. Two spreaders must be used.

Normally, where it is not possible to detour traffic only one half of the roadway shall be sprayed at one time, permitting one-way controlled traffic on the other half. In no case shall a longitudinal joint be so placed that it is in a wheel path, the exception being when a double graded seal is being applied.

In order to ensure a uniform distribution of asphalt material and avoid the formation of a lap or ridge at the transverse junction of two successive applications, building paper shall be spread over the treated surface for a sufficient length back so that the spray jets are operating properly (fully open) when the uncovered surface is reached. The building paper shall then be removed and disposed of prior to the application of aggregate. (Refer to Section 165.)

There shall be a maximum 100 mm overlap of sprayed material at the longitudinal joint between sprayed lanes.



The spray shall be cut off before the distributor tank has been completely emptied to ensure that a full application of asphalt material is made up to the point of cut off.

Pressure hand sprays shall be used to properly treat small patches or inaccessible places that have been missed by the distributor. Care shall be taken and building paper shall be used, if necessary, to ensure against staining any curbs, guardrails or faces of any improvements near the work.

The progress of the application of the asphalt material shall be governed by the weather, the curing rate of the asphalt and the rate at which the cover aggregate is applied and rolled. No traffic shall be permitted on the uncovered asphalt material. The Contractor shall organize work so that seal-coating can normally be completed to the full width of the road surface each day.

#### 531.37.02 Application of Cover Aggregate

**a) Application** - The uniform application of the specified cover aggregate, at the spread rate set by the Ministry Representative, shall immediately follow the application of the asphalt material, before the emulsion breaks or within 2 minutes if a cutback asphalt is sprayed. An approved screen shall be used to place the larger chips or particles of aggregate onto the sprayed asphalt first so that maximum embedment of the larger material is obtained. Any segregation shall be corrected immediately.

#### b) Moisture Content

**i) Seal Coat Aggregates** - At the time of spreading, the moisture content of the cover aggregate shall not exceed the percentage by mass, indicated in Table 531-I.

The Contractor shall wet down dry chip stock piles prior to their use and finer aggregate piles as and when ordered by the Ministry Representative so as to provide such moisture content, below the limits specified, as may be required to ensure good coating of the aggregate particle surface by the asphalt binder. Inasmuch as this applied moisture will be weighed out of stockpile as aggregate, no extra payment will be made for wetting down aggregate stockpiles.

**ii) Graded Seal Aggregates** - At the time of spreading, the moisture content of the aggregates shall be such that the material will flow freely in the hopper without segregation and/or a build up of material on the screen.

**c)** Prior to and during the rolling operation, any non-uniformity in the distribution of the cover aggregate shall be corrected by spreading additional aggregate and/or by light raking or hand brooming over such sections of the road as the Ministry Representative directs.

**531.37.03 Rolling** - Immediately after the aggregate has been uniformly spread, the road surface shall be rolled sufficiently to embed the aggregate into the asphalt material to the satisfaction of the Ministry Representative.

Sufficient pneumatic tired rollers shall be used to ensure that the entire surface of the aggregate receives at least five complete coverages within 15 minutes of the application of asphalt material; or when asphalt emulsion is used, five complete coverages shall be completed before the emulsion starts to break. On a chipseal, embedment of 40 to 50% of the average stone size is required from mechanical compaction before traffic is allowed on the new mat.

The speed of the rollers shall be such that the suction of the tires shall not displace the aggregate from the road surface or a maximum of 8 km/h, whichever is less.

The completed surface shall present a uniform appearance. Any segregation or non-uniformity in the distribution of the aggregate shall be corrected by spreading additional material over the area and re-rolling with five coverages of the rollers.

#### 531.37.04 Protection of the Surface

**a)** No traffic shall be permitted on the sealed surface until after the rolling has been completed and when the Ministry Representative is satisfied that the applied aggregate will not be picked up or be displaced under traffic. Generally, traffic shall not be permitted on the sealed roadway until at least 2 hours after the rolling is completed. If traffic must be passed over a sealed surface

**TABLE 531-I MAXIMUM MASS PERCENTAGE FOR MOISTURE CONTENT OF COVER AGGREGATE**

AGGREGATE TYPES	MAXIMUM ALLOWABLE MOISTURE CONTENT FOR LIQUID CUT BACK AND ASPHALT EMULSIONS
Fine Cover Sand	5%
Coarse Cover Sand	4%
Small Cover Aggregate	3%
Medium Cover Aggregate	2%
Large Cover Aggregate	1%



before 2 hours have passed then they will be kept to a speed of 20 km/h or less. After 2 hours, then the speed may be increased to 30 km/h up to 4 hours and not more than 50 km/h for 24 hours or until the surface has been swept. The curing period shall be increased if so directed by the Ministry Representative.

**b)** From the completion of rubber tired rolling on any section of sealed surface and for a further continuous period of 3 days or more including weekends and public holidays, the Contractor shall have a vehicle(s) and maintenance crew (a minimum of three employees) immediately available to arrest any tendency of the asphalt binder to bleed through the surface of the cover aggregate and to prevent pickup and blackening of the surface by the action of traffic. All bleeding spots shall be blotted with a sufficient quantity of blinding sand necessary to correct the defect and in such a manner as the Ministry Representative shall direct. No payment will be made for the supplying and placing of the sand.

**c) Blinding Sand** - In the event of rain, traffic will be kept off a newly sealed surface until sand, provided by the Contractor, has been applied in sufficient quantity to protect the surface of the road from damage. Sanding will continue as long as necessary to protect the freshly laid seal.

Payment for the supply and application of this sand will be by Order for Extra Work.

**531.37.05 Removal of Loose Aggregate** - To be read in conjunction with Sections 145 and 165.

**a)** The Contractor shall, when directed by the Ministry Representative, sweep off all surplus aggregate and spread it neatly along the gravel shoulders. Sweeping of the road surface will normally be completed 24 hours after the final rolling for chip seals and 48 hours for graded aggregate seals. This operation shall be done while the road surface is cool and care should be exercised not to disturb the aggregate that has been retained in the asphalt. In the event that cover aggregate is being disturbed, brooming will cease until curing is complete and the cover aggregate is firmly held in place. Water shall be used in sufficient quantity to reduce dust hazard and to meet pollution control requirements.

**b)** Alongside barriers and curbs and where catch basins or drainage outlets are encountered, the Contractor shall pick up and dispose of the surplus aggregate, including any pertinent cleaning of catch basins, behind the barriers or curbs or within the right-of-way, in any manner the Contractor elects, subject to the approval of the Ministry Representative.

### 531.38 Double Pass Surface Treatment

**531.38.01 Preparation of Existing Surface** - Existing surface preparation shall be performed in accordance with Subsections 531.33 through 531.36 as applicable and as detailed in the Special Provisions.

**531.38.02 Surface Treatment - First Pass** - The first pass of the surface treatment shall be performed in accordance with Subsections 531.37.01 and 531.37.02, using the graded seal cover aggregate specified in the Special Provisions. Rolling, Surface Protection and Removal of Loose Aggregate shall conform to Subsections 531.37.03 through 531.37.05.

**531.38.03 Surface Treatment - Second Pass** - The second pass of the surface treatment shall commence not less than 24 hours after completion of the first pass, subject to acceptable weather conditions as detailed in Subsection 531.31, and as the Ministry Representative may direct. Asphalt material shall be applied in accordance with Subsection 531.37.01, followed by an application of graded seal aggregate as specified in the Special Provisions and detailed in Subsection 531.37.02, and rolling, surface protection and removal of loose aggregate per Subsections 531.37.03 through 531.37.05.

## MEASUREMENT

**531.81 Surface Treatment** - Surface treatment will be measured by the SQUARE METRE.

**531.82 Flag Persons** - Flag persons will be measured by the HOUR.

**531.83 Pilot Cars** - Pilot cars will be measured by the HOUR.

**531.84 Asphalt Binder** - Asphalt binder (100 000 ℓ or less) will be measured by the LITRE.

Asphalt binder (greater than 100 000 ℓ) will be supplied by the Ministry f.o.b. the Contractor's tanks.

**531.85 Aggregates** - Where the Special Provisions requires the Contractor to supply the aggregate, the aggregate will be measured by the CUBIC METRE in stockpile. The volume will be determined by cross-sectioning and end area volume calculations.

**531.86 Stockpile Bases** - NO MEASUREMENT will be made for work and materials required for the preparation of stockpile bases, as directed by the Ministry Representative.



**PAYMENT**

**531.91 Surface Treatment** - Payment for SURFACE TREATMENT will be at the Contract Unit Price per square metre. The Unit Price shall cover everything done and supplied including ordering, receiving, storing and heating of asphalt materials, traffic control equipment, and all equipment and labour required to complete the work.

**531.92 Flag Persons** - Payment for FLAG PERSONS will be at the Contract Unit Price per hour.

**531.93 Pilot Cars** - Payment for PILOT CARS will be at the Contract Unit Price per hour.

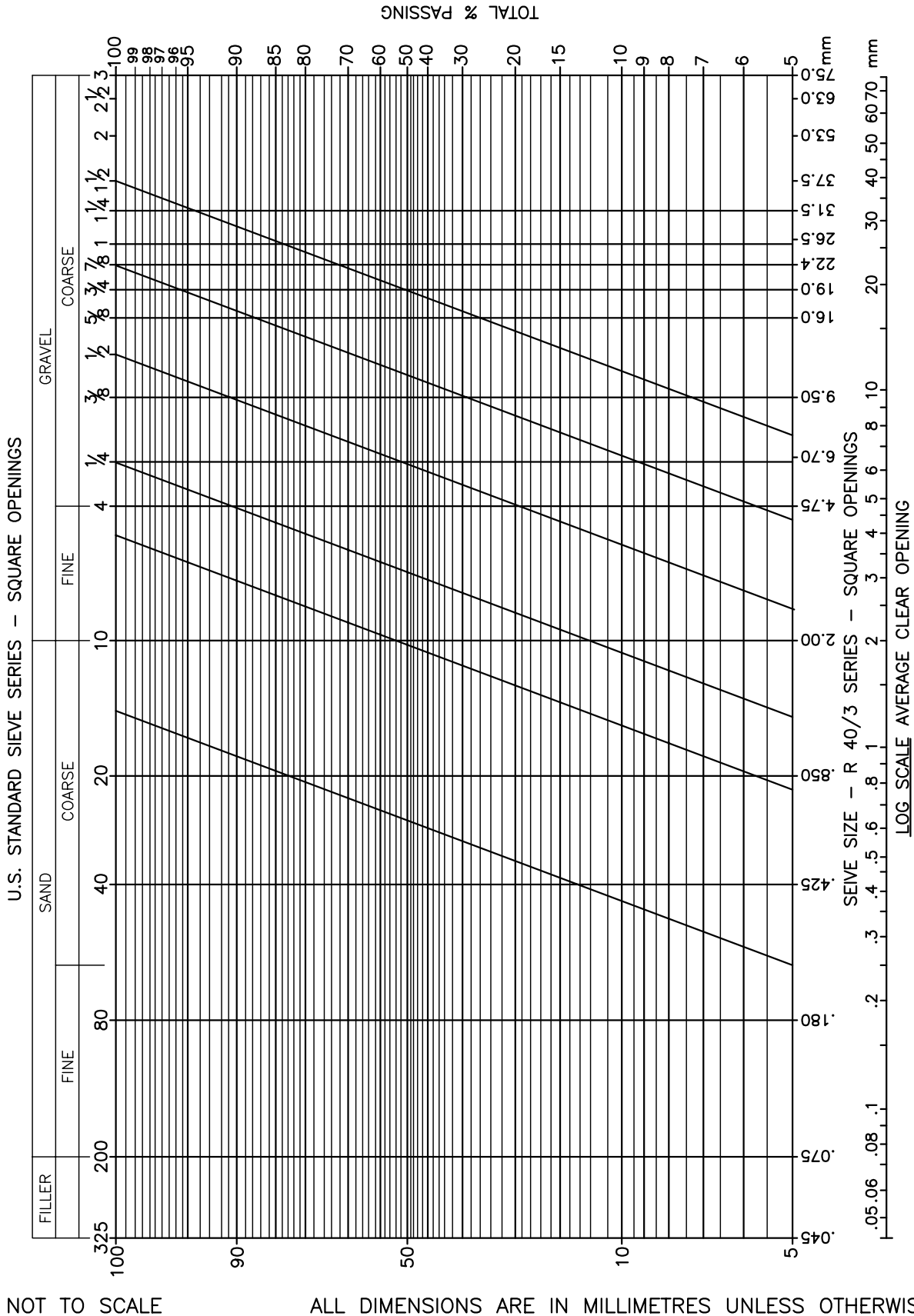
**531.94 Asphalt Binder** - Payment for ASPHALT BINDER will be at the Contract Unit Price per litre actually sprayed.

**531.95 Aggregates** - Payment for AGGREGATE will be at the Contract Unit Price per cubic metre in stockpile.

No additional payment will be made for washing when needed in order to meet gradation requirements.

**531.96 Stockpile Bases** - All work and materials required for the PREPARATION OF STOCKPILE BASES, as directed by the Ministry Representative, will be paid for, on an Order for Extra Work basis from the Provisional Sum included in the Schedule of Approximate Quantities and Unit Prices.







## SECTION 536

### PAVEMENT CRACK SEALING

#### DESCRIPTION

**536.01 Scope** - This work consists of restoring the asphalt concrete pavement surface to a less permeable condition. The work includes routing when necessary, cleaning and filling the crack with sealant, and dusting or sanding.

**536.02 Purpose** - The purpose of crack sealing shall be to prevent moisture from penetrating into the road base through surface cracks and to extend pavement life. This shall be carried out by effectively sealing the cracked surface with a highly rubberized and elasticized or high float asphalt sealant.

#### MATERIALS

**536.11 Asphaltic** - The rubberized and elasticized asphalt sealant products shall meet the requirements listed in Table 536-A.

It shall be noted that ASTM D 3405 requirements are not mandatory in the Lower Mainland, Vancouver Island or the Sunshine Coast.

As specified in the Special Provisions the Contractor shall use a Rubberized or High Float Emulsified Asphalt HF150S or equivalent.

**TABLE 536-A REQUIREMENTS**

BCH Test	ASTM Test	DESCRIPTION
	D 3405	Specification for joint sealants, hot poured for concrete and asphalt pavements
	D 1190	Specification for concrete joint sealer, hot poured elastic type

**536.12 Sand** - On pavements that require the use of High Float Emulsified Asphalt, the Contractor shall supply a "blinding sand." The sand, when tested according to ASTM C 117, shall meet the gradation requirements shown in Table 536-B and shall be approved by the Ministry Representative.

**536.13 Dust Cover** - Pavements that are sealed with rubberized or elasticized sealant shall receive a dust coating with a material such as Portland Cement, talc, lime or the equivalent material approved by the Ministry Representative.

#### EQUIPMENT

**536.21 Router** - The Contractor shall provide a vertical

router capable of routing asphaltic pavements to a depth of 25 mm and a width of 16 mm. It shall be capable of a minimum production of 200 metres per hour, even when following meandering cracks without unnecessary pavement cutting.

**TABLE 536-B GRADATION REQUIREMENTS**

Sieve (mm)	% Passing
12.5	100
9.5	80 - 100
4.75	50 - 95
2.36	30 - 80
0.600	10 - 50
0.300	0 - 25
0.075	0 - 6

**536.22 Cleaner** - The cleaner unit shall be a hot compressed air fed propane fired device capable of cleaning, heating and drying routed cracks with not less than 1.7 m<sup>3</sup>/min. of compressed air at 690 kPa. It shall have valving/hoses and fittings for the mixture of liquid propane gas and compressed air. The hot air exhaust shall not exceed 315°C.

**536.23 Melter** - The melting kettle shall be of the double boiler type supplying indirect heating so as to slowly heat the asphaltic material with heat transfer oil. It shall have built in calibrated thermometers for both transfer oil and the sealing compound. The heating of the sealant shall be efficient and thermostatically controlled so as not to exceed the manufacturer's maximum safe heating temperature and shall be such as to maintain a constant temperature once the sealant is heated. The melter shall be capable of constantly agitating the asphaltic material as it is being heated and shall have a pump circulating the sealant from the bottom to the top of the kettle.

The melter must comply with the Gas Safety Act Regulations and Codes and any other applicable acts and regulations.

**536.24 Filler Tools** - Crack filler devices and strike off tools must be such that successful forming of the bead of sealant over the prepared crack is as specified in this Specification.

#### CONSTRUCTION

**536.31 General** - Crack sealing shall only be performed when the pavement surfaces are dry, and the crack and road base are dry or nearly dry (no visible moisture), and the temperature is steady at 10°C or rising.



A random sample of virgin sealant shall be selected from each lot for testing purposes by the Ministry Representative.

Cracks up to 16 mm in width shall be widened by using a router to form a sealant reservoir 16 mm in width and from 19 to 25 mm in depth. All routing shall be performed keeping the crack centreline within  $\pm 8$  mm of the centre of the rout and shall be cleaned with a hot compressed air lance. Material removed from the cracks shall be disposed of as approved by the Ministry Representative.

The routing speed shall be such that the pavement is carefully cut, not broken or torn out, and the sides of the rout are smooth and uniform. The surface of the pavement and routed crack shall be cleaned of all dust and routing debris.

Routing should not be carried out on pavements that are of such an age that the pavement fractures or spalls occur along the edge of the freshly routed crack. Normally pavement fractures or spalls should not occur unless pavements are in excess of 10 years old. The decision to forgo routing shall be made by the Ministry Representative.

The crack shall be filled with sealant from the bottom to the surface level in such a manner that the sealant does not bridge entrapped air pockets. Material shall be placed to overfill the crack. It will then be struck off to leave a uniform amount of sealant directly over the crack, with the edges of the spread evenly feathered to overlap on the pavement surface from a minimum of 25 mm to a maximum of 40 mm on each side of the crack. The sealant overband shall not be so thick that it can be removed during snow plowing or produce a noticeable bump when traversed by traffic.

Any damage done to the sealant by stones or any other deleterious material being embedded in the sealing compound shall be repaired by the Contractor.

The Contractor shall ensure that traffic is kept off the sealed cracks until such time as the sealant has properly set up and will not be damaged or pulled out by the passage of traffic.

#### **536.32 Rubberized and Elasticized Asphalt Sealants -**

These shall be used on pavements that are less than 10 years old and where the majority of cracks are less than 25 mm in width.

The sealant shall be applied to cracks that have been routed to a uniform depth and width.

Cracks having a width greater than 16 mm need not be routed but shall be cleaned to a minimum depth of 25 mm.

Within two minutes of the completion of the cleaning operation the crack shall be filled with sealant from a melter using a connecting wand or manual applicator (pouring cone) which ensures minimum pour application temperatures for the product are maintained.

Upon completion of the pouring the sealant shall be dusted to prevent the asphalt from tracking. Excess dusting material shall be removed.

**536.33 High Float Emulsified Asphalt -** High Float Emulsified Asphalt shall be used on pavement where there are depressions or lipping at the cracks, or the majority of cracks are over 25 mm in width.

The cracks shall be cleaned as close to the actual depth as possible and the removed material shall be disposed of as approved by the Ministry Representative. Immediately after cleaning, they shall be filled with sealant from a distributor truck or melter. The distributor truck or melter shall have an efficient means of heating the sealant to any temperature up to 100°C and maintaining it constantly at the manufacturer's prescribed temperature without overheating.

Upon completion of the sealing of the crack, the sealant shall be sanded to prevent the asphalt from tracking. Excess sand shall be removed and disposed of by the Contractor as approved by the Ministry Representative.

**536.34 Warranty -** The Contractor warrants to the Province that for a period of one year following the completion of crack sealing all work shall be free from defect resulting from work done or material supplied, and the Contractor shall rectify any such defects within 21 days from the time first detected by or reported to the Contractor to the satisfaction of the Ministry Representative.

## **MEASUREMENT**

**536.81 General -** Pavement Crack Sealing will be measured by the LINEAR METRE using a line that is generally representative of the routed and/or cleaned crack.

Measuring will be done using a measuring wheel.

## **PAYMENT**

**536.91 General -** Payment for PAVEMENT CRACK SEALING will be at the contract unit price bid per linear metre. The unit price shall be full compensation for all labour, equipment and material supplied as required to rout, clean and seal the pavement cracks, as specified.



## SECTION 541

### RUBBLE MASONRY

#### DESCRIPTION

**541.01 Scope** - This Section covers the construction of stone paving for grouted traffic island and median capping, dry-laid and grouted slope protection, culvert and spillway aprons, ditches and other like uses.

Paving rock minimum thickness of 100 to 200 mm will be specified depending upon location, use and setting requirements. Requirements for rock exceeding 200 mm minimum thickness are specified by Section 205 for hand-laid and grouted riprap.

#### MATERIALS

##### 541.11 Materials

**541.11.01 Rock** - Rock for stone paving shall generally be obtained from the roadway excavation, stockpiled where designated and selected as necessary for use at the locations indicated on the Drawings, unless the supply of off-site rock is specified.

Rock will be required either as: angular rock as found or blasted, or rounded rock.

All rock shall be sound, durable and clean, relatively flat on the face to be exposed, reasonably consistent in colour tone, of acceptable size (200 to 450 mm across) and of the required thickness range.

**541.11.02 Gravel Base** - Gravel base shall be 25 mm minus well-graded crushed granular aggregate.

**541.11.03 Bedding Mortar** - Bedding mortar shall consist of one part Portland cement to three parts clean, well-graded fine aggregate or coarse sand mixed with water to give a 150 mm slump.

**541.11.04 Setting and Jointing Mortar** - Setting and jointing mortar shall consist of one part Portland cement to three parts clean, well-graded fine aggregate mixed with water to give a 75 mm slump.

#### CONSTRUCTION

**541.31 Preparation** - Graded surfaces to receive paving shall be trimmed and well tamped to the lines and grades indicated on the Drawings and to the approval of the Ministry Representative.

Edges of paving shall be constructed of thicker stones to form a stable foundation and protection against any undercutting in waterways.

All paved areas shall receive a minimum 150 mm layer of gravel base, well consolidated.

Gravel level inside curbs shall permit the surface of the jointing mortar to be flush with the top of the curb.

**541.32 Construction** - Construction shall be carried out with all material, labour, tools, equipment and incidentals supplied by the Contractor as necessary to complete all stone paving work in accordance with good work practice.

Gravel base of grouted stone paving shall be well saturated with bedding mortar slurry.

All rock shall be firmly embedded into the base material so that the voids between stones are of minimal width with the rock surfaces relatively even as indicated on Drawing SP541-01.

Voids of grouted paving rock shall be filled with setting and jointing mortar, 75 mm thick and, after consolidation and any necessary chinking of the larger voids, the mortar surface shall be smooth finished and sloped to drain freely.

Finished stone paving shall show a clean even appearance, free of disfiguring spalls and, where grouted, cleaned of mortar staining.

#### MEASUREMENT

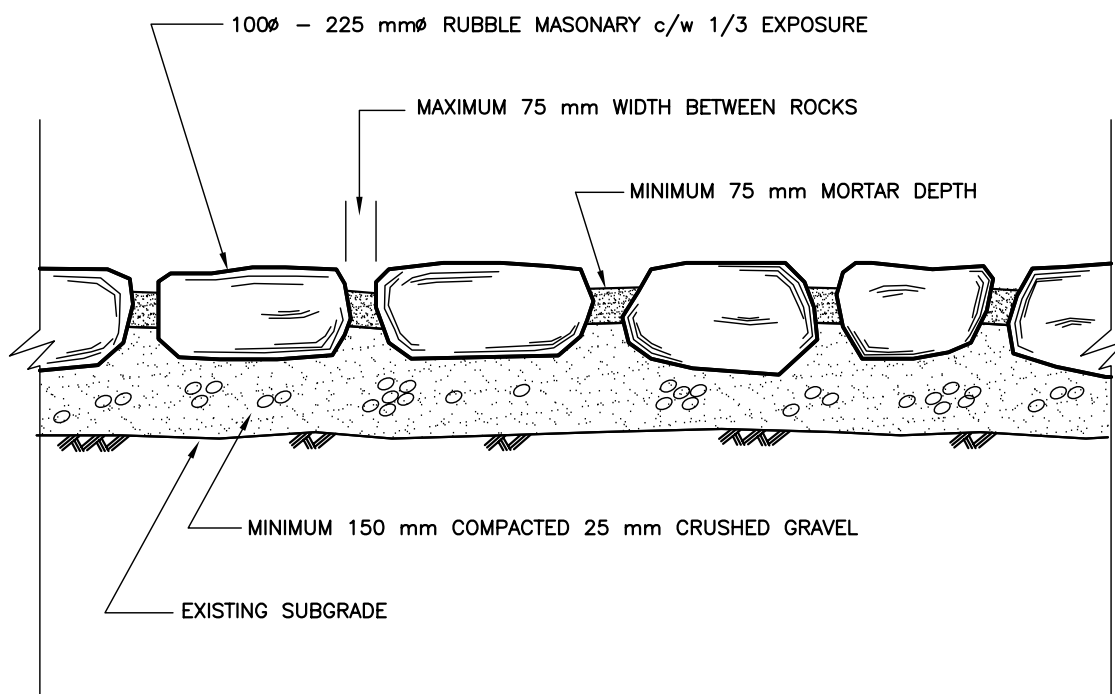
**541.81 General** - Stone Paving work will be measured by the SQUARE METRE of stone in place.

#### PAYMENT

**541.91 General** - Payment for STONE PAVING work will be at the Contract Unit Price per square metre of stone in place.

The Contract Unit Price shall be accepted as full compensation for the supply of the gravel base, stone and mortar, for complete installation, including trimming and incidental excavation, compaction, finishing, and for all subsidiary work not required to be separately paid for.





NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 582

### CONCRETE CURB AND GUTTER AND STORM DRAINAGE

#### DESCRIPTION

**582.01 Scope** - This Section describes the requirements for construction of roadside curb and gutter and associated underground drainage systems. Such work shall consist of constructing and/or installing appurtenances shown or indicated on the drawings and Schedule of Approximate Quantities and Unit Prices.

#### MATERIALS

**582.11 Drain Pipe** - All drain pipe shall be of first quality, sound, true in form and free from defects of all kinds.

**582.12 Salt Glazed Clay Sewer Pipe** - Salt glazed clay sewer pipe shall be in accordance with the current ASTM Specifications.

#### **582.13 Concrete Pipe**

**582.13.01 Reinforced Concrete Pipe** - Reinforced concrete pipe shall have joints of the tongue and groove type and shall meet the requirements of the current specification ASTM C 76 Series.

**582.13.02 Plain Concrete Pipe** - Plain concrete pipe shall meet the requirements of the current specification ASTM C 14 Series.

**582.13.03 Requirements** - Pipe shall be legibly marked with the date of manufacture, the name or trademark of the manufacturer and by marks denoting plain concrete pipe, reinforced concrete pipe or extra strength reinforced concrete pipe as the case may be. Pipe containing elliptically placed reinforcement shall be marked on the inside of the pipe with the words "Top" or "Bottom" at the correct place to indicate the proper position when laid.

Upon request, the Contractor shall furnish at the Contractor's expense such test and other information as may be required regarding the concrete pipe proposed to be used.

**582.14 Corrugated Steel Pipe** - Corrugated metal pipe shall conform to the requirements of Section 320.

#### CONSTRUCTION

**582.31 Portland Cement Concrete Curb and Gutter** - Combined Portland cement concrete curb and gutter shall be constructed to the line and grade shown on the Drawings or as otherwise directed by the Ministry Representative and will include returns at the intersections if so directed.

The combined curb and gutter shall be constructed to the standard cross-section shown on Drawing [SP582-01.01](#) and to such layout plans as are attached, except where the face of the curb varies and at lanes and driveways where drop curbs are ordered.

Expansion joints 13 mm in thickness cut to the cross-section of the combined curb and gutter, composed of premoulded joint filler shall be installed at approximately 15 m intervals as directed by the Ministry Representative.

**582.32 Catch Basins** - Catch basins shall be constructed, where shown and as required in the plans or as the Ministry Representative may direct, in accordance with the intent of Drawings [SP582-02.01](#) through [SP582-02.05](#).

**582.33 Manholes** - Manholes shall be constructed at the locations and to invert levels shown in plans or as the Ministry Representative may direct in accordance with the intent of Drawings [SP582-03.01](#) through [SP582-03.08](#).

**582.34 Storm Drains** - Storm drains shall be constructed where shown on plans, or as directed by the Ministry Representative, and in accordance with the plans and specifications covering the various types and attached herewith. The trench and other preparatory work shall be approved by the Ministry Representative before actual placing starts.

#### **582.35 Placing**

**582.35.01 Spigot and Bell Pipe** - Spigot and bell pipe shall be laid beginning at the lower end with the bell end pointing up-grade. Suitable excavation or bedding must be provided to accommodate the bell so that the pipe is supported along its full length and not at the ends alone.

**582.35.02 Concrete Pipe** - Concrete pipe shall be laid beginning at the lower end with the groove end pointing up-grade. Pipe with elliptical reinforcement shall be laid with the minor axis of the reinforcement as marked by the manufacturer in a vertical position.

When jointing salt glazed clay and concrete pipes, the trench shall be in a dry condition and the joints shall be cleaned and wetted before sealing with mortar. The mortar shall consist of one part of Portland cement to two parts of fine sand, mixed to the proper consistency. Sealing shall be neatly and thoroughly done and the interior of the pipe cleaned of all surplus mortar. Joints shall be kept damp with burlap or earth for at least three days after sealing.

**582.35.03 Corrugated Steel Pipe** - Corrugated steel pipe shall be laid beginning at the lower end with the outside laps



pointing up-grade and the longitudinal joint on the side. The separate sections shall be firmly jointed together and any metal in joints which is not thoroughly protected by galvanizing shall be coated with a suitable asphaltum paint.

**582.35.04 General** - The Contractor shall provide and fix at such points, as may be directed, properly painted substantial sight rails set to correct levels. At least three sight rails shall be in position for each length of sewer. Pipes shall be accurately set and laid to even gradients, concentric and in straight lines between manholes.

**582.36 Special Jointing Material** - Where pipe trenches are necessarily restricted in width or where unavoidable wet conditions exist, which would prevent proper normal jointing of pipes with Portland cement mortar, special prefabricated joints may be authorized to be used. In such a case, the Ministry will pay the Contractor for providing such jointing material at net cost after deducting all trade discounting and commissions. The Contractor shall install the prefabricated jointing material instead of cement mortar jointing at no extra cost.

**582.37 Bedding and Backfilling** - The bedding of all concrete pipes shall consist of 19 mm or 25 mm crushed gravel to a minimum depth of 150 mm below the pipe. The backfill shall consist of 19 mm or 25 mm crushed gravel with a minimum cover of 150 mm and in the remainder of the trench shall consist of the natural excavated material unless such material is considered unsuitable by the Ministry Representative. Such natural material shall have a maximum size of 75 mm. All materials shall be compacted in horizontal layers not more than 200 mm.

**582.38 Concrete End Walls** - See Subsection 303.31.04.

### MEASUREMENT

**582.81 Portland Cement Concrete Curb and Gutter** - Portland Cement Concrete Curb and Gutter will be measured by the METRE.

**582.82 Catch Basins** - Catch Basins will be measured per EACH.

**582.83 Manholes** - Manholes will be measured per EACH.

The Contractor shall allow in the bid price for the construction of manholes having an overall depth of concrete section of 2 m (see dimensions marked "variable"). In addition, the Contractor shall bid a price per 0.3 m of depth of manhole, which shall be added to or subtracted from the bid price for the manhole depending on the actual depth of the manhole to be constructed.

**582.84 Storm Drains** - Storm drains will be measured by the METRE in place.

**582.85 Bedding and Backfill** - Bedding and backfill will be measured by the CUBIC METRE in place.

**582.86 Concrete End Walls** - Concrete end walls will be measured by the CUBIC METRE.

### PAYMENT

**582.91 Portland Cement Concrete Curb and Gutter** - Payment for combined Portland cement CONCRETE CURB AND GUTTER will be at the Contract Unit Price per metre. The Contract Unit Price shall include everything furnished and done in connection with form setting, supply and placing of air entrained concrete; supply and installation of expansion joints; finishing, curing, protection and superintendence.

**582.92 Catch Basins** - Payment for CATCH BASINS will be at the Contract Unit Price per each. The Contract Unit Price shall include everything furnished and done; excavation, backfilling and tamping around catch basins, formwork, concreting, setting in of pipe drains, setting and securing of cast iron catch basin frames and gratings, steel baffles, reinstatement of surface, cleaning out, protection and superintendence and, all other things necessary.

**582.93 Manholes** - Payment for MANHOLES will be at the Contract Unit Price per standard 2 m manhole with appropriate depth correction as described in Subsection 582.83. The Contract Unit Price shall include everything furnished and done; formwork, concreting, setting in of storm drains, construction of smooth invert sections, cement mortar settings, steel ladder rungs, brick construction, setting of manhole frames and covers, cleaning out, protection and superintendence, and all other things necessary.

**582.94 Storm Drains** - Payment for STORM DRAINS will be at the Contract Unit Price per metre in place. The Contract Unit Price shall be accepted as full compensation for everything furnished and everything done in connection herewith, but shall not include payment for excavation, riprap, paving, concrete cradles, end walls, bedding and backfill. These shall be paid for at their respective prices in the Schedule of Approximate Quantities and Unit Prices.

**582.95 Bedding and Backfill** - Payment for BEDDING and BACKFILL will be at the Contract Unit Price per cubic metre in place.

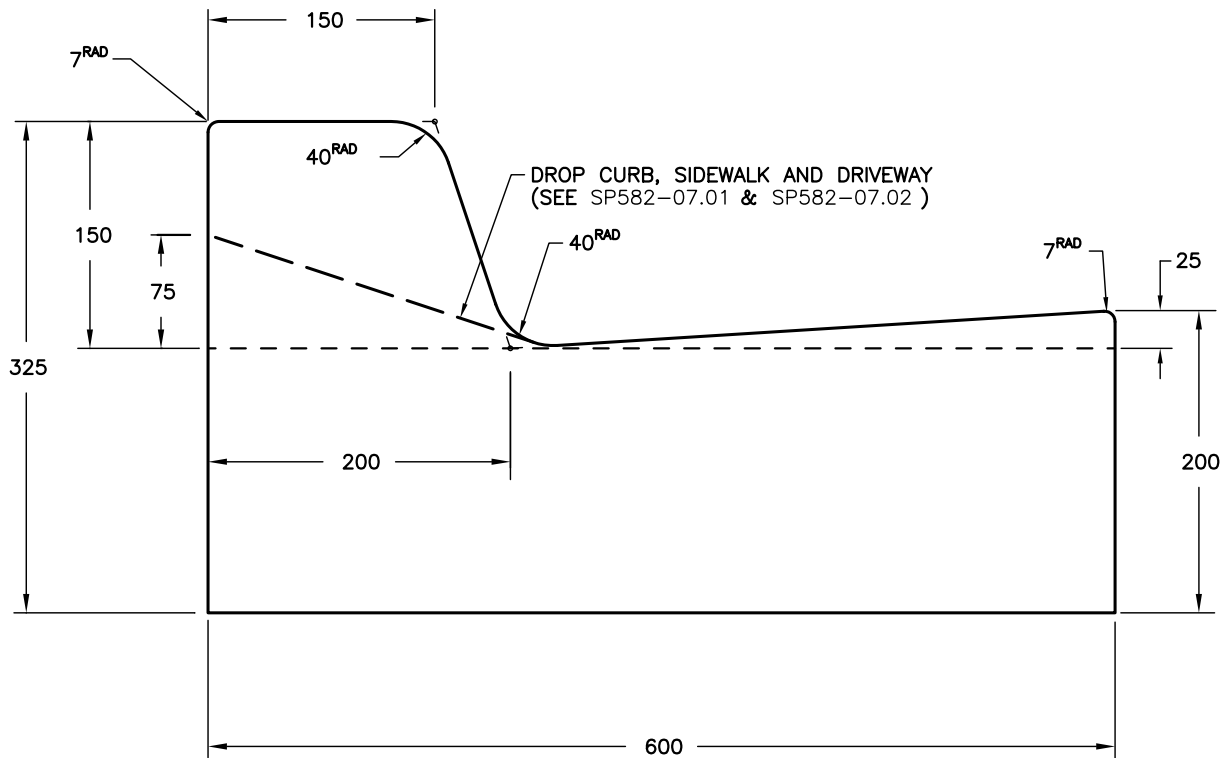
**582.96 Concrete End Walls** - Payment for CONCRETE END WALLS will be at the Contract Unit Price per cubic



metre. The Contract Unit Price shall include provision of everything necessary; formwork, air entrained concrete, placing and tamping, stripping and cleaning, curing and any

other work necessary in connection therewith, but shall not include excavation and backfilling, riprap or other items not connected with concrete work..



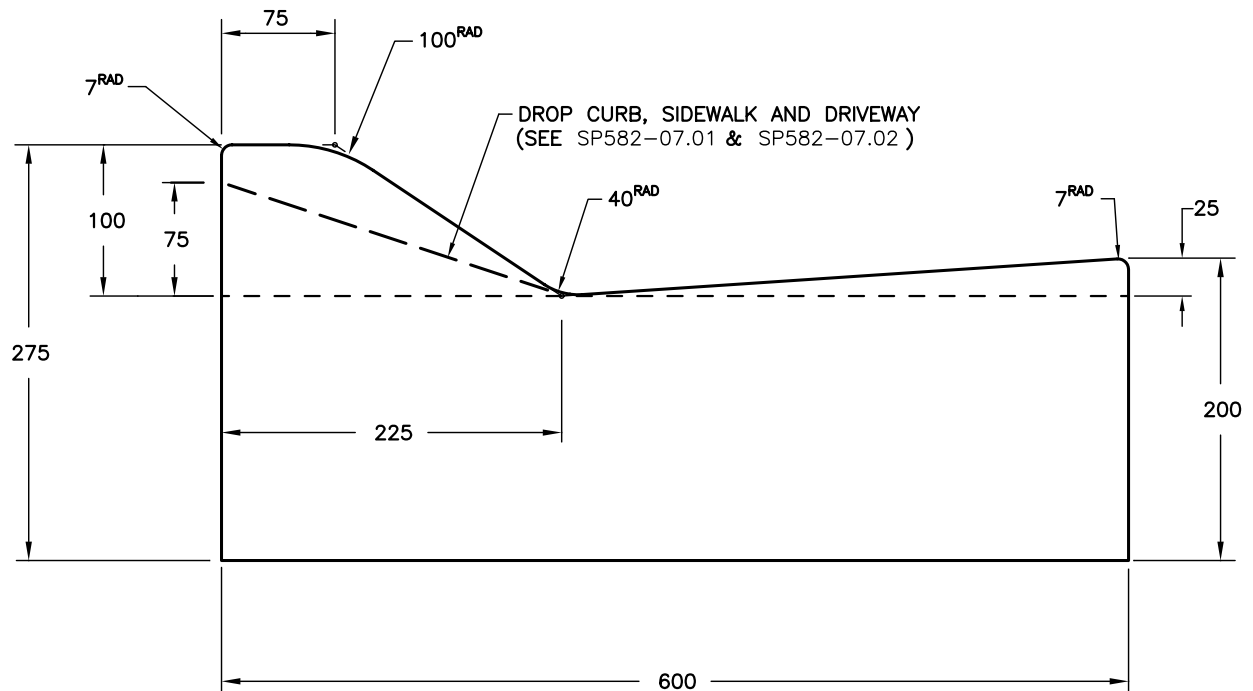
**NOTES:**

1. THE CONCRETE INCORPORATED IN THE CURB SHALL HAVE:
  - MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS;
  - COARSE AGGREGATE OF MAXIMUM PARTICLE SIZE NOT EXCEEDING 25 mm;
  - MINIMUM CEMENT CONTENT OF 350 kg/m<sup>3</sup>;
  - ENTRAINED AIR OF 6 – 8%;
  - SLUMP: BETWEEN 10 mm AND 25 mm FOR EXTRUDED  
MAXIMUM 65 mm FOR POURED IN PLACE;
  - MAXIMUM WATER – CEMENT RATIO OF 0.45.
2. CONTRACTION JOINTS SHALL BE CUT AND TOOLED INTO THE CONCRETE TO A DEPTH 60% OF THE THICKNESS OF THE CONCRETE AT INTERVALS OF 3 m.
3. EXPANSION JOINTS 13 mm IN THICKNESS CUT TO THE CROSS-SECTION OF THE COMBINED CURB AND GUTTER, COMPOSED OF PREMOULDED JOINT FILLER SHALL BE INSTALLED AT APPROXIMATELY 15 m INTERVALS AS WELL AS AT CURB RETURNS, EITHER SIDE OF DRIVEWAYS AND OTHER LOCATIONS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





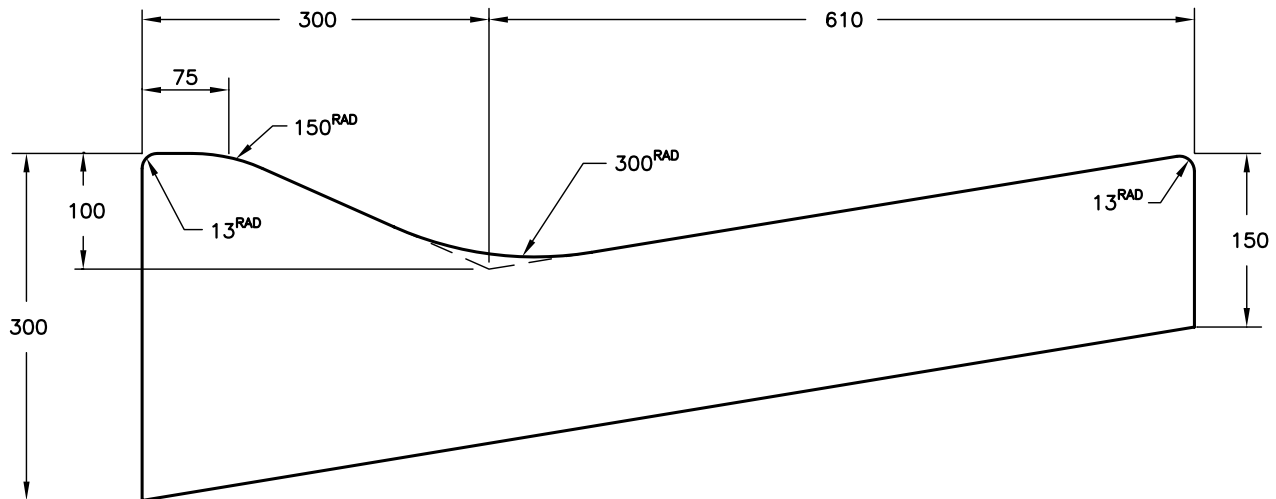
## NOTES:

- THE CONCRETE INCORPORATED IN THE CURB SHALL HAVE:
  - MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS;
  - COARSE AGGREGATE OF MAXIMUM PARTICLE SIZE NOT EXCEEDING 25 mm;
  - MINIMUM CEMENT CONTENT OF 350 kg/m<sup>3</sup>;
  - ENTRAINED AIR OF 6 - 8%;
  - SLUMP: BETWEEN 10 mm AND 25 mm FOR EXTRUDED  
MAXIMUM 65 mm FOR POURED IN PLACE;
  - MAXIMUM WATER - CEMENT RATIO OF 0.45.
- CONTRACTION JOINTS SHALL BE CUT AND TOOLED INTO THE CONCRETE TO A DEPTH 60% OF THE THICKNESS OF THE CONCRETE AT INTERVALS OF 3 m.
- EXPANSION JOINTS 13 mm IN THICKNESS CUT TO THE CROSS-SECTION OF THE COMBINED CURB AND GUTTER, COMPOSED OF PREMOULDED JOINT FILLER SHALL BE INSTALLED AT APPROXIMATELY 15 m INTERVALS AS WELL AS AT CURB RETURNS, EITHER SIDE OF DRIVEWAYS AND OTHER LOCATIONS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



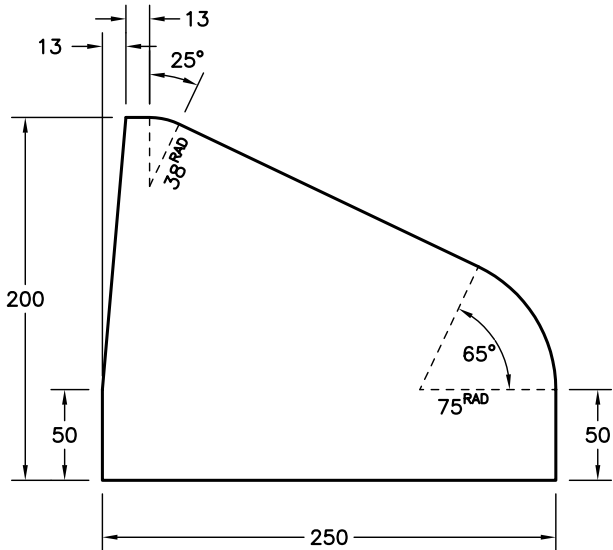
**NOTES:**

1. THE CONCRETE INCORPORATED IN THE CURB SHALL HAVE:
  - MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS;
  - COARSE AGGREGATE OF MAXIMUM PARTICLE SIZE NOT EXCEEDING 25 mm;
  - MINIMUM CEMENT CONTENT OF 350 kg/m<sup>3</sup>;
  - ENTRAINED AIR OF 6 – 8%;
  - SLUMP: BETWEEN 10 mm AND 25 mm FOR EXTRUDED  
MAXIMUM 65 mm FOR POURED IN PLACE;
  - MAXIMUM WATER – CEMENT RATIO OF 0.45.
2. CONTRACTION JOINTS SHALL BE CUT AND TOOLED INTO THE CONCRETE TO A DEPTH 60% OF THE THICKNESS OF THE CONCRETE AT INTERVALS OF 3 m.
3. EXPANSION JOINTS 13 mm IN THICKNESS CUT TO THE CROSS-SECTION OF THE COMBINED CURB AND GUTTER, COMPOSED OF PREMOULDED JOINT FILLER SHALL BE INSTALLED AT APPROXIMATELY 15 m INTERVALS AS WELL AS AT CURB RETURNS, EITHER SIDE OF DRIVEWAYS AND OTHER LOCATIONS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.

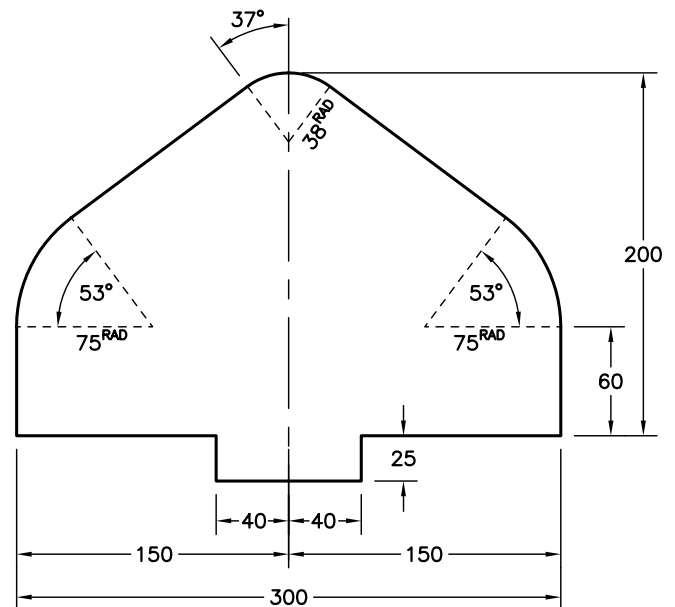
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



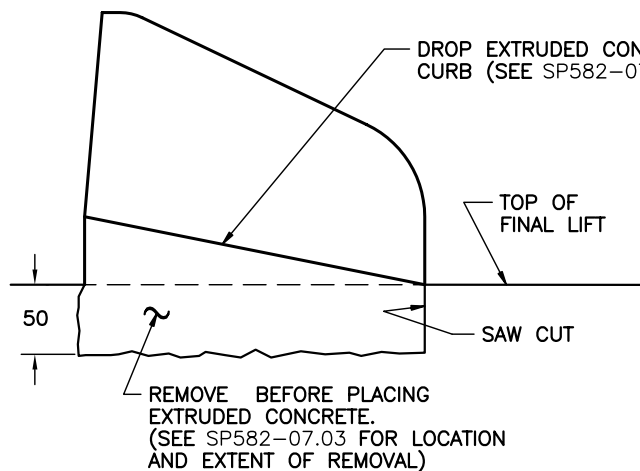


EXTRUDED CONCRETE CURB  
FOR ISLANDS & MEDIANS

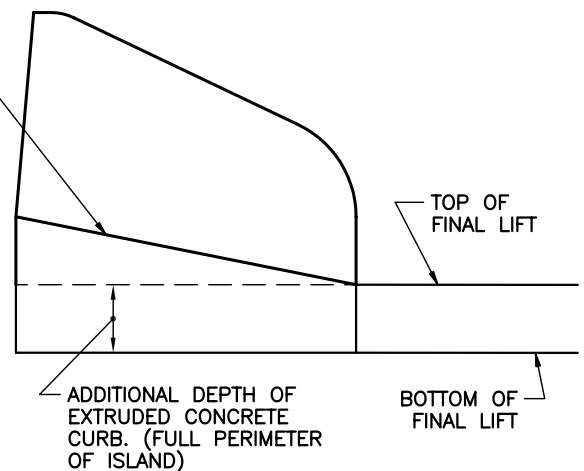


EXTRUDED CONCRETE CURB  
CENTER DIVIDER

## TYPICAL SECTIONS



FINAL LIFT IN PLACE



FINAL LIFT NOT IN PLACE

## SECTIONS THRU ISLAND RAMP CURBS

### NOTES:

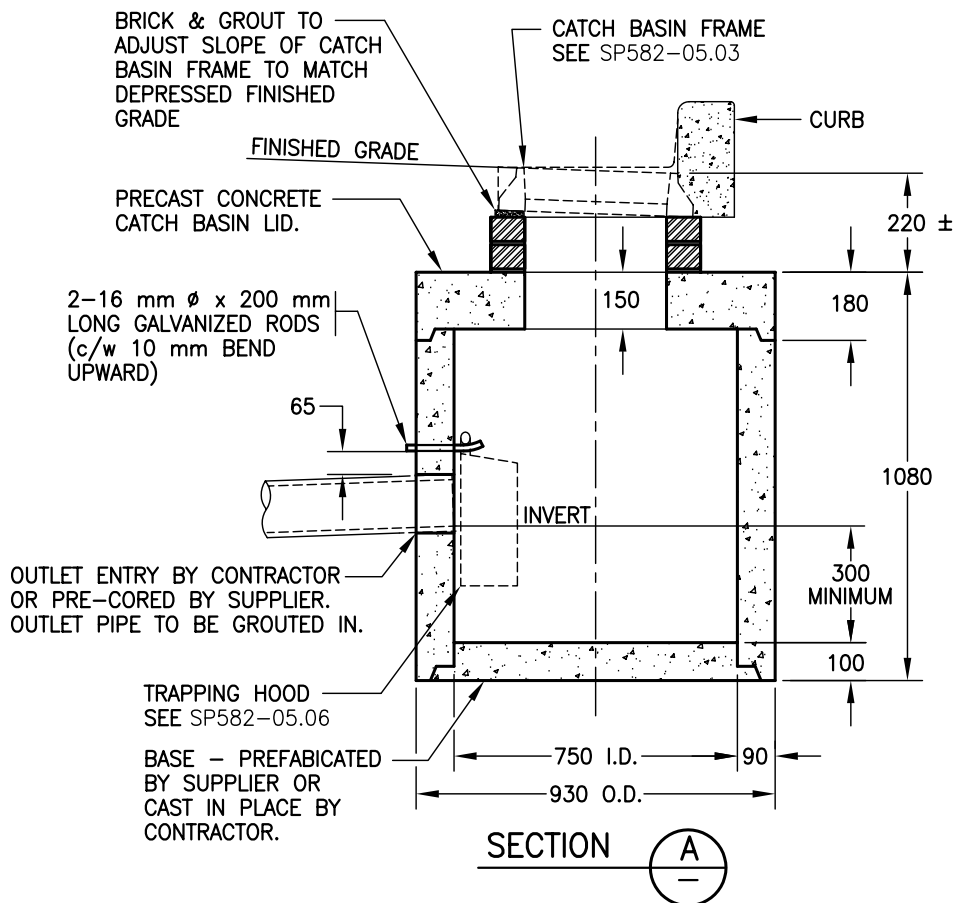
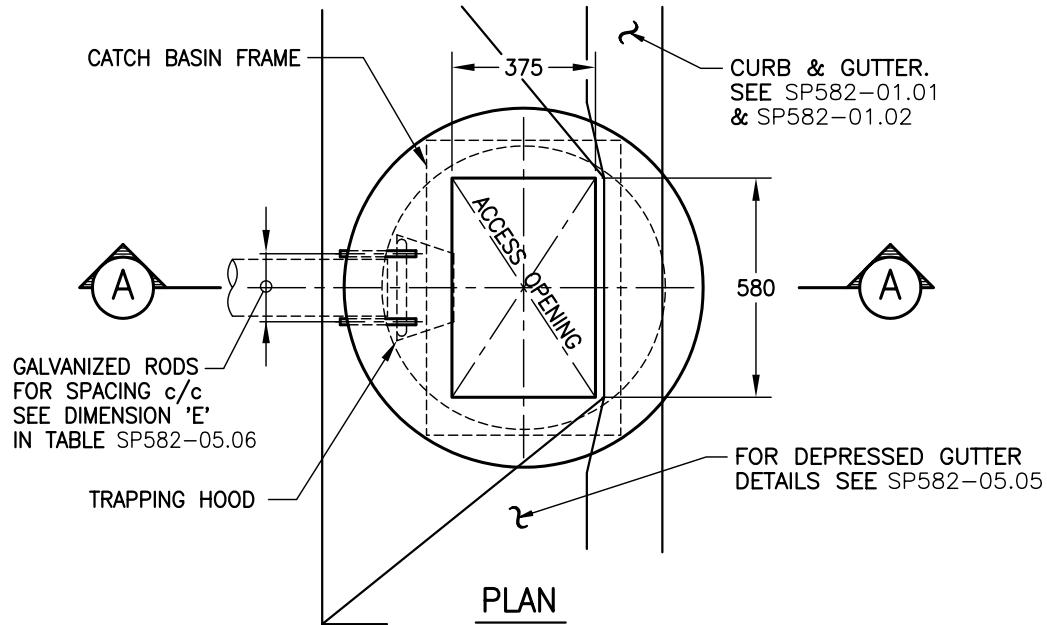
1. THE CONCRETE INCORPORATED IN THE CURB SHALL HAVE:
  - MINIMUM COMPRESSIVE STRENGTH OF 30 MPa AT 28 DAYS;
  - COARSE AGGREGATE OF MAXIMUM PARTICLE SIZE NOT EXCEEDING 25 mm;
  - MINIMUM CEMENT CONTENT OF 350 kg/m<sup>3</sup>;
  - ENTRAINED AIR OF 6 - 8%;
  - SLUMP: BETWEEN 10 mm AND 25 mm;
  - MAXIMUM WATER - CEMENT RATIO OF 0.45.

2. CONTRACTION JOINTS SHALL BE CUT AND TOOLED INTO THE CONCRETE TO A DEPTH 60% OF THE THICKNESS OF THE CONCRETE AT INTERVALS OF 3 m.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





**NOTES:**

1. ALL CAST IN PLACE CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
2. ALL PRECAST WORK TO CONFORM TO ASTM C 478M.
3. CATCH BASIN LID TO WITHSTAND HS 20 LOADING.

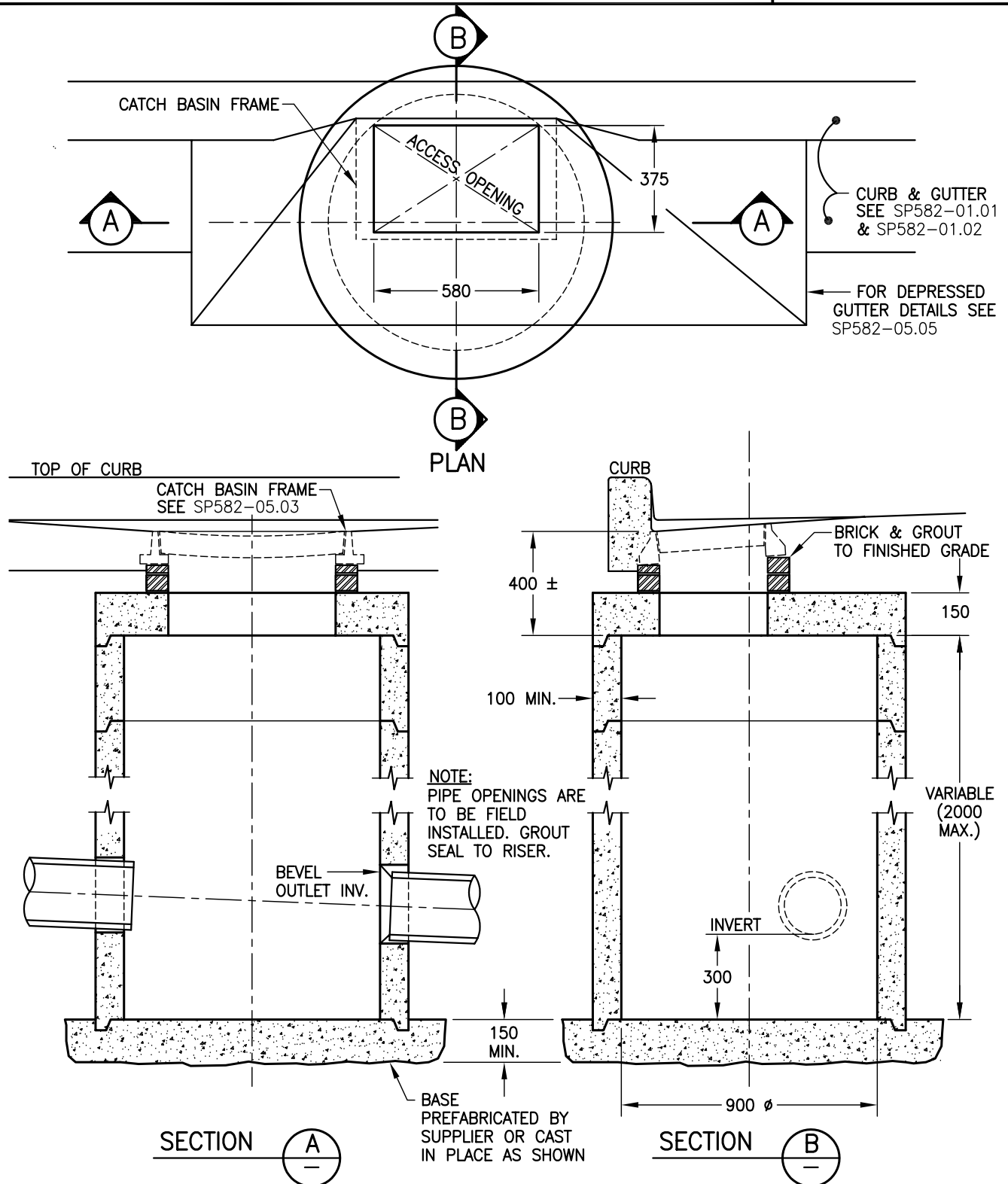
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



# PRECAST REINFORCED CONCRETE VARIABLE DEPTH CATCH BASIN

SP582-02.02



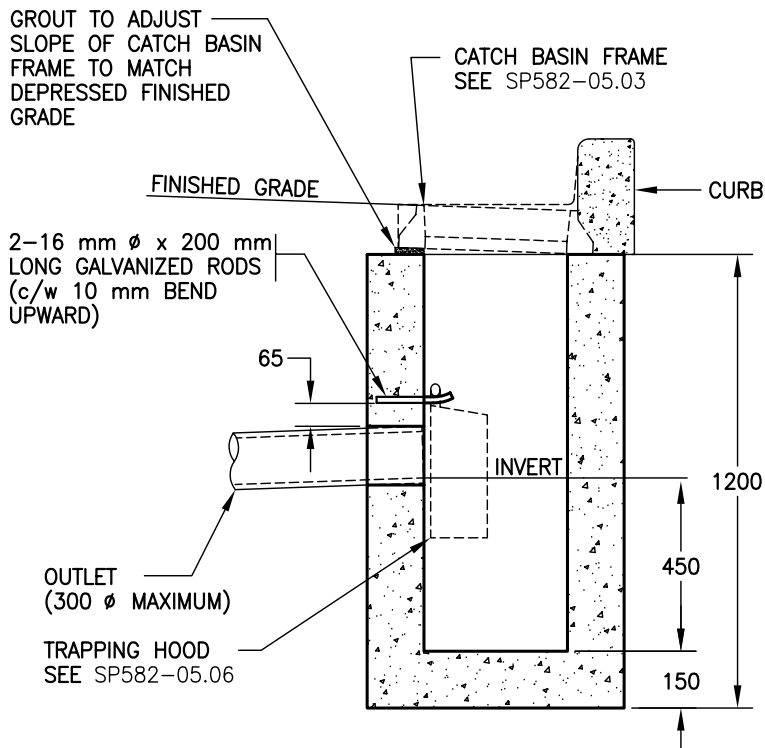
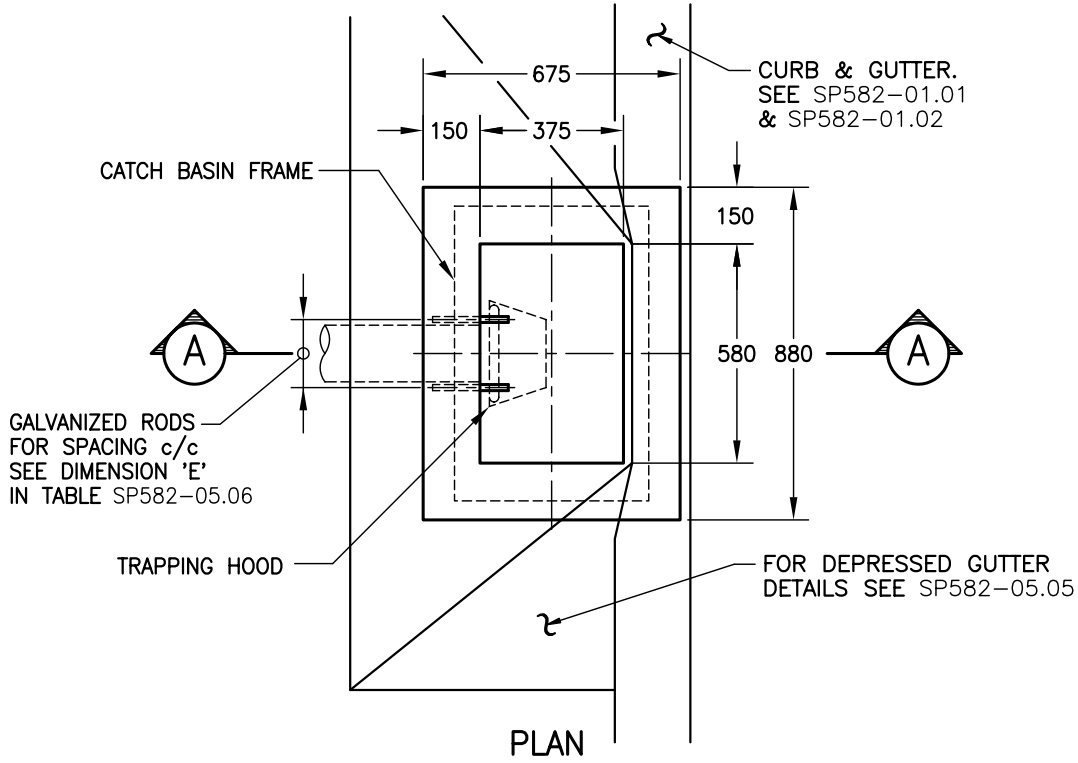
## NOTES:

1. ALL CAST IN PLACE CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
2. ALL PRECAST WORK TO CONFORM TO ASTM C 478M.
3. CATCH BASIN LID TO WITHSTAND HS 20 LOADING.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



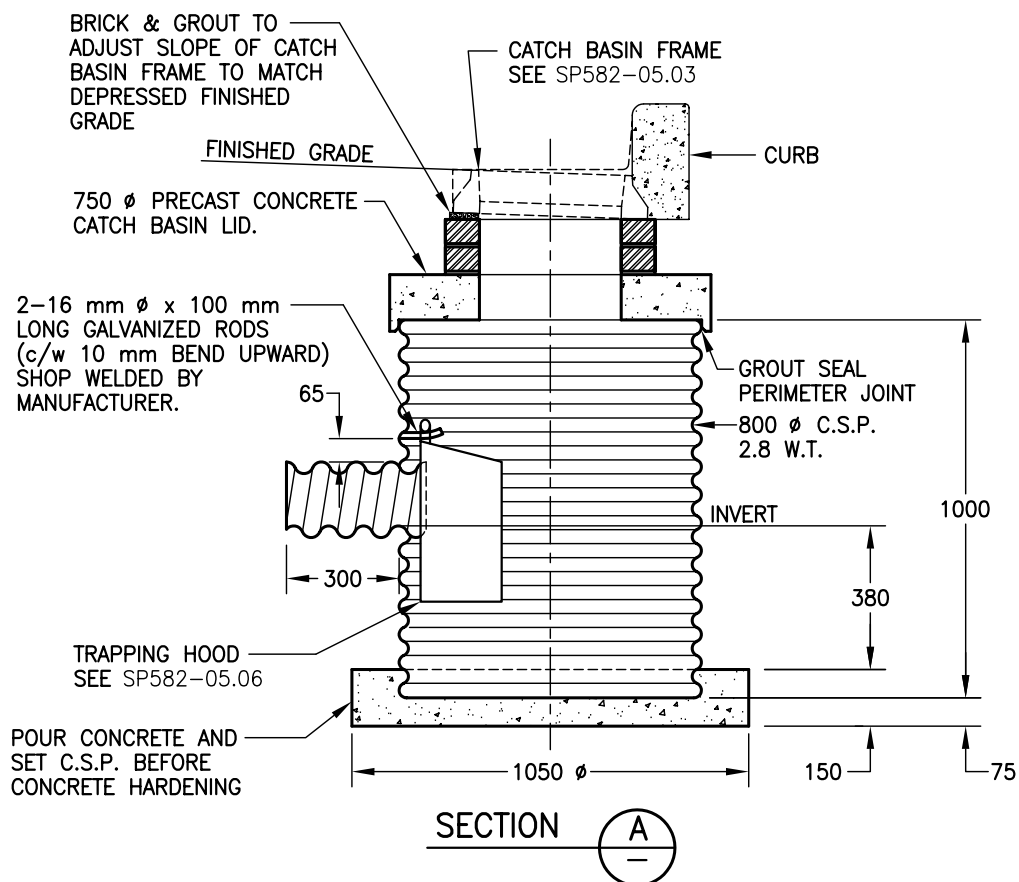
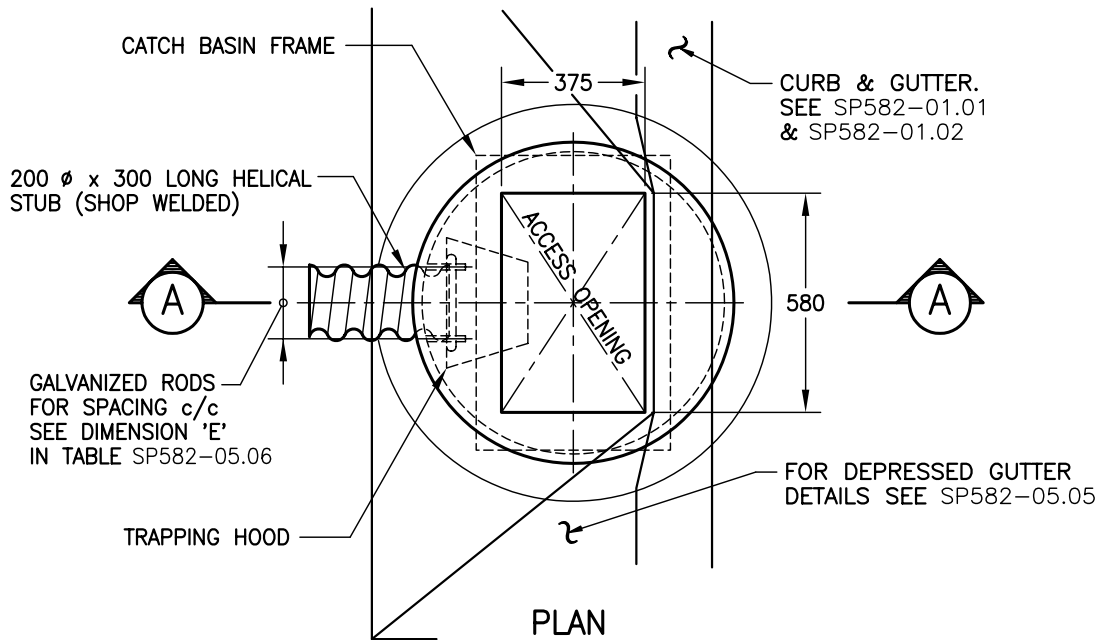


**NOTE:**  
ALL CONCRETE TO BE CLASS 'A'  
(SEE SECTION 218).

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



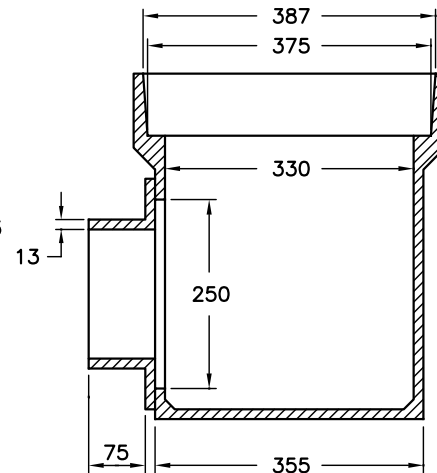
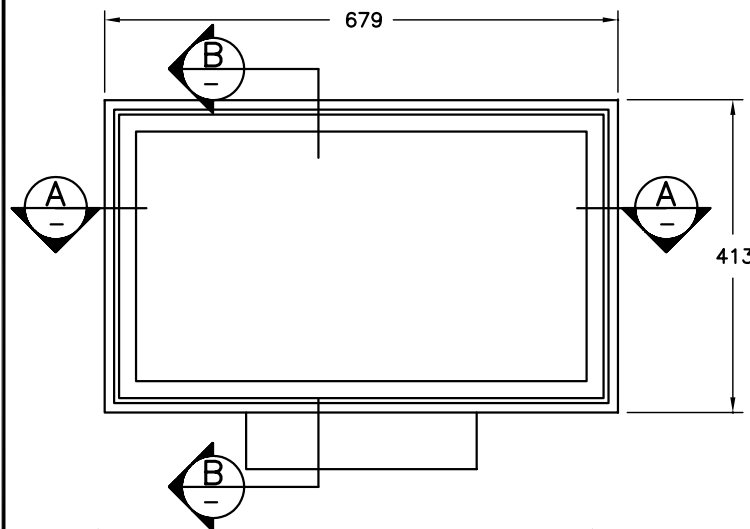
**NOTES:**

1. ALL CAST IN PLACE CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
2. ALL PRECAST WORK TO CONFORM TO ASTM C 478M.
3. CATCH BASIN LID TO WITHSTAND HS 20 LOADING.

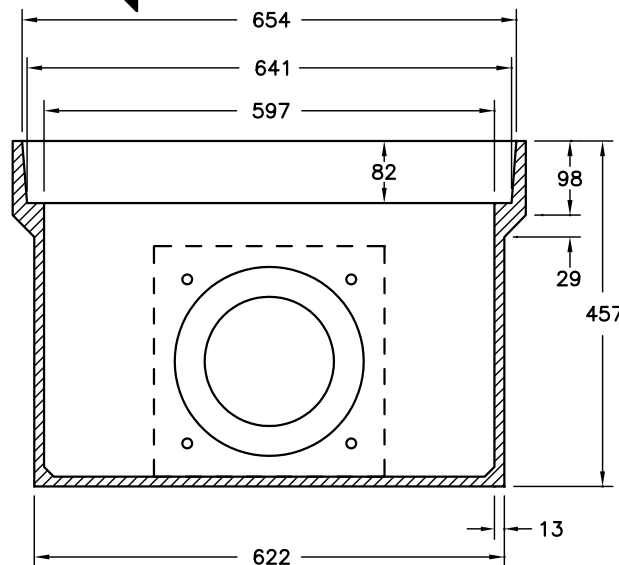
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





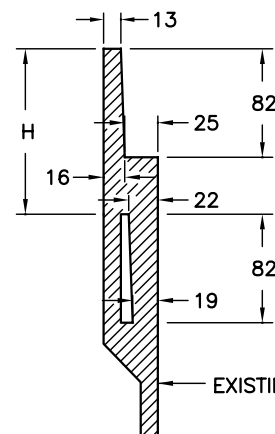
SECTION B



SECTION A

## NOTE:

THIS CATCH BASIN BOX IS TO BE USED IN CONJUNCTION WITH A STANDARD CATCH BASIN GRATE (SEE SP582-05.01 OR SP582-05.02). MATERIAL TO BE CAST STEEL OR CAST IRON AS ORDERED. APPROXIMATE WEIGHT 136 kg

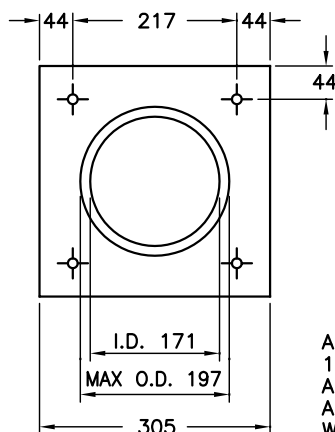


HEIGHT H TYPE A....100  
TYPE B....125  
TYPE C....150

OUTSIDE DIMENSIONS OF CAST IRON EXTENSION ARE 679 x 413

EXISTING CAST IRON CATCH BASIN BOX

### EXTENSION FOR CAST IRON CATCH BASIN BOX



ADAPTOR PLATE

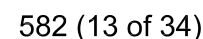
ADAPTOR PLATE TO BE DRILLED TO CLEAR 13 mm STUDS. THE FACE OF THE BOX AND PLATE TO BE GROUND SMOOTH, AND A RUBBER GASKET USED TO ENSURE A WATER TIGHT JOINT.

NOT TO SCALE

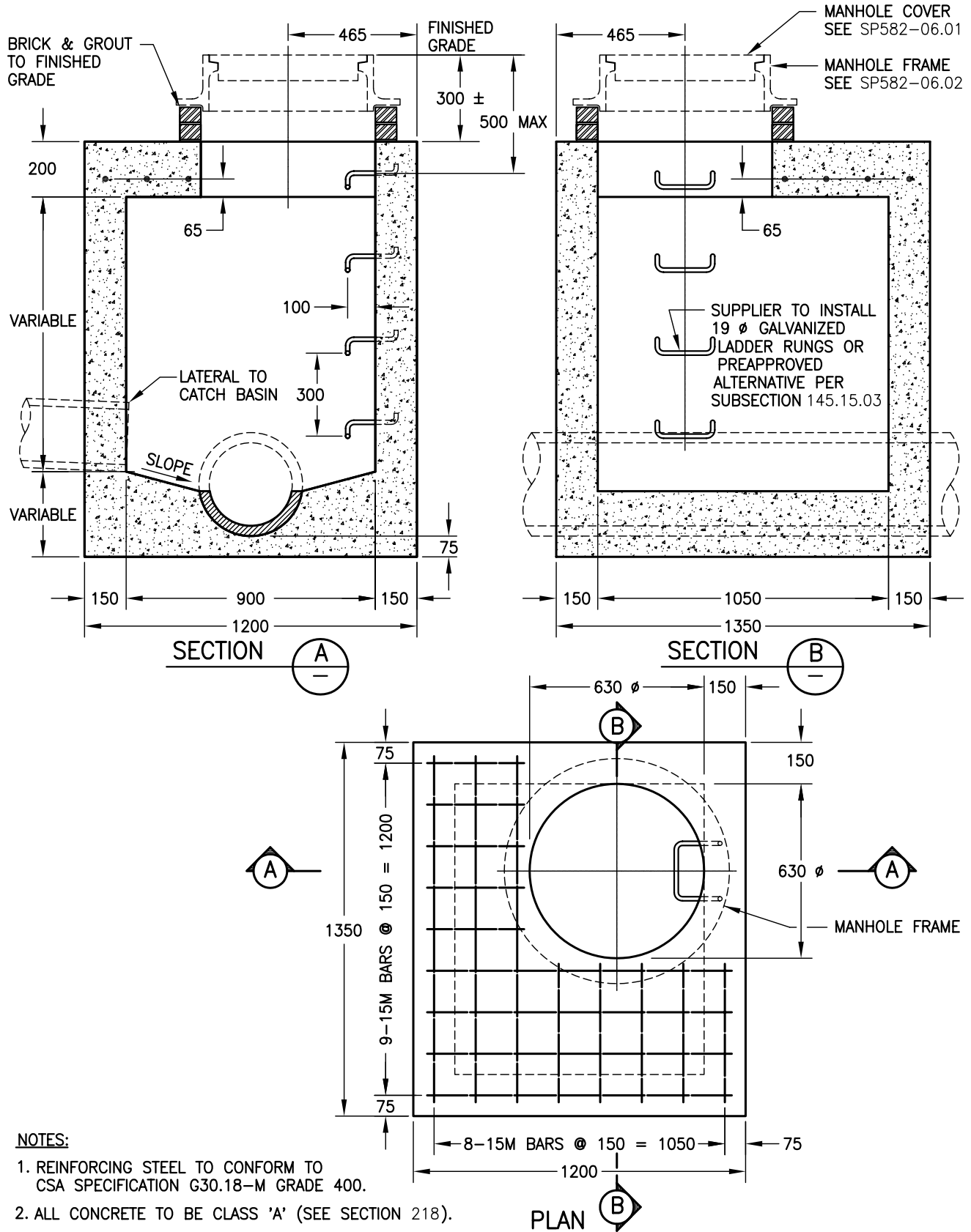
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



SP582-03.01





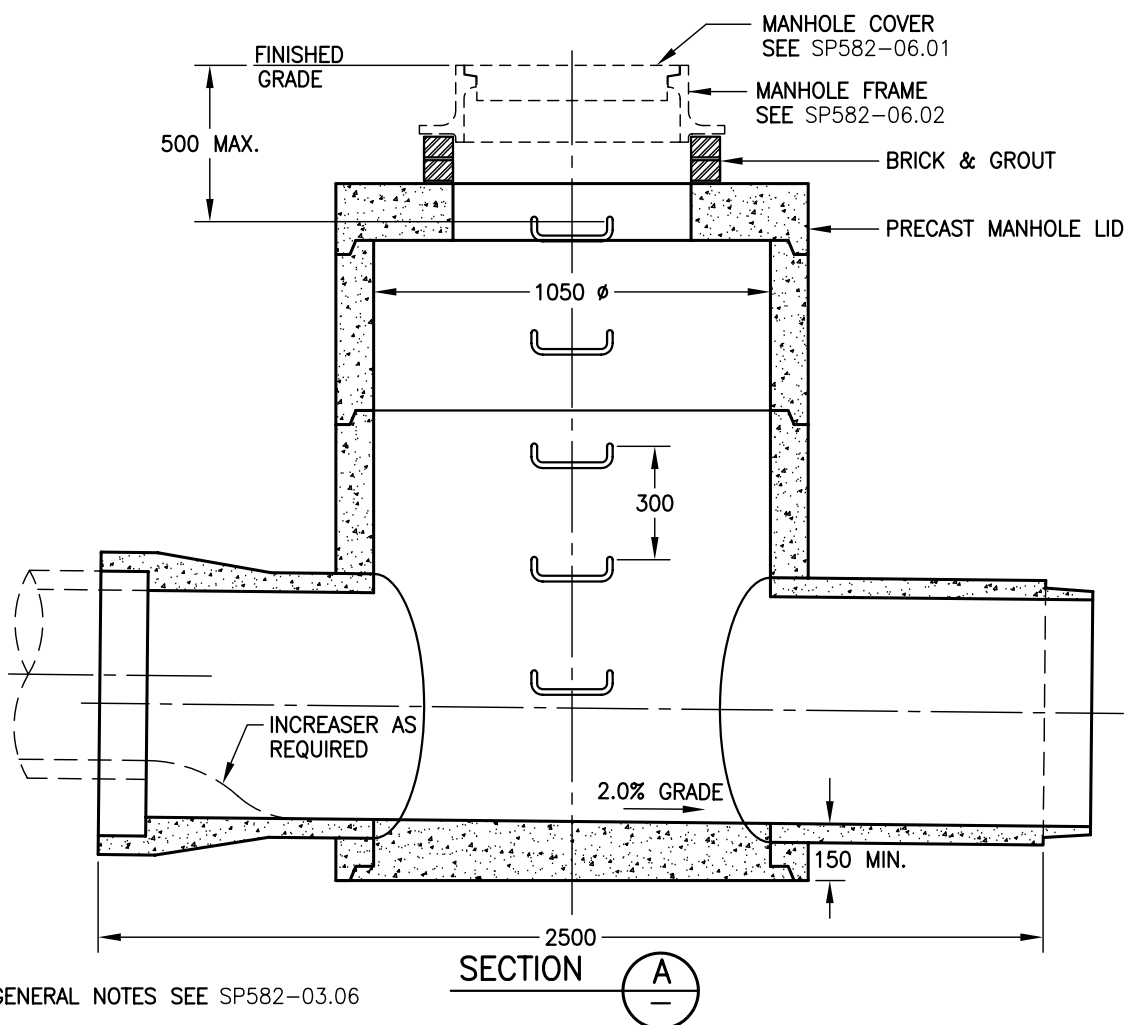
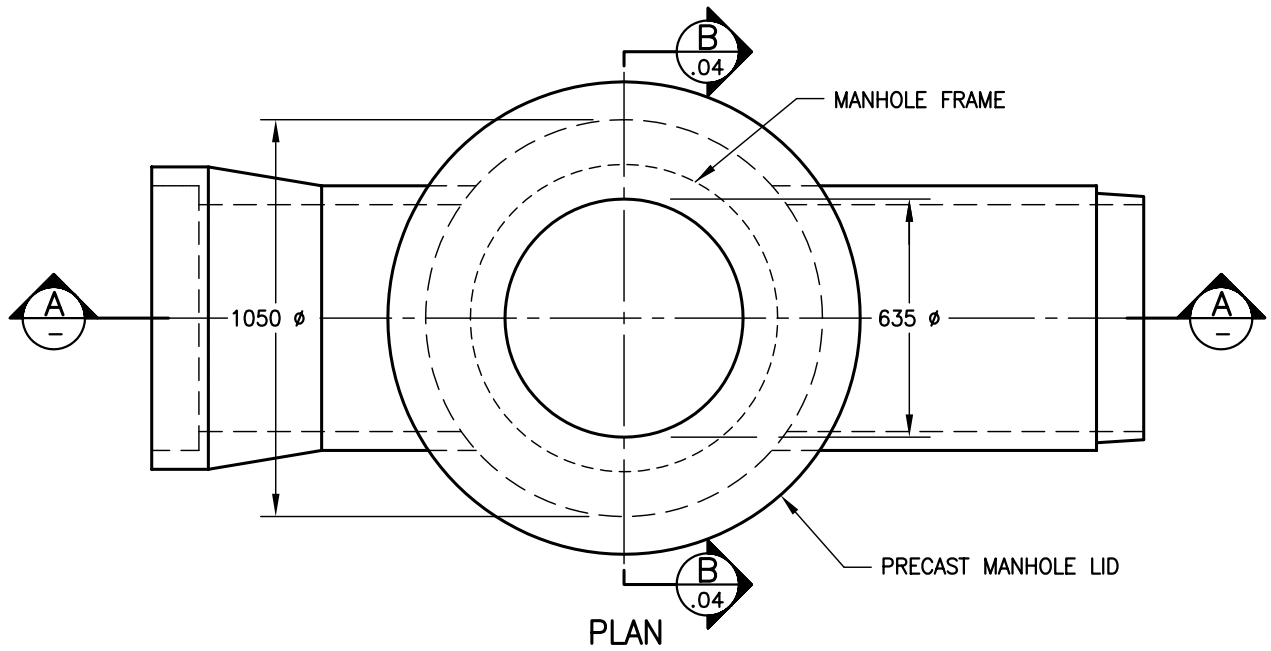


NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SP582-03.03



**NOTE:**  
FOR GENERAL NOTES SEE SP582-03.06

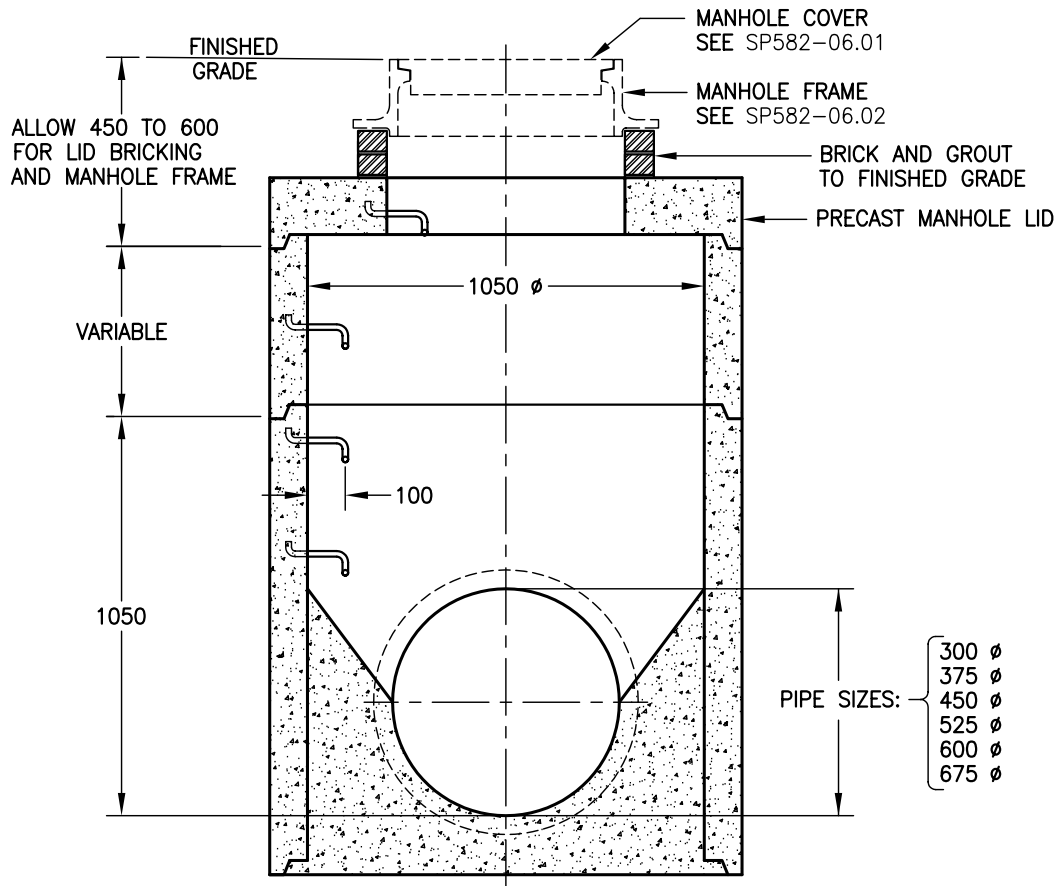
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PREFABRICATED CONCRETE TEE MANHOLES  
PIPE SIZES – 300 mm TO 675 mm

SP582-03.04



SECTION



NOTE: FOR LOCATION OF SECTION  
SEE SP582-03.03

NOTE:  
FOR GENERAL NOTES SEE SP582-03.06

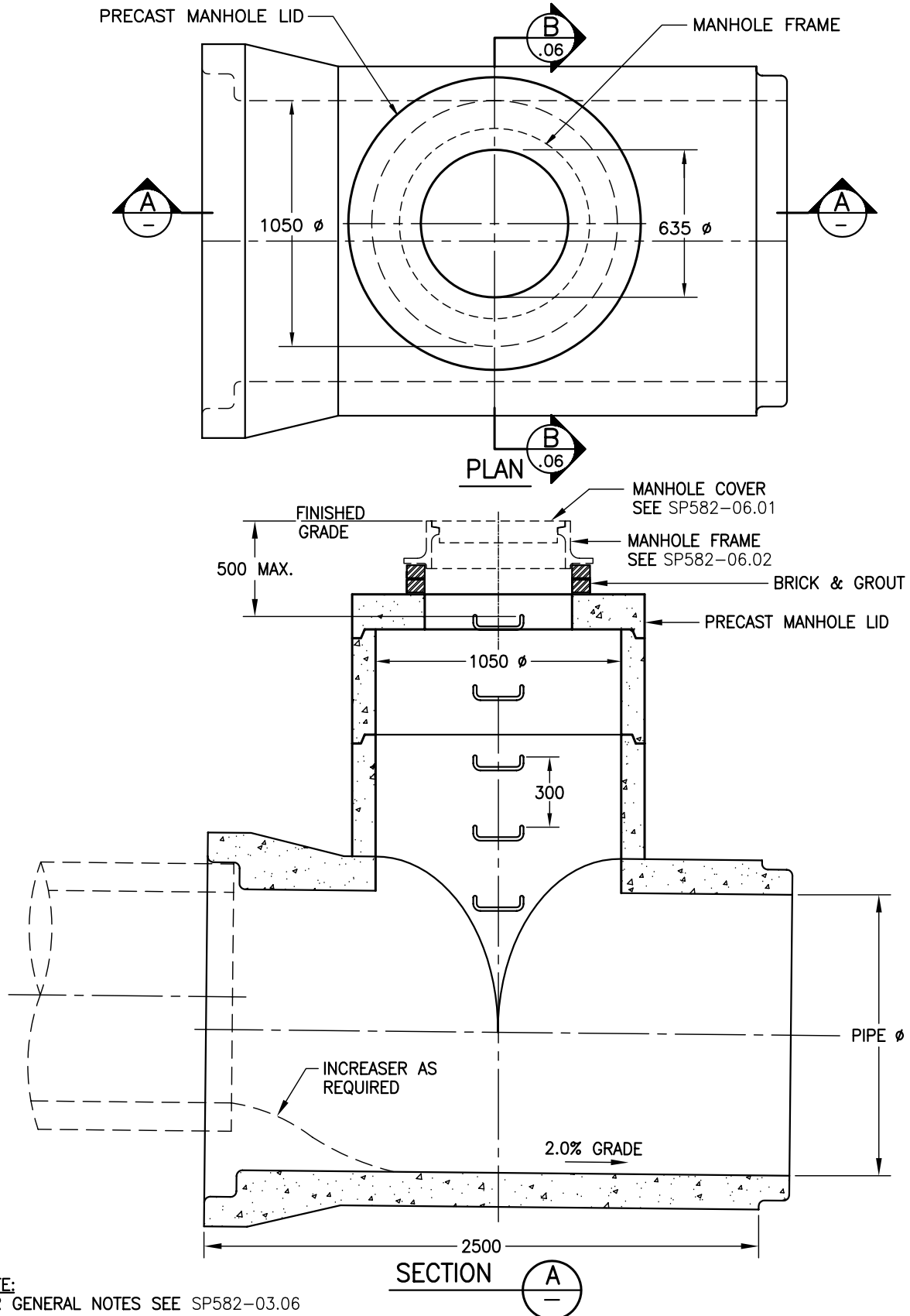
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PREFABRICATED CONCRETE TEE MANHOLES  
PIPE SIZES – 750 mm TO 3050 mm

SP582–03.05



NOTE:  
FOR GENERAL NOTES SEE SP582–03.06

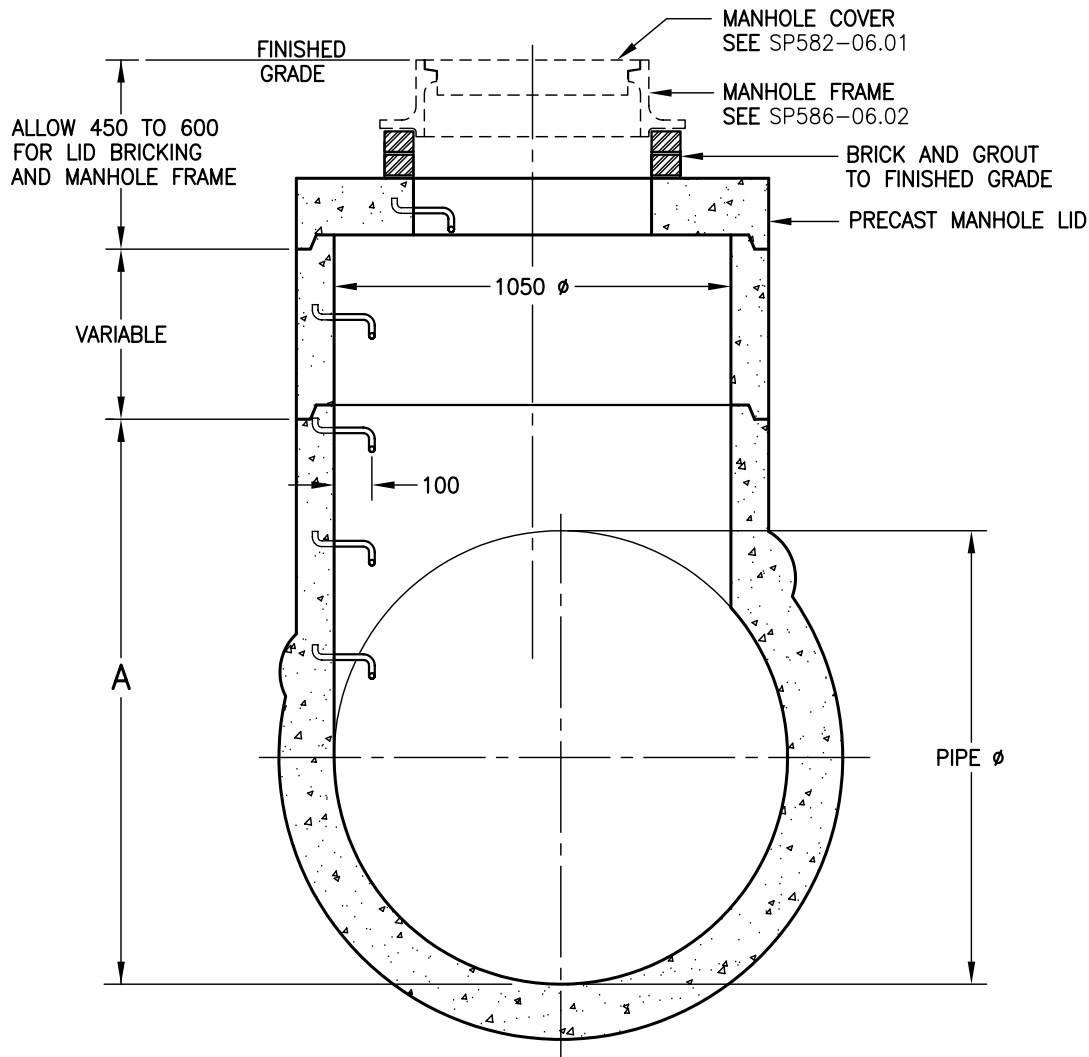
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



# PREFABRICATED CONCRETE TEE MANHOLES PIPE SIZES – 750 mm TO 3050

SP582-03.06



SECTION

B  
05

NOTE: FOR LOCATION OF SECTION  
SEE SP582-03.05

## NOTE:

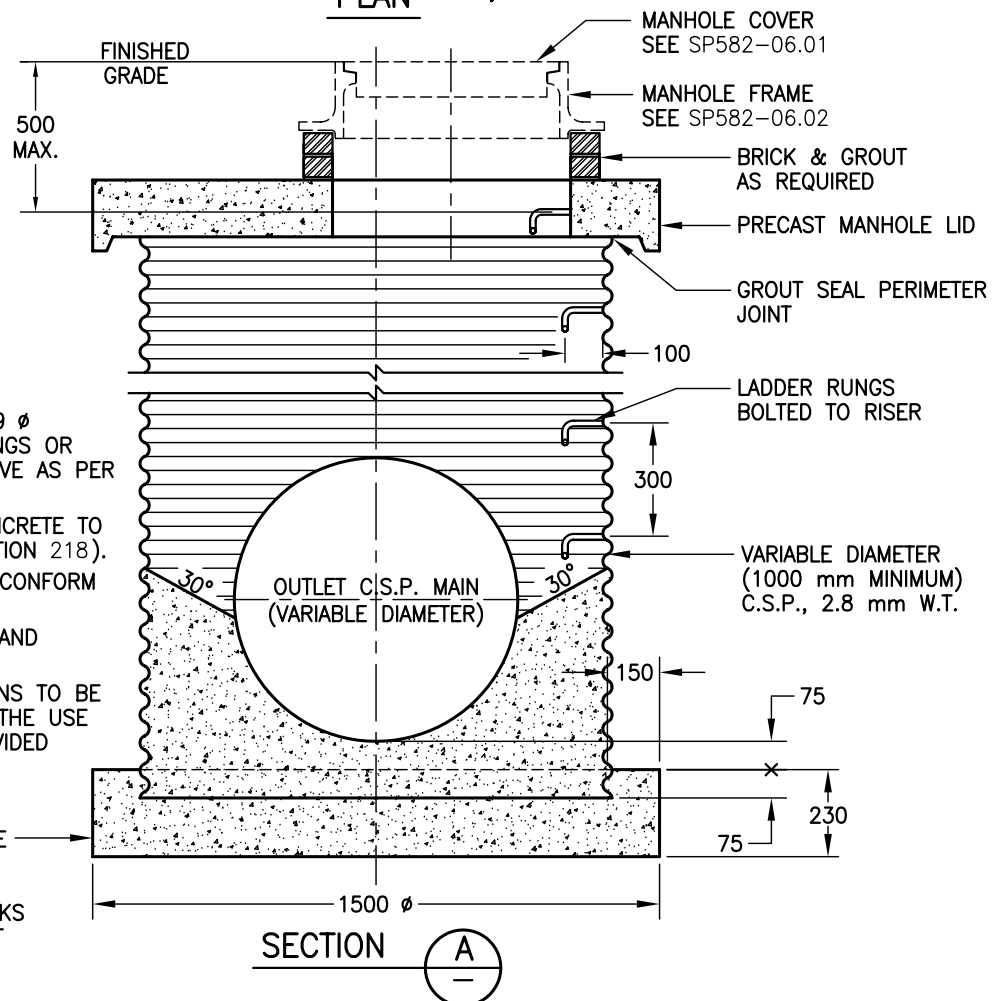
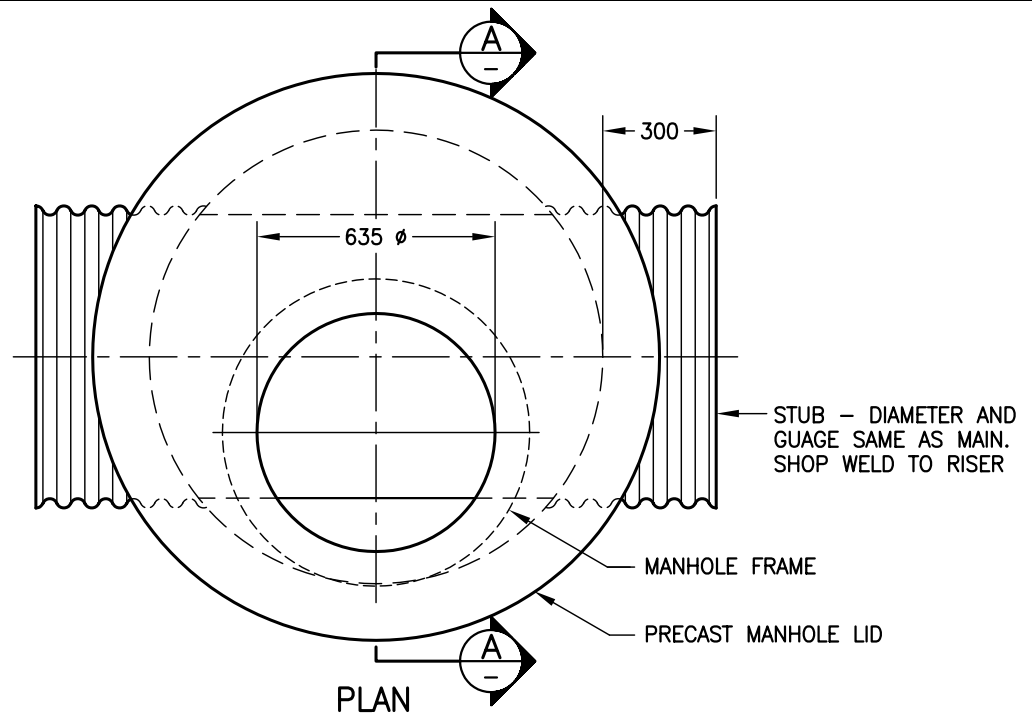
1. SUPPLIER TO INSTALL 19 Ø GALVANIZED LADDER RUNGS OR PREAPPROVED ALTERNATIVE AS PER SUBSECTION 145.15.03
2. CONCRETE PIPE TO CONFORM TO ASTM C 76.
3. ALL PRECAST WORK TO CONFORM TO ASTM C 478 M.
4. MANHOLE LID TO WITHSTAND HS 20 LOADING.
5. MANHOLE TEE SECTION SHALL BE BEDDED AS PER SUBSECTION 582.37.
6. MANHOLE TEE SECTIONS MAY BE ORDERED AS INCREASERS ON THE UPSTREAM END TO ALLOW FOR PIPE SIZE CHANGES.

PIPE Ø	A
750	1270
900	1400
1050	1550
1200	1720
1350	1880
1500	1970
1800	2210

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**NOTES:**

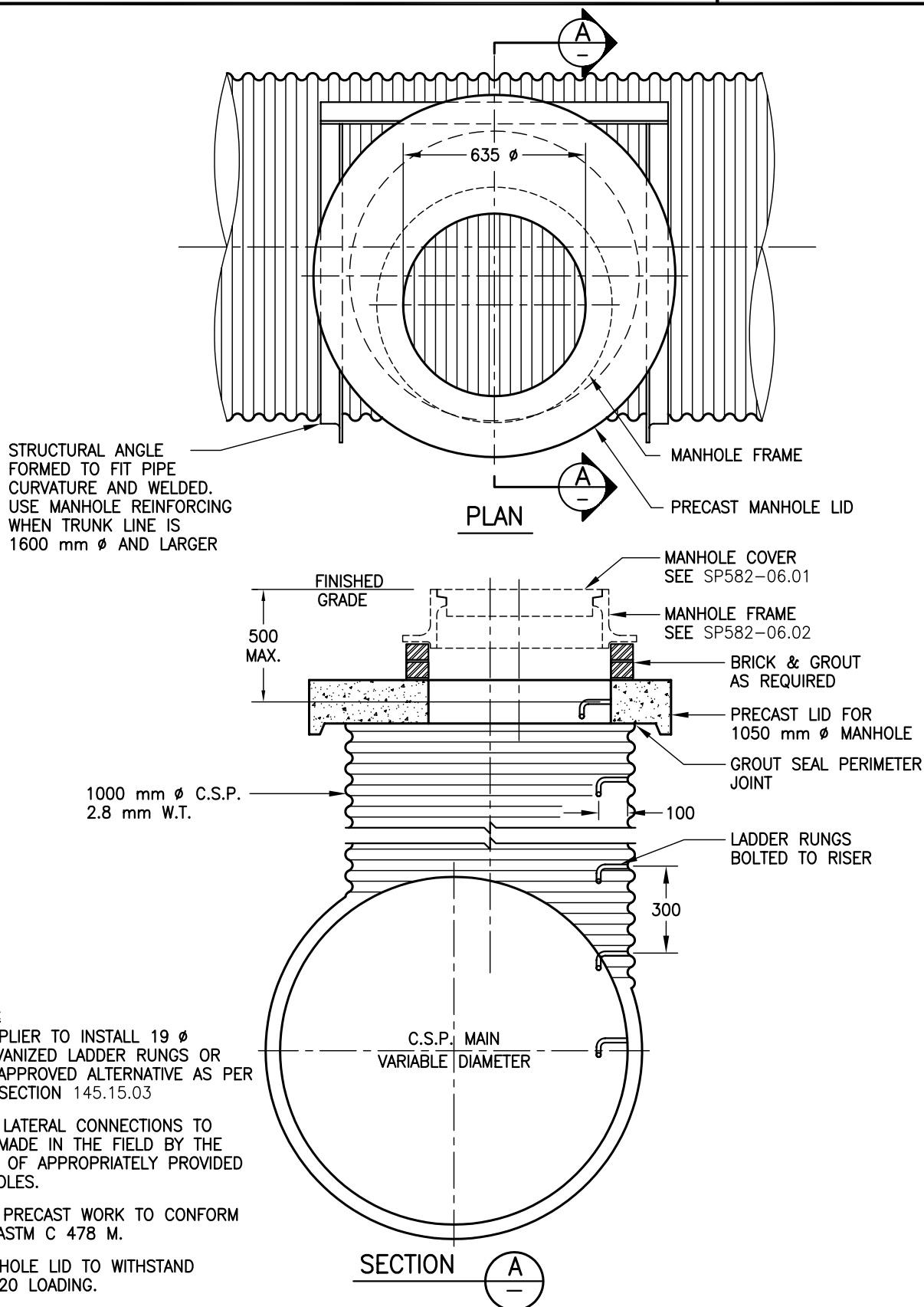
1. SUPPLIER TO INSTALL 19 Ø GALVANIZED LADDER RUNGS OR PREAPPROVED ALTERNATIVE AS PER SUBSECTION 145.15.03
2. ALL CAST IN PLACE CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
3. ALL PRECAST WORK TO CONFORM TO ASTM C 478 M.
4. MANHOLE LID TO WITHSTAND HS 20 LOADING.
5. ALL LATERAL CONNECTIONS TO BE MADE IN THE FIELD BY THE USE OF APPROPRIATELY PROVIDED SADDLES.

REINFORCED CONC. BASE  
TO BE POURED DURING  
THE INSTALLATION. USE  
BRICKS OR CONC. BLOCKS  
AS TEMPORARY SUPPORT  
FOR VERTICAL BARREL.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



SP582-04.01

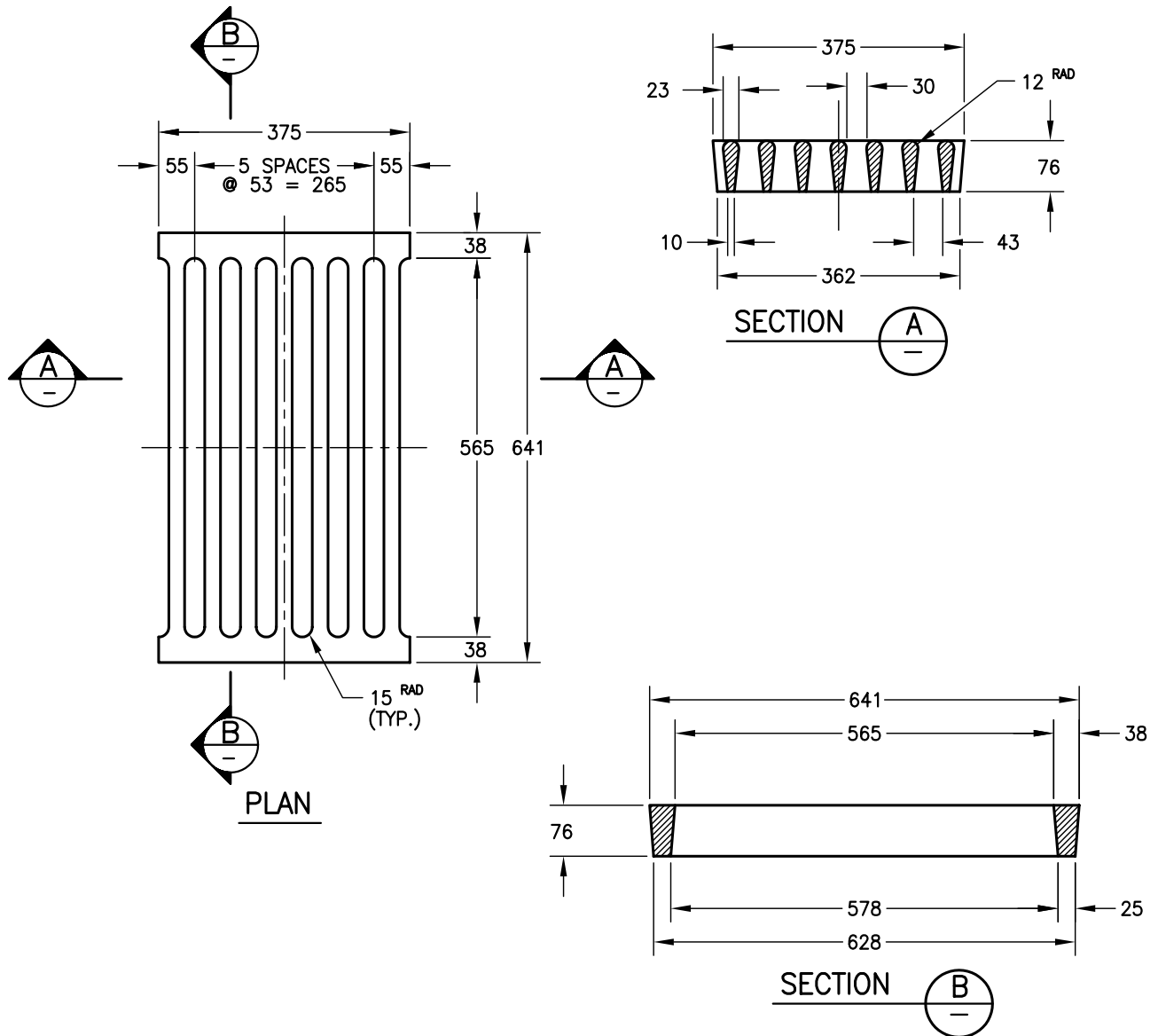


- |     |      |    |
|-----|------|----|
| 600 | 1209 | 34 |
|-----|------|----|
- NOTES:
1. ALL CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
  2. ALL STEELWORK TO CONFORM TO CSA SPECIFICATION CAN3-G40.21M GRADE 300W.
  3. ALL STEELWORK TO BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH CSA SPECIFICATION G164 TABLE 1.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



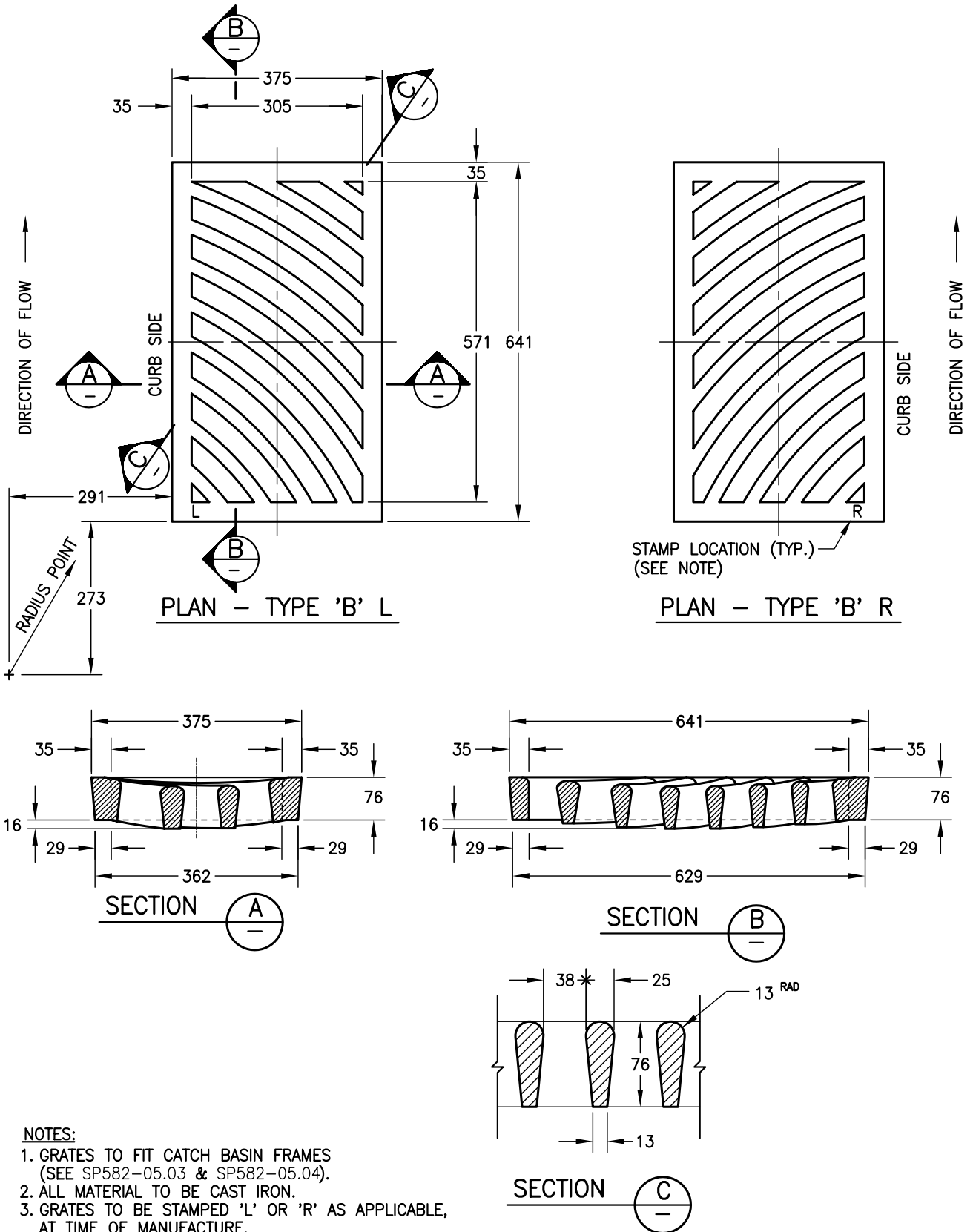
**NOTE:**

1. GRATES TO FIT CATCH BASIN FRAMES (SEE SP582-05.03 & SP582-05.04 ).
2. ALL MATERIAL TO BE CAST IRON.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

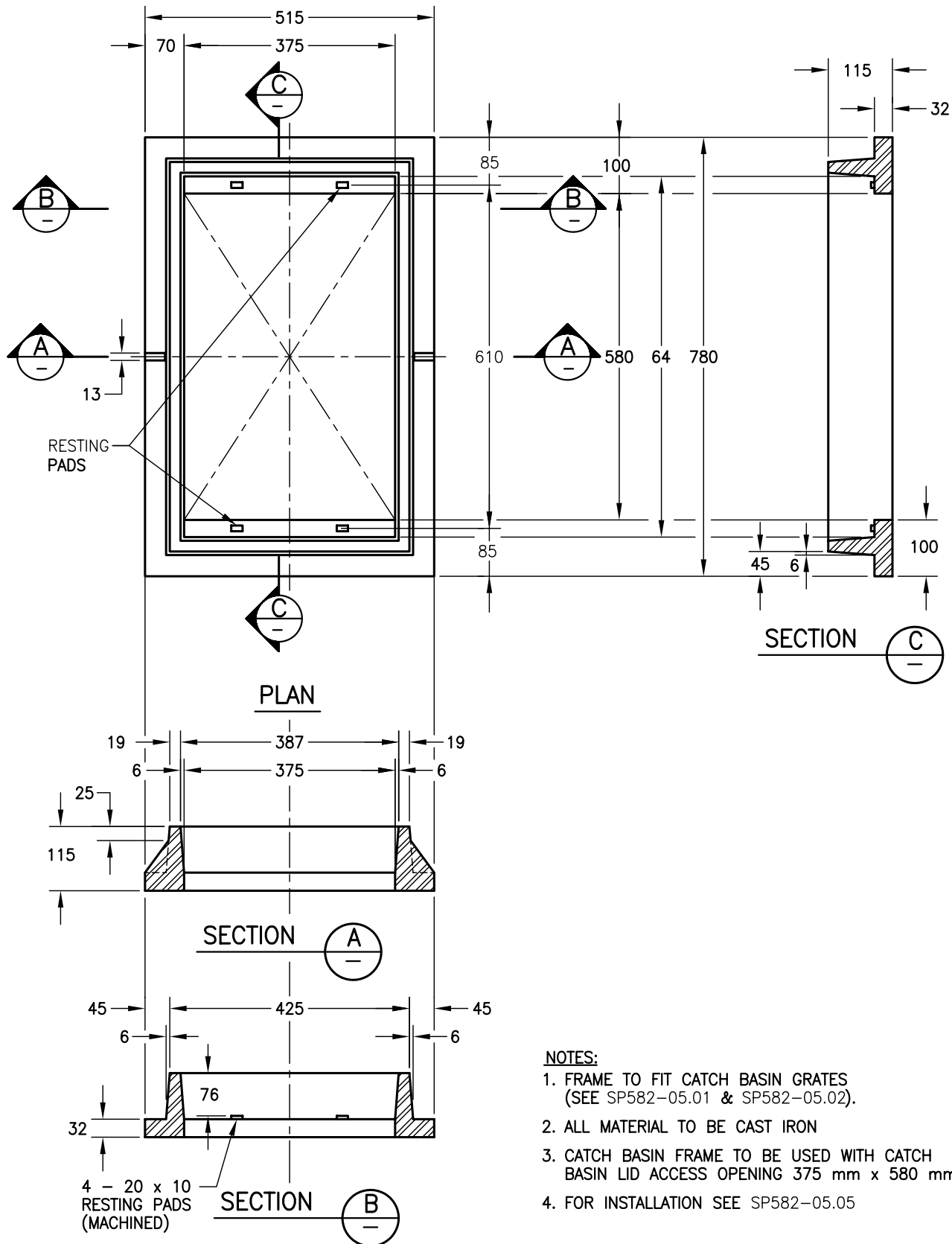




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

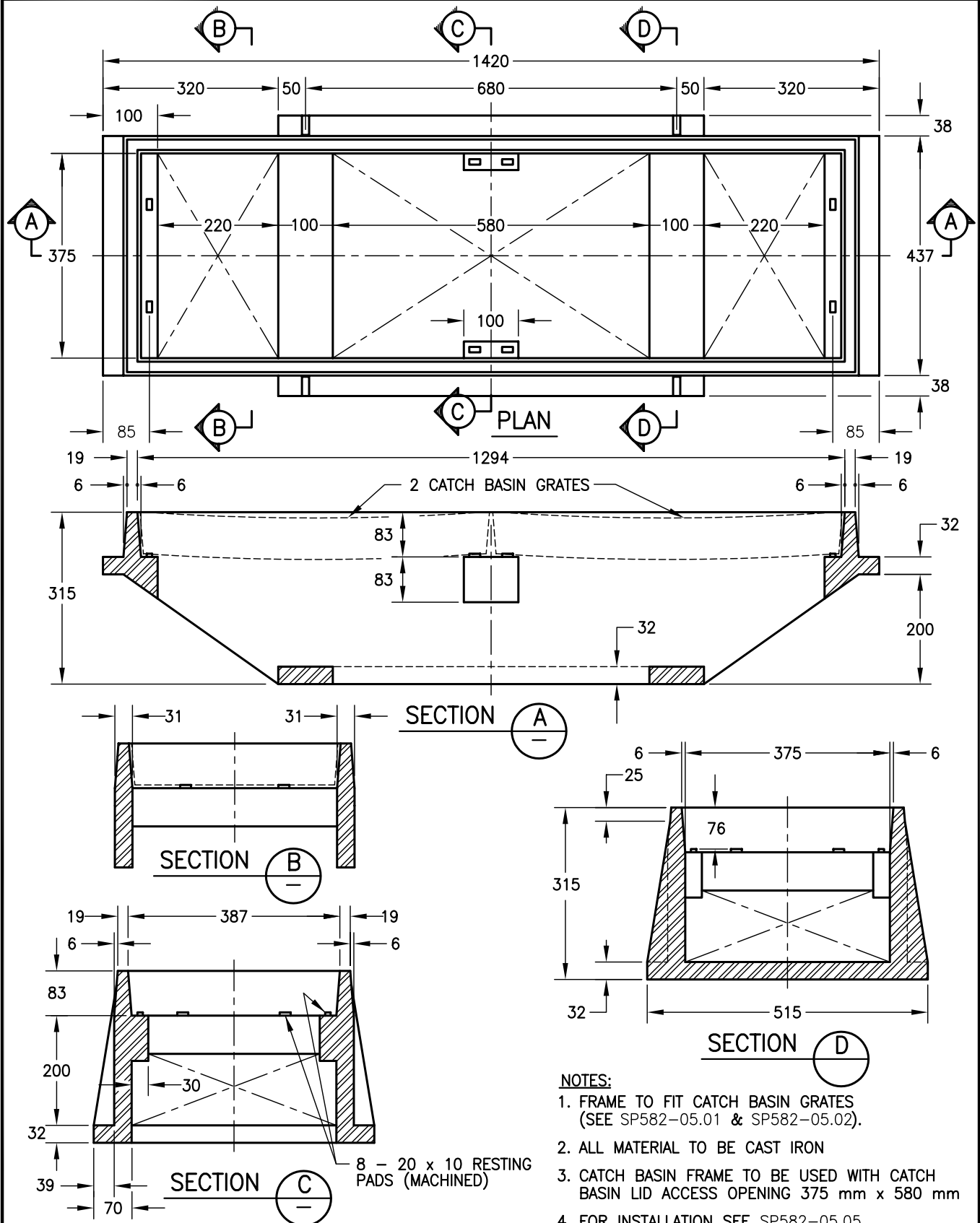




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

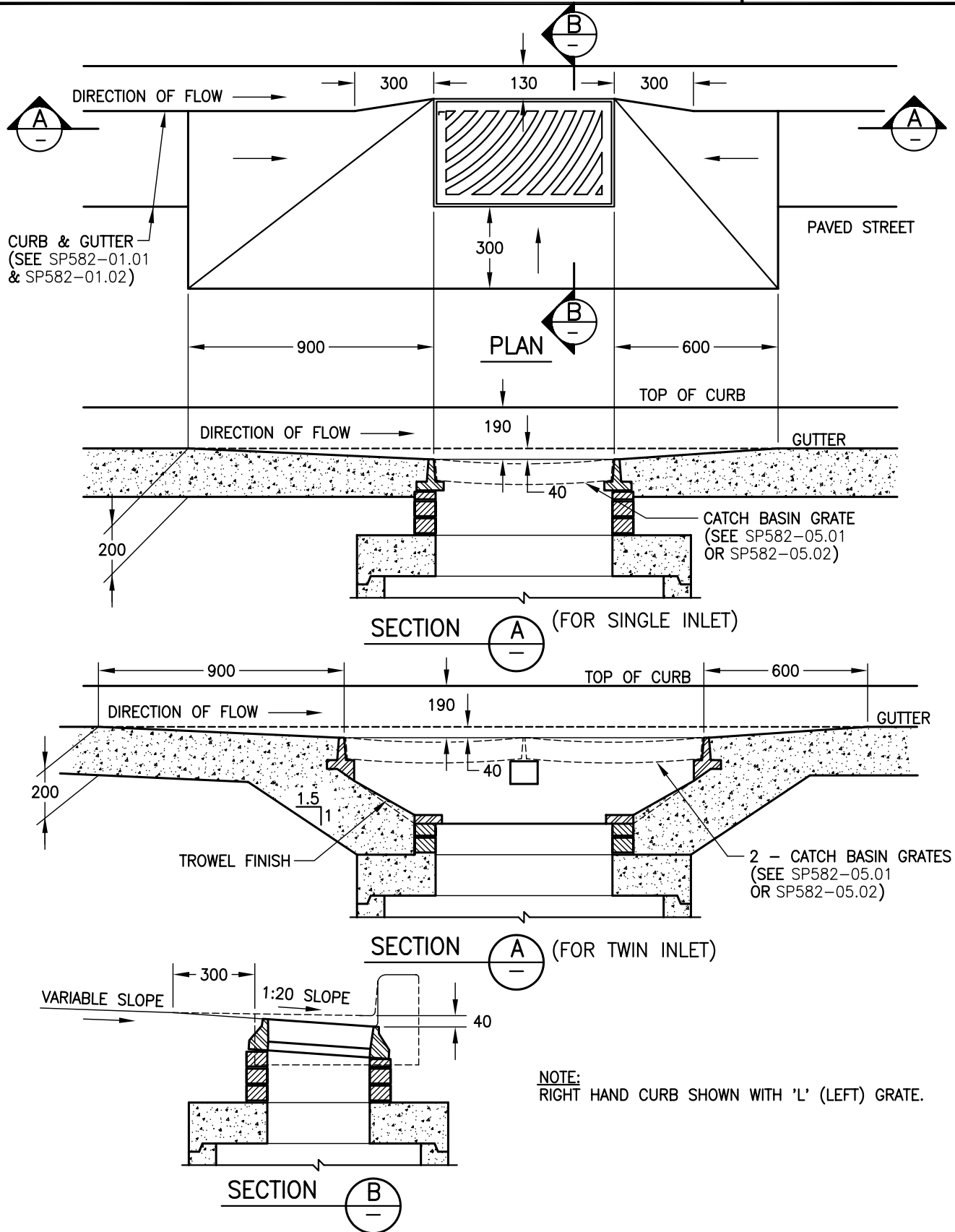




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





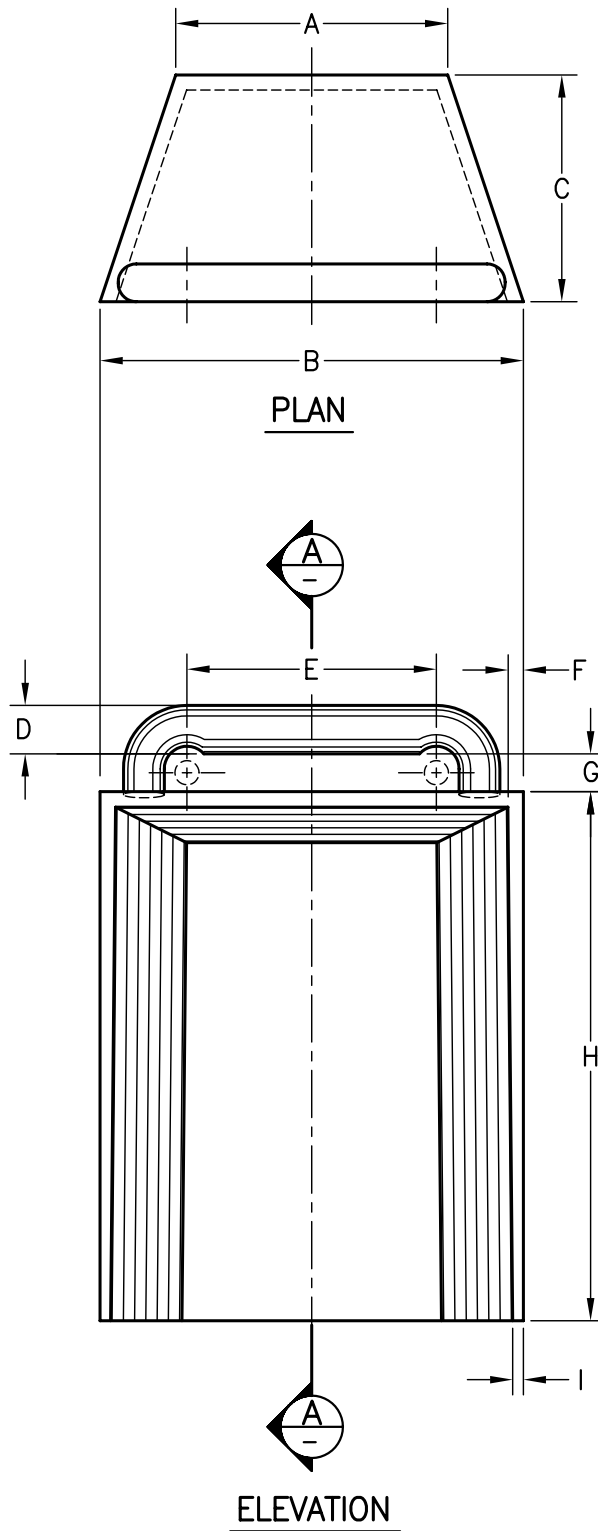
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

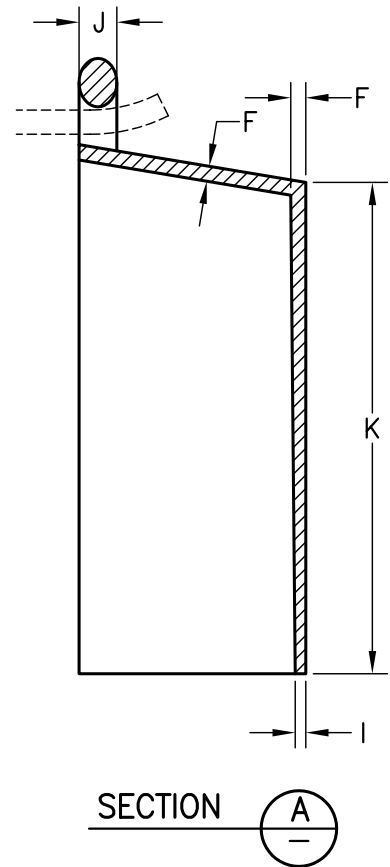


# TRAPPING HOOD

SP582-05.06



DIM.	1A 150 OUTLET	9 200 OUTLET	9A 300 OUTLET
A	180	215	320
B	280	345	445
C	150	215	255
D	32	32	38
E	165	190	305
F	10	13	13
G	25	25	25
H	350	425	535
I	7	10	10
J	25	29	29
K	325	370	470
MASS	16 kg	25 kg	49 kg

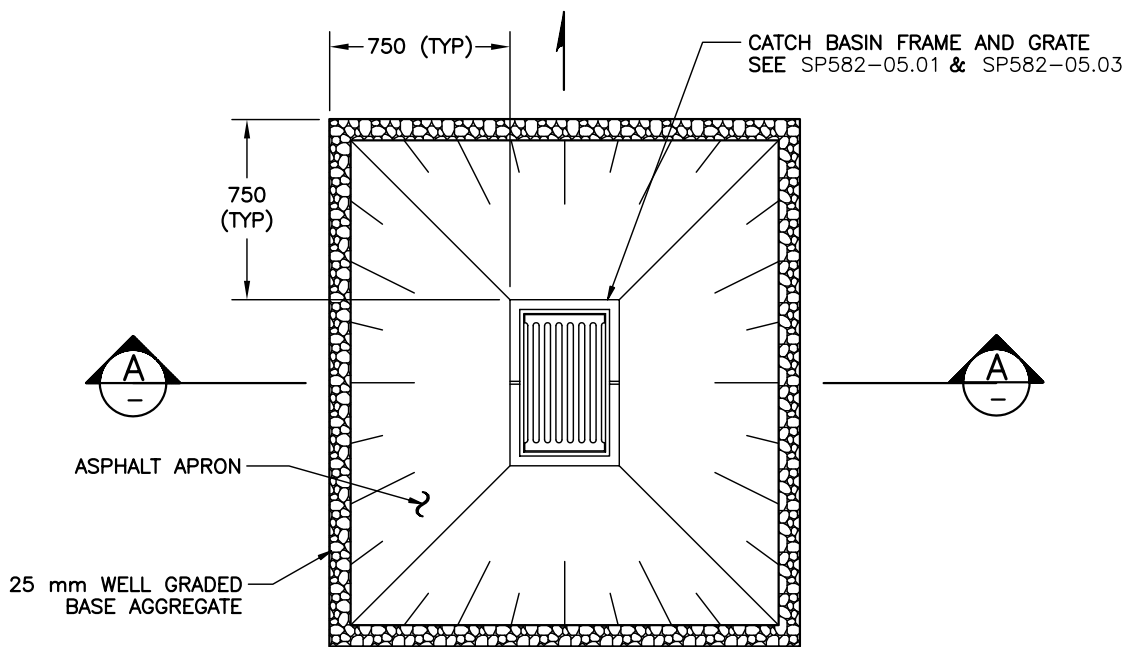


**NOTE:**  
ALL MATERIAL TO BE CAST IRON.

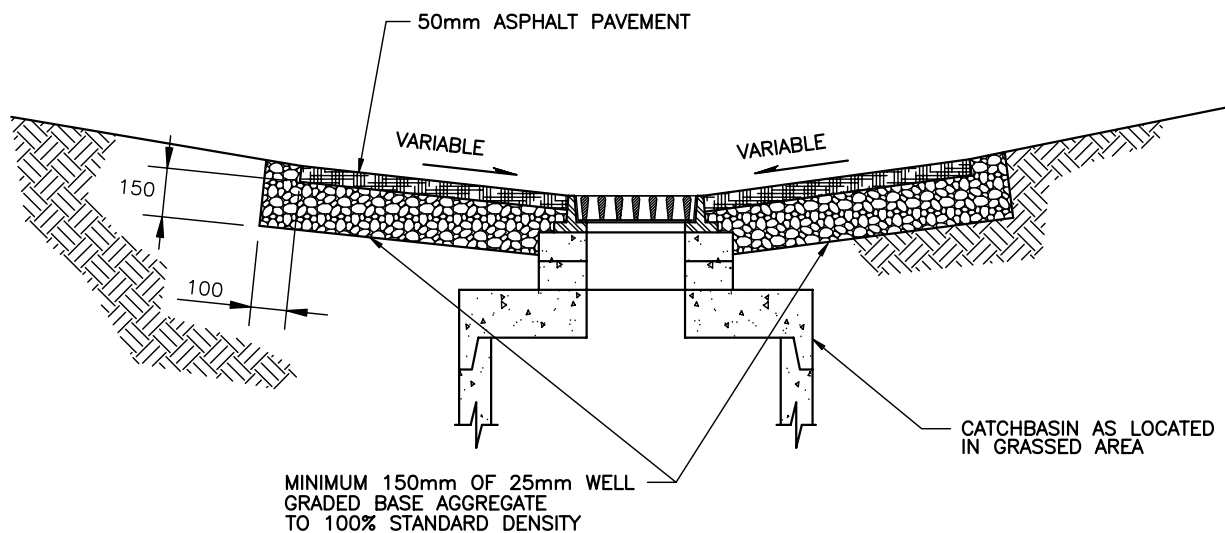
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





FLOW  
DIRECTION  
**PLAN**



**SECTION**

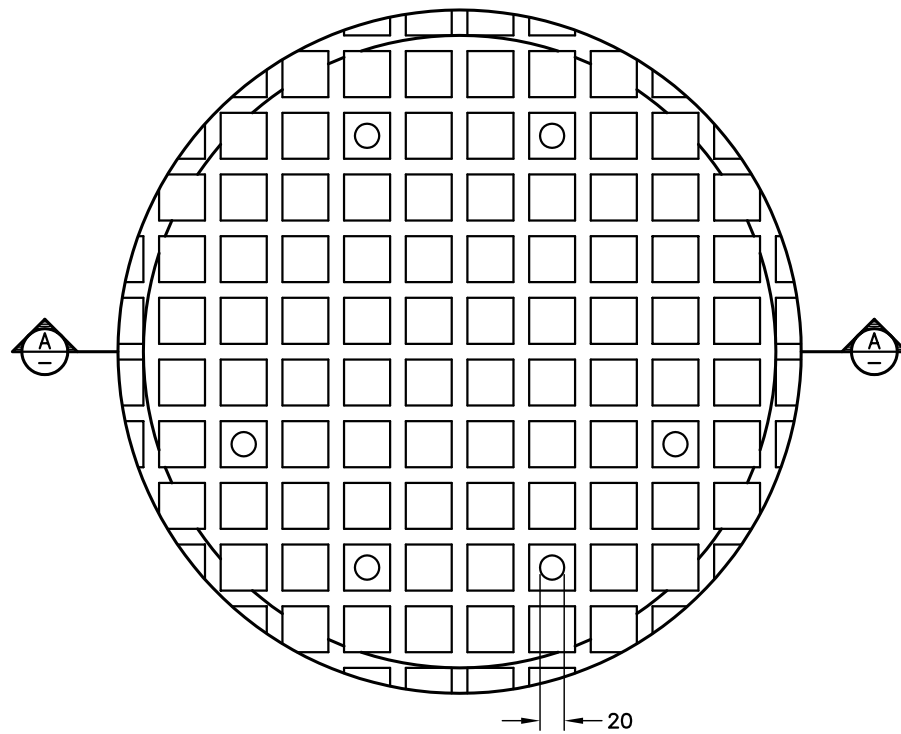


**NOTE:**  
FOR DETAILS OF CATCH BASIN  
SEE SP582-02.01 THROUGH SP582-02.05.

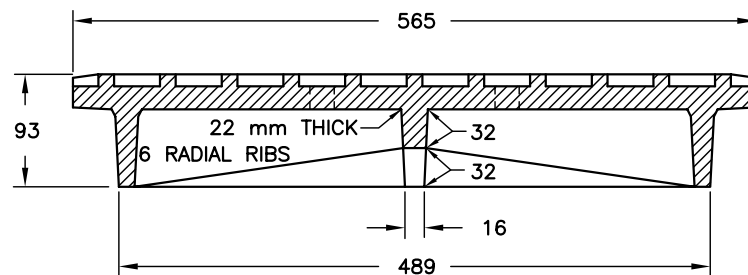
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

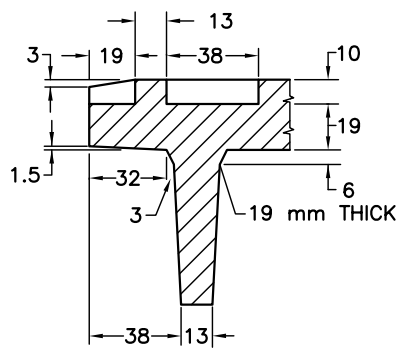




MATERIAL: CAST IRON



SECTION



DETAIL OF RIM

NOTE: FOR FRAME SEE SP582-06.02

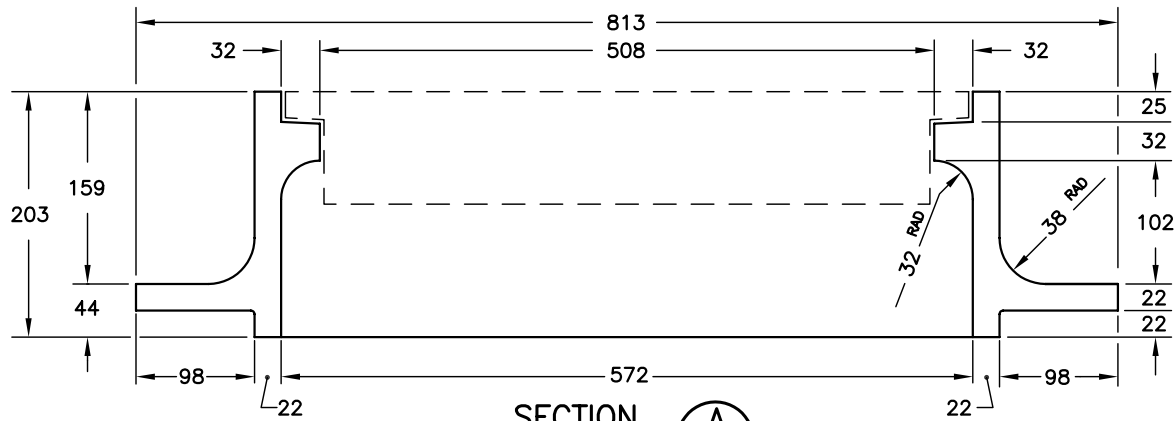
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

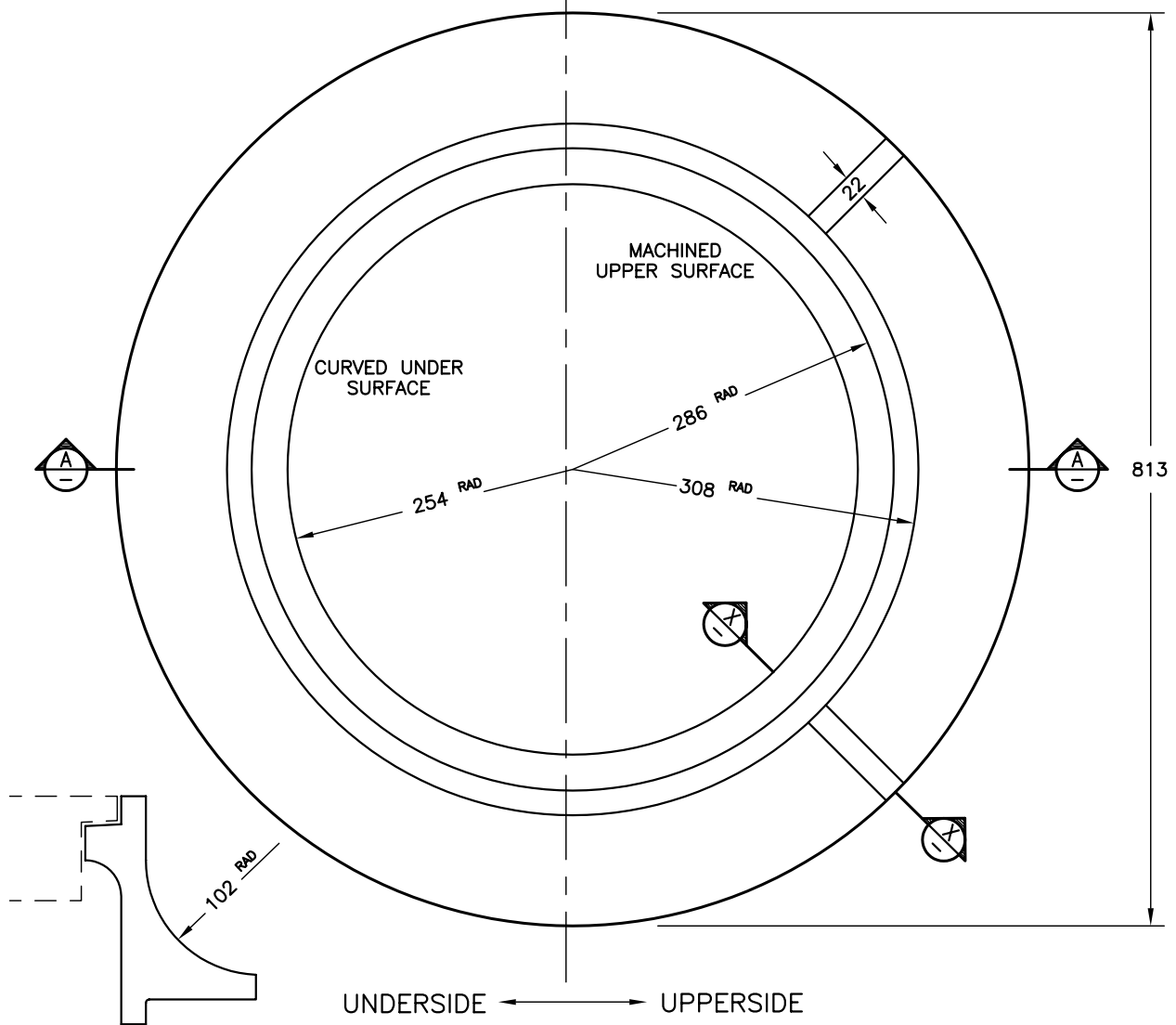



MANHOLE FRAME

SP582-06.02



SECTION \_\_\_\_\_



SECTION 

NOTE: FOR COVER SEE SP582-06.01

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

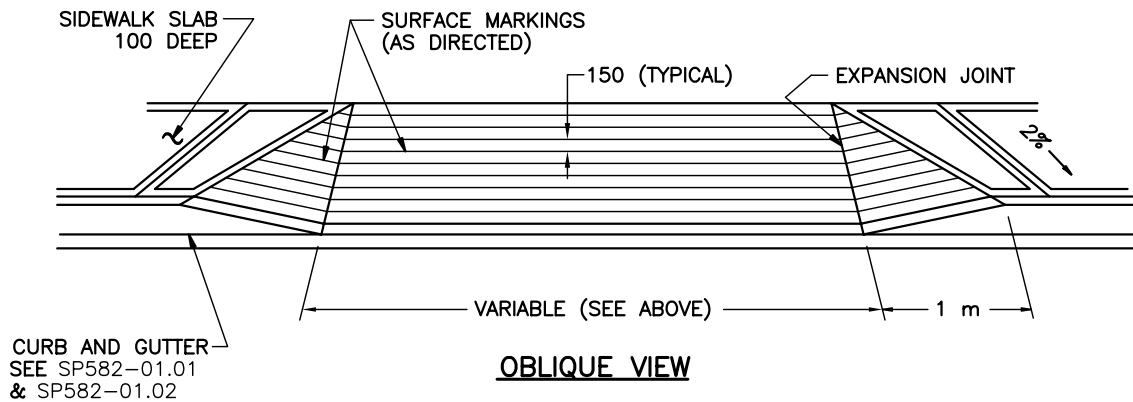
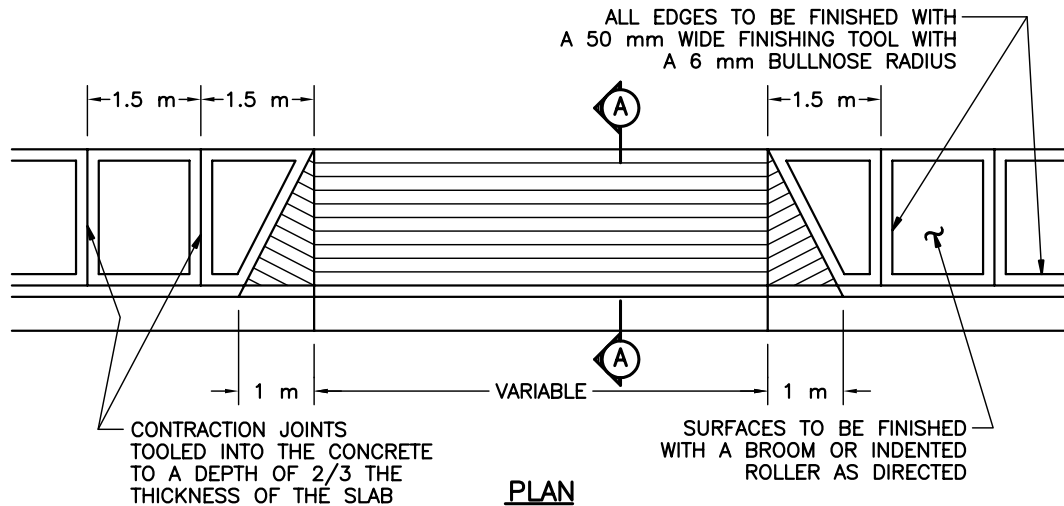


## EXPANSION JOINTS

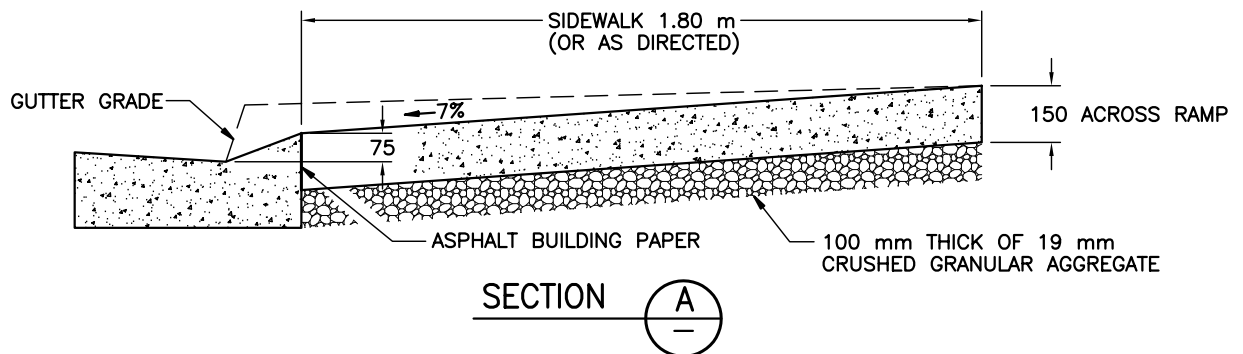
- AT 6 m INTERVALS ACROSS SIDEWALK.
- AROUND UTILITY POLES, CONCRETE STRUCTURES AND BUILDINGS.
- AT EACH END OF THICKENED SIDEWALK SECTION AND AT MID-SPAN WHEN THE LENGTH IS GREATER THAN 6 m.

## DRIVEWAY WIDTHS

- COMMERCIAL 2 WAY TRAFFIC 7.5 - 15 m
- COMMERCIAL 1 WAY TRAFFIC 6 - 10 m
- RESIDENTIAL.....6 m



CURB AND GUTTER  
SEE SP582-01.01  
& SP582-01.02



## NOTES:

1. FOR OPEN SHOULDER DRIVEWAY DETAIL SEE B.C. SUPPLEMENT TO TAC.
2. ADD 150 mm TO WIDTH WHEN SIDEWALK FENCE IS REQUIRED.
3. ALL CONCRETE TO BE CLASS 'A' (SEE SECTION 218).

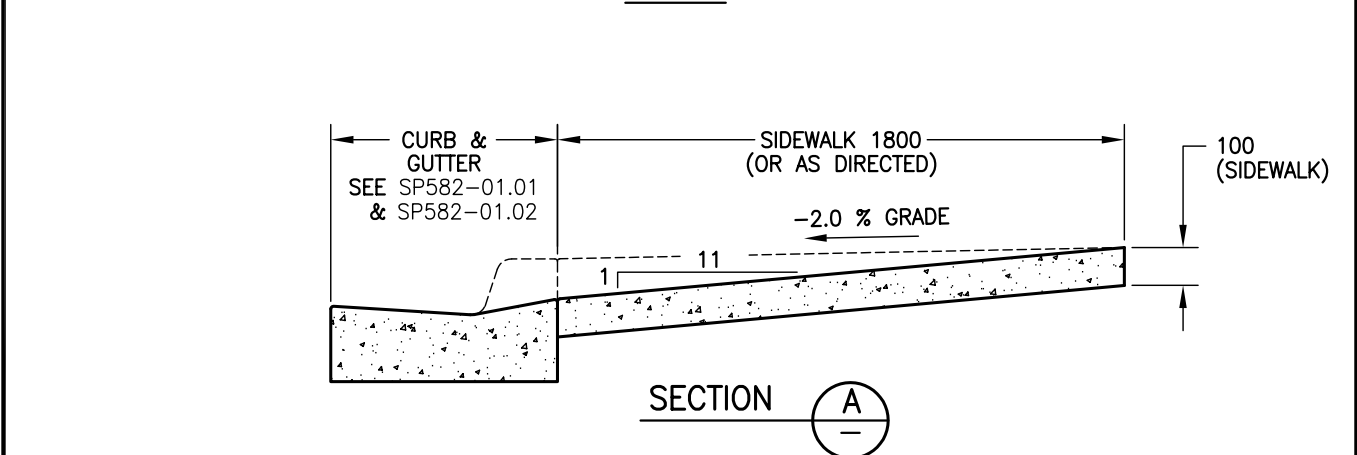
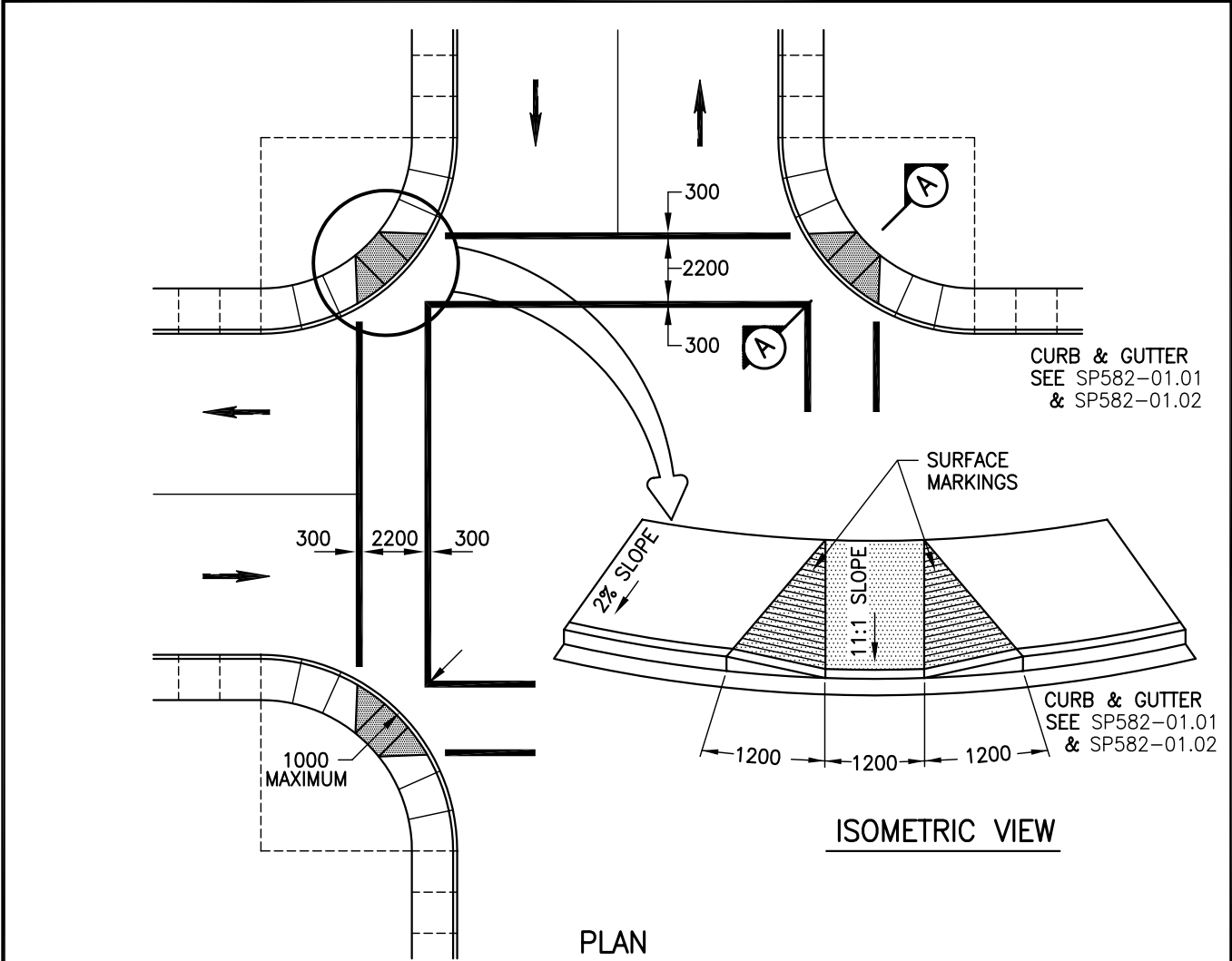
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



SIDEWALK RAMP	SP582-07.02
---------------	-------------

SIDEWALK RAMP	SP582-07.02
---------------	-------------



NOTE:

NOTE:  
ALL CONCRETE TO BE CLASS 'A' (SEE SECTION 218).

NOT TO SCALE      ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

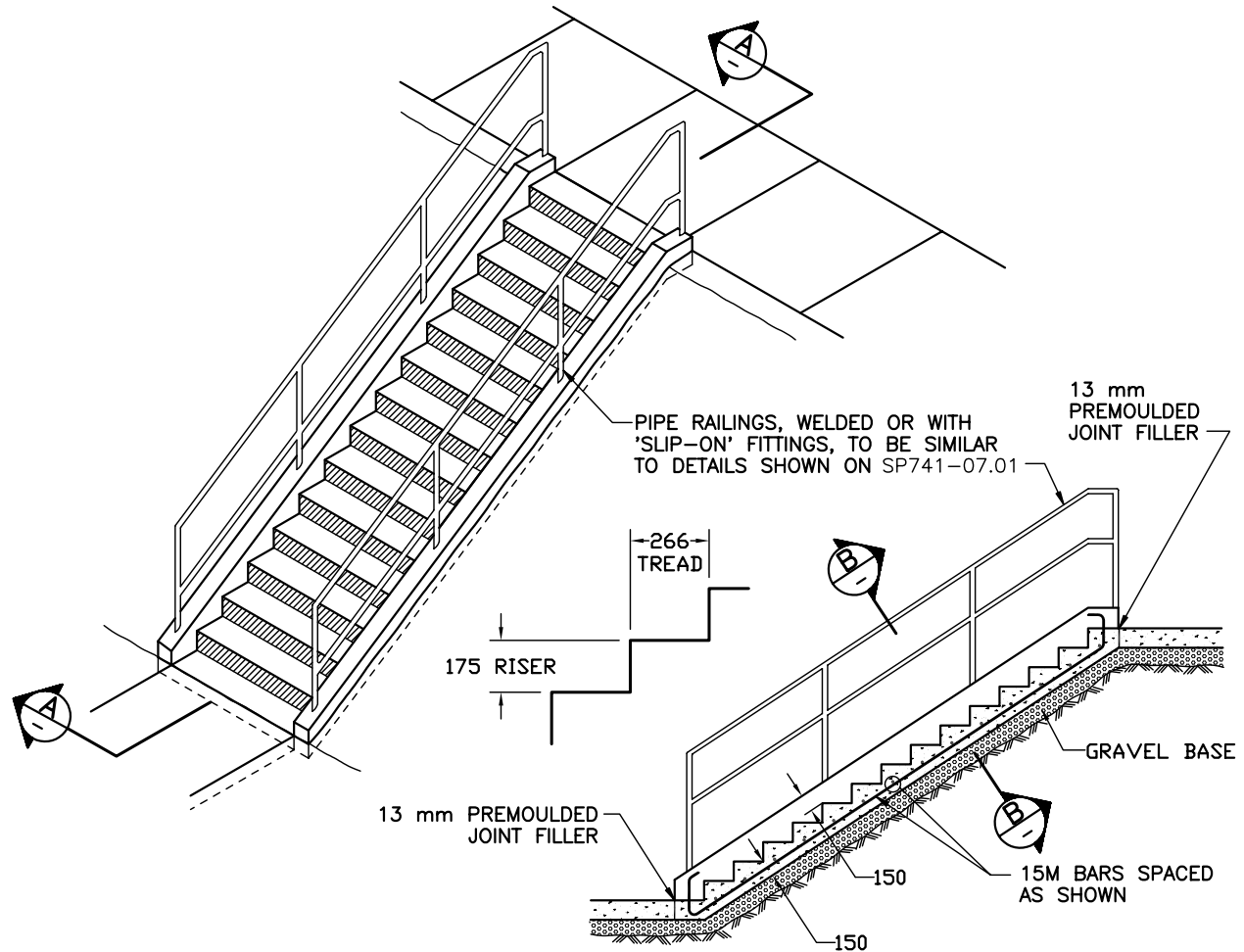
NOT TO SCALE      ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

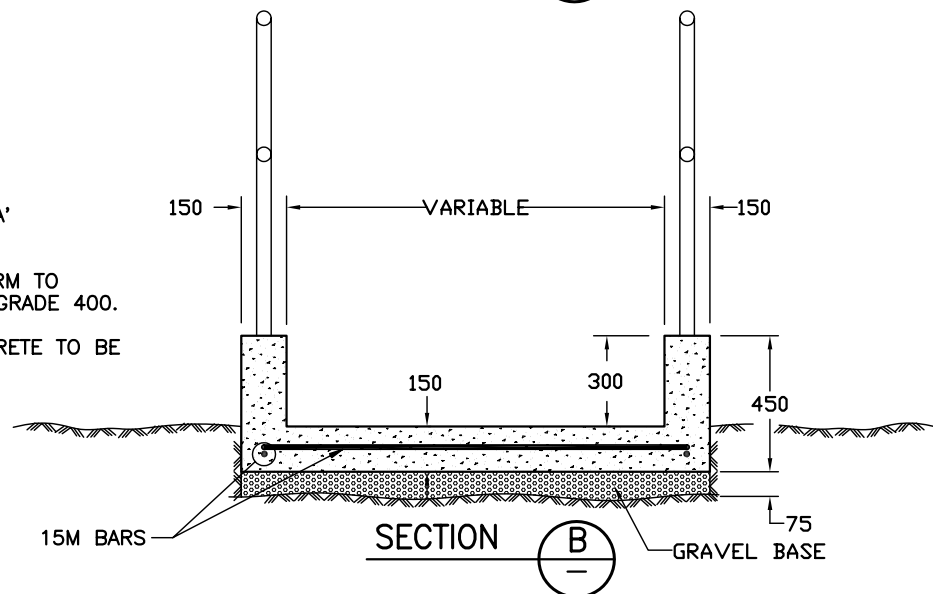




SECTION A

**NOTES:**

1. ALL CONCRETE TO BE CLASS 'A' (SEE SECTION 218).
2. REINFORCING STEEL TO CONFORM TO CSA SPECIFICATION G30.18-M GRADE 400.
3. ALL EXPOSED EDGES OF CONCRETE TO BE ROUNDED TO 13 mm RADIUS.



SECTION B

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 586

### PLANT MIXED PORTLAND CEMENT TREATED BASE COURSE

#### DESCRIPTION

**586.01 Preliminary and General** - This Specification describes the materials, plant equipment and quality of work required for the stabilization of base course material with Portland cement.

**586.02 General Description of Work** - The cement treated base shall consist of prepared aggregate, Portland cement and water uniformly mixed in the proportions directed, in a central mixing plant of satisfactory type, hauled out and laid on the prepared subgrade and compacted to established line and grade.

#### MATERIALS

**586.11 Cement** - Portland cement to be supplied for the work will comply with the requirements and tests of the Canadian Standards Association CAN 3-A5-M86 "Standard Portland Cements" and subsequent revisions thereof.

**586.12 Water** - The water shall be clean and free from substances deleterious to the hardening of the cement stabilized base course and shall be subject to the approval of the Ministry Representative.

**586.13 Aggregate** - The aggregate supplied shall be composed of inert durable material uniform in quality and free from organic impurities and soft or disintegrated particles. When tested according to ASTM C 136, the aggregate shall meet the gradation requirements listed in Table 586-A.

The material shall have a liquid limit not greater than

**TABLE 586-A GRADATION REQUIREMENTS FOR AGGREGATE**

SIEVE SIZE (mm)	PERCENT PASSING BY MASS
25	100
19	80 - 1000
9.5	50 - 100
4.75	35 - 70
2.36	25 - 50
1.18	15 - 35
0.300	5 - 20
0.075	0 - 5

twenty-five and plasticity index not greater than six.

All aggregate shall be stockpiled in horizontal layers not more than 1.0 m in thickness. The stockpile area shall be cleared of all vegetation, trees, brush, rock and other debris and a uniform ground surface prepared before the aggregate is deposited on the site. The material shall be loaded from the stockpile into the plant in such a manner as to ensure that a uniform cut of the pile is obtained. Mixing may not commence until a minimum of 30% of the total quantities of aggregate required is in the stockpile. Subsequent addition of prepared aggregate to the pile shall be so organized to ensure continued uniformity of the aggregate supply to the mixing plant.

#### EQUIPMENT

**586.21 Mixing Plant** - The Portland cement treated base course shall be mixed in a stationary plant employing either continuous or batch type equipment. The plant shall be equipped with interlocked feeding and metering devices which will add the cement, water and aggregates in proportions established by the Ministry Representative to a tolerance of  $\pm 3\%$  by weight. The plant shall be capable of mixing the ingredients uniformly. Suitable storage shall be provided for bulk cement, and if required, bulk mineral filler. The capacity of the mixing plant shall be such that a minimum of 0.4 km of full width cement treated base can be laid per daily shift, i.e., sustained mixing capacity shall normally be not less than 250 tonnes per hour. Details of the plant and its operation shall be submitted to the Ministry Representative for approval prior to the award of the contract.

**586.22 Cement Treated Base Spreader** - The spreading device may be self-propelled, pushed or towed; and shall be so constructed and operated as to produce without segregation or surface tearing, a layer of material which is uniform in thickness and surface contour, either longitudinal or transverse, and free from irregularities in density. Whichever type of spreader may be used, it is mandatory that it be provided with a positive mechanical means for distributing the cement treated base transversely across the front of the cutoff mechanism or screed.

Spreading equipment which rides on the freshly spread material and produces tracks or partially compacted areas behind the cutoff blade will be acceptable provided no displacement of material or filling of the tracks occurs, and provided further that the tracks are not of such depth as to be visible after compaction is completed. The use of a motor grader or any other spreading device, which requires repeated trips over the same area, will not be permitted for spreading.



**586.23 Water Distributors** - Water distributors shall be the pressure type equipped with a spray bar mounting nozzles similar to those used on asphalt distributors and capable of applying the water in accurate quantities and as a uniform spray. Splash plate type distributors or those equipped with spray bars that eject fine streams of water will not be permitted. The distributor must be provided with a satisfactory accurate means of measuring the quantity of water sprayed.

## CONSTRUCTION

**586.31 Mixing** - The mix proportions shall be determined by the Ministry Representative from samples taken at the commencement of aggregate production. The approximate estimated mix proportions of aggregate, cement, filler and water will be indicated in the Special Provisions if adequate advance information is available.

The aggregate, mineral filler and cement shall be fed into the pugmill accurately, according to the proportions required, and shall be thoroughly dry mixed. Water shall then be added in the required amount and mixing continued until uniformity is achieved.

### 586.32 Spreading and Compaction

**586.32.01 Surface** - The surface of the subgrade shall be thoroughly moistened just prior to placing the cement treated base mixture thereon and shall be kept moist but not excessively wet until covered by the mixture.

**586.32.02 Cement Treated Base Mixture** - The cement treated base mixture shall be hauled to the roadbed in trucks equipped with protective covers and shall then be laid through a Titan ABG paver or equivalent in a manner to produce a layer of uniform density and cross-section and in sufficient quantity to provide a compacted base conforming to the grade and cross-section set by the Ministry Representative. End dumping on the roadway followed by spreading will not be permitted. Depositing and spreading the material on the roadway shall progress continuously without breaks, except as otherwise directed by the Ministry Representative. At the end of each day's full width construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face and by installing a temporary wooden header, if required by the Ministry Representative.

**586.32.03 Compaction** - Immediately following spreading, the material shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698.

**586.32.04 Compaction Equipment** - While the Contractor may be given considerable discretion to select the method of compaction to be employed subject to the approval of the Ministry Representative, the compaction equipment to be used may include at least one three-wheeled tandem self-propelled steel wheel roller, able to exert a minimum pressure of 60 kg/cm per cm width of roller and generally meeting the requirements of Subsection 501.36. In addition, the Contractor must be prepared to supply a minimum of one vibratory compaction unit, either steel wheel roller or multiple plate type, if so required by the Ministry Representative. The use of compacting equipment which marks, ruts, cracks or otherwise loosens or damages the surface of the cement treated base will not be permitted. The compacting equipment shall have sufficient capacity to produce the specified degree of compaction within the time limits specified.

Wherever compaction planes are formed in the cement treated base during spreading, shaping or compaction, they shall be removed by scarifying or tilling the surface to such depth as directed by the Ministry Representative and in such a manner as to thoroughly break up the compaction planes. Scarifying and pulverization may be performed by any suitable equipment - nail drag, weeder, disk harrow or rotary tiller that will satisfactorily perform the work required. The scarified material will be regraded and recompacted, to the satisfaction of the Ministry Representative.

**586.32.05 Water** - Water shall be applied at the rates and in the quantities directed by the Ministry Representative. The surface of the uncompacted, partially compacted and completely compacted material shall be kept moist at all times. An adequate water supply shall be maintained at the point of compacting.

**586.32.06 Speed** - The speed of operations shall be such that not more than forty-five minutes shall elapse between the time of starting mixing and the time of starting compaction. Shaping and final compaction shall be completed within two hours of commencement of mixing at the plant.

**586.32.07 Finished Surface** - The finished surface of the compacted base shall at all points be accurate to  $\pm 15$  mm of the grade and shall not, at any point, deviate by more than 10 mm from the bottom of a 3 m straight edge laid in any direction on the surface on either side of the crown of the roadway.

**586.32.08 Temperature** - No construction shall be undertaken when the temperature is below 4.0°C or when the conditions indicate that the temperature will fall below



4.0°C in the next 24 hours or if the subgrade is frozen.

### 586.33 Protection and Cover

**586.33.01 General** - Protection and cover shall be provided by one of the methods, A or B, given below and as directed in the Special Provisions.

a) **Method A - Crushed Gravel Course** - 25 mm crushed gravel shall be laid not more than 24 hours after the treated base is laid. The surface of the treated base and the overlying gravel shall be kept moist by the application of water as directed by the Ministry Representative.

b) **Method B - Bituminous Seal** - As soon as possible after the cement treated base course has been finished, in accordance with preceding subsections, a bituminous seal shall be applied to the surface and sanded to protect the cement treated base course from drying out during the seven day curing period. The finished base course shall be kept continuously moist until the seal has been applied.

The bituminous sealing material shall be applied at a rate between 0.7 to 1.0 /m<sup>2</sup> or as directed by the Ministry Representative in order to give complete surface coverage without excessive runoff.

Generally, this work shall be governed by the applicable provisions of Subsection [501.31](#) "Spray Primer and Tack Coat". At the time of sealing, the surface of the cement treated base must be dense, free from all loose and extraneous material and shall contain sufficient moisture to prevent penetration of the bituminous material. If needed, water shall be applied in sufficient quantity to fill the surface voids of the soil cement immediately before the bituminous material is applied. The seal cover shall be effectively maintained by the Contractor during the seven day curing period.

**586.33.02 Protection** - Any finished portion of the base course adjacent to construction, which is travelled by equipment used in constructing an adjoining section, shall be protected in such a manner as to prevent equipment from marring or damaging the completed work.

**586.33.03 Temperature** - At any time when the air temperature may be expected to fall to the freezing point,

during the day or the night, sufficient above protection shall be given to the cement treated base to prevent its freezing for seven days after placement and until the soil cement has hardened.

**586.34 Maintenance** - The Contractor shall maintain the entire base course in good condition satisfactory to the Ministry Representative from commencement of construction until it has been paved with asphalt concrete. Maintenance shall include immediate repairs to any defects that may occur and shall be repeated at the Contractor's expense as often as may be necessary to keep the section continuously intact.

### MEASUREMENT

**586.81 Cement Treated Base** - Cement treated base in place will be measured by the TONNE for the total mass actually accepted and incorporated in the base of the road.

**586.82 Water** - Water applied to the road will be measured by the THOUSAND LITRES for the actual quantity applied to the road.

### PAYMENT

**586.91 Cement Treated Base** - Payment for CEMENT TREATED BASE will be at the Contract Unit Price per tonne for the total mass actually accepted and incorporated in the base of the road. Payment shall provide full compensation for production of aggregate; handling, hauling and storage of bulk cement and filler; provision of mixing water and plant mixing of cement treated base; haulage, spreading, grading and compaction of the base material in place; and for all labour, equipment, plant, tools, superintendence, traffic control and all other incidentals necessary to complete the work in accordance with the specifications.

**586.92 Water** - Payment for WATER will be at the Contract Unit Price per thousand litres for the actual quantity applied to the road, as directed, and shall be full compensation for furnishing all labour, materials, tools and equipment required, and doing all the work incidental to furnishing, hauling and applying water to the road as specified.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**





# STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

2004

**EFFECTIVE  
JANUARY 1, 2004**

Construction Engineering Section  
Construction and Maintenance Branch  
Ministry of Transportation



**Canadian Cataloguing in Publication Data**

British Columbia. Ministry of Transportation and  
Highways.

Standard specifications for highway construction  
effective February 1,...-- 1991 -

Annual.

ISSN 1188-0120 = Standard specifications for  
highway construction (Victoria)

1. Roads - Specifications - British Columbia. I.  
Title.

TE27.B7B74

625.7

C91-092305-1



# NOTICE TO USERS

## SECTIONS 100 to 599 - VOLUME ONE

## SECTIONS 600 to 999 - VOLUME TWO

All text changed or added since the 2003 edition is shown with double underlining and vertical bar in the margin.

New or completely revised sections are noted in the footer (no double underlining or vertical bar).

### To obtain the Standard Specifications for Highway Construction Volume - 1 & 2 - 2004

- Order online at **www.publications.gov.bc.ca**, click on browse the index and in the “keywords” field type in 7680001898, the Queen’s Printer stock number, select the item and click the “add to shopping cart” button. You will require a Visa or MasterCard to process this order. (Visa and/or MasterCard information is stored on our secure server)
- Mail in a Company Cheque, Money Order or Certified Cheque payable to the Minister of Finance to:  

Queen’s Printer,  
Government Publication Services,  
Box 9452, Stn Prov Govt  
Victoria BC V8W 9V7
- Phone toll free 1 800 663-6105 or locally in Victoria at 387-6409, with your Visa or MasterCard Number and we will place the order for you.

To view the electronic version of these specifications go to:

[www.th.gov.bc.ca/Publications/const\\_maint/contract\\_serv/standardspecs.htm](http://www.th.gov.bc.ca/Publications/const_maint/contract_serv/standardspecs.htm)

For technical content please contact:

Senior Specifications and Construction Technician  
Construction and Maintenance Branch  
Ministry of Transportation  
940 Blanshard Street Level 4C  
PO Box 9850 STN PROV GOVT  
Victoria BC V8W 9T5

Telephone: (250) 356-5540  
Facsimile: (250) 356-7276



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



# SECTION TITLES

## VOLUME ONE CONTAINS THE FOLLOWING SECTIONS:

[SECTION 107](#) - GLOSSARY OF TERMS

[SECTION 108](#) – SAMPLE FORMS

[SECTION 115](#) - MAJOR WORKS CONSTRUCTION AGREEMENT – GENERAL CONDITIONS

[SECTION 117](#) - MINOR WORKS CONSTRUCTION AGREEMENT – GENERAL CONDITIONS

[SECTION 125](#) - VALUE ENGINEERING - PROPOSAL GUIDELINES

[SECTION 135](#) – CONSTRUCTION SITE SAFETY

[SECTION 145](#) – GENERAL REQUIREMENTS FOR HIGHWAY, BRIDGE AND MARINE  
CONSTRUCTION

[SECTION 165](#) - PROTECTION OF THE ENVIRONMENT

[SECTION 194](#) - TRAFFIC MANAGEMENT FOR WORK ZONES

[SECTION 200](#) - CLEARING AND GRUBBING

[SECTION 201](#) - ROADWAY AND DRAINAGE EXCAVATION

[SECTION 202](#) - GRANULAR SURFACING, BASE AND SUB-BASES

[SECTION 204](#) - ROCK CUTS

[SECTION 205](#) - RIPRAP

[SECTION 206](#) - ROCK BOLTS

[SECTION 207](#) - SLOPE MESH FOR ROCK CUTS

[SECTION 208](#) - DRAINS FOR ROCK CUTS

[SECTION 209](#) - SHOTCRETE FOR ROCK CUTS

[SECTION 211](#) - PORTLAND CEMENT CONCRETE

[SECTION 213](#) - TIMBER BRIDGES - CONSTRUCTION

[SECTION 214](#) - TIMBER PILING CONSTRUCTION

[SECTION 215](#) - BRIDGES

[SECTION 216](#) - PAINTING OF STEEL STRUCTURES

[SECTION 218](#) - CONCRETE FOR MINOR WORKS

[SECTION 232](#) - METAL BIN-WALL

[SECTION 303](#) - CULVERTS

[SECTION 308](#) - COATING SYSTEMS

[SECTION 312](#) - STEEL TRAFFIC BARRIERS AND WOOD POSTS

[SECTION 316](#) - STEEL AND WIRE FENCE MATERIALS

[SECTION 317](#) - P.E. PLASTIC DRAINAGE PIPE

[SECTION 318](#) - PVC PLASTIC DRAINAGE PIPE

[SECTION 320](#) - CORRUGATED STEEL PIPE

[SECTION 321](#) - TRAFFIC PAINT

[SECTION 407](#) - FOUNDATION EXCAVATION

[SECTION 412](#) - REINFORCING STEEL



- SECTION 413 - BRIDGE DECKS AND HIGH-DENSITY CONCRETE OVERLAYS
- SECTION 415 – MANUFACTURE AND ERECTION OF PRECAST AND PRESTRESSED CONCRETE MEMBERS
- SECTION 416 – MANUFACTURE AND INSTALLATION OF POST-TENSIONED CONCRETE MEMBERS
- SECTION 418 - CONCRETE BRIDGE DECK SEALANTS - SILANE SURFACE TREATMENT OF NEW PORTLAND CEMENT CONCRETE
- SECTION 419 - CONCRETE BRIDGE DECK WATERPROOFING SYSTEM - PREFABRICATED MEMBRANE
- SECTION 421 - STRUCTURAL STEELWORK
- SECTION 422 - MISCELLANEOUS STEELWORK
- SECTION 501 - HOT MIXED ASPHALT PAVEMENT
- SECTION 502 – END PRODUCT SPECIFICATION FOR ASPHALT PAVEMENT CONSTRUCTION - NEW
- SECTION 503 - BASE PREPARATION AND BASE PROCESSING
- SECTION 504 - PAVEMENT DRAINAGE
- SECTION 507 - PRODUCTION AND STOCKPILING OF ASPHALT MIX
- SECTION 508 – END PRODUCT SPECIFICATION FOR GRADED AGGREGATE SEAL COAT - NEW
- SECTION 511 - COLD MILLING
- SECTION 514 - HOT IN-PLACE RECYCLE
- SECTION 515 – END PRODUCT SPECIFICATION FOR HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT - NEW
- SECTION 521 - ASPHALT STABILIZED BASE COURSE MIXED IN PLACE
- SECTION 531 - ASPHALT SURFACE TREATMENTS
- SECTION 536 - PAVEMENT CRACK SEALING
- SECTION 541 - RUBBLE MASONRY
- SECTION 582 - CONCRETE CURB AND GUTTER AND STORM DRAINAGE
- SECTION 586 - PLANT MIXED PORTLAND CEMENT TREATED BASE COURSE



# SECTION TITLES

## VOLUME TWO CONTAINS THE FOLLOWING SECTIONS:

SECTION 604 - STEEL TRAFFIC BARRIER CONSTRUCTION  
SECTION 635 - ELECTRICAL AND SIGNING  
SECTION 741 – FENCE CONSTRUCTION  
SECTION 751 - TOPSOIL AND LANDSCAPE GRADING  
SECTION 754 - PLANTING OF TREES, SHRUBS, AND GROUND COVERS  
SECTION 757 – REVEGETATION SEEDING  
SECTION 766 - IRRIGATION  
SECTION 769 - PROTECTION AND RETENTION OF VEGETATION  
SECTION 903 - TIMBER - MATERIALS  
SECTION 904 - TIMBER (TREATED AND UNTREATED) - FABRICATION AND HANDLING  
SECTION 905 - TIMBER - GLUED LAMINATED  
SECTION 906 - ROUND TIMBER PILES  
SECTION 908 - PRESERVATIVE TREATMENT - WOOD PRODUCTS  
SECTION 909 - TREATED WOOD FENCE POSTS  
SECTION 913 - REINFORCEMENT FOR CONCRETE  
SECTION 917 - WIRE ROPE  
SECTION 931 - PORTLAND CEMENT  
SECTION 933 - ADMIXTURES FOR PORTLAND CEMENT CONCRETE  
SECTION 941 – PRECAST REINFORCED CONCRETE BARRIERS  
SECTION 951 - ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE  
SECTION 952 – CONTRACTOR SUPPLY ASPHALT AND PAVING MATERIALS FOR  
HIGHWAY USE  
SECTION 971 - PLASTIC TRAFFIC CONES  
SECTION 991 - CALCIUM CHLORIDE AND SODIUM CHLORIDE



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



# TABLE OF CONTENTS

VOLUME TWO

NOTE: \* = CHANGED OR ADDED

## SECTION 604 - STEEL TRAFFIC BARRIER CONSTRUCTION

604.01 Scope .....	604-1
604.02 Provision of Steel Barriers .....	604-1
604.03 Materials .....	604-1
604.04 Post Installation .....	604-1
604.05 Steel Beam Erection .....	604-2
604.06 End Assemblies .....	604-2
604.07 Measurement and Payment .....	604-3

## SECTION 635 - ELECTRICAL AND SIGNING

PART A - GENERAL .....	635-1
* 635.01 Scope .....	635-1
* 635.02 Work Regulations .....	635-1
* 635.03 Electrical Permits & Inspections .....	635-1
635.04 Electrical Energy Supply .....	635-1
* 635.05 Materials .....	635-1
* 635.06 Utilities .....	635-2
PART B - UNDERGROUND .....	635-2
* 635.07 Concrete Bases .....	635-2
* 635.08 Junction Boxes and Vaults .....	635-3
635.09 Conduits .....	635-5
635.10 Trenching and Backfilling for Conduit .....	635-5
* 635.11 Trenchless Conduit Installation .....	635-6
* 635.12 Asphalt Pavement.....	635-6
* 635.13 Concrete Curbs and Sidewalks .....	635-7
* 635.14 25 mm Well Graded Base Course Aggregate.....	635-7
* 635.15 Removal of Rejected Excavated Material .....	635-8
635.16 Restoration .....	635-8
PART C - ELECTRICAL .....	635-8
* 635.17 Luminaire, Signal and Sign Poles.....	635-8
635.18 Service Equipment .....	635-9
* 635.19 Wiring.....	635-10
* 635.20 Traffic Counter Stations .....	635-10
* 635.21 Controllers.....	635-11
* 635.22 Detector Loops .....	635-11
635.23 Repairing Galvanized Surfaces .....	635-11
635.24 Flasher Luminaires .....	635-11
PART D - SIGNING .....	635-12
* 635.25 Overhead Signs .....	635-12
* 635.26 Breakaway Sign Structures .....	635-12
* 635.27 Wood Post Sign Structures .....	635-13
635.28 Perforated Square Steel Sign Post Structures.....	635-14
* 635.29 Round Steel Sign Post Structures.....	635-14
* 635.30 Sign Mounting on the Side of Poles.....	635-15
635.31 Delineators .....	635-15
* 635.32 Signs .....	635-15



**SECTION 741 - FENCE CONSTRUCTION**

DESCRIPTION	
741.01 Scope.....	741-1
MATERIALS	
741.11 General.....	741-1
741.12 Standard Wire Type A, B & C Fences and Gates.....	741-1
741.13 High-tensile Smooth-wire Fences.....	741-1
741.14 Chain Link Type D Fences and Gates .....	741-1
741.15 Wood Fences .....	741-1
CONSTRUCTION	
741.31 Provision of Fencing.....	741-2
741.32 Clearing & Grading .....	741-2
741.33 Setting Out and Connections to Existing.....	741-2
741.34 Standard Wire Type A, B & C Fences and Gates.....	741-2
741.35 High-tensile Smooth-wire Fences.....	741-4
741.36 Chain Link Type D Fences and Gates .....	741-4
741.37 Wood Fences .....	741-5
MEASUREMENT	
741.81 Fencing .....	741-6
741.82 Gates and Cattleguards .....	741-6
PAYMENT	
741.91 Fencing .....	741-6
741.92 Gates and Cattleguards .....	741-6

**SECTION 751 - TOPSOIL AND LANDSCAPE GRADING**

DESCRIPTION	
751.01 Scope.....	751-1
751.02 Related Work.....	751-1
751.03 References.....	751-1
751.04 Topsoil Supplied by the Contractor.....	751-1
MATERIALS	
751.11 General.....	751-1
751.12 Topsoil Types .....	751-1
751.13 On-Site Topsoil.....	751-1
751.14 Imported Topsoil .....	751-1
751.15 Manufactured Topsoil.....	751-1
751.16 Requirements For Topsoil .....	751-1
751.17 Soil Amendments.....	751-2
751.18 Fertilizers .....	751-3
751.19 Fill Material .....	751-3
CONSTRUCTION	
751.31 Area Preparation .....	751-3
751.32 Placing Topsoil .....	751-4
751.33 Applying Fertilizers .....	751-4
751.34 Finish Grading .....	751-4
MEASUREMENT	
751.81 General.....	751-4
PAYMENT	
751.91 General.....	751-4



**SECTION 754 - PLANTING OF TREES, SHRUBS, AND GROUND COVERS**

DESCRIPTION	
754.01 Scope .....	754-1
754.02 Related Work .....	754-1
754.03 References .....	754-1
754.04 Guarantee/Maintenance .....	754-1
MATERIALS	
754.11 Source Quality Control .....	754-1
754.12 Transporting Plants to Site .....	754-1
754.13 Unloading and Handling Procedures .....	754-2
754.14 Storage .....	754-2
754.15 Plant Material .....	754-2
754.16 Water .....	754-3
754.17 Fertilizer .....	754-3
754.18 Bark Mulch .....	754-3
754.19 Backfill Topsoil .....	754-3
754.20 Other Materials .....	754-3
CONSTRUCTION	
754.31 Scheduling .....	754-3
754.32 Preplanting Operations .....	754-4
754.33 Location of Planting .....	754-4
754.34 Area Preparation .....	754-4
754.35 Time of Planting .....	754-4
754.36 Planting Procedures - Trees and Shrubs .....	754-4
754.37 Seeding .....	754-5
754.38 Sodding .....	754-5
754.39 Watering .....	754-6
754.40 Pruning .....	754-6
754.41 Mulching .....	754-6
754.42 Clean-up .....	754-6
754.43 Conditions for Acceptance .....	754-6
MAINTENANCE	
754.71 Maintenance .....	754-6
MEASUREMENT	
754.81 Planting .....	754-7
754.82 Seeding and Sodding .....	754-7
754.83 Mulch .....	754-7
PAYMENT	
754.91 General .....	754-7

**SECTION 757 - REVEGETATION SEEDING**

DESCRIPTION	
757.01 Scope .....	757-1
757.02 References .....	757-1
MATERIALS	
757.11 Handling and Storage .....	757-1
757.12 Seed .....	757-1
757.13 Fertilizer .....	757-1



757.14 Hydraulic Mulch .....	757-1
757.15 Water .....	757-1
757.16 Other Materials .....	757-1
EQUIPMENT	
757.21 General .....	757-2
757.22 Hydraulic Seeding/Mulching Equipment .....	757-2
CONSTRUCTION	
757.31 Scheduling .....	757-2
757.32 Protection .....	757-2
757.33 Timing of Material Application .....	757-2
757.34 Methods .....	757-2
757.35 Rates of Application .....	757-2
757.36 Record of Application .....	757-2
757.37 Application Method for Mechanical Drop or Broadcast Dry Seeding .....	757-2
757.38 Hydraulic Application of Materials .....	757-2
757.39 Related Work .....	757-3
757.40 Clean-up .....	757-3
757.41 Conditions for Acceptance .....	757-3
757.42 Repairs .....	757-3
MEASUREMENT	
757.81 General .....	757-3
PAYMENT	
757.91 General .....	757-3

## SECTION 766 - IRRIGATION

DESCRIPTION	
766.01 Scope .....	766-1
766.02 Site Security .....	766-1
766.03 Electrical Trades .....	766-1
766.04 Drawings and Instructions .....	766-1
766.05 References - Codes & Standards .....	766-1
MATERIALS	
766.11 General .....	766-1
766.12 Pipes and Fittings .....	766-1
766.13 Cement .....	766-2
766.14 Sprinkler Heads .....	766-2
766.15 Valves .....	766-2
766.16 Controllers .....	766-2
766.17 Wiring .....	766-2
766.18 Selected Native Fill .....	766-2
CONSTRUCTION	
766.31 General - Damaged Material .....	766-2
766.32 Line Location .....	766-2
766.33 Compaction .....	766-2
766.34 Excavation .....	766-2
766.35 Laying the Pipe .....	766-2
766.36 Connections .....	766-3
766.37 Inspection and Testing .....	766-3
766.38 Backfill .....	766-3



766.39	Controller Installation .....	766-3
766.40	Adjustments.....	766-3
766.41	Surplus Material .....	766-3
766.42	Conditions for Acceptance .....	766-3
766.43	General .....	766-3
	PAYMENT	
766.91	General .....	766-3

## **SECTION 769 - PROTECTION AND RETENTION OF VEGETATION**

	DESCRIPTION	
769.01	Scope .....	769-1
769.02	Related Work.....	769-1
769.03	Definitions.....	769-1
	MATERIALS	
769.11	Water .....	769-1
769.12	Fertilizer .....	769-1
	CONSTRUCTION	
769.31	Operational Constraints.....	769-1
769.32	Clearing and Grubbing.....	769-1
769.33	Barriers for Existing Vegetation Protection .....	769-1
769.34	Pruning and Repair of Specimen Trees.....	769-2
	MAINTENANCE	
769.71	Watering .....	769-2
769.72	Fertilizing .....	769-2
	MEASUREMENT	
769.81	General .....	769-2
	PAYMENT	
769.91	General .....	769-2

## **SECTION 903 - TIMBER - MATERIALS**

903.01	General .....	903-1
903.02	Species and Grade .....	903-1
903.03	Inspection .....	903-1

## **SECTION 904**

### **TIMBER (TREATED AND UNTREATED) - FABRICATION AND HANDLING**

904.01	General .....	904-1
904.02	Framing .....	904-1
904.03	Bridge Iron .....	904-1
904.04	Handling of Untreated Timber .....	904-1
904.05	Preparation of Timber Before Treatment .....	904-1
904.06	Condition After Treatment .....	904-1
904.07	Handling of Treated Timber.....	904-1



**SECTION 905 - TIMBER - GLUED LAMINATED**

905.01	General.....	905-1
905.02	Classification .....	905-1
905.03	Quality Control .....	905-1
905.04	Incising .....	905-1
905.05	Handling of Treated Glued Laminated Members .....	905-1
905.06	Storage of Glued Laminated Members .....	905-1
905.07	Inspection.....	905-1

**SECTION 906 - ROUND TIMBER PILES**

906.01	Scope.....	906-1
906.02	Species .....	906-1
906.03	Size .....	906-1
906.04	Diameter .....	906-1
906.05	Length.....	906-1
906.06	General Material Requirements .....	906-2
906.07	Prohibited Defects .....	906-2
906.08	Permitted Defects.....	906-2
906.09	Limited Defects.....	906-2
906.10	Manufacturing Requirements .....	906-3
906.11	Storage .....	906-3
906.12	Handling .....	906-3
906.13	Inspection.....	906-3

**SECTION 908 - PRESERVATIVE TREATMENT - WOOD PRODUCTS**

908.01	Materials .....	908-1
908.02	Treatment.....	908-1
908.03	Inspection.....	908-2

**SECTION 909 - TREATED WOOD FENCE POSTS**

909.01	General.....	909-1
909.02	Species .....	909-1
909.03	Size and Measurement .....	909-1
909.04	Prohibited Defects .....	909-1
909.05	Limited Defects.....	909-1
909.06	Manufacturing Requirements - Round Fence Posts and Braces .....	909-2
909.07	Sawn Lumber Posts and Braces.....	909-2
909.08	Fence Droppers .....	909-2
909.09	Pressure Treatment .....	909-2
909.10	Inspection.....	909-3

**SECTION 913 - REINFORCEMENT FOR CONCRETE**

913.01	Requirements .....	913-1
--------	--------------------	-------



**SECTION 917 - WIRE ROPE**

917.01 Wire Rope .....	917-1
------------------------	-------

**SECTION 931 - PORTLAND CEMENT**

931.01 General .....	931-1
----------------------	-------

**SECTION 933 - ADMIXTURES FOR PORTLAND CEMENT CONCRETE**

933.01 Scope .....	933-1
933.02 Air-Entraining and Chemical Admixtures.....	933-1
933.03 Pozzolan Admixtures .....	933-1

**SECTION 941 - PRECAST REINFORCED CONCRETE BARRIERS**

941.01 Scope .....	941-1
941.02 Concrete Quality .....	941-1
941.03 Reinforcing Steel, Attachment Hardware & Miscellaneous Items.....	941-1
941.04 Optional Features .....	941-1
941.05 Placing and Finishing of Concrete .....	941-1
941.06 Tolerances .....	941-2
941.07 Procedure for Manufacture.....	941-2
941.08 Handling.....	941-2
941.09 Payment.....	941-2

**SECTION 951 - ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE**

951.01 Scope .....	951-1
951.02 Quality Control Requirements.....	951-1
951.03 Sampling and Testing.....	951-1
951.04 Storage and Handling.....	951-2
951.05 Ordering and Accounting for Materials .....	951-2
951.06 Delivery of Asphalt and Paving Material.....	951-2
951.07 Asphalt Cement .....	951-3
951.08 Cutback Asphalts.....	951-4
951.09 - 951.15 Not Used .....	951-4
951.16 Asphalt Emulsions.....	951-4
951.17 Anionic Type Emulsion for Road Purposes .....	951-4
951.18 Cationic Type Emulsions for Road Purposes.....	951-5
951.19 High Float Emulsified Asphalt.....	951-5
951.20 Tall Oil Pitch .....	951-5
951.21 Emulsified Products .....	951-6



### **SECTION 952 – CONTRACTOR SUPPLY ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE**

952.01 Scope.....	952-1
952.02 Quality Control Requirements.....	952-1
952.03 Sampling and Testing .....	952-1
952.04 Delivery of Asphalt and Paving Materials.....	952-1
952.05 Asphalt Cement.....	952-2
952.06 Cutback Asphalts .....	952-2
952.07 Asphalt Emulsions .....	952-2
952.08 Anionic Type Emulsions for Road Purposes .....	952-3
952.09 Cationic Type Emulsions for Road Purposes .....	952-3
952.10 High Float Emulsified Asphalt .....	952-3
952.11 Tall Oil Pitch (TOP) .....	952-3
952.12 Emulsified Products .....	952-4

### **SECTION 971 - PLASTIC TRAFFIC CONES**

971.01 Scope.....	971-1
971.02 Classification .....	971-1
971.03 General Requirements.....	971-1
971.04 Dimensions .....	971-1
971.05 Mass.....	971-1
971.06 Tensile Properties .....	971-1
971.07 Colour .....	971-2
971.08 Resistance to Colour Change.....	971-2
971.09 Specular Gloss .....	971-2
971.10 Recovery after Bending .....	971-2
971.11 High Temperature Requirement .....	971-2
971.12 Resistance to Flexing.....	971-2
971.13 Cold Temperature Requirement.....	971-2
971.14 Blowover Resistance.....	971-2
971.15 Stacking Qualities .....	971-2
971.16 Marking.....	971-2
971.17 Bid Samples .....	971-2
971.18 Inspection.....	971-2

### **SECTION 991 - CALCIUM CHLORIDE AND SODIUM CHLORIDE**

991.01 Calcium Chloride.....	991-1
991.02 Sodium Chloride.....	991-1
991.03 Chemical Contamination of Road Salt .....	991-1



## Part B - Underground

- \* SP635-1.1.1 Concrete Base Index
- SP635-1.1.2 Types A and B Concrete Bases (Precast or Poured in Place)
- SP635-1.1.3 Type C Concrete Base (Precast or Poured in Place)
- SP635-1.1.4 Type D1 and E1 Concrete Spread Footings (Poured in Place or Precast)
- SP635-1.1.5 Type D1 and E1 Concrete Spread Footings (Poured in Place or Precast)
- SP635-1.1.6 Type D1 and E1 Concrete Spread Footings (Poured in Place or Precast)
- SP635-1.1.7 Types D2 and E2 Concrete Bases (Precast)
- SP635-1.1.8 Type D2 and E2 Concrete Bases (Precast)
- SP635-1.1.9 Type D3 and E3 Concrete Bases (Poured in Place)
- SP635-1.1.10 Type D3 and E3 Concrete Bases (Poured in Place)
- \* SP635-1.1.11 Type F1 and L1 Concrete Spread Footings (Poured in Place)
- \* SP635-1.1.12 Type F1 and L1 Concrete Spread Footings (Poured in Place)
- \* SP635-1.1.13 Type F1 and L1 Concrete Spread Footings (Poured in Place)
- \* SP635-1.1.14 Type F2 and L2 Concrete Bases (Precast)
- \* SP635-1.1.15 Type F2 and L2 Concrete Bases (Precast)
- \* SP635-1.1.16 Type F3 and L3 Concrete Bases (Poured in Place)
- \* SP635-1.1.17 Type F3 and L3 Concrete Bases (Poured in Place)
- \* SP635-1.1.18 Anchor Bolt Cage for Type 6 and 7 Shafts
- \* SP635-1.1.19 Anchor Bolt Cage for Type L Poles
- SP635-1.1.20 Type M1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.21 Type M1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.22 Type M1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.23 Type M2 Concrete Base (Poured in Place)
- SP635-1.1.24 Type M2 Concrete Base (Precast or Poured in Place)
- \* SP635-1.1.25 Anchor Bolt Cage for Type M Poles
- SP635-1.1.26 Type H1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.27 Type H1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.28 Type H1 Concrete Spread Footing (Poured in Place)
- SP635-1.1.29 Type H2 Concrete Base (Precast or Poured in Place)
- SP635-1.1.30 Type H2 Concrete Base (Poured in Place)
- \* SP635-1.1.31 Anchor Bolt Cage for Type H Poles
- SP635-1.1.32 Concrete Spread Footing for Breakaway Sign Structure (Poured in Place)
- SP635-1.1.33 Concrete Spread Footing for Breakaway Sign Structure (Poured in Place)
- SP635-1.1.34 Concrete Spread Footing for Breakaway Sign Structure (Poured in Place)
- SP635-1.1.35 Concrete Bases for Perforated Square Steel Sign Posts (Precast or Poured in Place)
- SP635-1.1.36 Concrete Base for Round Steel Sign Posts (Precast or Poured in Place)
- SP635-1.1.37 Post Mounted Flasher Concrete Base (Precast or Poured in Place)
- SP635-1.1.38 Concrete Controller Base Details (Precast)
- SP635-1.1.39 Concrete Controller Base Rebar Details (Precast)
- SP635-1.1.40 Controller Base Installation Details (for Type M Cabinet)
- SP635-1.1.41 Controller Base Installation Details (for Type S Cabinet)
- \* SP635-1.1.42 Anchor Bolt Repair Procedures
- \* SP635-1.1.43 Anchor Bolt Repair Procedures
- SP635-1.2.1 Type 6 Rectangular Plastic Junction Box Installation Details
- SP635-1.2.2 Type 6 'Special' Rectangular Plastic Junction Box Installation Details
- SP635-1.2.3 Type 7 Rectangular Plastic Junction Box Installation Details
- SP635-1.2.4 Type 8 Rectangular Plastic Junction Box Installation Details
- SP635-1.2.5 Type 9 Rectangular Plastic Junction Box Installation Details
- SP635-1.2.6 Rectangular Plastic Junction Box Details
- SP635-1.2.7 Type 10 Round Plastic Junction Box Installation Details



- \* SP635-1.2.8 Type 11 Round Plastic Junction Box Installation Details
- SP635-1.2.9 Type 12 Round Plastic Junction Box Installation Details
- SP635-1.2.10 Type 13 Round Plastic Junction Box Installation Details
- SP635-1.2.11 Round Plastic Junction Box Details
- SP635-1.2.12 Rectangular to Round Plastic Junction Box Installation Details
- SP635-1.2.13 Rectangular to Round Plastic Junction Box Adaptor Details
- SP635-1.2.14 Type 14 Small Round Plastic Junction Box Installation Details
- SP635-1.2.15 Small Round Plastic Junction Box Details
- SP635-1.2.16 Conduit Entry into Plastic Junction Boxes
- \* SP635-1.3.1 Concrete Junction Box Details
- \* SP635-1.3.2 Concrete Junction Box Details
- SP635-1.3.3 Small Concrete Vault Details (1020 Square x 1015 Deep)
- SP635-1.3.4 Conduit Entry into Concrete Vault or Junction Box
- SP635-1.4.1 Luminaire Pole Base and Junction Box Installation Detail for Standard Roadway
- SP635-1.4.2 Luminaire Pole Base and Junction Box Installation Detail for Asphalt Curb
- SP635-1.4.3 Luminaire Pole Base and Junction Box Installation Detail for Sidewalk
- \* SP635-1.4.4 Backfill Requirements for Type A, B, C, D2, D3, E2, E3, F2, F3, L2, L3, M2 & H2 Concrete Bases
- \* SP635-1.4.5 Backfill Requirements for Type D1, E1, F1, L1, M1 and H1 Concrete Spread Footings
- SP635-1.5.1 Conduit Installation in Paved Areas
- SP635-1.5.2 Conduit Installation in Non-Paved Areas
- SP635-1.6.1 Loop Conduit Installation Details at Concrete Curb
- SP635-1.6.2 Loop Conduit Installation Details in Gravel Shoulder
- SP635-1.7.1 Conduit Tie-in to Telephone Vault, Manhole or Junction Box
- Part C - Electrical**
- \* SP635-2.1.1 Type 1 Shaft Installation Details (Signal Pole)
- SP635-2.1.2 Type 1 Shaft Installation Details (Signal Pole)
- SP635-2.1.3 Type 2 Shaft Installation Details (7.5 m, 9.0 m and 11.0 m Luminaire Poles)
- SP635-2.1.4 Type 2 Shaft Installation Details (7.5 m, 9.0 m and 11.0 m Luminaire Poles)
- SP635-2.1.5 Type 2 Shaft Installation Details (13.5 m Luminaire Pole)
- SP635-2.1.6 Type 2 Shaft Installation Details (13.5 m Luminaire Pole)
- \* SP635-2.1.7 Type 3 Shaft Installation Details (Signal Pole)
- SP635-2.1.8 Type 3 Shaft Installation Details (Signal Pole)
- \* SP635-2.1.9 Type 4, 4A and 5 Shaft Installation Details
- SP635-2.1.10 Type 4, 4A and 5 Shaft Installation Details (Signal Posts)
- \* SP635-2.1.11 Type 6 Shaft Installation Details (Signal Pole)
- SP635-2.1.12 Type 6 Shaft Installation Details (Signal Pole)
- \* SP635-2.1.13 Type 7 Shaft Installation Details (Signal Pole)
- \* SP635-2.1.14 Type 7 Shaft Installation Details (Signal Pole)
- SP635-2.1.15 Aluminum Frangible Base for 9.0 m and 11.0 m Luminaire Poles
- SP635-2.1.16 Breakaway Base for 13.5 m Luminaire Poles
- \* SP635-2.2.1 Type L Signal Pole Installation Details
- SP635-2.2.2 Type L Signal Pole Installation Details
- SP635-2.2.3 Type L Signal Pole Installation Details
- \* SP635-2.2.4 Type M Signal Pole Installation Details
- SP635-2.2.5 Type M Signal Pole Installation Details
- SP635-2.2.6 Type M Signal Pole Installation Details
- SP635-2.2.7 Type S Signal Pole Installation Details
- SP635-2.2.8 Type S Signal Pole Installation Details
- SP635-2.2.9 Type S Signal Pole Installation Details
- SP635-2.2.10 Signal Pole Accessories



SP635-2.3.1	Signal and Pedestrian Head Side Mount Installation Details
* SP635-2.3.2	Overhead Spring Cushion End Signal Head Hanger Installation Details
* SP635-2.3.3	Overhead Spring Cushion Mid Hanger Signal Head Installation Details
* SP635-2.3.4	Signal Head Plumbizer Installation Details
* SP635-2.3.5	Signal Head Adjustable Bracket Details
* SP635-2.3.6	Four-way Overhead Flashing Signal Head Installation Details
* SP635-2.3.7	Pedestrian Pushbutton Installation Details
* SP635-2.3.8	Audible Signal Installation Details
* SP635-2.3.9	Fire Signal Indication Light Installation Detail
<u>SP635-2.3.10</u>	<u>Signal Head Plumbizer Installation Details (For Type 3 Signal Arms)</u>
<u>SP635-2.3.11</u>	<u>Signal Head Aiming Program</u>
<u>SP635-2.3.12</u>	<u>Video Detection Installation Detail On Special 2A Arm</u>
<u>SP635-2.3.13</u>	<u>Video Detection Installation Detail On Signal Arm</u>
SP635-2.4.1	100A - Overhead Drop Service Installation Details
SP635-2.4.2	100A - Service Panel Installation Details for Overhead Drop Service
SP635-2.4.3	100A - Underground Dip Service Installation Details
SP635-2.4.4	100A - Distribution Panel Installation Details for Underground Dip Service
SP635-2.4.5	Underground Dip Service Installation Details
SP635-2.4.6	100A - Service Disconnect Panel Installation Details
SP635-2.4.7	30A-120/240V Overhead Drop Service Installation Details
SP635-2.4.8	30A-120/240V Service Panel Installation Details for Overhead Drop Service
SP635-2.4.9	Telephone Overhead Drop Service Installation Details
SP635-2.4.10	Telephone Underground Service Installation Details
SP635-2.4.11	Telephone Demarcation Panel Installation Details
SP635-2.4.12	Telephone Conduit Installation Details (Wood Pole)
* SP635-2.4.13	Service Panel Bushing Detail
* SP635-2.4.14	Ground Plate Installation Detail
SP635-2.4.15	Insulating Clevis Installation Details
SP635-2.4.16	Service Panel Working Pad Detail
SP635-2.5.1	Wiring Inside Types 6 to 9 Rectangular Plastic Junction Boxes
SP635-2.5.2	Wiring Inside Types 10 to 14 Round Plastic Junction Boxes
SP635-2.5.3	Wiring Inside Concrete Junction Box
SP635-2.5.4	Wiring Inside Concrete Vaults
SP635-2.5.5	Wiring Inside Concrete Vaults
SP635-2.5.6	Luminaire Wiring in Pole Handhole
SP635-2.5.7	Single Conductor Colour Coding
SP635-2.5.8	Single Conductor Colour Coding
<u>SP635-2.5.9</u>	<u>Signal Cable Wiring &amp; Colour Coding</u>
<u>SP635-2.5.10</u>	<u>Signal Cable Wiring In Pole Handhole</u>
SP635-2.6.1	Short Duration Traffic Count Station Installation Details
SP635-2.6.2	Permanent Traffic Count Station Installation Details
SP635-2.6.3	Site Plan and Loop Layout for Permanent Traffic Count Stations
* SP635-2.6.4	Ground Plate Installation Detail for Permanent Count Stations
SP635-2.7.1	Type M Controller Cabinet Installation Details
SP635-2.7.2	Type S Controller Cabinet Installation Details
* SP635-2.7.3	Types B, C and G Controller Cabinet Installation Details
SP635-2.8.1	Detector Loop Installation Details
SP635-2.8.2	Diamond Detector Loop Installation Details
* SP635-2.8.3	Round Detector Loop Installation Details
SP635-2.8.4	Rectangular Detector Loop Installation Details
SP635-2.8.5	Loop and Home Run Slot Details



SP635-2.8.6	Detector Loop Colour Coding
SP635-2.8.7	Detector Loop to Shielded Cable Splicing Details
* SP635-2.8.8	Detector Loop Installation Procedures and Rules
* SP635-2.8.9	Detector Loop Installation Procedures and Rules
SP635-2.8.10	Loop Check Sheet
SP635-2.8.11	Layout for Diamond or Round Traffic Signal Detector Loops
SP635-2.8.12	Layout for Diamond or Round Counting Detector Loop
SP635-2.8.13	Layout for Diamond or Round Counting Detector Loop
SP635-2.8.14	Layout for Rectangular Counting Detector Loops
SP635-2.8.15	Pre-Formed Diamond Detector Loop Installation Details
* SP635-2.8.16	Pre-Formed Diamond Detector Loop Installation Details
SP635-2.8.17	Layout for Pre-Formed Traffic Signal Detector Loops
SP635-2.9.1	Flasher Luminaire Installation Details on Perforated Square Steel Tubing (1 Sign)
SP635-2.9.2	Flasher Luminaire Installation Details on Perforated Square Steel Tubing (2 Signs)
SP635-2.9.3	Flasher Luminaire Installation Details on Perforated Square Steel Tubing
SP635-2.9.4	Flasher Luminaire Installation Details on Steel Pole (1 Sign)
SP635-2.9.5	Flasher Luminaire Installation Details on Steel Pole (2 Signs)
SP635-2.9.6	Flasher Luminaire Installation Details on Steel Pole
<b>Part D - Signing</b>	
SP635-3.1.1	Type 1 Shaft Installation Details (Sign Pole)
SP635-3.1.2	Type 1 Shaft Installation Details (Sign Pole)
SP635-3.1.3	Type 3 Shaft Installation Details (Sign Pole)
SP635-3.1.4	Type 3 Shaft Installation Details (Sign Pole)
SP635-3.1.5	Breakaway Base for Advanced Warning and Directional Signs on Type 1 and 3 Poles
SP635-3.1.6	Type 6 Shaft Installation Details (Sign Pole)
SP635-3.1.7	Type 6 Shaft Installation Details (Sign Pole)
SP635-3.1.8	Type 7 Shaft Installation Details (Sign Pole)
SP635-3.1.9	Type 7 Shaft Installation Details (Sign Pole)
SP635-3.1.10	Type L Sign Pole Installation Details
SP635-3.1.11	Type L Sign Pole Installation Details
SP635-3.1.12	Type L Sign Pole Installation Details
SP635-3.1.13	Type M Sign Pole Installation Details
SP635-3.1.14	Type M Sign Pole Installation Details
SP635-3.1.15	Type M Sign Pole Installation Details
SP635-3.1.16	Type H Sign Pole Installation Details
SP635-3.1.17	Type H Sign Pole Installation Details
SP635-3.1.18	Type H Sign Pole Installation Details
SP635-3.1.19	<u>Type S Sign Pole Installation Details</u>
SP635-3.1.20	<u>Type S Sign Pole Installation Details</u>
SP635-3.1.21	<u>Type S Sign Pole Installation Details</u>
SP635-3.1.22	Sign Pole Accessories
SP635-3.2.1	Overhead Streetname Sign Installation Details (On Signal Pole Arms)
SP635-3.2.2	Small Overhead Sign Installation Details (On Type L & M Signal Poles)
SP635-3.2.3	Small Overhead Sign Installation Details (On Type 3 Signal Arms)
SP635-3.2.4	Small Overhead Sign Installation Details (On Type 3 Signal Arms)
SP635-3.2.5	2-Way Small Overhead Sign Installation Details (On Type 3 Signal Arms)
SP635-3.2.6	2-Way Small Overhead Sign Installation Details (For Type 3 and L Signal Arms)
SP635-3.3.1	Large Overhead Plywood Guide Sign Installation Details (For Signs Up To 1500 X 3000)
SP635-3.3.2	Large Overhead Plywood Guide Sign Installation Details (For Signs Up To 1500 X 3000)
SP635-3.3.3	Large Overhead Plywood Guide Sign Installation Details (Up To 2400 Wide Signs)
SP635-3.3.4	Large Overhead Plywood Guide Sign Installation Details (2500 to 3600 Wide Signs)



SP635-3.3.5	Large Overhead Plywood Guide Sign Installation Details (3700 to 4800 Wide Signs)
SP635-3.3.6	Large Overhead Plywood Guide Sign Assembly Details
SP635-3.3.7	Large Overhead Extruded Aluminum Advance Warning Sign Assembly Details
SP635-3.3.8	Large Overhead Extruded Aluminum Advance Warning Sign Installation Details
SP635-3.3.9	Large Overhead Extruded Aluminum Traffic Signal Advance Warning Sign Installation Details
SP635-3.3.10	Large Overhead Extruded Aluminum Railway Advance Warning Sign Installation Details
SP635-3.3.11	Large Overhead Extruded Aluminum Guide Sign Assembly Details
SP635-3.3.12	Large Overhead Extruded Aluminum Guide Sign Installation Details
SP635-3.3.13	Large Overhead Extruded Aluminum Guide Sign Installation Details
SP635-3.3.14	Large Overhead Extruded Aluminum Guide Sign Assembly Details
SP635-3.3.15	Large Overhead Extruded Aluminum Guide Sign Assembly Details
SP635-3.3.16	Large Overhead Extruded Aluminum Guide Sign Assembly Details
SP635-3.3.17	Large Overhead Extruded Aluminum Guide Sign Assembly Details
SP635-3.3.18	Large Overhead Guide Sign Luminaire Installation Details
SP635-3.3.19	Junction Box Installation Details on Sign Arms
SP635-3.3.20	Large Overhead Extruded Aluminum Guide Sign Flat Bar at Splice Details
SP635-3.4.1	Two Leg Breakaway Sign Structure Installation Detail
SP635-3.4.2	Three Leg Breakaway Sign Structure Installation Details
SP635-3.4.3	Breakaway Leg and Stub Post Installation Details
SP635-3.4.4	Breakaway Fuse Joint Installation Details
SP635-3.4.5	Breakaway Connection Joint Installation Details (For Plywood Sign Only)
SP635-3.4.6	Breakaway Sign Support Column Details
SP635-3.4.7	Plywood Sign Mounting Details on Breakaway Sign Structure
SP635-3.4.8	Plywood Sign Mounting Details on Breakaway Sign Structure
SP635-3.4.9	Extruded Aluminum Sign Mounting Details on Breakaway Sign Structure
SP635-3.4.10	Extruded Aluminum Sign Mounting Details on Breakaway Sign Structure
SP635-3.4.11	Extruded Aluminum Sign Mounting Details on Breakaway Sign Structure
SP635-3.4.12	Extruded Aluminum Sign Mounting Details on Breakaway Sign Structure
SP635-3.5.1	Single Wood Post Sign Structure Installation Details
SP635-3.5.2	Wood Post Sign Structure Installation Detail (Two Post)
SP635-3.5.3	Wood Post Sign Structure Installation Details (Three Post)
SP635-3.5.4	Plywood Sign Installation Details on Wood Posts (2 & 3 Post Structures)
SP635-3.5.5	Plywood Sign Installation Details on Wood Posts
SP635-3.5.6	Extruded Aluminum Sign Installation Details on Wood Posts
SP635-3.5.7	Extruded Aluminum Sign Installation Details on Wood Posts
SP635-3.5.8	Extruded Aluminum Sign Installation Details on Wood Post
SP635-3.5.9	Extruded Aluminum Sign Installation Details on Wood Post
SP635-3.6.1	Perforated Square Galvanized Steel Sign Post Installation Detail (One Post)
SP635-3.6.2	Perforated Square Galvanized Steel Sign Post Installation Detail (Two Post)
SP635-3.6.3	Perforated Square Galvanized Steel Sign Post Installation Detail
SP635-3.6.4	Plywood Sign Mounting Details on Perforated Square Galvanized Steel Two Post Sign Structure
SP635-3.7.1	Plywood Exit Tab Mounting Details
SP635-3.7.2	Extruded Aluminum Exit Tab Mounting Details
SP635-3.7.3	Extruded Aluminum Exit Tab Mounting Details
SP635-3.8.1	Round Steel Sign Post Installation Details
SP635-3.8.2	Round Steel Sign Post Installation Details
SP635-3.8.3	Round Steel Sign Post on Barrier Sign Stand Installation Details
SP635-3.9.1	Sign Installation on the Side of Poles
SP635-3.10.1	Wood Delineator Post Installation Details



SP635-3.10.2	Perforated Square Steel Tubing Delineator Post Installation Details
SP635-3.10.3	Plastic Delineator Installation on Pole
SP741-01.01	Type A, B, & B1 Standard Wire Fence
SP741-01.02	Type A, B & B1 Fence - Stabilization Requirements
SP741-01.03	Type A, B & B1 Fence - Stabilization Requirements
SP741-02.01	Type C, C1, & C2 Standard Wire Fence
SP741-02.02	Type C, C1, & C2 Fence - Stabilization Requirements
SP741-02.03	Type C, C1, & C2 Fence - Stabilization Requirements
SP741-03.01	High-Tensile Fences (Smooth Wire & Wood Posts)
SP741-03.02	High-Tensile Fence Stabilization
SP741-03.03	High-Tensile Fence Stabilization
SP741-04.01	Type A, B, B1, C, C1 & C2 Fences On or Over Rock
SP741-04.02	Type A, B, B1, C, C1 & C2 Fence Special Conditions
SP741-04.03	Type A, B, B1, C, C1 & C2 Fence Special Conditions
SP741-04.04	Farm and Range Gates
SP741-04.05	Farm and Range Gates
SP741-05.01	Type D - Chain Link Fence - General Layout
SP741-05.02	Type D - Chain Link Fence Components
SP741-05.03	Type D - Chain Link Fence Gates
SP741-05.04	Type D - Chain Link Fence Gate Details
SP741-06.01	Wood Fence – Privacy – General Arrangement
SP741-06.02	Wood Fence – Privacy - Details
SP741-06.03	Wood Fence – Privacy – General Arrangement
SP741-07.01	Sidewalk Fence – Welded or Slip-on
SP751-01	Crowning Detail for Islands & Medians
SP754-01	Plantation Edging Detail
SP754-02	Trees Within Lawn Areas
SP754-03	Cedar Liner Details
SP754-04	Tripod Bracing Detail
SP754-05	Double Tree Stakes for Trees Over 3 m High
SP754-06	Single Tree Stake for Trees up 1.5 m to 3 m High
SP754-07	Double Tree Stakes for Boulevard Planting Areas
SP766-01	Swing Joint Detail - Impact Head
SP766-02	Swing Joint Detail - Turf Head
SP906-01	Measurement of Sweep and Crook in Piles
SP906-02	Reverse Sweep in Piles
SP941-01.01.01	Precast Concrete Bull-Nose 460 mm - CBN-H & CBN-E
SP941-01.01.02	Precast Concrete Low Barrier 460 mm - CLB-E & H
SP941-01.02.01	Precast Concrete Roadside Barrier 690 mm - CRB-H
SP941-01.02.02	Precast Concrete Roadside Barrier 690 mm - CRB-E
SP941-01.02.03	Precast Concrete Roadside Barrier 690 mm - CRB-H Details
SP941-01.02.04	Precast Concrete Roadside Barrier 690 mm - CRB-E Details
SP941-01.02.05	Precast Concrete Drainage Barrier 690 mm - CDB-E Details
SP941-02.01.01	Precast Concrete Median Barrier 810 mm - CMB-H
SP941-02.01.02	Precast Concrete Median Barrier 810 mm - CMB-E



SP941-02.01.03	Precast Concrete Median Barrier 810 mm - CMB-H Details
SP941-02.01.04	Precast Concrete Median Barrier 810 mm - CMB-E Details
SP941-02.01.05	Precast Concrete Pier Barrier 810 mm - CPB-H
SP941-02.01.06	Precast Concrete Pier Barrier 810 mm - CPB-E
SP941-02.01.07	Precast Concrete Pier Barrier 810 mm - CPB-H & CPB-E Details
SP941-03.01.01	Precast Concrete Transition Barrier 690 mm to 460 mm - CTB-1E
SP941-03.02.01	Precast Concrete Transition Barrier 810 mm to 690 mm - CTB-2H
SP941-03.03.01	Precast Concrete Transition Barrier 686 mm to 690 mm - CTB-3H
SP941-03.03.02	Precast Concrete Transition Barrier 686 mm to 690 mm - CTB-3H Details
SP941-03.03.03	Precast Concrete Transition Barrier 686 mm to 690 mm - CTB-3E&H
SP941-03.03.04	Precast Concrete Transition Barrier 686 mm to 690 mm - CTB-3E&H Details
SP941-03.04.01	Standard Bridge Parapet 810 mm High Transition
SP941-03.04.02	Standard Bridge Parapet 810 mm High Transition - Details
SP941-04.01.01	No Post Barrier Anchoring Hardware
SP941-04.02.01	Precast Concrete Roadside and Median Barriers Shear Key Void Details
SP951-01	Truck Tank Sampling Valve
SP951-02	Viscosity Requirements For Distillation Residues From High Float Emulsified Asphalt, HF-100S
SP951-03	Gradation of High Float Emulsified Asphalt
SP951-04	Absolute Viscosity vs Penetration
SP952-01	Truck Tank Sampling Valve
SP952-02	Viscosity Requirements For Distillation Residues From High Float Emulsified Asphalt, HF-100S
SP952-03	Gradation of High Float Emulsified Asphalt
SP952-04	Absolute Viscosity vs Penetration



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 604

### STEEL TRAFFIC BARRIER CONSTRUCTION

**604.01 Scope** - This Section covers the construction of roadside and median steel traffic barriers in accordance with the general layout and details indicated on Drawings of the [SP312](#) series.

Steel beam guardrail, wood posts and accessory materials are specified by Section [312](#).

Design and part number references are taken from the ARTBA Technical Bulletin #268-B, as noted in Section [312](#), unless indicated otherwise on Drawings [1-SP312](#) and [2-SP312](#).

**604.02 Provision of Steel Barriers** - Barriers of the type(s) called for shall be constructed at the locations and as shown on the Contract Drawings with the materials, accessories and necessary ancillary work all in accordance with the details indicated on the Contract Drawings, Specifications, Special Provisions and/or typical standard SP Drawings or to the direction of the Ministry Representative.

All material will be supplied by the Ministry f.o.b. the Contractor's job site yard or Ministry's yard, as noted, except where required by the Contract Drawings, Specifications or Special Provisions for supply in whole or in part by the Contractor.

Construction shall be carried out with all labour, tools, equipment and incidentals necessary to complete all barrier work in accordance with good work practice, for a substantially supported and anchored steel barrier developing a continuous beam strength together with necessary crashworthy end treatment.

**604.03 Materials** - Detailed material requirements are set out in Section [312](#) and indicated on Drawings [1-SP312](#), [2-SP312](#) and the manufacturer's drawings.

Concrete for post footings shall be constructed of minimum 15 MPa Portland cement concrete in accordance with Section [218](#), and reinforcement, 152 x 152 MW18.2 welded steel wire fabric to CSA G30.5 and 10M deformed bar or minimum 7 mm stirrups in accordance with Section [412](#).

Preservative treatment for protecting field cuts and borings and for making good any superficial damage to treated wood post material, as approved by the Ministry Representative, shall be creosote, pentachlorophenol or preservative salts in proper solution corresponding to the original pressure treatment for application in three separate heavy coatings.

Touch-up treatment for damaged galvanized metal surfaces shall be a heavy application of zinc rich paint to CGSB Standard 1-GP-181M Specification for Ready Mixed Zinc Rich Coating.

**604.04 Post Installation** - Posts shall be set true to the lines, spacing, depth(s) and height(s) indicated or required. The layout, type of support and fixing treatment at ends of barriers or where adjacent to abutments and the like shall be as indicated on the Contract Drawings and relevant Drawings [1-SP312](#) and [2-SP312](#), and/or to the direction of the Ministry Representative.

Wood posts shall be driven in place with equipment approved by the Ministry Representative or set in augered or dug holes with necessary dampened and well tamped layers of approved backfill material. Driving will be permitted only if no damage results to shoulders and adjacent slopes. In broken rock embankments the prepunching of holes will be permitted only prior to final compaction, surfacing and paving. Construction details appertaining on exposed rock, rock with minimum overburden or on concrete shall be to the indicated requirements and/or the direction of the Ministry Representative.

All work preparatory to and for the installation of posts shall be to the direction and prior approval of the Ministry Representative for each type of sub-surface condition to produce a thoroughly sound guardrail support system.



Surplus excavated material remaining after guardrail support installation shall be disposed of in a uniform manner within the right of way or cleared away, as directed by the Ministry Representative.

Tops of all posts shall be set a uniform  $25 \text{ mm} \pm 5 \text{ mm}$  above the line of the beam's top edge and where necessary cut to line up.

Posts damaged by the driving operation or other damage from their handling and installation not acceptable to the Ministry Representative shall be replaced at the Contractor's expense.

The tops of all posts and offset blocks, all post bolt holes and bored holes in posts shall receive a heavy soaking coat of the specified preservative treatment on three succeeding days.

**604.05 Steel Beam Erection** - Beam sections will normally be supplied or required for joining at 3.81 m intervals.

All punching, cutting or welding shall be shop executed except for special details in unforeseen and exceptional cases and to the prior approval of the Ministry Representative.

Sections shall have full bearing one to another at laps with splicing bolts drawn tight to 100 N·m for a continuous beam effect. Where guardrail is on a curve, the beam sections shall make close contact over the whole splice area. Shop bent beams will normally be supplied or required for curvature radii under 45 m.

Beam sections shall be bolted to posts so that the edges and centre portion(s) of beams make full bearing with each offset block or where applicable with back-up plate, post or other support. Where posts are treated with waterborne preservative salts, the bolt holes shall be filled with heavy grease before bolt insertion for corrosion protection.

Bolts shall not extend more than 15 mm beyond the fixing nut when tightened, with any excess removed and the threads burred.

Washers shall be used only where indicated on the standard Drawings of the [SP312](#) series.

**604.06 End Assemblies** - End assemblies shall be carried out strictly according to the manufacturer's specifications unless specifically directed otherwise by the Ministry Representative in writing as to approved alternative methods and the like.

Note the safety preference for:

- a) Continuing guardrail to shield the entire length of any hazard (as indicated on Drawing [1-SP312](#)), bridge abutment and the like in place of a bolted connector (RE-8).
- b) Approach transitions stiffened by means of reduced post spacing and, where necessary, the use of Thrie-beam or nested twin W-beams.
- c) End assemblies to be NCNRD 350 certified.

**Note:** the discontinuance of the flared (spade shaped) terminal section, especially at the approach ends of guardrails.

Footings for posts shall be constructed of specified concrete and reinforcement to the minimum sizes indicated on Drawing [2-SP312](#), neatly trowelled on top to weathering slope with bullnosed edge circular on plan.



**604.07 Measurement and Payment** - Measurement of steel traffic barriers will be by the linear metre from end to end of all rail sections along the line of the completed guardrail or centreline of any doubled median barrier and, unless otherwise specified, overall terminal assemblies.

Payment will be made for steel traffic barrier work at the contract unit price(s) for standard steel W-beam shoulder or median barrier guardrail supplied and/or installed complete in place or for Thrie-beam shoulder or median barrier guardrail supplied and/or installed complete in place.

The contract price(s) shall be accepted as full compensation for taking delivery of the Ministry supplied material, as and where noted, or the furnishing by the Contractor of material, as applicable, all labour, tools, equipment and incidental work to complete the required installation including bolting, transitions, curves, all excavation, backfilling, and surplus disposal, but excluding such work as may be required to be separately paid for as follows:

- a) Where steel beams and accessories are supplied by the Ministry, but wood (or steel) posts are required to be supplied by the Contractor, payment will be made for each post including offset block(s) supplied, as specified, and installed or set aside as the Ministry's property for future use, as directed by the Ministry Representative.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 635

### ELECTRICAL AND SIGNING

#### PART A - GENERAL

**635.01 Scope** - This Section covers the requirements for electrical and signing works. Temporary construction signing is covered in Section 194 - Traffic Control.

Effective Spring, 2004, it is anticipated that all Ministry Electrical Maintenance will be undertaken by non-Ministry forces, to be known as the Electrical Maintenance Contractor. The contractor will be required to coordinate the work with the Electrical Maintenance Contractor and the appropriate Ministry Regional Electrical Manager.

The contractor shall arrange the supply, installation and removal temporary C-63 (Traffic Pattern Changed), C-64 (Signal Operation Changed Signs) and W-329 (New) tabs with Ministry Electrical Maintenance. The Electrical Maintenance Contractor will supply, install and remove these signs at no expense to the contractor.

**635.02 Work Regulations** - All electrical work shall comply with the latest edition of the Canadian Electrical Code. In addition, any applicable bulletins as published by the Province of British Columbia shall apply.

The Contractor shall also conform to all applicable regulations of the Workers' Compensation Board and if required, submit a Notice of Project Form 52E49 before commencing a Ministry project. The Contractor shall ensure compliance with the following sections:

- a) A Workers' Compensation Board Form 30M33 must be completed prior to working in the vicinity of overhead power lines.
- b) Notice of Construction Projects, Workers' Compensation Board Occupational Health and Safety Regulation, Section 20.2.

**635.03 Electrical Permits & Inspections** - All electrical work shall be performed by a Registered Electrical Contractor under the provisions of the Electrical Safety Act. The Registered Electrical Contractor shall appoint at least one Registered Representative whose qualifications shall comply with the provisions of the Electrical Safety Act. The Contractor shall provide the Ministry Electrical Representative with the name and phone number of the Registered Representative prior to starting construction.

Prior to construction the Contractor shall obtain and pay for all permits required under the provisions of the Electrical Safety Act. The Contractor shall submit a copy of all permits to the Ministry Electrical Representative prior to starting construction.

Upon completion of an installation and prior to signal start-up the Contractor shall advise the Ministry Electrical Maintenance Contractor, the Engineer of Record and the Ministry Regional Electrical Manager the work is complete and ready for final inspection. The Ministry Electrical Maintenance Contractor will inspect the installation and report deficiencies to the Ministry Regional Electrical Manager. The Ministry Regional Electrical Manager will in turn advise the contractor of the deficiencies. The Engineer of Record may also undertake a review of the installation for conformance to the design where specifically noted in the Special Provisions. The Engineer of Record will report comments to the Ministry Regional Electrical Manager.

Once the items identified have been completed and corrected the contractor will advise the Regional Electrical Manager who will undertake a final check and will advise if acceptable. If acceptable "notification of completion" will be issued by the Ministry Regional Electrical Manager. If not corrections will be required by the contractor.

The Ministry will not accept the installation until all work has been approved by the Electrical Safety Branch, and the Ministry Regional Electrical Manager

**635.04 Electrical Energy Supply** - The electrical energy will be supplied from overhead lines of the utility company's secondary distribution system unless otherwise noted on the Plans.

The Contractor shall be responsible for making the necessary arrangements with the utility company for the connection of new service(s) and, if required, the disconnection of existing service(s). The Ministry will pay all utility connection costs.

**635.05 Materials** - The Contractor shall supply all materials necessary for the satisfactory completion of the project other than those materials listed in the Special Provisions as supplied by the Ministry. All materials shall be new and conform to the requirements of the Plans, Drawings, other Subsections of the Specifications, and the *Electrical and Signing Material Standards Manual*.

The *Electrical and Signing Material Standards Manual* may be purchased from:

Government of British Columbia  
Ministry of Management Services  
Publication Index Website:

**[www.publications.gov.bc.ca](http://www.publications.gov.bc.ca)**

(Go Shopping)



(Keywords: *Electrical and Signing Material Standards Manual*)

email: QPPublications@gems5.gov.bc.ca  
 Phone: (250)387-6409 or 1-800-663-6105  
 Fax: (250)387-1120

Address: PO BOX 9452 STN PROV GOVT  
 VICTORIA BC V8W 9V7

It is anticipated the Electrical and Signing Material Standards will be available on the Ministry of Transportation web at

**[www.th.gov.bc.ca/publications/eng\\_publications/eng\\_pubs.htm](http://www.th.gov.bc.ca/publications/eng_publications/eng_pubs.htm)**

Traffic Electrical Highway Safety and Geometric Standards Section Publications

on or before March 31, 2004.

All products contained in the Electrical and Signing Material Standards shall be supplied from the Ministry's *Recognized Products List*. This list identifies the manufacturer, the approved product, the product model number and the product approval date. This list can be viewed via the Ministry web page at:

**[www.th.gov.bc.ca/publications/eng\\_publications/geotech/rpb.htm](http://www.th.gov.bc.ca/publications/eng_publications/geotech/rpb.htm)**

This list will be updated periodically as more products become pre-approved.

All electrical materials shall conform to all applicable CSA Standards and shall meet the approval of the Electrical Safety Branch Inspector.

Unless noted otherwise, all permanent signs shall meet current Ministry specifications. The Ministry Specifications for Standard Highway Sign Materials, Fabrication and Supply are located on our Ministry web page at:

**[www.th.gov.bc.ca/publications/eng\\_publications/geomet/geometsigns.htm](http://www.th.gov.bc.ca/publications/eng_publications/geomet/geometsigns.htm)**

Where alternative materials are permitted, approval must be received from the Ministry Electrical Representative prior to their use.

**635.06 Utilities** - Existing utilities are generally not shown on the electrical and signing Plans. Where utilities are shown on the Plans, their locations are approximate.

The Contractor shall locate and protect all existing utilities such as power lines, fibre optic cables, telephone lines, gas and oil pipelines, sewers, water works, etc. The Contractor shall at all times conduct its operations in accordance with the requirements of the utility authorities having jurisdiction.

In the event of any damage to utilities, the Contractor shall be held responsible for the cost of all necessary repairs and restoration to the satisfaction of the Ministry Electrical Representative and Utility Authority.

All costs for locating and protecting utilities will be considered incidental to the Work.

## PART B - UNDERGROUND

**635.07 Concrete Bases** - Concrete bases shall be constructed in accordance with Drawings [SP635-1.1.1 through SP635-1.1.43](#) and [SP635-1.4.1 through SP635-1.4.5](#).

The use of the term "concrete bases" in Section [635](#) shall also mean "concrete spread footings" where applicable.

The Drawings make reference to concrete bases that are poured in place or precast. Poured-in-place bases shall be constructed in the excavation whereas precast bases shall be constructed outside the excavation (e.g., at a precast plant or precast on site by the Contractor). The Contractor has the option to use either precast or poured-in-place bases.

Supply and installation of concrete bases shall include the following:

- excavation and backfill;
- supply and installation of concrete and formwork;
- supply and installation of reinforcing steel;
- supply and installation of conduit;
- supply and installation of steel tubing sleeves in sign post bases, and
- installation of anchor bolts.

For poured-in-place bases, the Contractor shall notify the Ministry Electrical Representative prior to pouring concrete.

The Contractor shall check for conflicts with overhead lines prior to excavating for concrete bases. If it appears there may be an overhead conflict, the Contractor shall contact the Ministry Electrical Representative for further instructions. If the Contractor installs a concrete base in a location where the pole conflicts with overhead power lines, the Contractor shall remove the pole and relocate the concrete base to a location approved by the Ministry Electrical Representative. The Contractor shall pay all costs for pole and base relocation.

**635.07.01 Excavation and Backfill** - Excavations shall meet the requirements, but not the Quantities and Payment provisions of Section [407](#) - Foundation Excavation.

All excavation work shall be carried out as required to suit concrete bases. Where directed by the Ministry Electrical



Representative, excavations shall be shored to avoid the cutting of pavement, sidewalks, and curb and gutter.

Base excavations shall be backfilled using the excavated material provided it consists of clean well graded granular soil having a maximum fines content of 8% (silt and clay size particles) and a maximum aggregate size of 100 mm. Where backfill material does not conform as noted above, base excavation shall be backfilled with 25 mm Well Graded Base Course Aggregate material as specified in Subsection 635.14. Unacceptable materials shall be disposed of as specified in Subsection 635.15.

Backfill shall be placed in layers not exceeding 150 mm compacted thickness and shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698. Layer thickness shall be reduced and moisture content of the material adjusted as required to achieve compaction. Care shall be taken not to damage conduits.

All excavated and backfilled areas shall be restored to their original condition.

Asphalt restoration shall be performed in accordance with Subsection 635.12.

Concrete curb and gutter restoration shall be performed in accordance with Subsection 635.13.

**635.07.02 Concrete and Formwork** - Concrete construction, including formwork, shall meet the requirements, but not the payment provisions of Section 211 - Portland Cement Concrete.

Proportioning of the concrete mixes shall be the responsibility of the Contractor. The Contractor shall notify the Ministry Electrical Representative 48 hours prior to pouring concrete for poured-in-place bases.

The concrete mix shall meet the specifications listed in Table 635-A.

Concrete shall be vibrated in accordance with Section 211 - Portland Cement Concrete.

All exposed concrete surfaces shall be given a Class 3 finish and all buried surfaces a Class 1 finish in accordance with Subsection 211.16.

When supplying poured-in-place concrete bases, the Contractor shall have the concrete strength verified, using concrete test cylinders, prior to installing the structure onto the base. Contrary to Section 211 the minimum number of concrete strength tests shall be one each week per mix

**TABLE 635-A CONCRETE MIX**

Minimum compressive strength at 28 days	30 MPa
Maximum nominal aggregate size	28 mm
Maximum W/C ratio by mass	0.45
Air content	5 ± 1%
Slump	50 ± 20 mm

design or concrete supplier. The Contractor shall take concrete test cylinders at the location of the pour and perform tests in accordance with Subsection 211.09.01. The Contractor must provide written confirmation of concrete test cylinder results prior to installing any structure on the bases.

Where installations are of a fast-track nature, the contractor shall use a stronger concrete mix that will give the equivalent 28 day strength.

All concrete bases shall have their concrete strength verified with the exception of controller bases, sign post bases and post mounted flasher bases. Pre-cast concrete bases constructed off-site shall have their strength verified only where specifically requested by the Ministry Electrical Representative or the Ministry Electrical Manager.

The top finished surface of a concrete base shall not vary by more than 3 mm in depth as measured across the widest surface. If this variation exceeds 3 mm then the top 50 mm of the base shall be broken off by hand and reformed or the base shall be replaced as directed by the Ministry Electrical Representative.

**635.07.03 Reinforcing Steel** - Reinforcing steel shall meet the requirements but not the payment provisions of Section 412 - Reinforcing Steel.

All reinforcing steel shall conform to CAN/CSA-G30.18-M 400R.

The Contractor shall adjust the spacing of reinforcing steel to suit anchor bolts and conduit.

**635.07.04 Anchor Bolts and Conduit** - Anchor bolts and conduits shall be cast into the concrete bases.

Where an anchor bolt is damaged it shall be repaired in accordance with Drawings SP635-1.1.42 and 1.1.43.

Welding of anchor bolts shall not be permitted.

**635.07.05 Steel Pipe Sleeves** - Steel pipe sleeves shall be



cast into the concrete bases. The type of sleeve shall be as noted on the Drawings and shall be in accordance with Subsections [635.28](#) or [635.29](#).

**635.07.06 Payment** - Payment for CONCRETE BASES will be at the Contract Unit Price per base.

The Unit Price shall include all costs of types B, C, and D excavation, other than concrete and asphalt removal; supply and installation of shoring to meet WCB requirements, formwork, concrete, reinforcing steel and conduit; supply and installation of grout and sand to fill knock-out voids in controller bases and concrete pads in front of controller bases; supply and installation of steel sleeves in sign post bases; installation of individual anchor bolts or anchor bolts in cages; placing and compaction of excavated material as backfill; removal and disposal of excess excavated material; and all other labour, equipment, and materials necessary to complete the installation.

Any additional costs for supplying higher strength concrete shall be borne by the Contractor.

Payment for excavation of type A material (solid rock) will be made on a Force Account Basis unless otherwise noted.

Shoring of excavations, as directed by the Ministry Electrical Representative, will be paid by Force Account unless otherwise noted. All costs related to shoring of excavations required to meet WCB regulations will be borne by the Contractor.

De-watering of excavations will be paid by Force Account.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

**635.08 Junction Boxes and Vaults** - Plastic junction boxes shall be installed in accordance with Drawings [SP635-1.2.1](#) through [SP635-1.2.16](#) and [SP635-1.4.1](#) through [SP635-1.4.3](#).

Concrete junction boxes shall be supplied and installed in accordance with Drawings [SP635-1.3.1](#), [1.3.2](#), and [1.3.4](#). Concrete vaults shall be supplied and installed in accordance with Drawings [SP635-1.3.3](#) and [1.3.4](#).

Concrete Junction Boxes shall be designed to withstand 5000 kg static loading.

Concrete vaults shall be designed to withstand CS600 (H-20) Static Loading.

The Ministry-approved concrete junction box and vault

suppliers are listed on Drawings [SP635-1.3.1](#) and [1.3.3](#). Concrete junction box or vault suppliers wishing to seek Ministry approval must submit shop drawings sealed by a Structural Engineer (registered with the APEGBC) to the Ministry of Transportation - Engineering Branch, Victoria, verifying that their junction box or vault meets the loading requirements. The junction box or vault shall also meet the size and functional characteristics shown on the Drawings.

Excavations for junction boxes and vaults shall meet the requirements but not the Quantities and Payment provisions of Section [407](#) - Foundation Excavation.

All excavation work shall be carried out as required to suit junction boxes and vaults. Where directed by the Ministry Electrical Representative, excavations shall be shored to avoid the cutting of pavement, sidewalks and curb and gutter.

Junction boxes and vaults shall be installed on a bedding of 25 mm Well Graded Base Course Aggregate material in accordance with Section [202](#) - Granular Surfacing, Base and Sub-bases.

Junction box or vault excavations shall be backfilled using the excavated material except where excavated material is ruled unacceptable by the Ministry Electrical Representative. Where new material is required, 25 mm Well Graded Base Course Aggregate material shall be used as specified in Subsection [635.14](#). Unacceptable materials shall be disposed of as specified in Subsection [635.15](#).

Bedding and backfill material shall be placed in layers not exceeding 150 mm compacted thickness and shall be compacted to a minimum 95% of the laboratory density obtained by the current ASTM test method D 698. Layer thickness shall be reduced and moisture content of the material adjusted as required to achieve compaction. Care shall be taken not to damage conduits.

The top of junction boxes and vaults shall be installed so that they are flush with the finished grade.

Concrete for junction box collars shall conform to Subsection [635.07.02](#).

All areas where excavation and backfilling have been performed shall be restored to their original condition.

Asphalt restoration shall be performed in accordance with Subsection [635.12](#).

Concrete curb and gutter restoration shall be performed in accordance with Subsection [635.13](#).



Lid hold down bolts shall be coated with anti-seize lubricant.

**635.08.01 Payment** - Payment for PLASTIC JUNCTION BOXES will be at the Contract Unit Price per junction box.

The Unit Price shall include all costs of types B, C, and D excavation, other than concrete and asphalt removal; installation of junction box sections, lids, drain plates, adapter plates and braces; supply and installation of shoring to meet WCB requirements, conductor support bars in boxes, concrete collars, 25 mm Well Graded Base Course Aggregate material below the junction box; placing and compaction of excavated material as backfill; removal and disposal of excess excavated material; and all other labour, equipment and materials necessary to complete the installation.

Payment for the excavation of type A material (solid rock) will be made on a Force Account Basis unless otherwise noted.

Shoring of excavations, as directed by the Ministry Electrical Representative, will be paid by Force Account unless otherwise noted. All costs related to shoring of excavations required to meet WCB regulations shall be borne by the Contractor.

De-watering of excavations will be paid by Force Account.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

Additional drainage in junction boxes, as required by the Ministry Electrical Representative, will be paid by Force Account.

**635.08.02 Payment** - Payment for CONCRETE JUNCTION BOXES AND VAULTS will be at the Contract Unit Price per junction box or vault.

The Unit Price shall include all costs of types B, C, and D excavation, other than concrete and asphalt removal; supply and installation of the concrete junction box or vault complete with collar and lid; supply and installation of conductor supports; supply and installation of 25 mm Well Graded Base Course Aggregate material below concrete junction box or the vault; placing and compaction of excavated material as backfill; removal and disposal of excess excavated material; and all other labour, equipment and materials necessary to complete the installation.

Payment for the excavation of Type A material (solid rock) will be made on a Force Account Basis unless otherwise

noted.

Shoring of excavations, as directed by the Ministry Electrical Representative, will be paid by Force Account unless otherwise noted. All costs related to shoring of excavations required to meet WCB regulations shall be borne by the Contractor.

De-watering of excavations will be paid by Force Account.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

Additional drainage in vaults as required by the Ministry Electrical Representative will be paid by Force Account.

**635.09 Conduits** - All electrical conduits shall be installed in accordance with the Drawings and Plans.

Rigid PVC (RPVC) conduit shall be unplasticized polyvinyl chloride and conform to CSA C22.2 No. 211.2. Couplings, adapters, bends and fittings shall be unplasticized polyvinyl chloride and conform to CSA C22.2 No. 85. RPVC conduit shall be installed using CSA certified cement. Each standard length of RPVC conduit and fitting shall bear a certification mark to the applicable CSA standard.

Rigid metal conduit (RMC) shall be hot-dipped galvanized rigid steel and conform to CSA C22.2 No. 45. Any exposed metal on conduit shall be coated with cold galvanizing compound in accordance with Subsection [635.23](#).

Flexible liquid-tight non-metallic conduit (FC) shall conform to CSA 22.2 No. 227.2. All joints shall be made with FC threaded couplers, adapters or conduit fittings.

Liquid-tight flexible metal conduit (FMC) shall conform to CSA 22.2 No. 56. All joints shall be made with FMC threaded couplers, adapters or conduit fittings.

Conduit straps shall be galvanized steel single hole or double hole type (sized to suit conduit).

All empty conduits shall have a pull string and shall be capped in accordance with Drawings [SP635-1.2.16](#) and [1.3.4](#). Pull string shall be polypropylene with a minimum tensile strength of 1.1 kN.

The Contractor shall lay out conduit so that 90° bends are avoided. Where 90° bend cannot be avoided, only one will be allowed for each conduit run.

Conduit couplings or bell ends damaged when pulling conductors shall be rejected and replaced at the Contractor's



expense. An appropriate pulling jig or method shall be used to avoid damaging conduit or fittings when pulling conductors.

**635.09.01 Payment** - Payment for CONDUIT will be at the Contract Unit Price per metre.

The Unit Price shall include all costs for the supply and installation of underground conduit, fittings, cement and pull strings; and all other labour, equipment and materials necessary to complete the installation.

Payment for conduits installed above ground on poles or sign structures is not included in this Subsection.

**635.10 Trenching and Backfilling for Conduit -**

Trenching and backfilling shall be performed in accordance with Drawings [SP635-1.5.1](#), [1.5.2](#), [1.6.1](#), [1.6.2](#) and [1.7.1](#).

RPVC conduits shall be installed in an open trench in accordance with Drawings [SP635-1.5.1](#), [1.5.2](#), [1.6.1](#), [1.6.2](#) and [1.7.1](#) except where conduits are to be drilled or pushed under the surface as specified in Subsection [635.11](#).

Trenches shall be excavated with neat, uniform sides to the minimum width necessary, but not less than the minimum dimensions indicated on Drawings [SP635-1.5.1](#) and [1.5.2](#) (care shall be taken to prevent sloughing). Material in the floor of the trench shall be undisturbed, or if disturbed shall be re-compacted to the requirement herein for backfill.

Trenches shall be backfilled using the excavated material except where excavated material is ruled unacceptable for backfill. Where new material is required, 25 mm Well Graded Base Course Aggregate material shall be used as specified in Subsection [635.14](#). Unacceptable materials shall be disposed of as specified in Subsection [635.15](#).

A 150 mm wide yellow plastic marker tape indicating "WARNING ELECTRICAL" shall be installed in each trench for the complete length of the trench. The location of the marker tape shall be as shown on Drawings [SP635-1.5.1](#) and [1.5.2](#).

Bedding and backfill material shall be placed in layers not exceeding 150 mm compacted thickness and shall be compacted to a minimum 100% (for road crossings) and 95% (for shoulder trenches) of the laboratory density obtained by the current ASTM test method D 698. Layer thickness shall be reduced and moisture content of the material adjusted as required to achieve compaction. Care shall be taken not to damage conduits.

All areas where trenching and backfilling have been performed shall be restored to their original condition.

Asphalt restoration shall be performed in accordance with Subsection [635.12](#).

Concrete curb and gutter and sidewalk restoration shall be performed in accordance with Subsection [635.13](#).

**635.10.01 Payment** - Payment for TRENCHING AND BACKFILLING FOR CONDUIT will be at the Contract Unit Price per metre.

The Unit Price shall include all costs of Types B, C and D excavation, other than concrete and asphalt removal; placing and compaction of excavated material as backfill; dewatering; supply and installation of trench marker tape; removal and disposal of excess excavated material; and all other labour, equipment and materials necessary to complete the installation.

Payment for excavation of Type A material (solid rock) will be made on a Force Account Basis.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

**635.11 Trenchless Conduit Installation** - Where noted on the plans the Contractor shall install the conduit using a suitable trenchless technology to avoid cutting the existing pavement or sidewalk.

The trenchless technology selected shall suit the site conditions.

The Contractor shall give the Ministry Electrical Representative a minimum of 48 hours notice prior to installing conduits.

The Contractor shall locate all underground utilities prior to installing conduits.

**635.11.01 Payment** - Payment for installing conduit using trenchless technology will be at the Contract Unit Price per metre.

The Unit Price shall include all costs of excavation for set up; backfilling and restoration when finished, and all other labour, equipment and materials necessary to complete the installation.

No separate payment will be made for unsuccessful installation.

Payment for the supply and installation of conduit is covered under Subsection [635.09.01](#).



**635.12 Asphalt Pavement** - Asphalt paving shall be performed in accordance with Section 501 - Hot Mixed Asphalt Pavement.

Asphalt patching of conduit trenches shall be performed in accordance with Drawing SP635-1.5.1. Asphalt patching of excavations for junction boxes, vaults and bases shall be performed similar to the details shown on Drawing SP635-1.5.1.

Contrary to the requirements of Section 501, Asphalt placing by a paving machine will not be required. Asphalt pavement restoration shall be Class 1 medium mix installed in three 50 mm lifts unless otherwise noted or directed by the Ministry Electrical Representative.

The Contractor shall use a pavement saw to cut pavement and shall exercise care to obtain a neat, uniform excavation line along the edge of the pavement. The Contractor shall also prevent the existing base gravel from sloughing and undermining the pavement.

Where three lifts of asphalt pavement are being placed to reinstate a trench, the first two lifts shall be compacted with vibratory equipment capable of operating within the excavated area and of compacting over the whole of it. The third lift shall be compacted with rolling equipment to produce a uniform surface matching the adjacent existing pavement.

**635.12.01 Payment** - Payment for ASPHALT PAVEMENT for electrical and signing work will be as follows:

- Where the electrical work forms part of a paving or road construction Project, measurement and payment will be made in accordance with Section 501 - Hot Mixed Asphalt Pavement.
- Where the electrical work does not form part of a paving or road construction Project, payment shall be made in accordance with Section 501 - Hot Mixed Asphalt Pavement, except that:
  - a) The extra payment provided in Appendix C for extra handwork shall not apply, and all costs of handwork shall be included.
  - b) No separate payment shall be made for spray primer and tack coat and all costs of this work shall be included.
  - c) Measurement for payment for conduit trenches shall be made in cubic meters of mix compacted in place, and shall be calculated using a 450 mm wide trench plus 300 mm (asphalt is excavated 150 mm beyond the trench on both sides as noted on Drawing SP635-1.5.1).

d) Measurement for payment for installation of all other works shall be made in cubic metres of mix compacted in place and shall be calculated from measurements of the work.

**635.12.02 Payment** - Payment for REMOVAL OF ASPHALT will be made at the Contract Unit Price per cubic metre.

The Unit Price shall include all costs of cutting, removing and disposing of existing asphalt; and all other labour, equipment and materials necessary to complete the removal of asphalt.

The volume for payment of asphalt removal for conduit trenches will be calculated by the actual volume of asphalt removed within a 450 mm wide trench plus 300 mm (asphalt is excavated 150 mm beyond the trench on both sides as noted on Drawing SP635-1.5.1).

The volume for payment of asphalt removal for all other work will be calculated from measurements of the work.

**635.13 Concrete Curbs and Sidewalks** - All concrete curbs and sidewalks shall be installed in accordance with Section 582 - Concrete Curb and Gutter and Storm Drainage.

Concrete shall meet the requirements of Note 1 on Drawing SP582-01.01.

The Contractor shall use a pavement saw to cut existing concrete unless otherwise directed by the Ministry Electrical Representative, and shall obtain a neat, uniform cut along the edge of concrete. The Contractor shall also prevent base gravel from sloughing and undermining the concrete.

**635.13.01 Payment** - Payment for CONCRETE CURBS will be at the Contract Unit Price in accordance with Section 582 - Concrete Curb and Gutter and Storm Drainage.

The Unit Price shall include all costs of excavation, other than concrete and asphalt removal; supply and installation of 25 mm Well Graded Base Course Aggregate bedding material; supply and installation of formwork, concrete and expansion joint material; removal and disposal of excess excavated material; and all other labour, equipment and materials necessary to complete the installation.

**635.13.02 Payment** - Payment for SIDEWALKS will be at the Contract Unit Price per cubic metre.

The Unit Price shall include all costs of excavation, other than concrete and asphalt removal; supply and installation of 25 mm Well Graded Base Course Aggregate bedding



material; supply and installation of formwork, concrete and expansion joint material; removal and disposal of excess excavated material; and all other labour, equipment and materials necessary to complete the installation.

**635.13.03 Payment** - Payment for REMOVAL OF CONCRETE will be at the Contract Unit Price per cubic metre.

The Unit Price shall include all costs for the cutting, removing and disposing of existing concrete roadway, sidewalk, etc.; and all other labour, equipment and materials necessary to complete the removal of concrete.

The volume for payment of concrete removal for conduit trenches will be calculated by the actual volume of concrete removed within a 450 mm wide trench.

The volume for payment of concrete removal for all other work will be calculated from measurements of the work.

**635.13.04 Payment** - Payment for REMOVAL OF CONCRETE CURBS will be at the Contract Unit Price per metre.

The Unit Price shall include all costs for cutting, removing and disposing of existing concrete; and all other labour, equipment and materials necessary to complete the removal of concrete curbs.

**635.14 25 mm Well Graded Base Course Aggregate** - 25 mm Well Graded Base Course Aggregate shall meet the requirements of Section 202 - Granular Surfacing, Base and Sub-bases.

When acceptable excavated material is not available, 25 mm Well Graded Base Course Aggregate shall be used as backfill. It shall also be used for additional backfill around bases, junction boxes, vaults, median island fill and other work as required by the Ministry Electrical Representative.

**635.14.01 Payment** - Payment for 25 mm WELL GRADED BASE COURSE AGGREGATE will be at the Contract Unit Price per cubic metre.

The Unit Price shall include all costs of the supply, hauling, placing, trimming and compacting the material, and all other labour and equipment necessary to complete the installation.

Where the 25 mm Well Graded Base Course Aggregate material is used to backfill a conduit trench, its volume shall be calculated in place using:

- a) The actual length of trench from which the material is designated unacceptable;

- b) a 450 mm wide trench;

- c) the actual depth of this material compacted in place.

Where 25 mm Well Graded Base Course Aggregate material is used to backfill bases, junction boxes, vaults, or other work the volume will be calculated by the actual compacted volume of material installed in the excavation less the area of the item installed in the excavation.

**635.15 Removal of Rejected Excavated Material** - Where excavated material is designated unacceptable for backfill by the Ministry Electrical Representative it shall be removed from the work site and disposed of by the Contractor.

The disposal site shall be approved by the Ministry Electrical Representative.

**635.15.01 Payment** - Payment for the REMOVAL OF REJECTED EXCAVATED MATERIAL will be at the Contract Unit Price per cubic metre.

The Unit Price shall include all costs of removal and disposal, and all other labour, equipment and materials necessary to complete the removal of rejected material.

Where the rejected material has been excavated from a conduit trench, its volume shall be calculated in place using:

- a) The actual length of trench from which the material is designated unacceptable;

- b) a 450 mm wide trench;

- c) the actual depth of material removed.

Where the rejected material has been excavated for bases, junction boxes, vaults or other work the volume will be calculated by the actual volume of excavated material less the area of the item installed in the excavation.

**635.16 Restoration** - Areas where work has been performed shall be returned to their original condition and must be left in a neat state to the satisfaction of the Ministry Representative. All costs for restoration will be considered incidental to the Work.

## PART C - ELECTRICAL

**635.17 Luminaire, Signal and Sign Poles** - Luminaire and signal poles shall be installed in accordance with Drawings SP635-2.1.1 through SP635-2.1.14, and SP635-2.2.1 through SP635-2.2.10.

Where specified, luminaire poles shall be mounted on



frangible or breakaway bases in accordance with Drawings [SP635-2.1.15](#) and [2.1.16](#).

Sign poles shall be installed in accordance with Drawings [SP635-3.1.1 through SP635-3.1.22](#).

Poles shall not be erected until concrete bases have attained a strength of 30 MPa.

Push button and signal head locations shall be verified before poles are drilled and assembled.

Field drilling of holes larger than 33 mm (1 5/16") diameter will not be permitted in Type 1, 3, 6, 7, L, M and H shafts, and all arms and extensions. Where larger holes are required, the holes shall be reinforced with a welded bushing in accordance with Drawing [SP635-2.4.13](#).

All components of the luminaire, signal and sign poles shall be handled with care to prevent stress to the components through bending or twisting. A nylon sling shall be used to transport and erect the components. The use of steel chains as slings will not be permitted. Any damage to the components through overstress, scratching or denting shall be repaired or replaced at the Contractor's expense to the satisfaction of the Ministry Electrical Representative.

All pole shafts shall be installed plumb. Where possible, all luminaire poles shall be positioned with the handhole oriented opposite the road and if not possible, on the downstream traffic side.

All wiring inside the poles shall be in accordance with Subsection [635.19](#).

Pole shafts shall mount directly on concrete bases and, where necessary, shall be trued to plumb using levelling shims.

The Contractor shall tighten all bolts and nuts to 1/3 past snug tight. "Snug-tight" is the tightness attained by a few impacts of an impact wrench or the full effort of a person using a spud wrench.

All scratches in poles and all field drilled holes shall be coated with cold galvanizing compound as per Subsection [635.23](#).

Hand hole bolts shall be coated with anti-seize lubricant.

**635.17.01 Traffic and Pedestrian Signal Heads** - Traffic and pedestrian signal heads shall be installed in accordance with Drawings [SP635-2.3.1 through SP635-2.3.6](#) and - [2.3.10](#).

All traffic and pedestrian signal heads and mounting hardware shall be securely attached to the pole.

Traffic and pedestrian signal heads shall be correctly aimed in the field to the satisfaction of the Ministry Electrical Representative.

All traffic and pedestrian signal heads shall have LED (light emitting diode) traffic signal heads unless noted otherwise on the plans.

The Contractor shall completely cover all traffic and pedestrian signal heads with burlap sacking from the time they are installed until the system is required by the Ministry.

The contractor shall aim all traffic signal heads in accordance with Drawing SP635-2.3.11. Pedestrian signal heads shall be aimed to line up with the opposing wheelchair ramp or centre of the crosswalk.

**635.17.02 Pedestrian Pushbuttons and Signs** - Pedestrian pushbuttons and signs shall be installed in accordance with Drawing [SP635-2.3.7](#).

Pedestrian push buttons and signs shall be securely attached to the pole. Pedestrian pushbutton signs shall be temporarily covered until the signal is in operation.

**635.17.03 Luminaires and Photocells** - Luminaires and photocells shall be installed as per manufacturer's instructions or as noted on the Plans. Luminaires shall be installed level. Where the luminaire has a multi-tap ballast, the Contractor shall verify the service voltage and adjust the luminaire voltage tap to suit.

When installing flat glass cobra head roadway luminaires the flat glass lens shall be oriented parallel to the roadway surface to reduce glare.

Sign luminaires will require different aiming depending on the manufacturer. Aiming angles shall be noted on the plans or shall be requested from the Ministry Electrical Representative.

Photocell eyes shall be aimed north.

**635.17.04 Streetname Signs** - Streetname signs shall be bolted directly to the pole arms in accordance with Drawing [SP635-3.2.1](#).

**635.17.05 Audible Signals** - Audible Signals shall be installed on pedestrian signal heads in accordance with Drawing [SP635-2.3.8](#). The Contractor shall aim and adjust



the audible signal heads to the satisfaction of the Ministry Electrical Representative.

**635.17.06 Emergency Vehicle Pre-emption Equipment** – Emergency vehicle pre-emption equipment shall be installed in accordance with the plans and manufactures instructions. The Contractor shall undertake all commissioning and set-up of the equipment under the direction of the supplier technical representative.

**635.17.07 Small Overhead Signs** - Small overhead signs are classed as signs 1200 mm x 900 mm or smaller. Small overhead signs shall be installed in accordance with Drawings [SP635-3.2.2 through SP635-3.2.6](#).

Sign installations shall meet the requirements of Subsection [635.32](#).

**635.17.08 Video Detection Equipment** – Video Detection equipment shall be installed in accordance with the plans and manufactures instructions. The cameras shall be installed on signal arms or on special combination type 2A luminaire / camera arms in accordance with Drawings SP635-2.3.12 and .13. The Contractor shall undertake all commissioning and set-up of the equipment under the direction of the supplier technical representative.

**635.17.09 Payment** - Payment for the installation of each SIGNAL POLE will be at the Lump Sum Price for that pole.

The Lump Sum Price shall include all costs for the installation of traffic signal poles and arms, traffic signal heads including mounting hardware, pedestrian pushbuttons and signs, luminaires and photocells, audible signals, street name signs, small overhead signs, and fire indication lights; supply and installation of wiring to the handhole at the base of the pole, fuse holders, fuses and splices; and all other labour, equipment and material necessary to complete the installation.

**635.17.10 Payment** - Payment for the installation of LUMINAIRE POLES will be at the Contract Unit Price for each pole.

The Unit Price shall include all costs for the installation of luminaire poles, luminaires and photocells, and frangible or breakaway bases; supply and installation of wiring to the handhole at the base of the pole, fuse holders, fuses and splices; and all other labour, equipment and materials necessary to complete the installation.

**635.17.11 Payment** – Payment for the supply and installation of EMERGENCY VEHICLE PRE-EMPTION EQUIPMENT will be made at the contract Lump Sum Price for each signal.

The Lump Sum shall include all costs for the installation of the pre-emption equipment, commissioning, set-up and adjusting.

**635.17.12 Payment** – Payment for the supply and installation of VIDEO DETECTION EQUIPMENT will be made at the contract Lump Sum Price for each signal.

The Lump Sum shall include all costs for the supply and installation of the video detection equipment, commissioning, set-up and adjusting.

**635.18 Service Equipment** - Service equipment shall be installed in accordance with Drawings [SP635-2.4.1 through SP635-2.4.16](#).

Service Equipment shall include electrical panels and telephone demarcation panels.

Specialized service equipment (e.g., service kiosks) shall be installed in accordance with the Plans and Special Provisions.

Service equipment shall be securely attached to the poles.

**635.18.01 Payment** - Payment for the installation of SERVICE EQUIPMENT will be at the Lump Sum Price for that service area.

The Lump Sum Price shall include all costs for the installation of electrical service, distribution and disconnect panels and telephone demarcation panels including the pole where a separate service pole is required; supply and installation of service wiring including wiring between the disconnect and distribution panels; supply and installation of rigid metal conduit, fittings, mounting hardware, ground wire, ground clamp, insulating clevis, ground plate and branch circuit wiring to the handhole at the base of the pole; supply and installation of a working pad including additional fill as required (see Drawing [SP635-2.4.16](#)); and all other labour, equipment and materials necessary to complete the installation.

**635.19 Wiring** - All wiring shall be installed in accordance with the Plans or as directed by the Ministry Electrical Representative.

All conductors shall be stranded copper, RW90 XLPE insulated unless otherwise noted.

Conductor gauges (AWG) shall be as specified on the Plans.

Shielded detector loop and telephone demarcation cables shall be 2 conductor No. 18 Ministry pre-approved product. Shielded detector loop cables shall run continuous with no



splices, from the traffic controller (or other type of control equipment) to the respective detector loop conductor.

Single conductor colour coding and labelling is required and shall be as noted on Drawings SP635-2.5.7 and 2.5.8. Conductor colour coding shall also meet the requirements of the Canadian Electrical Code.

Where specifically noted on the Plans signal cable shall be used. Signal cable colour coding and conductor designations shall be as noted on Drawing SP635-2.5.9. Where signal cable is used all conductor splices shall be made in pole hand holes in accordance with Drawing SP635-2.5.10.

Each traffic and pedestrian signal head section and luminaire shall be wired separately to the base of the pole. A separate neutral and bond conductor shall run to each signal head and luminaire from the base of the pole. The neutral and bond conductors shall be bundled with the feeder circuits.

Luminaire conductor wiring and fusing in pole handholes shall conform to Drawing SP635-2.5.6.  
Wiring inside junction boxes and vaults shall conform to Drawings SP635-2.5.1 through SP635-2.5.5.

Conductor splices shall be secured with solderless "Marrette" type connectors. Where the number and/or size of conductors exceeds the capacity of the Marrette split bolt connectors shall be used.

All wiring shall be neatly bundled and labelled in all junction boxes, vaults, traffic controllers, handholes at pole bases, and service panels.

Sealing of connections shall be performed using one of the following methods:

- a) Double dipping using 3M "Scotchcote" or approved alternate. Dipping shall be performed strictly adhering to the manufacturer's specifications.
- b) Each conductor shall have a wrap of the self-holding tape (3M Linerless Rubber Splicing Tape, Steadfast 8 Ounce Splicing tape or approved alternate), then the complete splice shall be wrapped. PVC tape shall then be applied to cover the complete splice.

If conductor connections require the use of split bolts or similar style devices due to wire size, then the splice shall be completely covered with Duct Seal to form a ball over the connection. This Duct Seal shall be thick enough to prevent sharp ends of the conductors and/or points of the connector from protruding through the taped connection. Once the duct seal has been applied, the splice shall be taped with

self-holding and PVC tape as described in Subsection 635.19 b).

All luminaires and signal heads shall be bonded with a No. 12 RW90 conductor. Steel junction box lids and steel vault lids shall be bonded in accordance with Drawings SP635-2.5.1 through SP635-2.5.5.

**635.19.01 Payment** - Payment for the installation of WIRING will be at the Lump Sum Price for all underground wiring included in the Work.

The Lump Sum Price shall include all costs for the supply and installation of wiring and cables located in the underground conduit system (unless otherwise noted) and splices; labelling of underground conductors; and all other labour, equipment and materials necessary to complete the installation.

**635.20 Traffic Counter Stations** - Traffic counter stations shall be short-duration type or permanent type.

Short duration traffic counter stations shall be installed in accordance with Drawing SP635-2.6.1.

Perforated square steel tubing shall conform to Subsection 635.28.

Permanent traffic counter stations shall be installed in accordance with Drawing SP635-2.6.2 and 2.6.3.

The Contractor will install all pole mount cabinets. The Ministry Electrical Maintenance Contractor will connect all field wiring in cabinets, trouble-shoot problems in the cabinet and undertake all equipment set-up

**635.20.01 Payment** - Payment for the installation of TRAFFIC COUNTER STATIONS will be at the Contract Unit Price per traffic counter station.

The Unit Price shall include all costs for the supply and installation of perforated steel tubing, above ground conduit and junction boxes, connectors; supply and installation of rigid metal conduits, fittings, mounting hardware and branch circuit wiring to the handhole at the base of pole for pole mount cabinets; installation of counter cabinet including the pole where a separate pole is required; Supply and installation of W-55 signs and concrete pad in front of the controller door; and all other labour, equipment and materials necessary to complete the installation.

**635.21 Controllers** - Type B, C, M and S traffic controller cabinets shall be installed in accordance with Drawings SP635-2.7.1 through SP635-2.7.3.



The Ministry Electrical Maintenance Contractor will install all base mount traffic controller and cabinets. The Contractor will install all pole mount cabinets. The Ministry Electrical Maintenance Contractor will connect all field wiring in controller cabinets, trouble-shoot problems in the cabinet, enter all signal timings, undertake modifications to existing signal phasing and timings, start-up controller and complete Ministry signal turn sheets.

The contractor shall be on hand to assist with controller start-up and make any repairs to field wiring or hardware as required. The contractor shall provide traffic control and assistance during the controller start-up.

The Contractor shall coil and label 2 m of each conductor inside the traffic controller for connections by the Ministry Electrical Maintenance Contractor. The Contractor shall verify that all traffic and pedestrian signal phases are wired as shown on the Plans and that all circuits are tested prior to activation. The Contractor shall verify that all signal and pedestrian phases are properly colour coded and labelled with identification tags.

**635.21.01 Payment** - Payment for the installation of each CONTROLLER will be at the Lump Sum Price for that controller.

The Lump Sum Price shall include all costs for the installation of pole mount cabinets and installation of the pole where a separate pole is required, rigid metal conduits, fittings, mounting hardware and branch circuit wiring to the handhole at the base of pole for pole mount cabinets; testing of all circuits; labelling of all conductors; traffic control and all other labour, equipment and materials necessary to complete the installation.

**635.22 Detector Loops** - Detector loops shall be constructed as noted on the Plans and shall be installed in accordance with Drawings [SP635-2.8.1 through SP635-2.8.16](#). Loop check sheets shall be completed and submitted to the Ministry Regional Electrical Manager prior to signal start-up.

**635.22.01 Payment** - Payment for DETECTOR LOOPS will be at the Contract Unit Price per loop.

The Unit Price shall include all costs for layout of the loop, asphalt cutting and preparation of pavement cuts; supply and installation of loop conductors or preformed loops as applicable, to the underground junction box, traffic counter post or cabinet; supply and installation of backer rod, sand and loop sealant; and all other labour, equipment and materials necessary to complete the installation.

**635.23 Repairing Galvanized Surfaces** - Any spots where

the galvanized finish is damaged due to drilling, tapping, reaming or welding and any surface damage incurred during transportation and erection shall be refinished with cold galvanizing compound. Cold galvanizing compound shall be Crown No. 67007 spray type (or approved alternative). The application of cold galvanizing compound shall conform to the Manufacturer's instructions and the following:

- a) The surface shall be mechanically cleaned with a wire brush or grinder and chemically cleaned to remove all welding flux, paint, grease, oil, rust, scale or other detrimental foreign matter.
- b) The surface shall be absolutely dry and the ambient temperature shall be over 10°C.
- c) Uniform coats shall be applied. Each coat shall be as thick as possible without causing runs on the finished surface.

All costs for the repair of galvanized surfaces will be considered incidental to the Work.

**635.24 Flasher Luminaires** - Flasher luminaires shall be mounted on perforated square steel tubing in accordance with Drawings [SP635-2.9.1 through SP635-2.9.3](#).

Flasher luminaires shall be mounted on poles in accordance with Drawings [SP635-2.9.4 through SP635-2.9.6](#).

All perforated square steel tubing shall be in accordance with Subsection [635.28](#).

**635.24.01 Payment** - Payment for the installation of Flasher Luminaires on Perforated Square Steel Tubing will be at the Contract Unit Price for a one or two sign unit.

The Unit Price shall include all costs for the supply and installation of perforated square steel tubing, mounting hardware, wiring to the junction box nearest to the flasher post, ty-raps and connectors, signs, flasher luminaires, lamps; and all other labour, equipment and materials necessary to complete the installation.

**635.24.02 Payment** - Payment for the installation of Flasher Luminaires on Poles will be at the Contract Unit Price for each item.

The Unit Price shall include all costs for the supply and installation of all fittings, hardware and wiring to the underground junction box nearest the pole, signs, flasher luminaires and lamps; and all other labour, equipment and materials necessary to complete the installation.



**PART D - SIGNING**

**635.25 Overhead Signs** - Overhead signs are categorized in two classes:

- a) small overhead signs are 1200 mm x 900 mm or smaller;
- b) large overhead plywood or extruded aluminum guide signs are larger than 1200 mm x 900 mm.

Small overhead signs are generally plywood or sheet aluminum, and are mounted on signal poles. Small overhead signs shall be installed in accordance with Drawings [SP635-3.2.2 through SP635-3.2.6](#).

Large overhead plywood guide signs are installed on sign poles in accordance with Drawings [SP635-3.3.1 through SP635-3.3.6](#), unless otherwise noted. Large overhead extruded aluminum signs are installed on sign poles in accordance with Drawings [SP635-3.3.11 through SP635-3.3.17](#), unless otherwise noted. Sign poles shall be installed in accordance with Drawings [SP635-3.1.1 through SP535-3.1.19](#). Large overhead plywood signs are not typically used for new installations.

Sign lighting, where specified by the Ministry, shall be installed in accordance with Drawing [SP635-3.3.18](#) and Subsection [635.17.03](#).

Overhead signs shall be securely installed on sign pole structures.

All horizontal supports and signs shall be level and vertical supports plumb.

Sign Poles shall be installed in accordance with Subsection [635.17](#).

Advance warning signs shall be extruded aluminum, and shall be installed in accordance with Drawings [SP635-3.3.7 through SP635-3.3.10](#).

All signs shall be installed in accordance with Subsection [635.32](#).

**635.25.01 Payment** - Payment for the installation of each OVERHEAD SIGN POLE will be at the Lump Sum Price for that sign pole.

The Lump Sum Price shall include all costs for installation of sign poles and arms, overhead signs complete with T Section mounting brackets and J clips, advance warning flasher equipment, sign luminaries and mounting hardware; small overhead signs and mounting brackets, wiring to the

handhole at the base of the pole, fuse holders, fuses, junction boxes on pole arms, splices; and all other labour, equipment and materials necessary to complete the installation.

Where small overhead signs are installed on signal poles, payment will be made under Subsection [635.17.08](#).

**635.26 Breakaway Sign Structures** - Breakaway sign structures shall be installed in accordance with Drawings [SP635-3.4.1 through SP635-3.4.12](#).

After concrete bases are installed, the Contractor shall survey the finished base elevations to determine the correct leg lengths. The fabricator shall cut legs to the correct lengths.

All legs and columns are to be transported in an unstressed manner.

All breakaway structures shall be installed with the legs and columns plumb, and the battens and signs level.

The Contractor shall tighten all bolts and nuts with a torque wrench to the torque specified on the drawings.

Signs shall be plywood or extruded aluminum as specified.

Plywood signs shall generally be installed in accordance with Drawings [SP635-3.4.7, 3.4.8](#) and Subsection [635.32](#).

Plywood signs shall be installed with wood battens on the breakaway sign columns to support the signs. Wood battens shall be 4" x 6" Douglas Fir/Larch, No. 1 Grade, surfaced four sides, in complete lengths without splices. Battens shall be straight and free of cracks. All wood battens shall be painted green with one coat of oil base exterior paint (General Paint No. 63-324 - Highway Green, or approved alternative) over a compatible primer (General Paint No. 32002 - Primer or approved alternative). All painting shall conform to Section [308](#) - Paint.

Signs shall not be installed until the paint on the battens has completely dried.

Extruded aluminum signs shall be installed in accordance with Drawings [SP635-3.4.9 through SP635-3.4.12](#) and Subsection [635.32](#).

Extruded aluminum signs on breakaway sign structures will not be illuminated.

All sign installations shall be in accordance with Subsection [635.32](#).

**635.26.01 Payment** - Payment for the installation of each



BREAKAWAY SIGN STRUCTURE will be at the Lump Sum Price for that breakaway sign structure.

The Lump Sum Price shall include all costs for the installation of breakaway sign legs, columns, stub posts, fuse and connection joints, sign or signs, sign luminaires and mounting brackets, wood battens, painting, sign mounting bolts and hardware for plywood signs; and all other labour, equipment and materials necessary to complete the installation.

**635.27 Wood Post Sign Structures** - Wood post sign structures shall be installed in accordance with Drawings [SP635-3.5.1 through SP635-3.5.9](#).

Excavations for wood posts shall be wide enough to allow for proper compaction of backfill around the wood posts. Wood posts shall be embedded in the ground to the depths indicated on Drawings [SP635-3.5.1 through SP635-3.5.3](#).

Wood post excavations shall be backfilled using the excavated material except where excavated material is ruled unacceptable by the Ministry Representative. Where new material is required, 25 mm Well Graded Base Course Aggregate material shall be used as specified in Subsection [635.14](#). Unacceptable materials shall be disposed of as specified in Subsection [635.15](#).

Wood posts shall be Douglas Fir/Larch, No. 1 Grade, surfaced four sides, and shall be supplied in complete lengths without splices. Posts shall be straight and free of cracks.

All portions of wood posts installed below finished grade shall be treated with wood preservative.

Wood posts shall be installed plumb and at the proper offset and elevation.

Backfill material shall be placed in layers not exceeding 150 mm compacted thickness and shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698. Layer thickness and moisture content of the material shall be adjusted as necessary to achieve compaction.

All areas excavated and backfilled shall be restored to their original condition.

Wooden sign posts shall be completely painted, prior to installing the sign or signs, with one coat of white oil base exterior paint (General Paint No. 10010 or approved alternative) over a compatible primer (General Paint No. 32002 primer or approved alternative) for the length of the post from the ground line to the bottom of the sign. Where

plywood signs are installed, the portion of the post behind the sign from the bottom of the sign to the top of the post shall be completely painted with one coat of green oil base exterior paint (General Paint No. 63-324 - Highway Green or approved alternative) over a compatible primer (General Paint No. 32002 primer or approved alternative). All painting shall meet the requirements of Section [308](#) - Paint.

Signs on single wood post structures shall be plywood or sheet aluminum. Sheet aluminum signs shall be installed in accordance with Drawing [SP635-3.5.1](#) and Subsection [635.32](#).

Signs on multiple wood post structures shall be plywood or extruded aluminum.

Plywood signs shall be installed in accordance with Drawings [SP635-3.5.4](#) and [3.5.5](#), and Subsection [635.32](#). Plywood signs shall be installed on wood battens mounted on the sign posts to support the signs. Wood battens shall be Douglas Fir/Larch, No. 1 Grade, surfaced four sides, and shall be supplied in complete lengths without splices. Wood battens shall be straight and free of cracks.

Wood battens shall be painted green with one coat of exterior paint (General Paint No. 63-324 - Highway Green, or approved alternative) over a compatible primer (General Paint No. 32002 primer or approved alternative).

Extruded aluminum signs shall be installed in accordance with Drawings [SP635-3.5.6 through SP635-3.5.9](#) and Subsection [635.32](#).

Wood signs or wood battens or extruded aluminum signs and angle mounting brackets shall not be installed on wood posts until the paint has completely dried.

All areas around the post shall be fully restored to their original condition.

**635.27.01 Payment** - Payment for the installation of SINGLE WOOD POST SIGN STRUCTURES will be at the Contract Unit Price for each wood post sign structure.

The Unit Price shall include all costs of Types B, C and D excavation, other than concrete or asphalt removal; supply and installation of wood posts, painting, sign mounting bolts and hardware and signs; placing and compaction of excavated materials as backfill; removal of excess excavated material; restoration; and all other labour, equipment and materials necessary to complete the installation.

Payment for excavation of type A material (solid rock) will be made on a Force Account Basis unless otherwise noted.



De-watering of excavations will be paid for by Force Account.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

**635.27.02 Payment** - Payment for the installation of each MULTI POST WOOD POST SIGN STRUCTURE will be at the Lump Sum Price for that wood post sign structure.

The Lump Sum Price shall include all costs of Type B, C, and D excavation, other than concrete or asphalt removal; supply and installation of wood posts, painting, sign mounting bolts and hardware, battens for plywood signs, sign(s) and aluminum angle sign supports for extruded aluminum signs; placing and compaction of excavated materials as backfill; removal of excess excavated material; restoration and all other labour, equipment and materials necessary to complete the installation.

Payment for excavation of type A material (solid rock) will be made on a Force Account Basis unless otherwise noted.

De-watering of excavations will be paid for by Force Account.

Where excavated material is ruled unacceptable for backfill, payment for 25 mm Well Graded Base Course Aggregate will be made under Subsection [635.14.01](#).

**635.28 Perforated Square Steel Sign Post Structures** - Perforated Square Steel Sign Post shall be supplied in accordance with Drawings [SP635-3.6.1 through SP635-3.6.4](#).

Sign posts shall be perforated square steel tubing. The perforated square steel tubing will be required in different outside dimensions as noted on the Drawings. The perforated square steel tubing shall be formed from 12 gauge cold rolled steel, conforming to ASTM Specification A 446, Grade A. The tubing shall be hot dipped galvanized conforming to ASTM Specification A 525, Designation G-90. Steel tubing shall have 7/16" holes on all four sides at 1" centres.

Galvanized perforated square steel tubing shall be supplied in continuous lengths, with no splices, and shall be field cut to suit the particular installation. All field cuts shall be painted with cold galvanizing compound in accordance with Subsection [635.23](#).

Perforated square steel tubing sign posts shall be installed on concrete bases in accordance with Drawing [SP635-1.1.35](#).

Perforated square steel tubing posts shall be installed plumb.

Signs on single perforated square steel sign posts shall be sheet aluminum or steel. Sheet aluminum and steel signs shall be installed in accordance with Drawings [SP635-3.6.1, 3.6.3](#) and Subsection [635.32](#).

Signs on double perforated square steel sign posts shall be plywood or sheet aluminum.

Double post plywood and sheet aluminum signs shall be installed in accordance with Drawings [SP635-3.6.2 through SP635-3.6.4](#) and Subsection [635.32](#).

**635.28.01 Payment** - Payment for the installation of SINGLE PERFORATED SQUARE STEEL SIGN POST STRUCTURES will be at the Contract Unit Price for each structure.

The Unit Price shall include all costs for the supply and installation of perforated square steel tubing, mounting hardware, sign(s); and all other labour, equipment and materials necessary to complete the installation.

**635.28.02 Payment** - Payment for DOUBLE PERFORATED SQUARE STEEL SIGN POST STRUCTURES will be at the Contract Unit Price for each sign structure.

The Unit Price shall include all costs for the supply and installation of perforated square steel tubing; mounting hardware, sign(s); and all other labour, equipment and materials necessary to complete the installation.

**635.29 Round Steel Sign Post Structures** - Round Steel sign posts shall be installed in accordance with Drawings [SP635-3.8.1 through SP635-3.8.3](#).

Barrier sign posts shall be mounted on barrier stands, which shall be securely bolted to concrete roadside or concrete median barriers.

Posts and pipe sleeves shall be round Schedule 40 steel pipe conforming to ASTM Specification A 53, Grade B. The pipe shall be hot dip galvanized in accordance with CSA Specification G164 Table A. Pipe shall be field cut to lengths to suit sign mounting heights as noted on the Plans or as directed by the Ministry Representative. All field cuts in galvanized steel pipes shall be coated with cold galvanizing compound in accordance with Subsection [635.23](#).

Signs shall be installed in accordance with Subsection [635.32](#).



**635.29.01 Payment** - Payment for the installation of ROUND STEEL SIGN POST STRUCTURES will be at the Contract Unit Price for each sign post.

The Unit Price shall include all costs for the supply and installation of sign or signs and barrier stands, sign posts and mounting hardware, pipe sleeves including trenching and backfilling where posts are installed in concrete sidewalks; and all other labour, equipment and materials necessary to complete the installation.

**635.30 Sign Mounting on the Side of Poles** - Signs mounted on the side of steel poles shall be installed in accordance with Drawing SP635-3.9.1.

Signs shall be securely attached to poles.

Signs shall be installed in accordance with Subsection 635.32.

Holes drilled in galvanized steel poles shall be coated with cold galvanizing compound in accordance with Subsection 635.23.

**635.30.01 Payment** - Payment for the installation of SIGN INSTALLATION ON THE SIDE OF POLES will be at the Contract Unit Price for signs installed on each pole.

The Unit Price shall include all costs for the supply and installation of signs, sign mounting hardware; and all other labour, equipment and materials necessary to complete the installation.

Where multiple signs are to be installed on a pole only one unit item will be paid.

**635.31 Delineators** - Delineators shall be wood, perforated steel tubing or plastic as noted on the Plans or as directed by the Ministry Representative.

Wood delineator posts shall be installed in accordance with Drawing SP635-3.10.1.

Perforated square steel tubing delineator posts shall be installed in accordance with Drawing SP635-3.10.2.

Where plastic delineators are specified, they shall be a Ministry preapproved type and shall be installed in accordance with the manufacturer's instructions. Where delineators are mounted on a pole, sign post or structure, they shall be plastic and shall be installed in accordance with Drawing SP635-3.10.3.

Wood delineator post excavation, backfill, type of wood, painting and installation methods shall be in accordance

with Subsection 635.27.

Perforated square steel tubing shall be in accordance with Subsection 635.28.

All holes drilled in galvanized surfaces shall be coated with cold galvanizing compound in accordance with Subsection 635.23.

**635.31.01 Payment** - Payment for the installation of DELINEATORS will be at the Contract Unit Price for each delineator.

The Unit Price shall include all costs of excavation, other than concrete or asphalt removal; supply and installation of delineator posts and mounting hardware, W-0055 background plate and reflectors for perforated sign posts and W-055 reflectors for wood sign posts; placing and compaction of excavated materials as backfill; removal of excess excavated materials; and all other labour, equipment and materials necessary to complete the installation.

**635.32 Signs** - Small signs which are generally 1200 mm x 900 mm or smaller shall be sheet aluminum or plywood. Large signs which are generally larger than 1200 mm x 900 mm shall be plywood or extruded aluminum as specified.

All sign installations shall meet the requirements of the most current edition of the Ministry *Manual of Standard Traffic Signs and Pavement Markings* available at:

**[www.th.gov.bc.ca/publications/eng\\_publications/electrical/MoST\\_PM.pdf](http://www.th.gov.bc.ca/publications/eng_publications/electrical/MoST_PM.pdf)**.

The Contractor shall have a current copy of this document on site when installing signs.

All signs shall be completely covered with burlap sacking from the time they are installed until the roadway is in full operation, unless otherwise directed by the Ministry Representative. The burlap material shall prevent sign messages from being visible.

All signs shall be handled so as not to damage them in any way. Slip sheets between signs shall be removed carefully to avoid damage due to adhesion of the slip sheet to the sign. Signs shall be stored on end on dunnage or racks in a dry, covered area, safe from damage. Damaged signs shall be replaced by the Contractor at the Contractor's expense. Taping, screwing, nailing, gluing, bolting or stapling to sign faces or back is prohibited unless otherwise noted.

The Contractor shall confirm that all signs have the correct messaging. The Contractor shall verify that all signs are free



of cracks, dents or warpage prior to installation. Any sign flaws shall be immediately reported to the Ministry Representative prior to sign installation.

Signs shall be bolted to the mounting hardware or structure as indicated on the applicable Drawings. Nylon washers shall be installed between the mounting bolt heads and the plywood sign face. The sign panels shall be tightened so as to eliminate sign movement but not over tightened so as to recess the bolt heads into the sign face.

Plywood signs larger than 1200 mm x 3000 mm will consist of multiple plywood panels. Each panel shall be correctly aligned so that no gaps exist between sign panels. The bottom of the sign panels shall be installed level.

Plywood exit number tabs shall be attached to plywood signs in accordance with Drawing [SP635-3.7.1](#).

Extruded aluminum signs will be supplied unassembled. Aluminum sign sections shall be assembled and correctly aligned to the satisfaction of the Ministry Representative.

Extruded aluminum signs are supplied in typical widths shown on Drawing [SP635-3.3.13](#).

Extruded aluminum exit number tabs shall attach to extruded aluminum signs in accordance with Drawings [SP635-3.7.2](#) and [3.7.3](#).

Any unused holes in wooden sign boards shall be sealed to

the satisfaction of the Ministry Representative. Holes on the sign face shall be covered with a trimmed piece of patching material to match the colour of the sign face.

Patching material shall meet current Ministry Specifications

All plywood and extruded aluminum signs will be identified with their sign numbers labelled on the back.

The Contractor shall maintain all signs installed as part of the work within the project area for the duration of the Work. Maintenance shall be performed for the duration of the work in accordance with the following:

- a) Sign maintenance shall include the straightening, replacing, repairing and cleaning of all signs installed under the work which are considered by the Ministry's Representative in need of repair and cleaning.
- b) The Contractor shall regularly inspect the signs to ensure consistent maintenance for maximum visibility.
- c) Where directed by the Ministry Representative the Contractor shall clean the signs by power washing or steam cleaning using pressures not exceeding 7 MPa and temperatures not exceeding 65°C. Chemical washing of sign faces will not be accepted.

All costs for installation and maintenance of signs shall be included in the prices for the applicable items.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



**PART B**

**UNDERGROUND  
DRAWINGS**



CONCRETE BASE INDEX			
TYPE	SP635 DRAWING	POLE TYPES	STYLE
A	1.1.2	TYPE 4 SHAFTS	SONOTUBE
B	1.1.2	TYPE 4A AND 5 SHAFTS	SONOTUBE
C	1.1.3	7.5m, 9.0m AND 11.0m LUMINAIRE POLES, TYPES 4, 4A AND 5 SHAFTS	TRAPEZOIDAL
D1	1.1.4 TO 1.1.6	13.5m LUMINAIRE POLES	SPREAD FOOTING
D2	1.1.7 & 1.1.8		TRAPEZOIDAL
D3	1.1.9 & 1.1.10		RECTANGULAR
E1	1.1.4 TO 1.1.6	TYPE 1 & 3 SHAFTS	SPREAD FOOTING
E2	1.1.7 & 1.1.8		TRAPEZOIDAL
E3	1.1.9 & 1.1.10		RECTANGULAR
F1	1.1.11 TO 1.1.13	TYPE 6 & 7 SHAFTS	SPREAD FOOTING
F2	1.1.14 & 1.1.15		TRAPEZOIDAL
F3	1.1.16 & 1.1.17		RECTANGULAR
S1	1.1.11 TO 1.1.13	TYPE S POLES	SPREAD FOOTING
S2	1.1.14 & 1.1.15		TRAPEZOIDAL
S3	1.1.16 & 1.1.17		RECTANGULAR
L1	1.1.11 TO 1.1.13	TYPE L POLES	SPREAD FOOTING
L2	1.1.14 & 1.1.15		TRAPEZOIDAL
L3	1.1.16 & 1.1.17		RECTANGULAR
M1	1.1.20 TO 1.1.22	TYPE M POLES	SPREAD FOOTING
M2	1.1.23 & 1.1.24		RECTANGULAR
H1	1.1.26 TO 1.1.28	TYPE H POLES	SPREAD FOOTING
H2	1.1.29 & 1.1.30		RECTANGULAR
—	1.1.32 TO 1.1.34	BREAKAWAY SIGN STRUCTURES	SPREAD FOOTING
—	1.1.35 & 1.1.36	SIGN POSTS BASES	SONOTUBE
—	1.1.37	POST MOUNTED FLASHER CONCRETE BASE	SONOTUBE
—	1.1.38 TO 1.1.41	CONTROLLER BASE	TRAPEZOIDAL
—	1.1.42 & 1.1.43	ANCHOR BOLT REPAIR PROCEDURES	—

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.



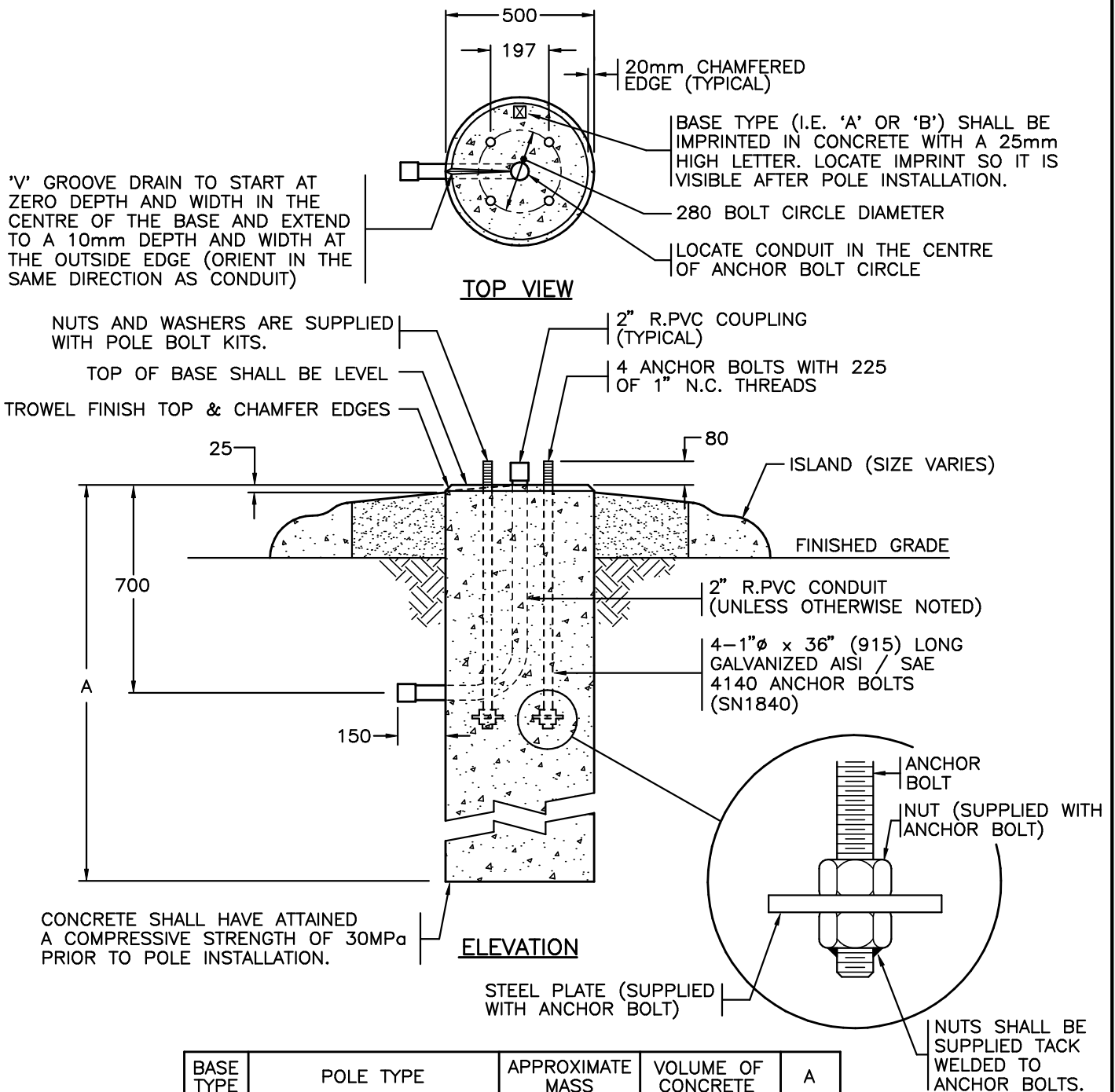
**BRITISH  
COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

No.	Revision	Date	CONCRETE BASE INDEX	
F				
E				
D				
C	TYPE S BASES ADDED	OCT 03	Date	Approved
B	DRAWING LIST REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635—1.1.1</b>
A	GENERAL REVISIONS	AUG 94		





BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A
A	TYPE 4 SHAFT	620 kg	0.24 m <sup>3</sup>	1200
B	TYPE 4A AND 5 SHAFTS	760 kg	0.30 m <sup>3</sup>	1500

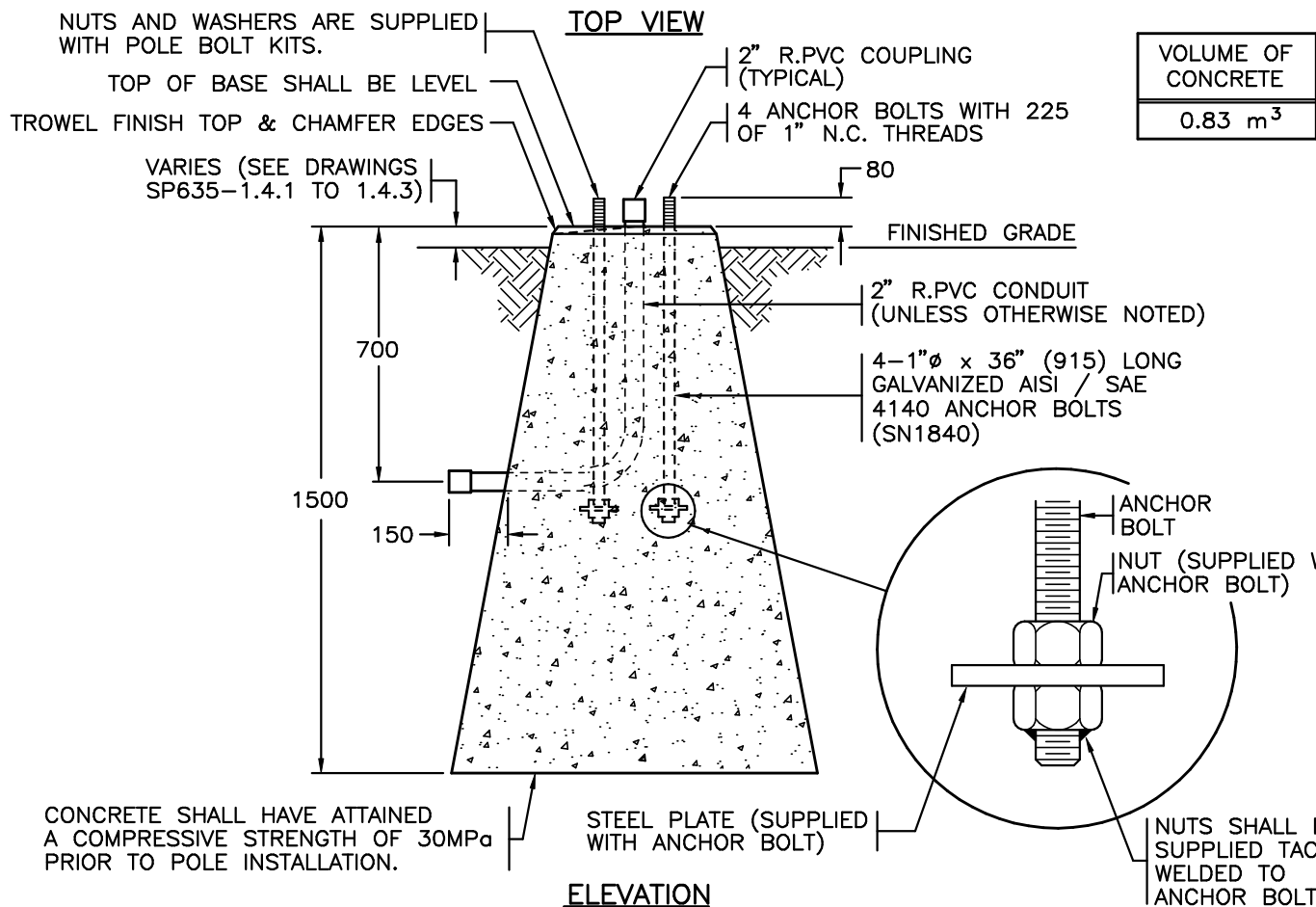
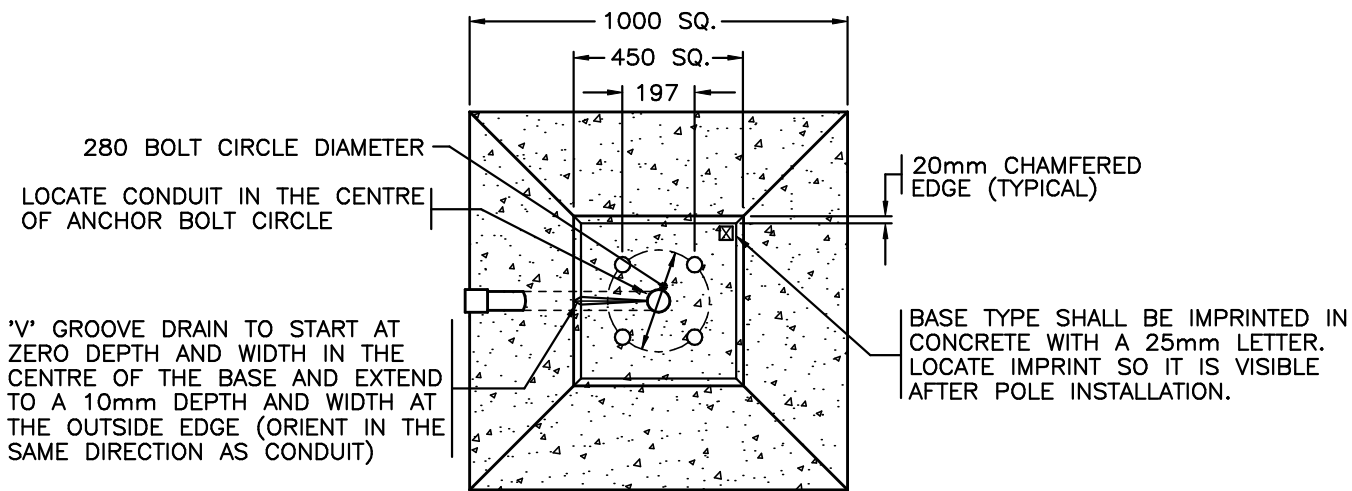
#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE

No.	Revision	Date	TYPES A AND B CONCRETE BASES (PRECAST OR POURED IN PLACE)	
F				
E				
D				
C				
B	NOTE 4 ADDED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date <b>30/09/93</b> Chief Highway Engineer	Approved <b>E.L. (Signature on File)</b> SPECIFICATION DRAWING No. <b>SP635-1.1.2</b>





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE

BASE TYPE	POLE TYPE	APPROXIMATE MASS
C	7.5m, 9.0m AND 11.0m LUMINAIRE POLES AND TYPES 4, 4A AND 5 SHAFTS	2000 kg



No.	Revision	Date	TYPE C CONCRETE BASE (PRECAST OR POURED IN PLACE)	
F				
E				
D				
C				
B	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date 30/09/93 E.L. (Signature on File) Chief Highway Engineer	APPROVED SPECIFICATION DRAWING No. SP635-1.1.3

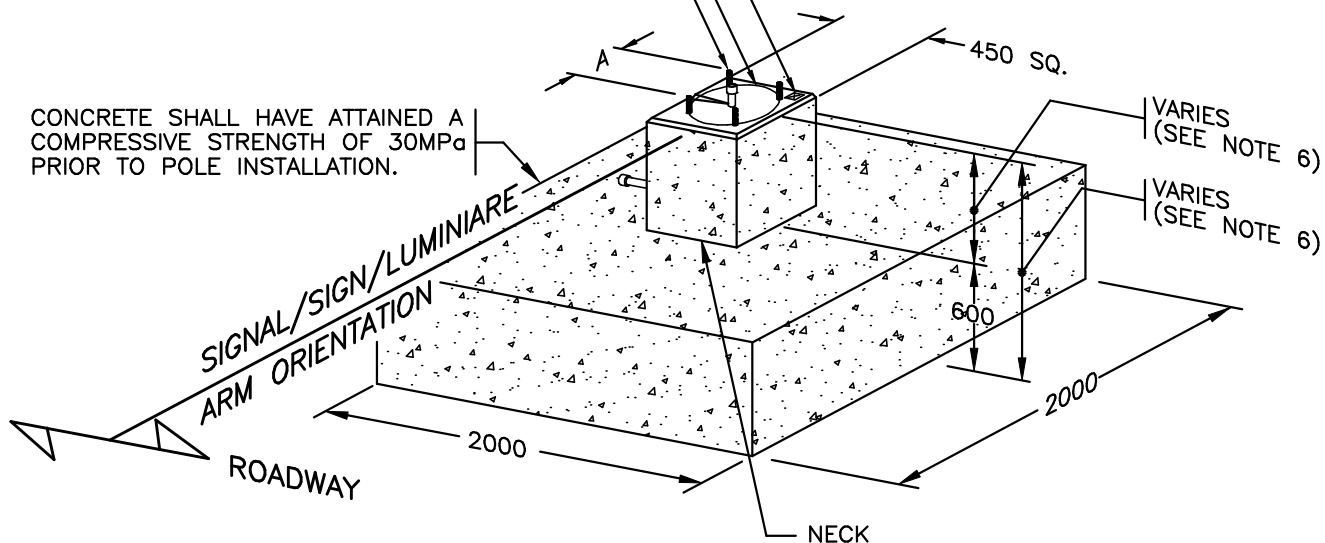


BASE TYPE (I.E. 'D1' OR 'E1') SHALL BE IMPRINTED IN CONCRETE WITH A 25mm HIGH LETTER. LOCATE IMPRINT SO IT IS VISIBLE AFTER POLE INSTALLATION.

B (ANCHOR BOLT CIRCLE)

C (ANCHOR BOLTS)

CONCRETE SHALL HAVE ATTAINED A COMPRESSIVE STRENGTH OF 30MPa PRIOR TO POLE INSTALLATION.



### CONCRETE SPREAD FOOTING

BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	FORMWORK	APPROXIMATE MASS	A	B	C (ANCHOR BOLTS)
D1	13.5m LUMINAIRE POLES	2.7 m <sup>3</sup> *	260 kg *	7.3 m <sup>2</sup> *	6600 kg*	216	305	4-1 1/4"Ø x 48" (1220) GALVANIZED AISI / SAE 4140 (SN1851)
E1	TYPE 1 AND 3 SHAFTS	2.7 m <sup>3</sup> *	260 kg *	7.3 m <sup>2</sup> *	6600 kg*	197	280	4-1"Ø x 36" (915) GALVANIZED AISI / SAE 4140 (SN1840)

(\*) BASED ON SPREAD FOOTING WITH 1400 HIGH NECK

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE PLANS FOR SIGNAL/SIGN/LUMINAIRE ARM ORIENTATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- SEE DRAWINGS SP635-1.1.5, 1.1.6 & 1.4.5 FOR ADDITIONAL DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- NECK HEIGHT MAY VARY FROM 750 TO 1400. SEE DRAWING SP635-1.4.5 FOR MORE INFORMATION.

BASE DESIGNED FOR SOILS WITH A MINIMUM BEARING PRESSURE OF 100KPa

NOT TO SCALE

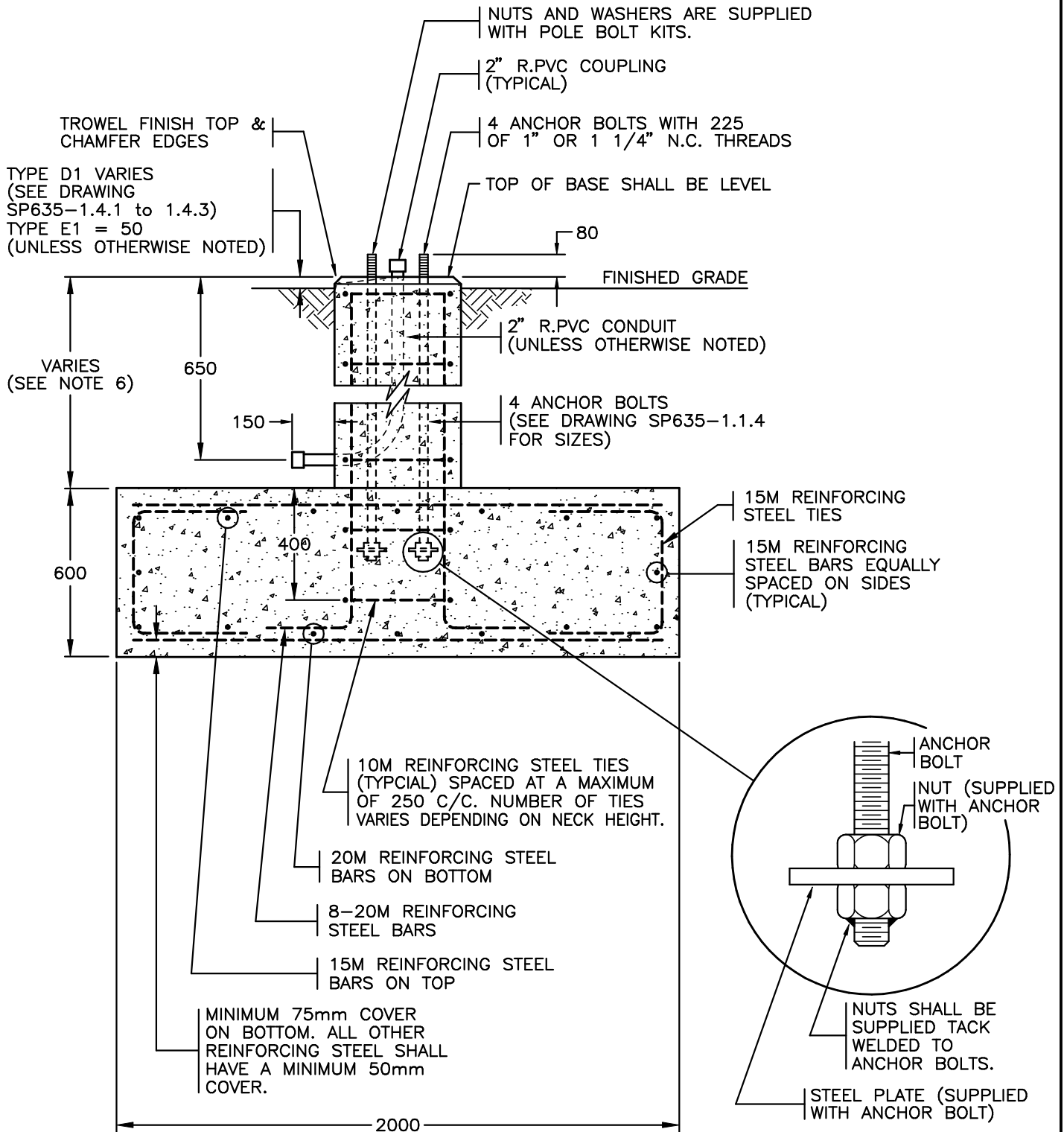


**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE D1 & E1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE OR PRECAST)	
F				
E				
D				
C				
B				
A				
			Date 15/11/95 M.C. (Signature on File) Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-1.1.4





**ELEVATION**

SEE DRAWING SP635-1.1.4 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

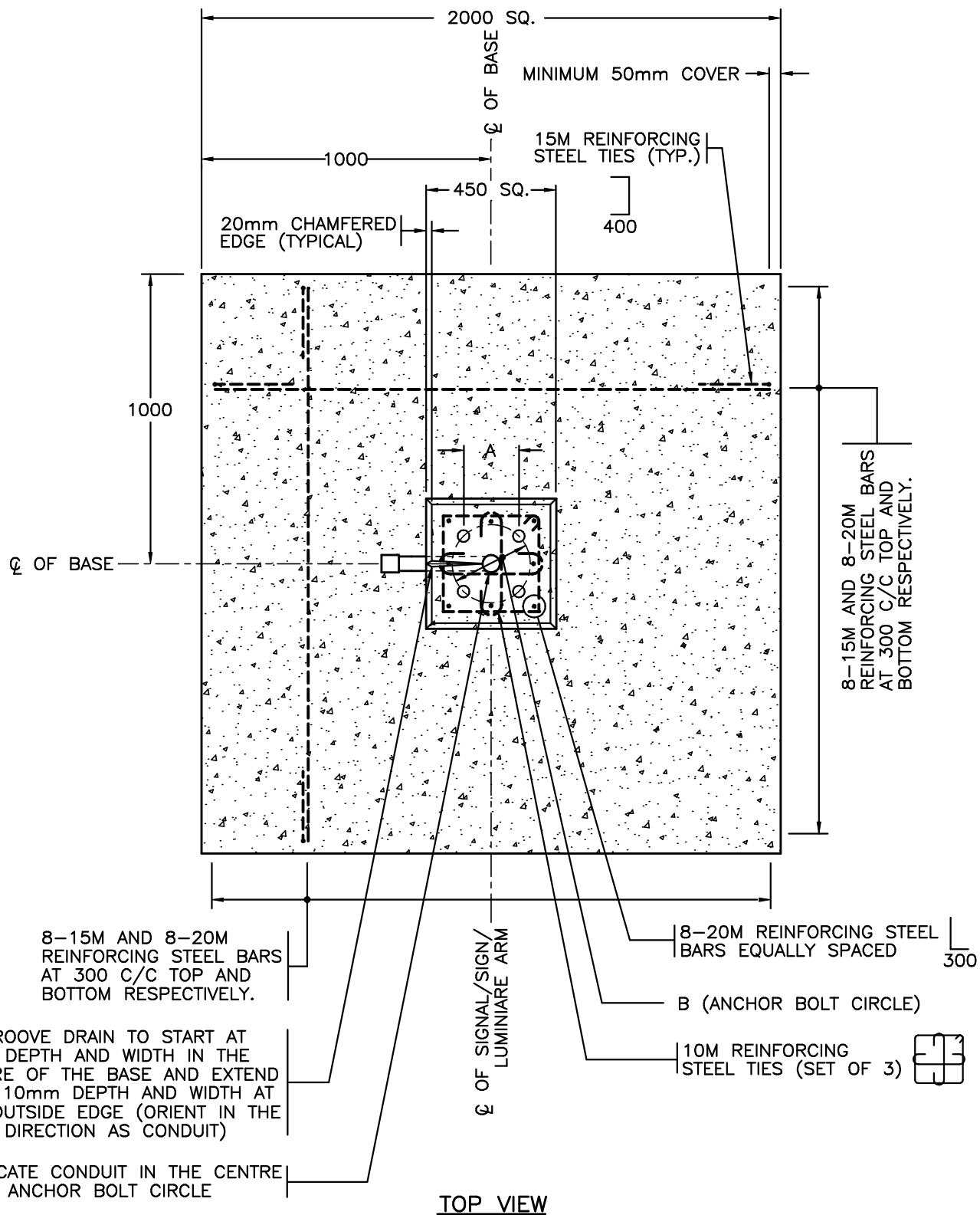


**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE D1 & E1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE OR PRECAST)		
F			Date Approved  <b>15/11/95    M.C. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635—1.1.5
E					
D					
C					
B					
A	ELEVATION OF BASE TO FINISHED GRADE REV'D	AUG 96			





SEE DRAWING SP635-1.1.4 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE D1 & E1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE OR PRECAST)	
F			Date	Approved
E				
D			<b>15/11/95</b> <b>M.C. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.1.6</b>
C				
B				
A				



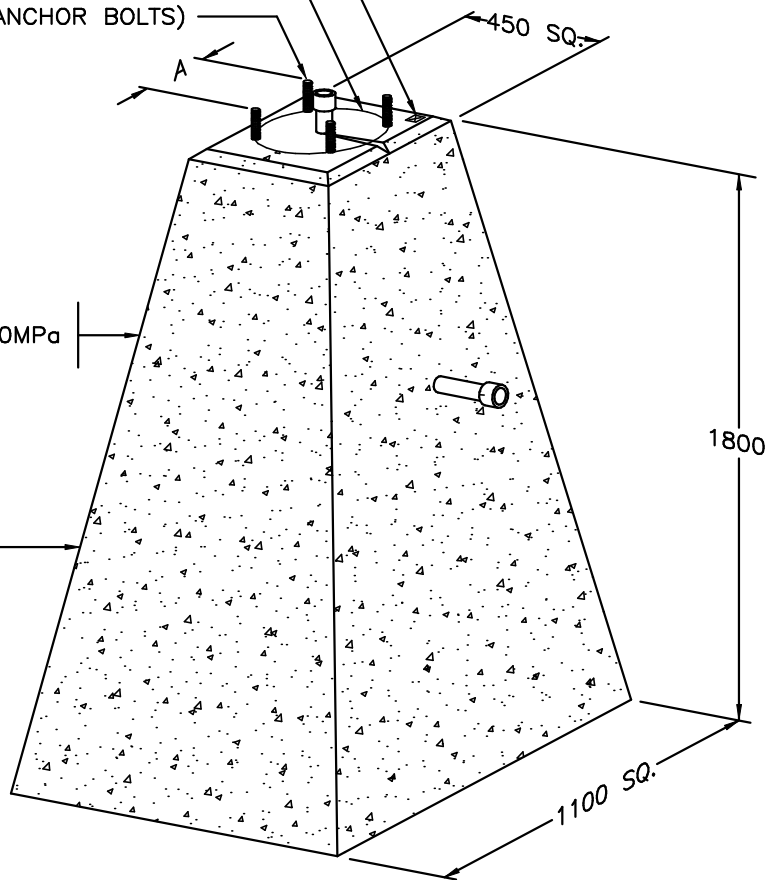
BASE TYPE (I.E. 'D2' OR 'E2') SHALL BE IMPRINTED IN CONCRETE WITH A 25mm HIGH LETTER. LOCATE IMPRINT SO IT IS VISIBLE AFTER POLE INSTALLATION.

B (ANCHOR BOLT CIRCLE)

C (ANCHOR BOLTS)

CONCRETE SHALL HAVE ATTAINED A COMPRESSIVE STRENGTH OF 30MPa PRIOR TO POLE INSTALLATION.

SEE DRAWING SP635-1.1.8 FOR REBAR DETAILS



### PRECAST CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C (ANCHOR BOLTS)
D2	13.5m LUMINAIRE POLES	2450 kg	1.0 m <sup>3</sup>	216	305	4-1 1/4" $\phi$ x 48" (1220) GALVANIZED AISI / SAE 4140 (SN1851)
E2	TYPE 1 AND 3 SHAFTS	2410 kg	1.0 m <sup>3</sup>	197	280	4-1" $\phi$ x 36" (915) GALVANIZED AISI / SAE 4140 (SN1840)

#### NOTES

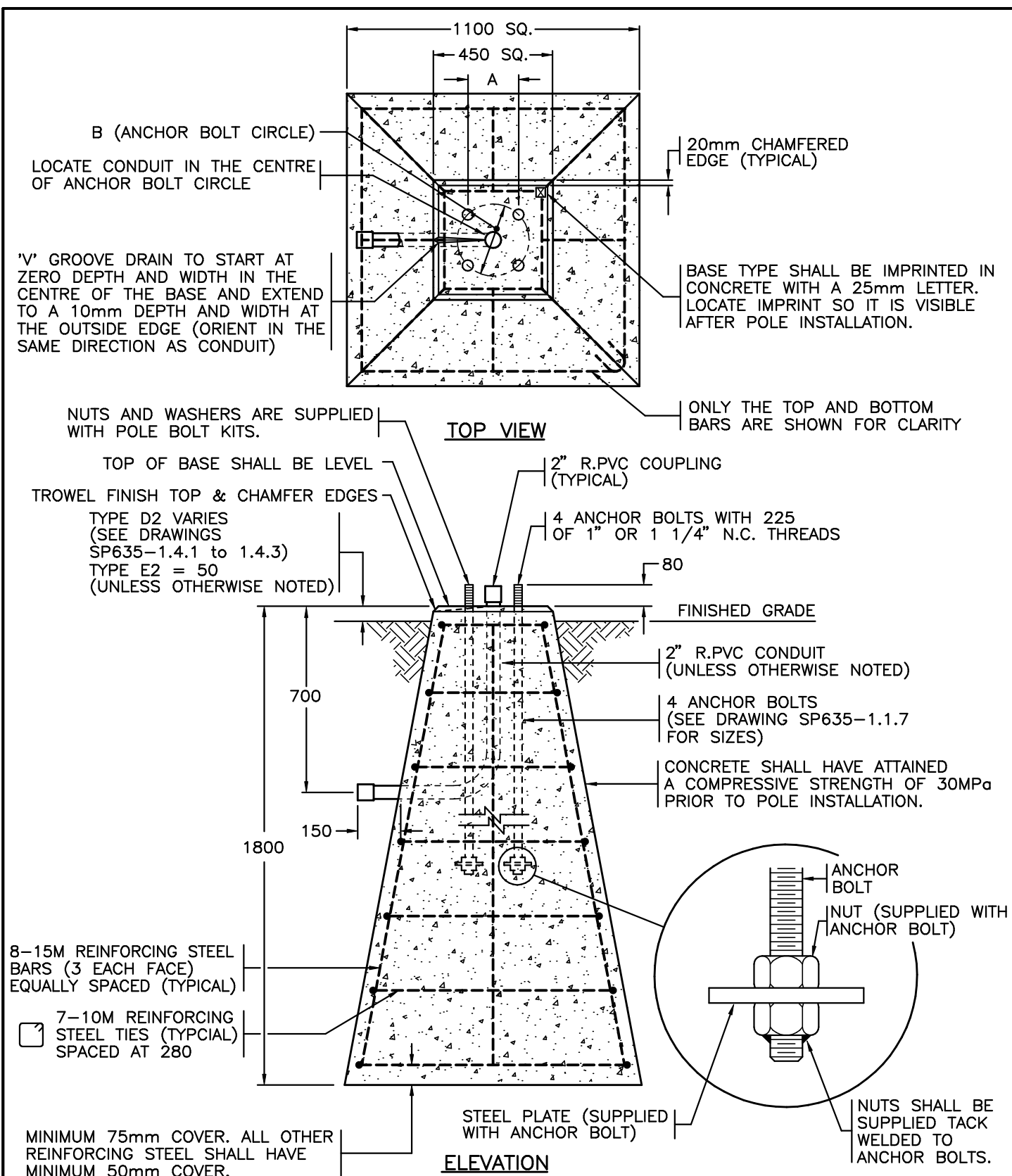
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- SEE DRAWING SP635-1.1.8 FOR ADDITIONAL DETAILS.
- SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE



No.	Revision	Date	TYPES D2 AND E2 CONCRETE BASES (PRECAST)		
F			Date Approved		
E					
D			Date Approved		
C	REBAR DRAWING REFERENCE REVISED	AUG 96			
B	DRAWING NUMBER CHANGED	AUG 95	30/09/93 E.L. (Signature on File) Chief Highway Engineer		
A	GENERAL REVISIONS	AUG 94			
			SPECIFICATION DRAWING No. SP635-1.1.7		





SEE DRAWING SP635-1.1.7 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

No.	Revision	Date	TYPE D2 AND E2 CONCRETE BASES (PRECAST)	
F				
E				
D				
C	ELEVATION OF BASE TO FINISHED GRADE REV'D	AUG 96	Date	Approved
B	REBAR ADDED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. <b>SP635-1.1.8</b>	



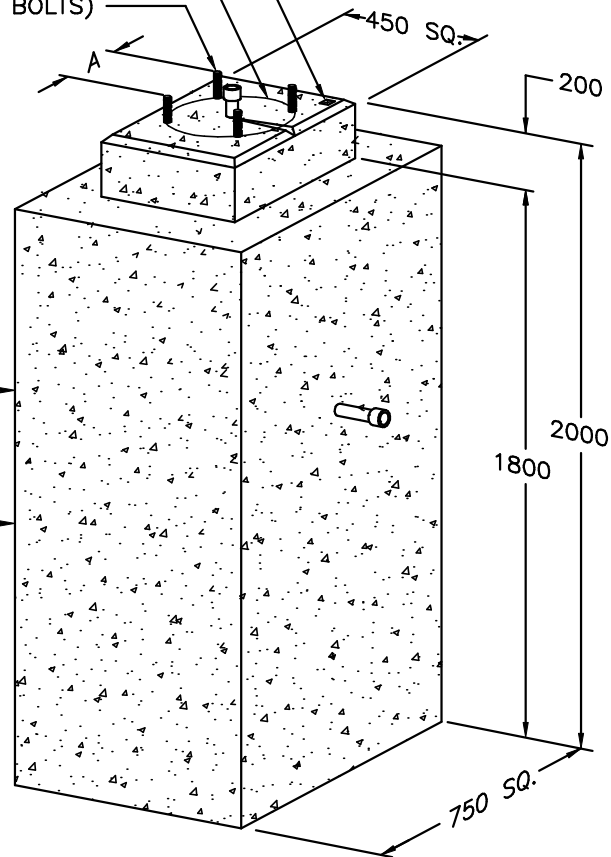
BASE TYPE (I.E. 'D3' OR 'E3') SHALL BE IMPRINTED IN CONCRETE WITH A 25mm HIGH LETTER. LOCATE IMPRINT SO IT IS VISIBLE AFTER POLE INSTALLATION.

B (ANCHOR BOLT CIRCLE)

C (ANCHOR BOLTS)

CONCRETE SHALL HAVE ATTAINED A COMPRESSIVE STRENGTH OF 30MPa PRIOR TO POLE INSTALLATION.

SEE DRAWING SP635-1.1.10 FOR REBAR DETAILS.



### POURED IN PLACE CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C (ANCHOR BOLTS)
D3	13.5m LUMINAIRE POLES	2550 kg	1.05 m <sup>3</sup>	216	305	4-1 1/4" $\phi$ x 48" (1220) GALVANIZED AISI / SAE 4140 (SN1851)
E3	TYPE 1 AND 3 SHAFTS	2510 kg	1.05 m <sup>3</sup>	197	280	4-1" $\phi$ x 36" (915) GALVANIZED AISI / SAE 4140 (SN1840)

#### NOTES

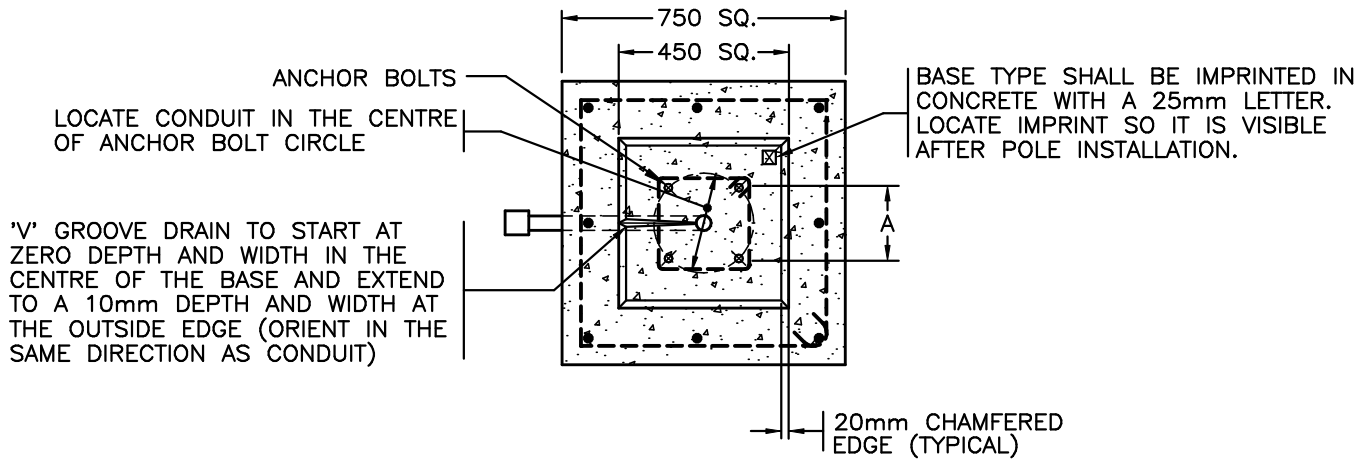
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. SEE DRAWINGS SP635-1.1.10 FOR ADDITIONAL DETAILS.
5. SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE

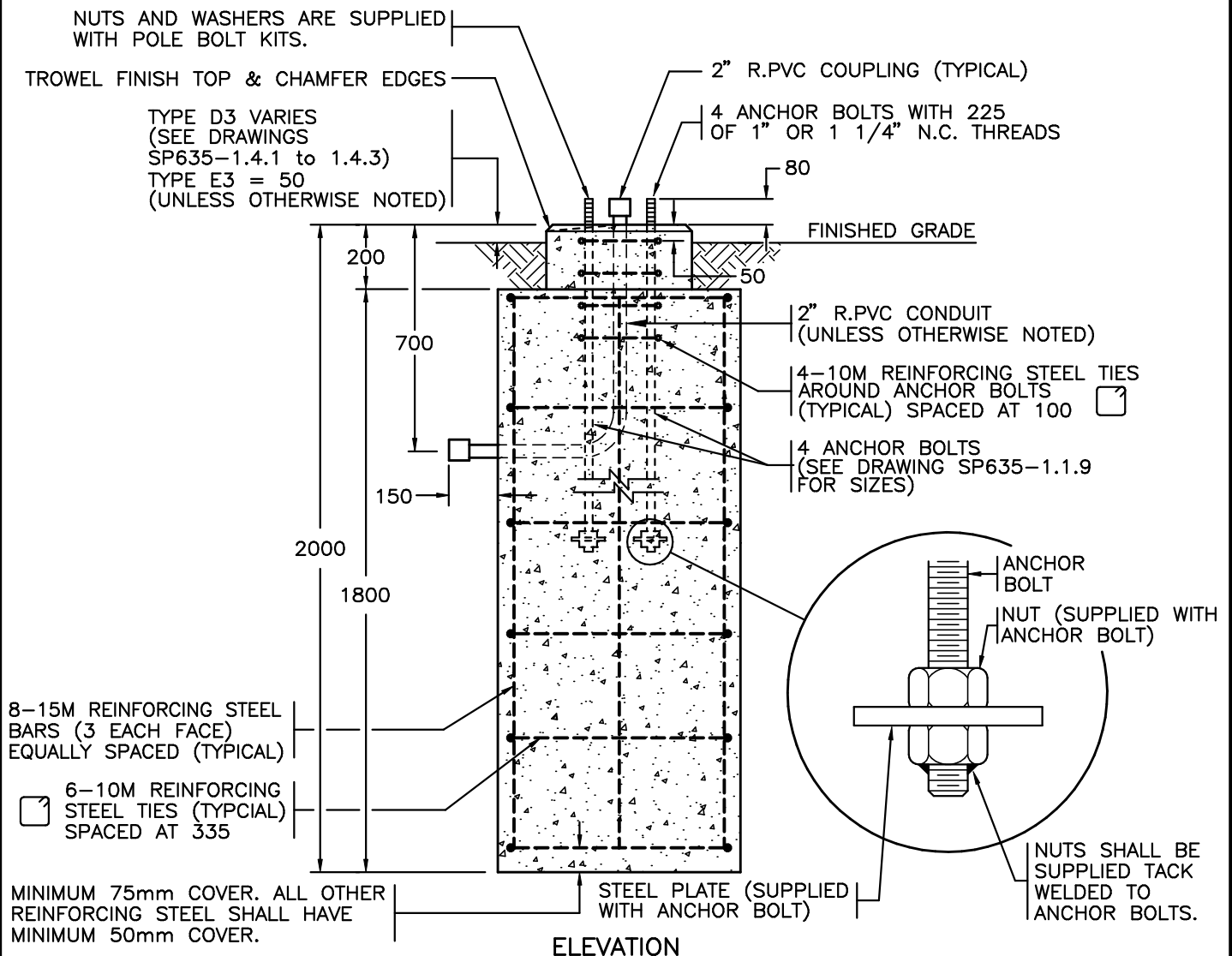


No.	Revision	Date	TYPE D3 AND E3 CONCRETE BASES (POURED IN PLACE)		
F			Date Approved		
E					
D			Date Approved		
C					
B	DRAWING NUMBER CHANGED	AUG 95	30/09/93 E.L. (Signature on File) Chief Highway Engineer		
A	GENERAL REVISIONS	AUG 94			
			SPECIFICATION DRAWING No. SP635-1.1.9		





**PLAN VIEW**



**ELEVATION**

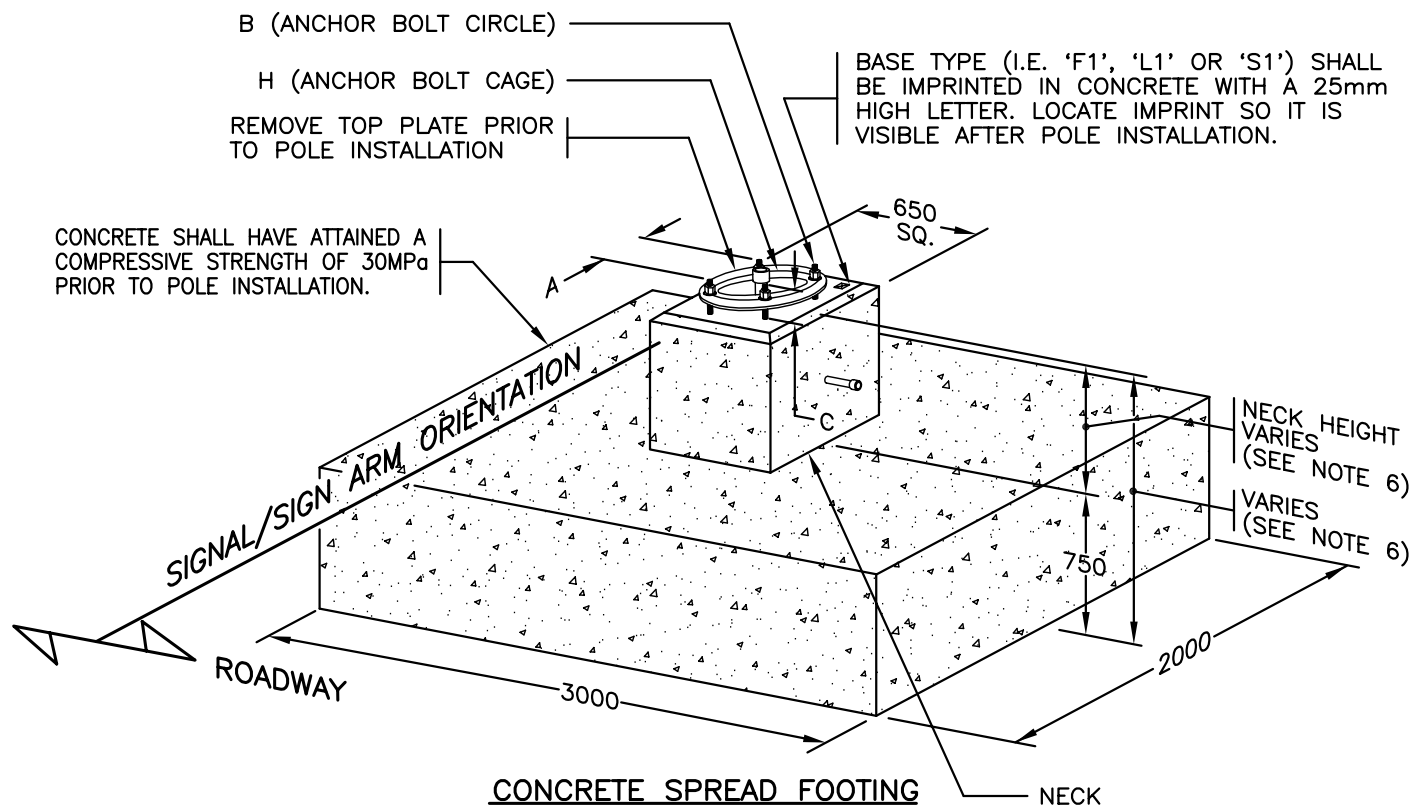
SEE DRAWING SP635-1.1.9 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



No.	Revision	Date	TYPE D3 AND E3 CONCRETE BASES (POURED IN PLACE)		SPECIFICATION DRAWING No.
F			Date 30/09/93 E.L. (Signature on File) Chief Highway Engineer		SP635-1.1.10
E					
D			Approved		
C	ELEVATION OF BASE TO FINISHED GRADE REV'D	AUG 96			
B	REBAR ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94			





BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	APPROXIMATE MASS	FORMWORK	A	B	C	H (ANCHOR BOLTS)
F1	TYPE 6 AND 7 SIGNAL POLES	5.0m <sup>3</sup>	455 kg*	12306 kg*	11.0m <sup>2</sup>	243	343	160	4-1"Ø x 48" (1220) GALVANIZED GRADE 150 DYWIDAG (SN1841A) PRE-ASSEMBLED IN A CAGE
S1	TYPE S SIGNAL POLES	5.0m <sup>3</sup>	455 kg*	12306 kg*	11.0m <sup>2</sup>	243	343	160	4-1"Ø x 48" (1220) GALVANIZED GRADE 150 DYWIDAG (SN1841A) PRE-ASSEMBLED IN A CAGE
L1	TYPE L SIGNAL POLES	5.0m <sup>3</sup>	455 kg*	12306 kg*	11.0m <sup>2</sup>	276	390	140	4-1 1/2"Ø x 54" (1370) GALVANIZED AISI / SAE 4140 (SN1839L) PRE-ASSEMBLED IN A CAGE

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE PLANS FOR SIGNAL/SIGN ARM ORIENTATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- SEE DRAWINGS SP635-1.1.12, 1.1.13 & 1.4.5 FOR ADDITIONAL DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- NECK HEIGHT MAY VARY FROM 750 TO 1400. SEE DRAWING SP635-1.4.5 FOR MORE INFORMATION.

NOT TO SCALE

BASE DESIGNED FOR SOILS WITH A MINIMUM BEARING PRESSURE OF 100KPa



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E		
D		
C		
B		
A	TYPE S1 BASE ADDED	OCT 03

### TYPE F1, L1 & S1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE)

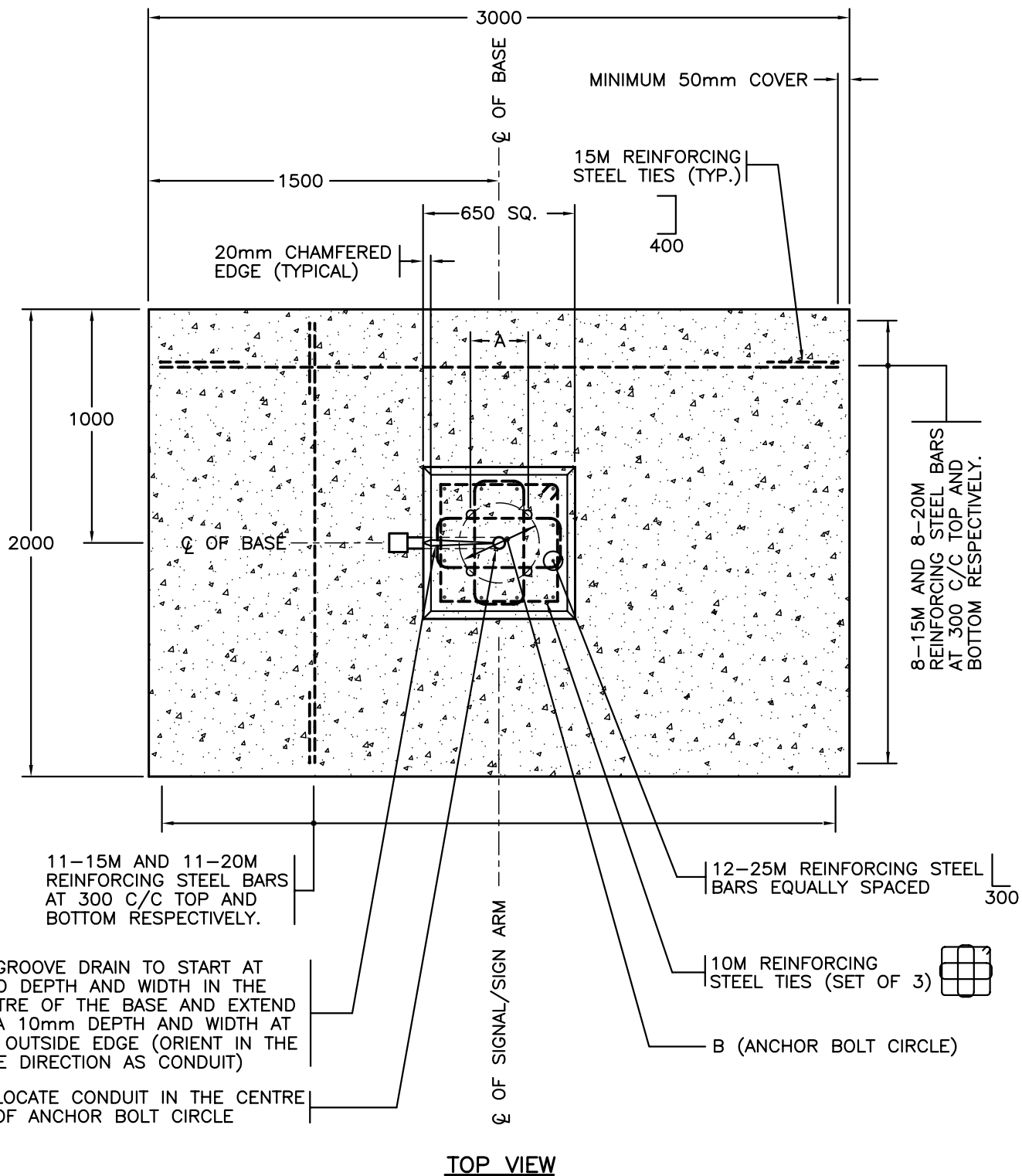
Date \_\_\_\_\_ Approved \_\_\_\_\_  
**15/11/95 M.C. (Signature on File)**  
 Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.1.11**



No.	Revision	Date	TYPE F1, L1 & S1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE)		
F			Date Approved  <b>15/11/95 M.C. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  <b>SP635-1.1.12</b>
E					
D					
C					
B	TYPE S1 BASE ADDED	OCT 03			
A	ELEVATION OF BASE TO FINISHED GRADE REV'D	AUG 96			





SEE DRAWING SP635-1.1.11 FOR NOTES AND ADDITIONAL DETAILS



**BRITISH COLUMBIA**

Ministry of Transportation

NOT TO SCALE

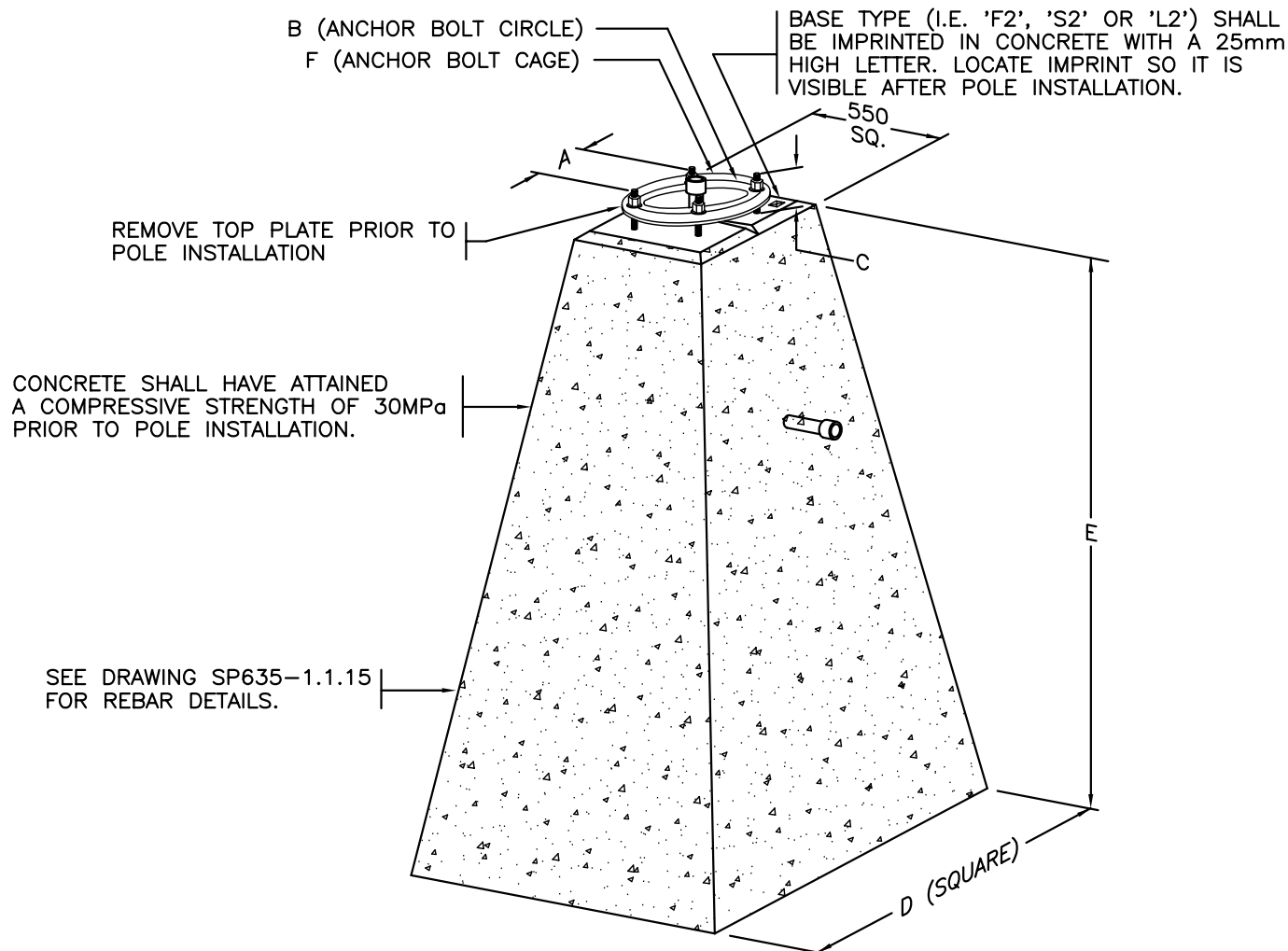
No.	Revision	Date
F		
E		
D		
C		
B		
A	TYPE S1 BASE ADDED	OCT 03

# TYPE F1, L1 & S1 CONCRETE SPREAD FOOTINGS (POURED IN PLACE)

Date Approved  
**15/11/95 M.C. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.1.13**





### PRECAST CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C	D	E	F (ANCHOR BOLTS)
F2	TYPE 6 AND 7 SHAFTS	4500 kg	1.8 m <sup>3</sup>	243	343	160	1240	2100	4-1" $\phi$ x 48" (1220) GALVANIZED GRADE 150 DYWIDAG (SN1841A) PRE-ASSEMBLED IN A CAGE
S2	TYPE S POLES	4500 kg	1.8 m <sup>3</sup>	243	343	160	1240	2100	4-1" $\phi$ x 48" (1220) GALVANIZED GRADE 150 DYWIDAG (SN1841A) PRE-ASSEMBLED IN A CAGE
L2	TYPE L POLES	5040 kg	2.0 m <sup>3</sup>	276	390	140	1300	2300	4-1 1/2" $\phi$ x 54" (1370) GALVANIZED AISI/SAE 4140 (SN1839L) PRE-ASSEMBLED IN A CAGE

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. SEE DRAWING SP635-1.1.15 FOR ADDITIONAL DETAILS.
5. SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE

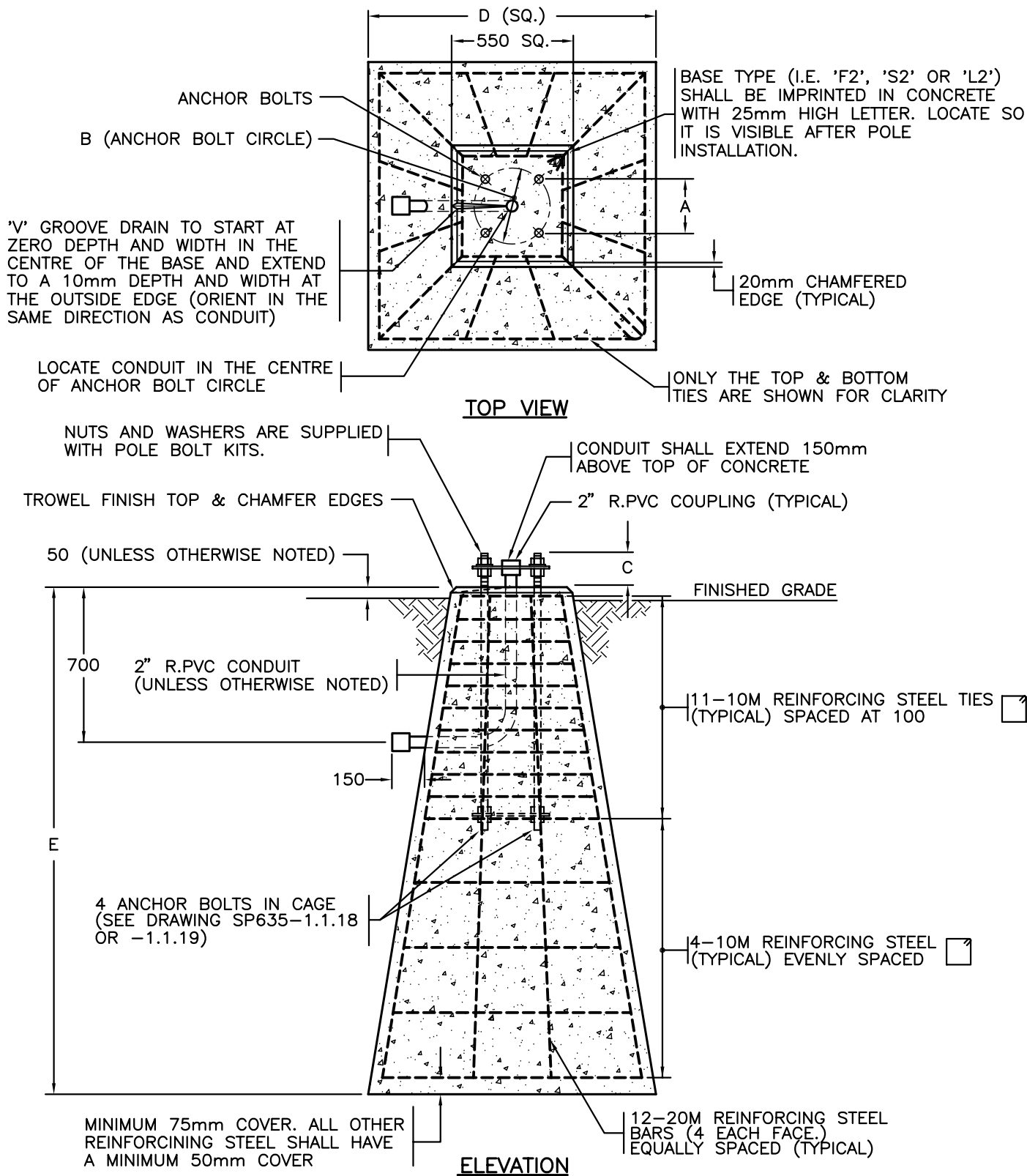


**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE F2, L2 AND S2 CONCRETE BASES (PRECAST)		
F					
E			Date Approved		
D					
C	TYPE S2 BASE ADDED	OCT 03	30/09/93 E.L. (Signature on File) Chief Highway Engineer		
B	DRAWING NUMBER CHANGED	AUG 95			
A	GENERAL REVISIONS	AUG 94			
			SPECIFICATION DRAWING No. SP635-1.1.14		





SEE DRAWING SP635-1.1.14 FOR NOTES AND ADDITIONAL DETAILS



**BRITISH COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

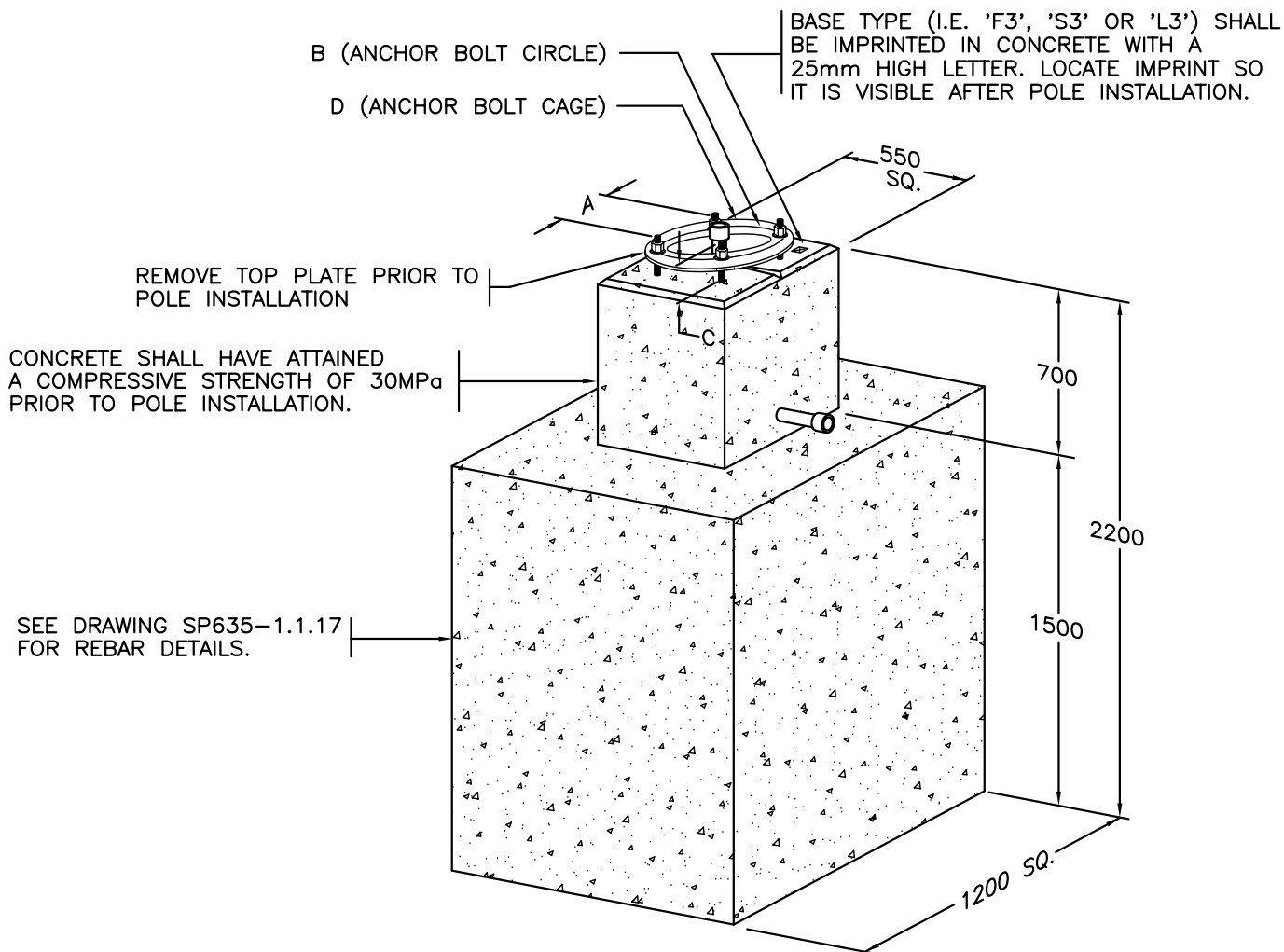
No.	Revision	Date
F		
E		
D	TYPE S2 BASE ADDED	OCT 03
C	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 96
B	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

## TYPE F2, L2 AND S2 CONCRETE BASES (PRECAST)

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.1.15**





### POURED IN PLACE CONCRETE BASES

BASE TYPE	POLE TYPE	APPROXIMATE MASS	VOLUME OF CONCRETE	A	B	C	D (ANCHOR BOLTS)
F3	TYPE 6 AND 7 SHAFTS	5925 kg	2.37m <sup>3</sup>	243	343	160	4-1" $\phi$ x 48" (1220) GALVANIZED GRADE 150 DYWIDAG BOLTS PRE-ASSEMBLED IN A CAGE (SN1841A)
S3	TYPE S POLES	5925 kg	2.37m <sup>3</sup>	243	343	160	4-1" $\phi$ x 48" (1220) GALVANIZED GRADE 150 DYWIDAG BOLTS PRE-ASSEMBLED IN A CAGE (SN1841A)
L3	TYPE L POLES	5965 kg	2.37m <sup>3</sup>	276	390	140	4-1 1/2" $\phi$ x 54" (1370) GALVANIZED AISI / SAE 4140 BOLTS PRE-ASSEMBLED IN A CAGE (SN1839L)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. SEE DRAWING SP635-1.1.17 FOR ADDITIONAL DETAILS.
5. SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE



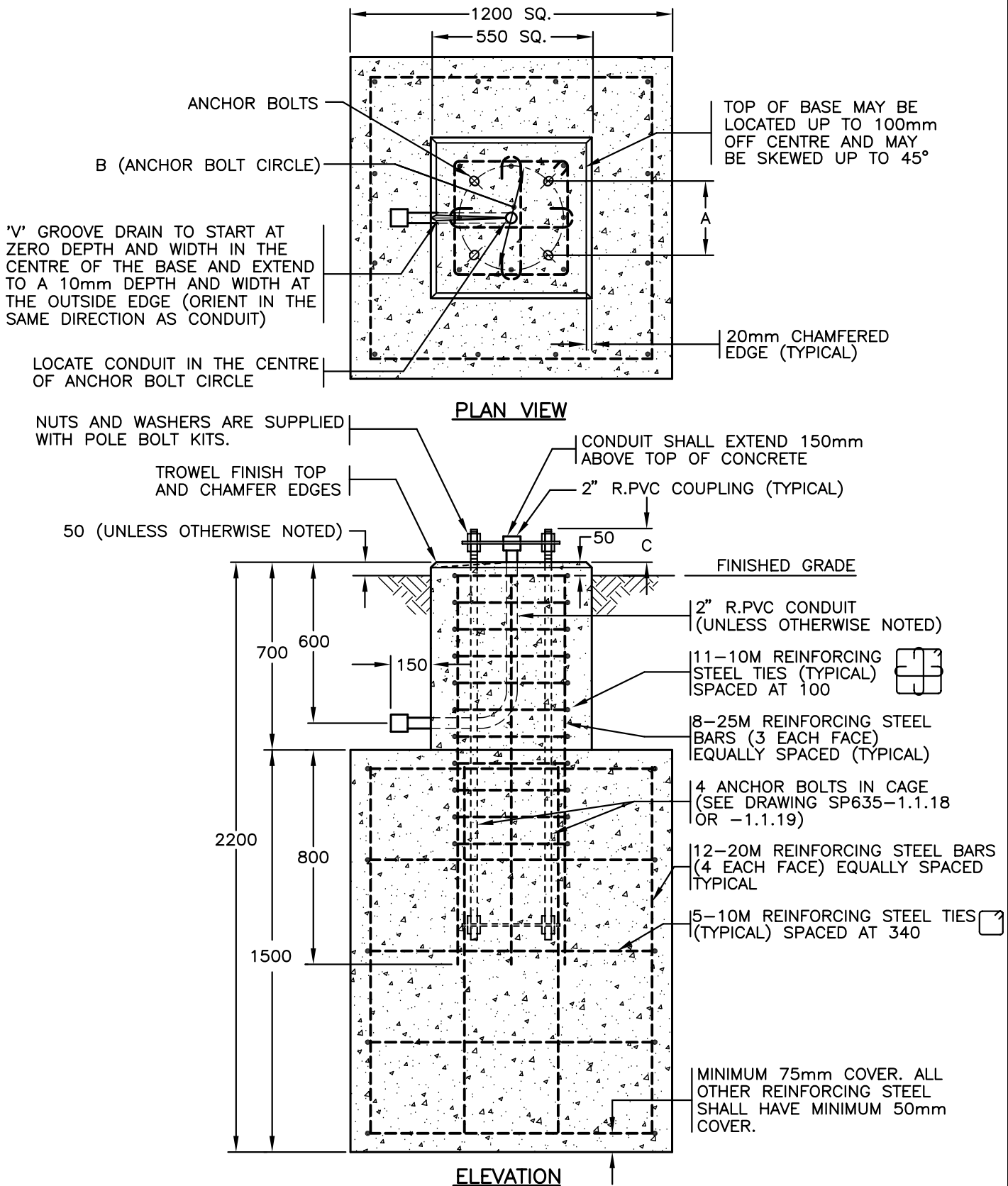
**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE F3, L3 & S3 CONCRETE BASES (POURED IN PLACE)		
F			Date Approved		
E					
D			Date Approved		
C	TYPE S3 BASE ADDED	OCT 03			
B	DRAWING NUMBER CHANGED	AUG 95	SPECIFICATION DRAWING No. <b>SP635-1.1.16</b>		
A	GENERAL REVISIONS	AUG 94			

**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer





SEE DRAWING SP635-1.1.16 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

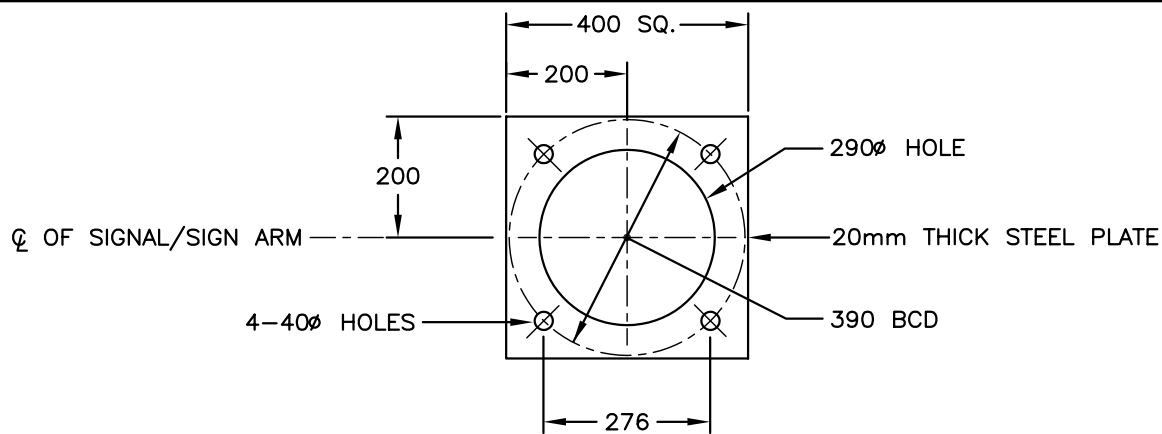


**BRITISH COLUMBIA**

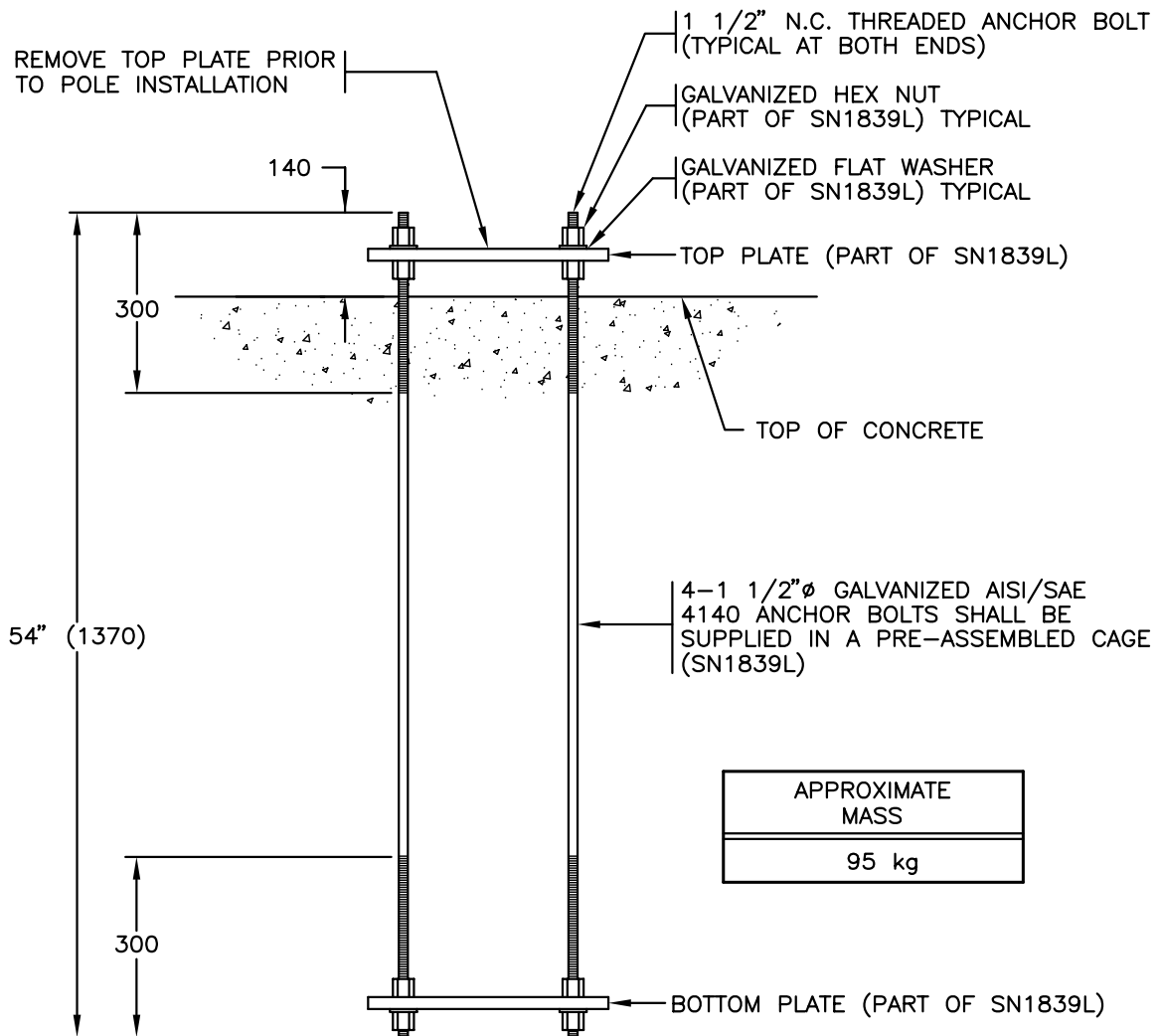
Ministry of  
Transportation

No.	Revision	Date	TYPE F3, L3 & S3 CONCRETE BASES (POURED IN PLACE)		
F					
E					
D	TYPE S3 BASE ADDED	OCT 03	Date	Approved	SPECIFICATION
C	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 96			DRAWING No.
B	NECK WIDTH REVISED & REBAR ADDED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635—1.1.17
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





**TOP AND BOTTOM PLATES**



**ANCHOR BOLT CAGE**  
SN1839L

SEE DRAWINGS SP635-1.1.11, 1.1.14 AND 1.1.16 FOR NOTES AND ADDITIONAL DETAILS



**BRITISH COLUMBIA**

Ministry of Transportation

NOT TO SCALE

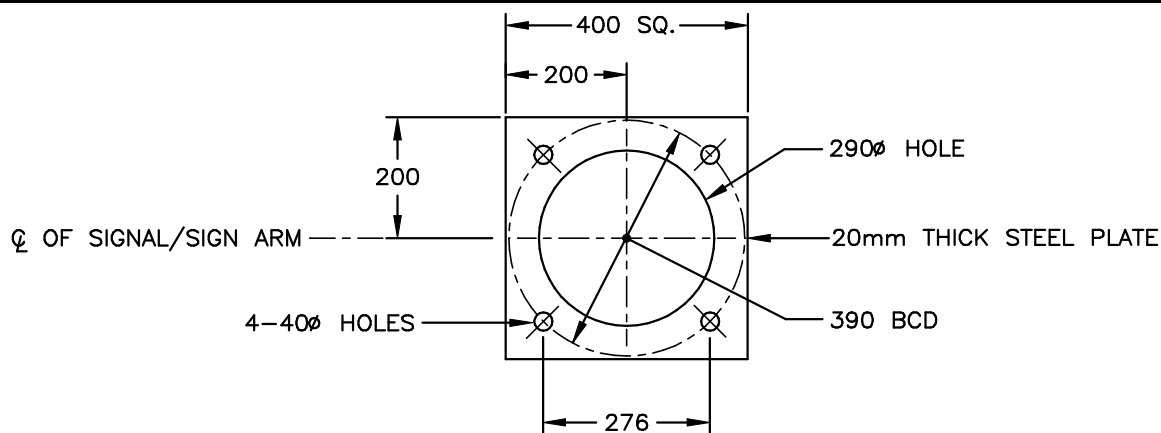
No.	Revision	Date
F		
E		
D		
C	TOP PLATE NOTE REVISED	OCT 03
B	HOLE SIZE IN PLATE REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

**ANCHOR BOLT CAGE  
FOR TYPE L POLES**

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

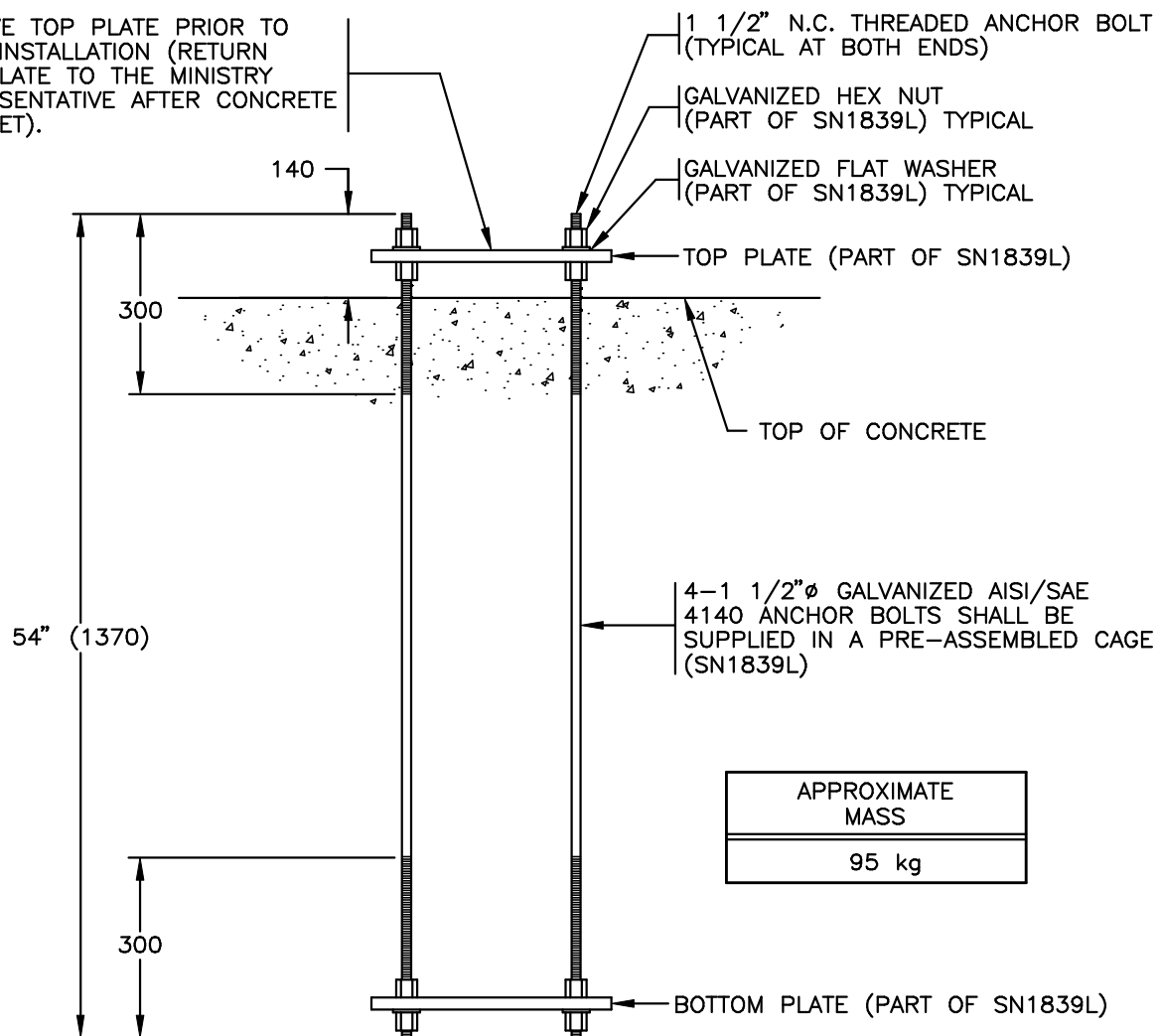
SPECIFICATION  
DRAWING No.  
**SP635-1.1.19**





**TOP AND BOTTOM PLATES**

REMOVE TOP PLATE PRIOR TO POLE INSTALLATION (RETURN TOP PLATE TO THE MINISTRY REPRESENTATIVE AFTER CONCRETE HAS SET).



**ANCHOR BOLT CAGE**  
SN1839L

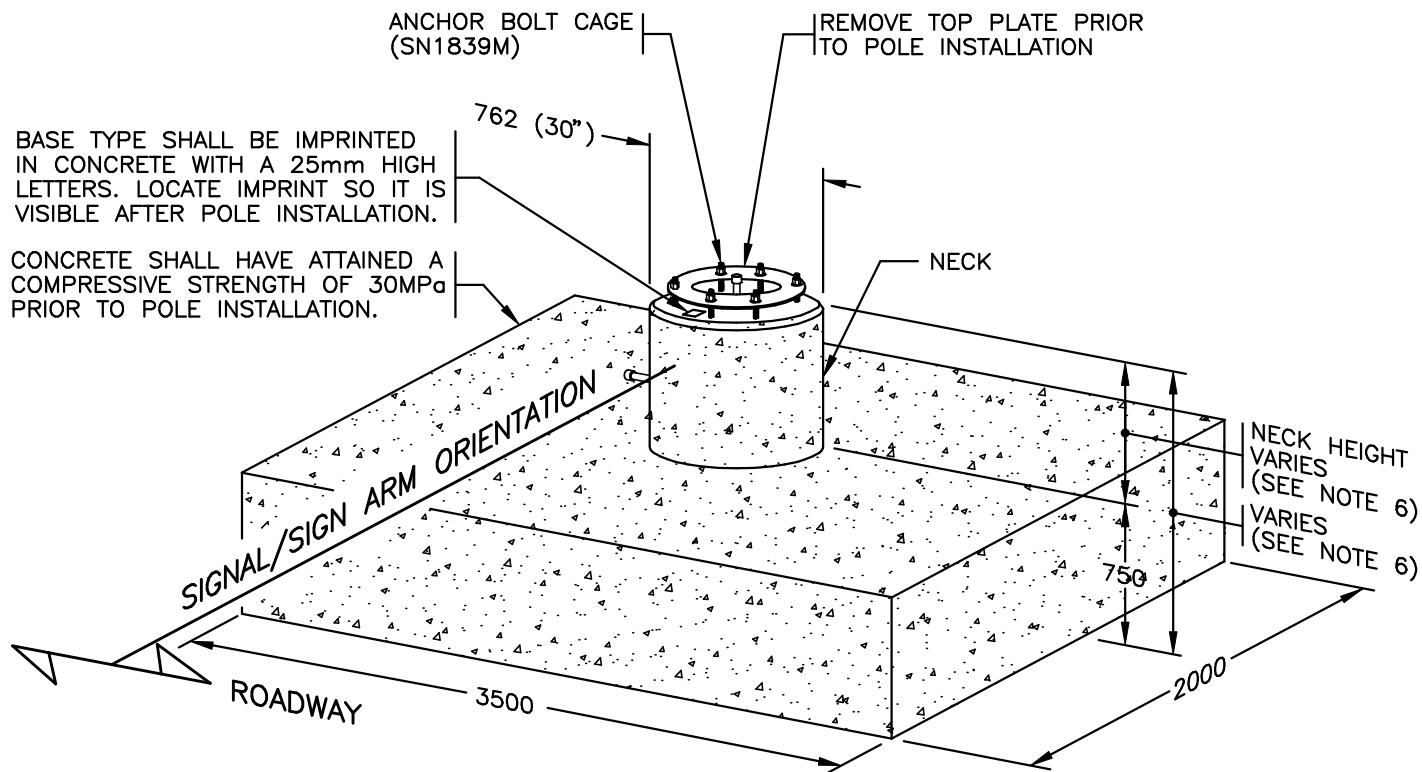
SEE DRAWINGS SP635-1.1.11, 1.1.14 AND 1.1.16 FOR NOTES AND ADDITIONAL DETAILS



NOT TO SCALE

No.	Revision	Date	ANCHOR BOLT CAGE FOR TYPE L POLES		
F			Date Approved		SPECIFICATION DRAWING No.  SP635—1.1.19
E					
D					
C					
B	HOLE SIZE IN PLATE REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94	30/09/93 E.L. (Signature on File) Chief Highway Engineer		





### CONCRETE SPREAD FOOTING

BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	FORMWORK	APPROXIMATE MASS
M1	TYPE M POLES	5.90 m <sup>3</sup> *	540 kg *	11.6 m <sup>2</sup> *	14400 kg *

(\*) BASED ON SPREAD FOOTING WITH 1400 HIGH NECK

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE PLANS FOR SIGNAL/SIGN ARM ORIENTATION.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. SEE DRAWINGS SP635-1.1.21, 1.1.22 & 1.4.5 FOR ADDITIONAL DETAILS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. NECK HEIGHT MAY VARY FROM 750 TO 2000. SEE DRAWING SP635-1.4.5 FOR MORE INFORMATION.

BASE DESIGNED FOR SOILS WITH  
A MINIMUM BEARING PRESSURE  
OF 100KPa

NOT TO SCALE

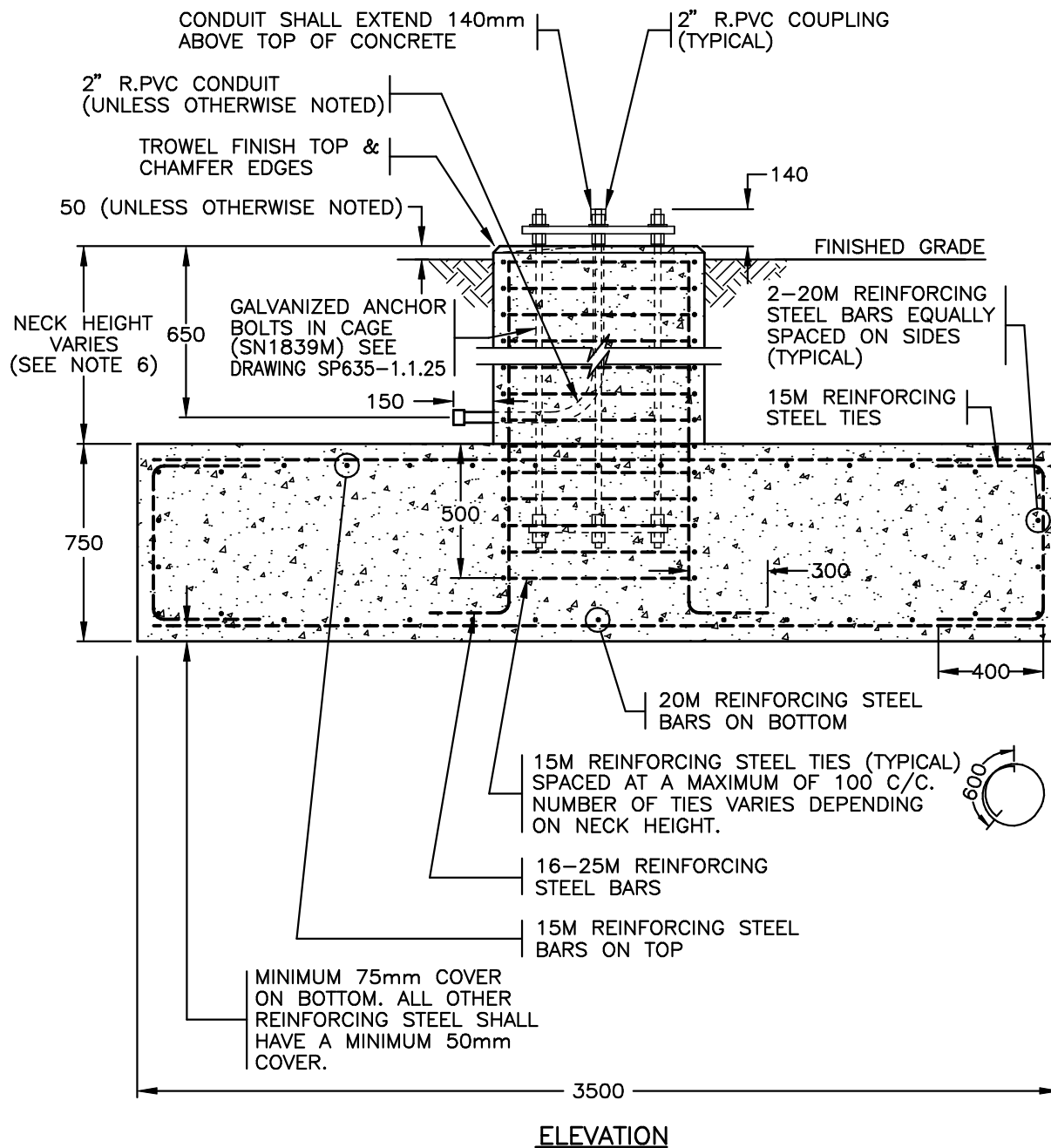


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE M1 CONCRETE SPREAD FOOTING (POURED IN PLACE)		
F					
E					
D					
C	NECK HEIGHT REVISED	AUG 96			
B	NECK HEIGHT REVISED & REBAR ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-1.1.20
			Chief Highway Engineer		





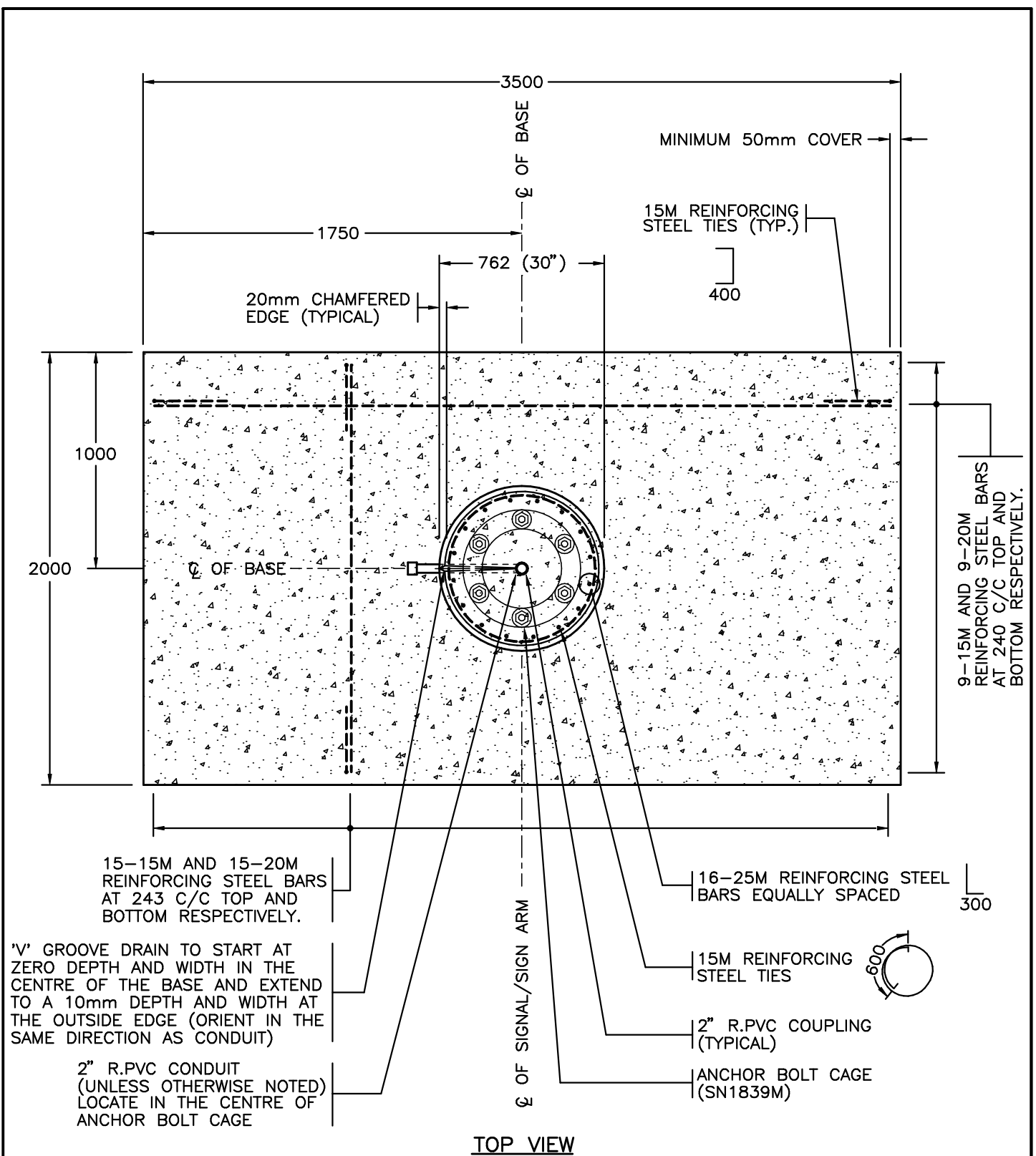
SEE DRAWING SP635-1.1.20 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



No.	Revision	Date	TYPE M1 CONCRETE SPREAD FOOTING (POURED IN PLACE)		
F			Date Approved		SPECIFICATION DRAWING No.  SP635—1.1.21
E					
D					
C	REBAR IN NECK & BASE ELEVATION REVISED	AUG 96			
B	NECK HEIGHT REVISED & REBAR ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94	30/09/93 E.L. (Signature on File) Chief Highway Engineer		





SEE DRAWING SP635-1.1.20 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

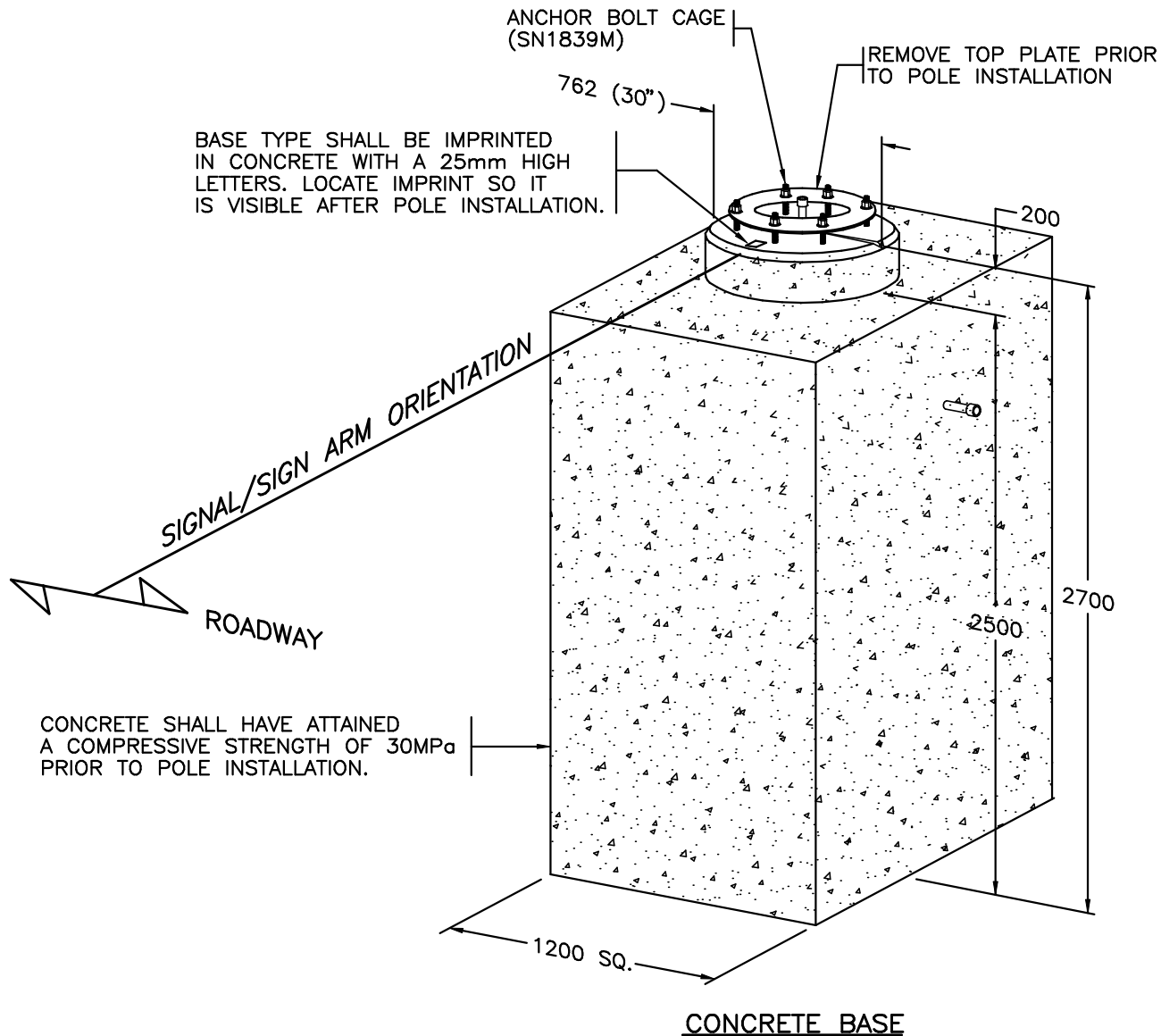


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE M1 CONCRETE SPREAD FOOTING (POURED IN PLACE)		SPECIFICATION DRAWING No.
F			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		<b>SP635-1.1.22</b>
E					
D					
C					
B	LENGTH REVISED & REBAR ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94			





BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	FORMWORK	APPROXIMATE MASS
M2	TYPE M POLES	3.7 m <sup>3</sup>	100 kg	12.5 m <sup>2</sup>	8935 kg

#### NOTES

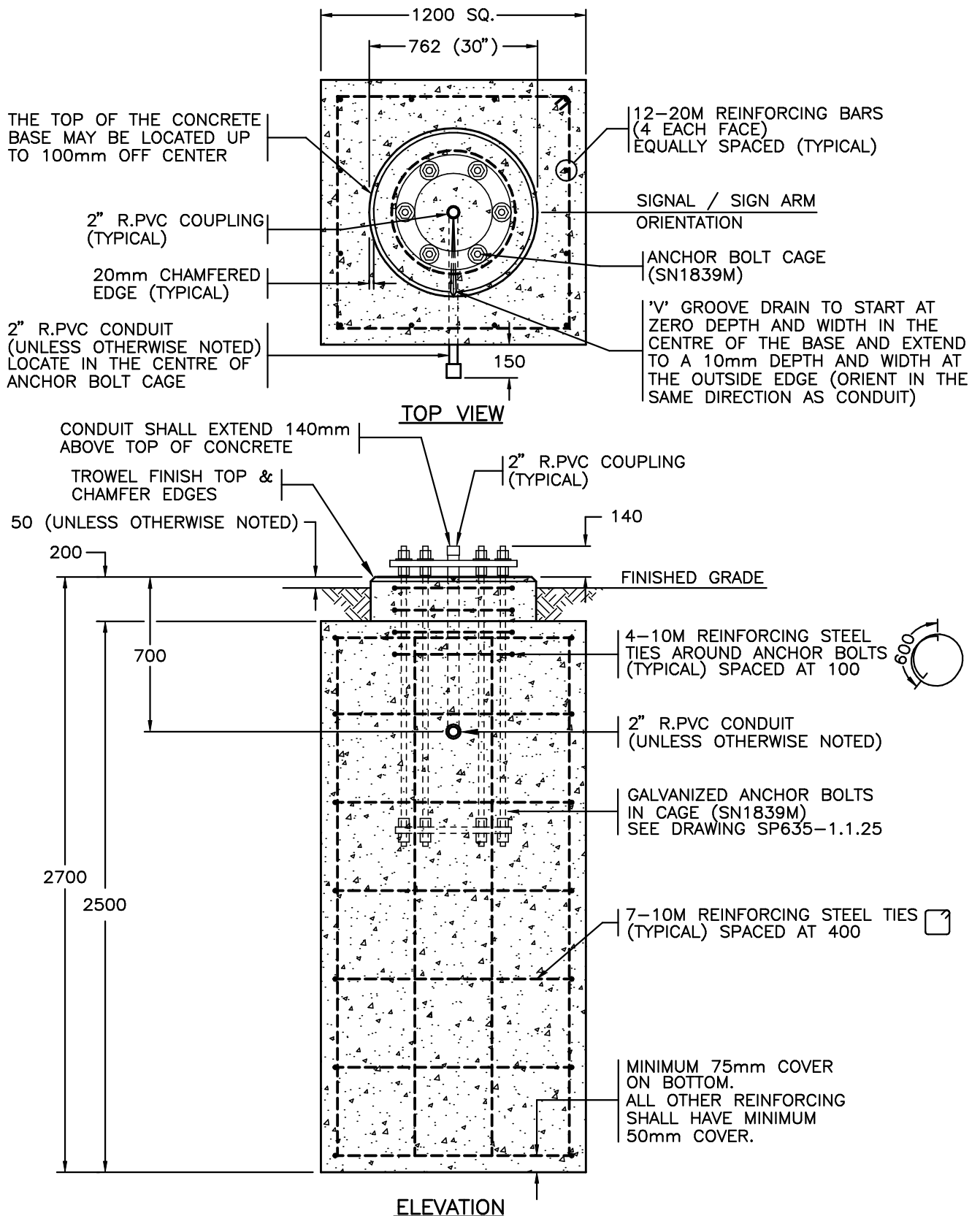
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE PLANS FOR SIGNAL/SIGN ARM ORIENTATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- SEE DRAWINGS SP635-1.1.24 & 1.4.1 to 1.4.4 FOR ADDITIONAL DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE



No.	Revision	Date	TYPE M2 CONCRETE BASE (POURED IN PLACE)		
F					
E					
D					
C	NOTE 4 REVISED	AUG 96			
B	NOTE 4 REVISED	AUG 95	Date	Approved	SPECIFICATION DRAWING No.
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SP635—1.1.23





SEE DRAWING SP635-1.1.23 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

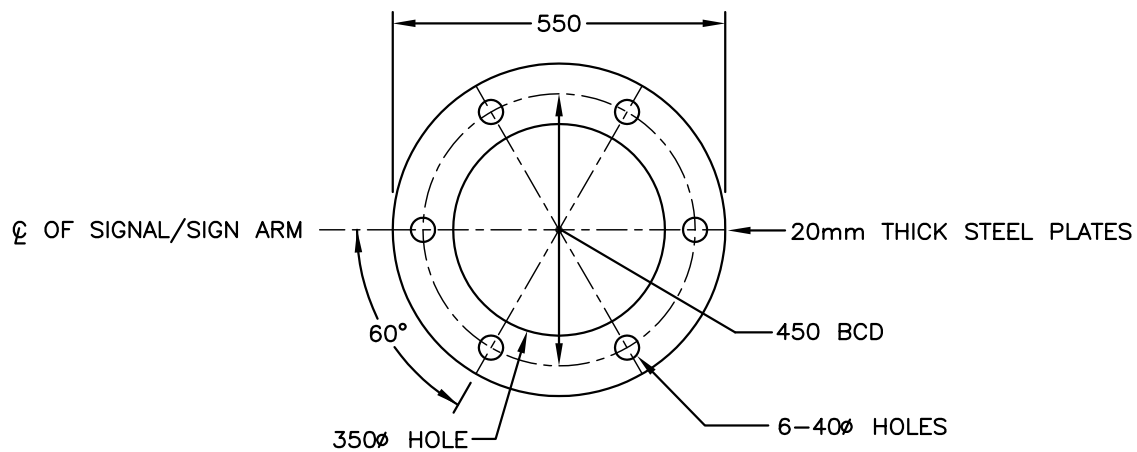


**BRITISH COLUMBIA**

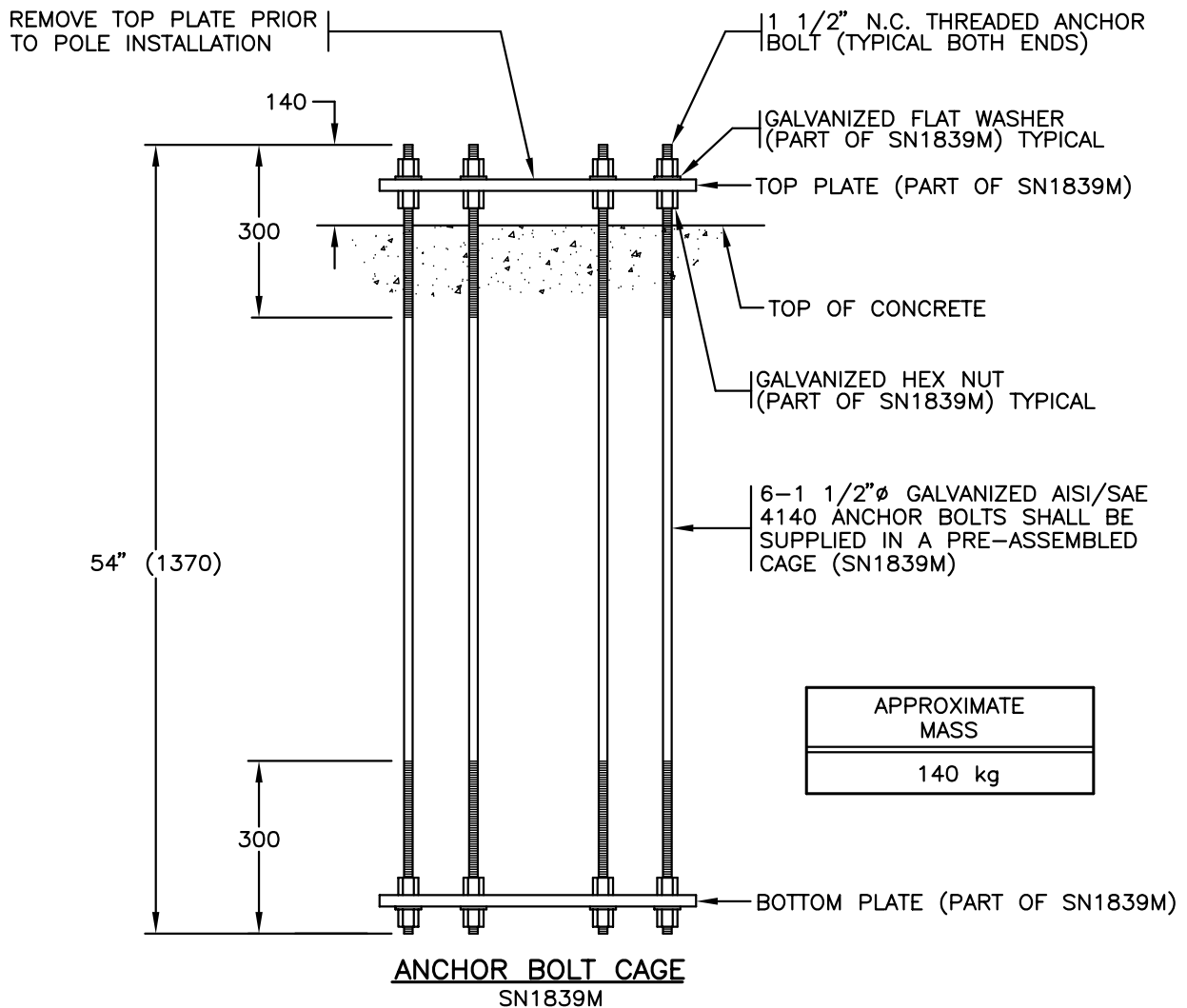
Ministry of  
Transportation

No.	Revision	Date	TYPE M2 CONCRETE BASE (PRECAST OR POURED IN PLACE)	
F				
E				
D				
C	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 96	Date	Approved
B	DRAWING REFERENCE CHANGED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. <b>SP635-1.1.24</b>	





**TOP AND BOTTOM PLATES**



SEE DRAWINGS SP635-1.1.20 AND 1.1.23 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



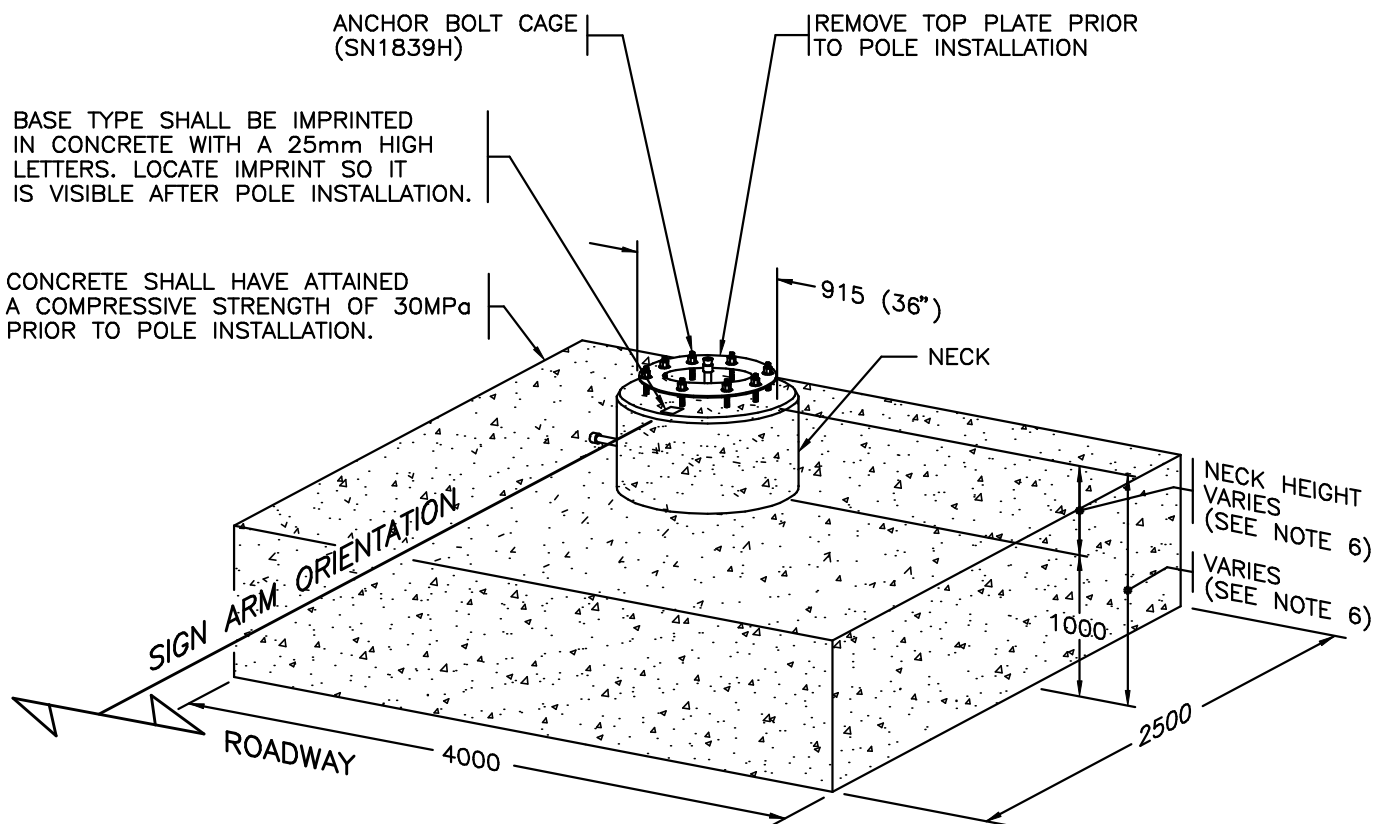
No.	Revision	Date
F		
E		
D		
C	TOP PLATE NOTE REVISED	OCT 03
B	HOLE SIZE IN PLATE REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

**ANCHOR BOLT CAGE  
FOR TYPE M POLES**

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.1.25**





### CONCRETE SPREAD FOOTING

BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	FORMWORK	APPROXIMATE MASS
H1	TYPE H POLES	10.9 m <sup>3</sup> *	760 kg *	17.0 m <sup>2</sup> *	26700 kg *

(\*) BASED ON SPREAD FOOTING WITH 1400 HIGH NECK

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE PLANS FOR SIGN ARM ORIENTATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- SEE DRAWINGS SP635-1.1.27, 1.1.28 & 1.4.5 FOR ADDITIONAL DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- NECK HEIGHT MAY VARY FROM 750 TO 2500. SEE DRAWING SP635-1.4.5 FOR MORE INFORMATION.

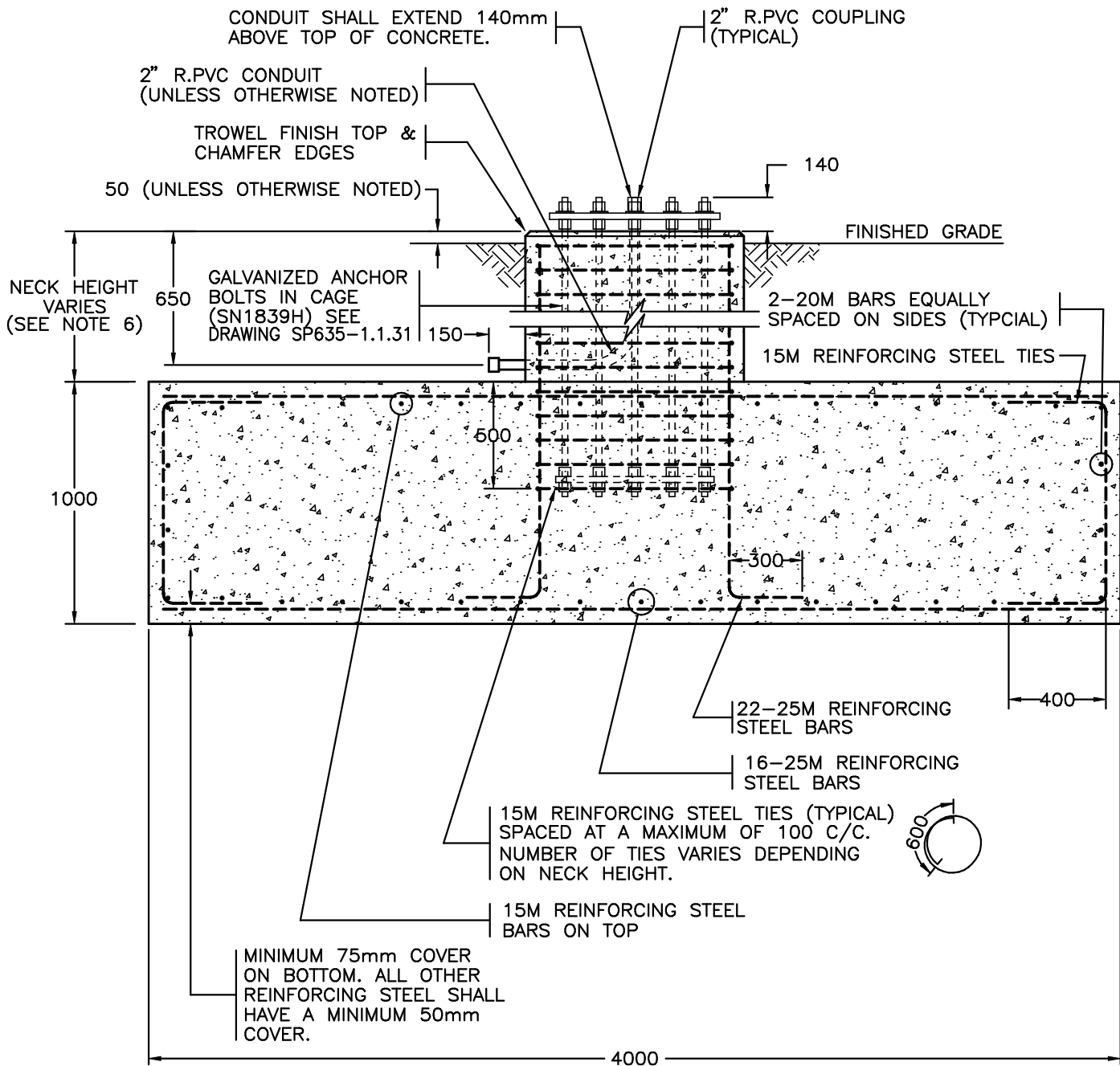
BASE DESIGNED FOR SOILS WITH  
A MINIMUM BEARING PRESSURE  
OF 100KPa

NOT TO SCALE



No.	Revision	Date	TYPE H1 CONCRETE SPREAD FOOTING (POURED IN PLACE)		
F					
E					
D					
C	NECK HEIGHT REVISED	AUG 96	Date	Approved	SPECIFICATION DRAWING No.
B	NECK HEIGHT REVISED & REBAR ADDED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635—1.1.26
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





SIDE VIEW

SEE DRAWING SP635-1.1.26 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



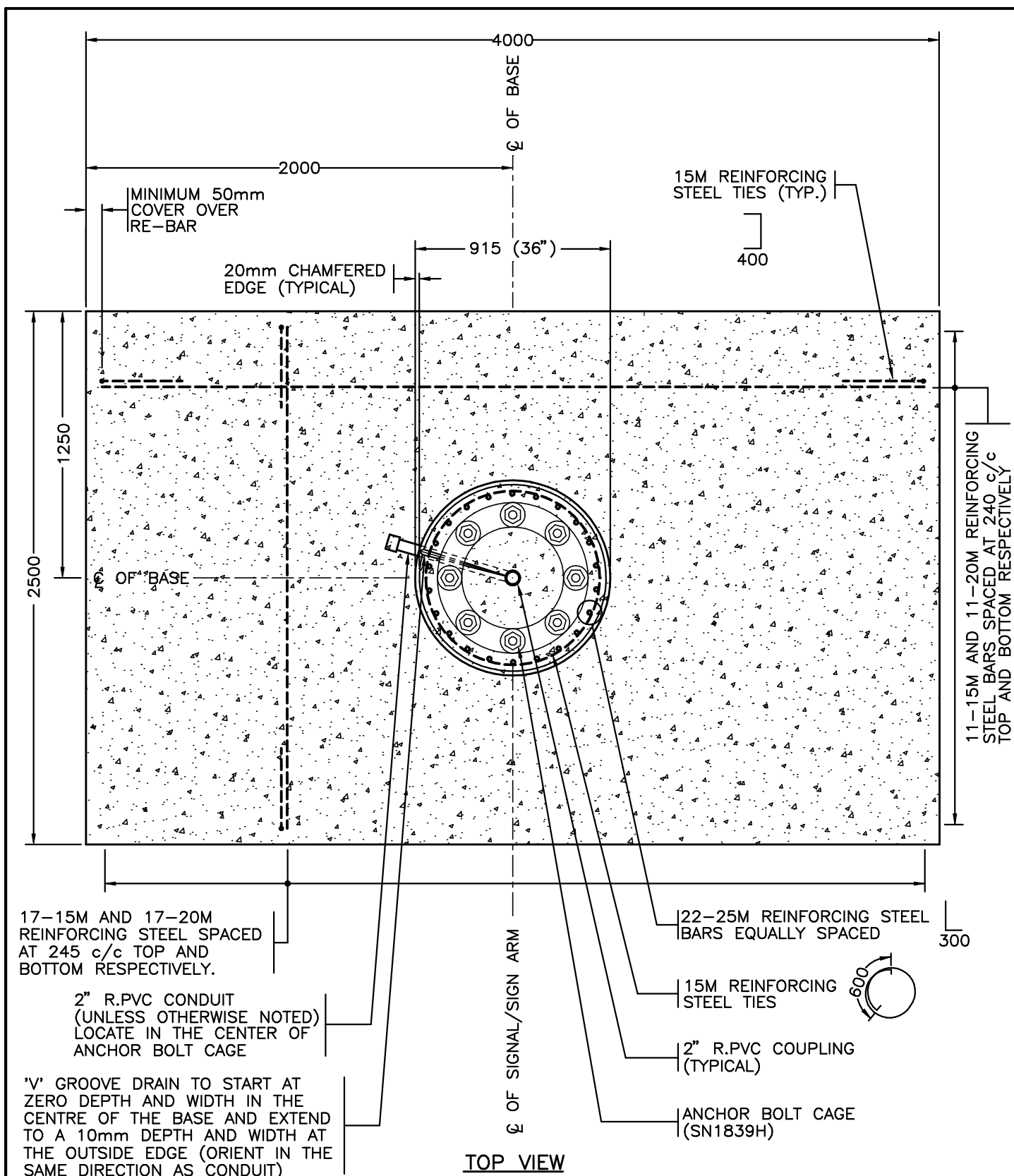
**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE H1 CONCRETE SPREAD FOOTING (POURED IN PLACE)	
F				
E				
D				
C	REBAR IN NECK & BASE ELEVATION REVISED	AUG 96	Date	Approved
B	NECK HEIGHT REVISED & REBAR ADDED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. SP635-1.1.27	

**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer





SEE DRAWING SP635-1.1.26 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
F		
E		
D		
C		
B	REBAR ADDED	AUG 95
A	GENERAL REVISIONS	AUG 94

## TYPE H1 CONCRETE SPREAD FOOTING (POURED IN PLACE)

Date Approved

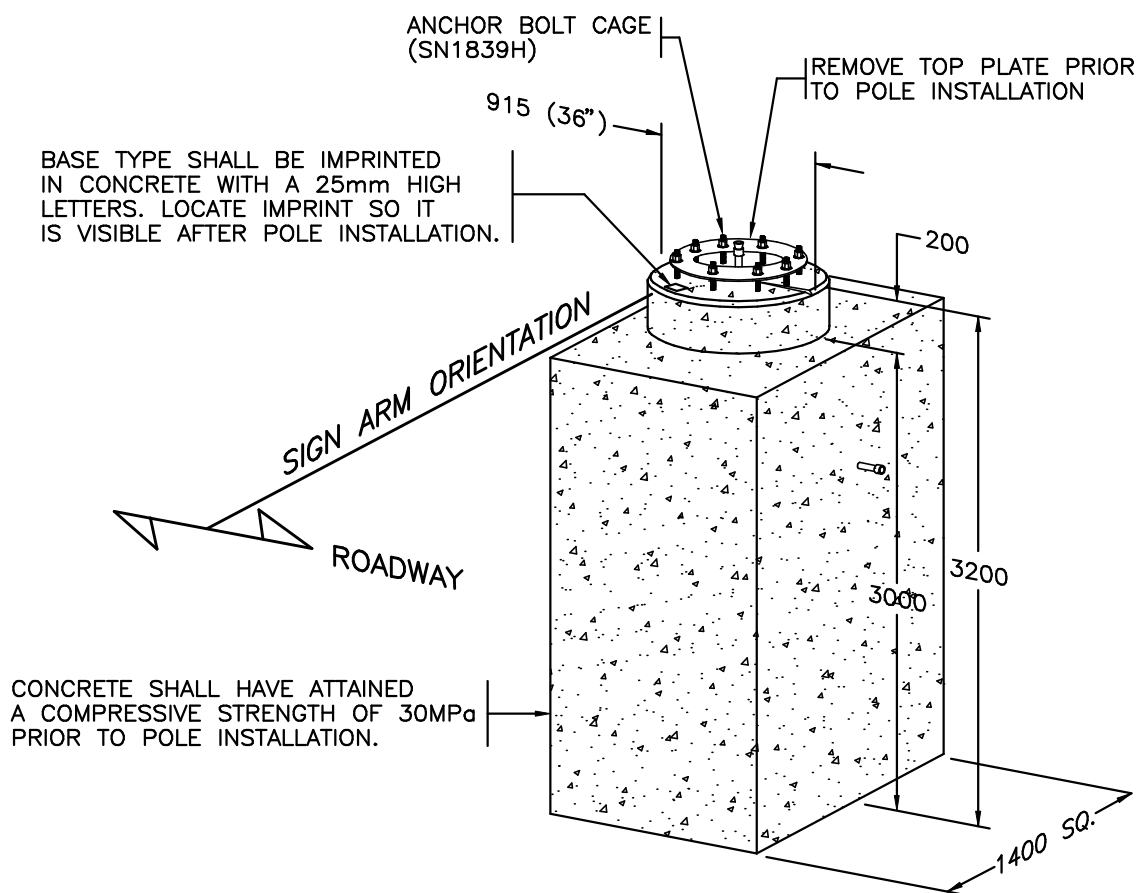
**30/09/93 E.L. (Signature on File)**

Chief Highway Engineer

SPECIFICATION  
DRAWING No.

**SP635-1.1.28**





**CONCRETE BASE**

BASE TYPE	POLE TYPE	VOLUME OF CONCRETE	MASS OF REBAR	FORMWORK	APPROXIMATE MASS
H2	TYPE H POLES	6.0 m <sup>3</sup>	155 kg	17.4 m <sup>2</sup>	14445 kg

**NOTES**

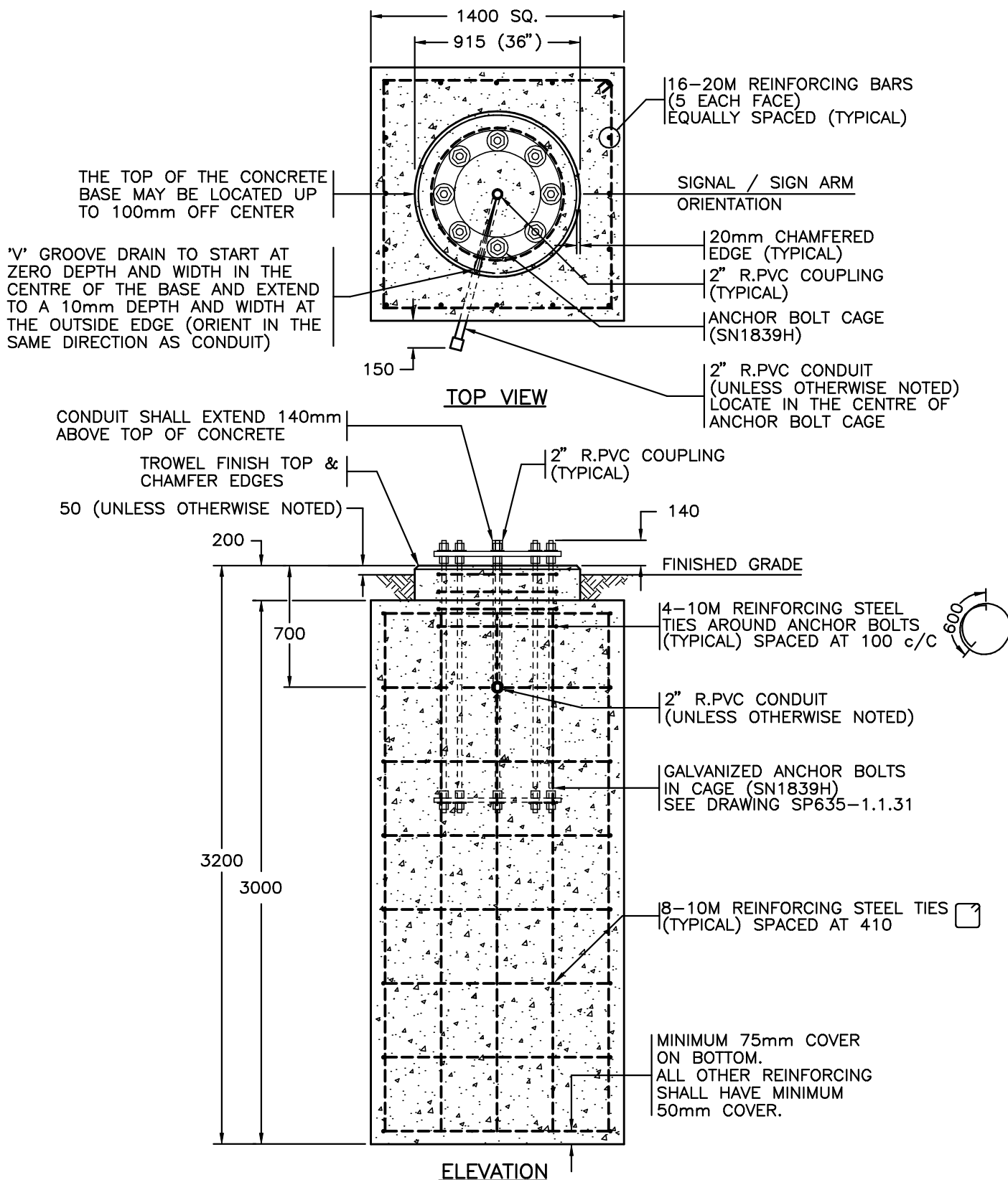
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE PLANS FOR SIGN ARM ORIENTATION.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. SEE DRAWINGS SP635-1.1.30 & 1.4.1 to 1.4.3 FOR ADDITIONAL DETAILS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. SEE DRAWINGS SP635-1.4.1 TO 1.4.4 FOR BACKFILL REQUIREMENTS.

NOT TO SCALE



No.	Revision	Date	TYPE H2 CONCRETE BASE (PRECAST OR POURED IN PLACE)		
F					
E					
D					
C	NOTE 4 REVISED	AUG 96	Date	Approved	SPECIFICATION DRAWING No.
B	NOTE 4 REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635—1.1.29
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





SEE DRAWING SP635-1.1.29 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

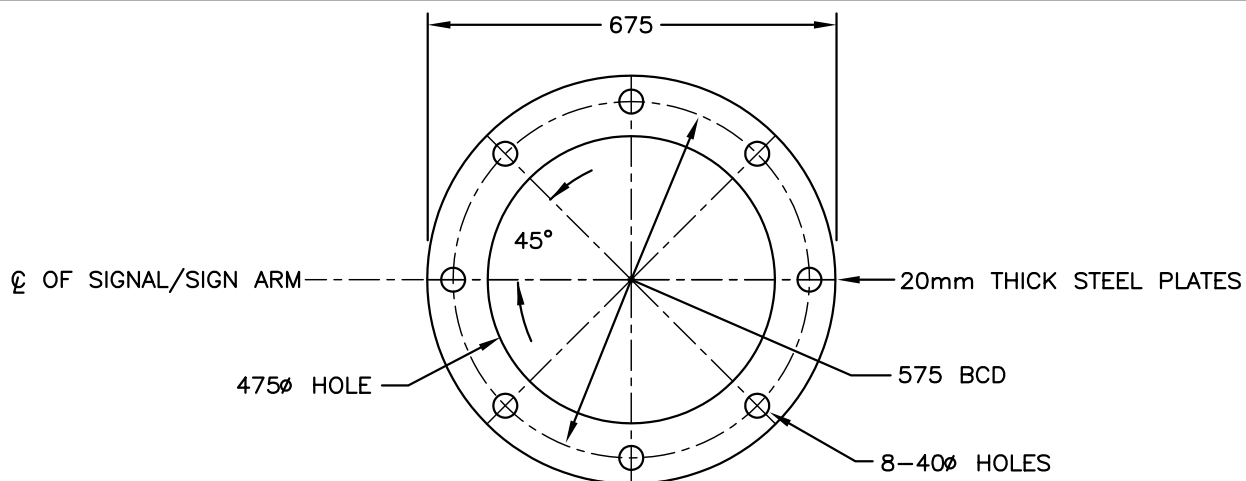


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

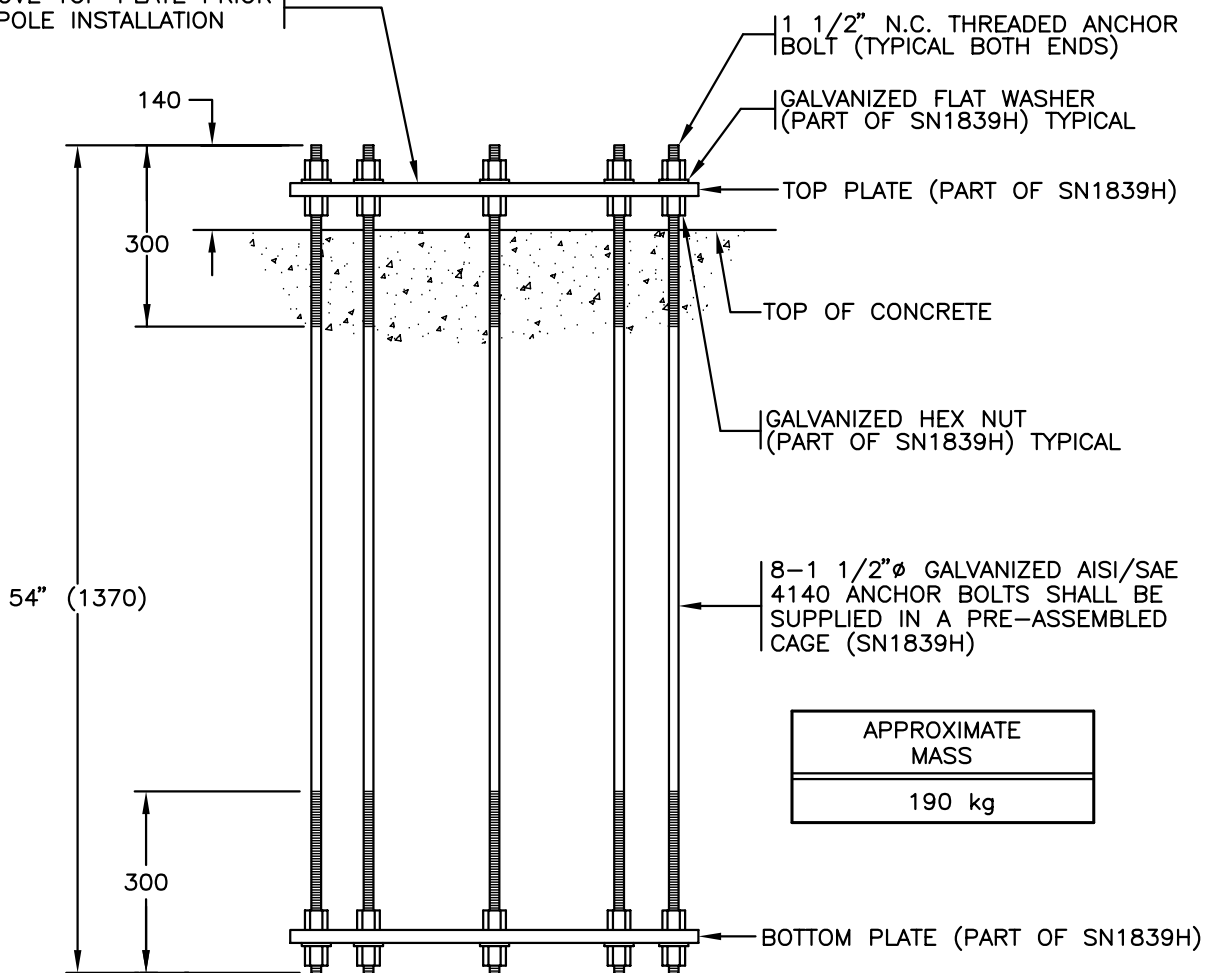
No.	Revision	Date	TYPE H2 CONCRETE BASE (POURED IN PLACE)	
F				
E				
D				
C	ELEVATION OF BASE TO FINISHED GRADE REVISED	AUG 96	Date	Approved
B	DRAWING REFERENCE CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			30/09/93 E.L. (Signature on File)	SPECIFICATION DRAWING No. SP635-1.1.30
			Chief Highway Engineer	





**TOP AND BOTTOM PLATES**

REMOVE TOP PLATE PRIOR  
TO POLE INSTALLATION



**ANCHOR BOLT CAGE**  
SN1839H

SEE DRAWINGS SP635-1.1.26 AND -1.1.29  
FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
F		
E		
D		
C	TOP PLATE NOTE REVISED	OCT 03
B	HOLE SIZE IN PLATE REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

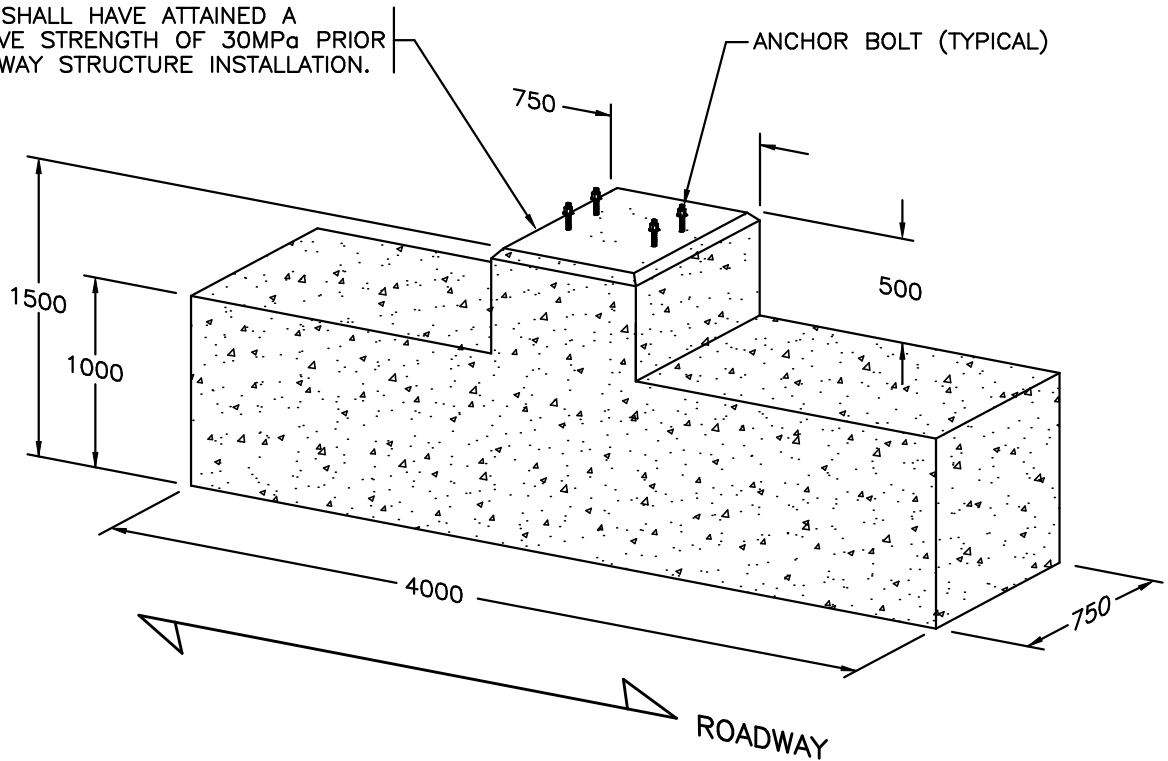
**ANCHOR BOLT CAGE  
FOR TYPE H POLES**

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.1.31**



CONCRETE SHALL HAVE ATTAINED A COMPRESSIVE STRENGTH OF 30MPa PRIOR TO BREAKAWAY STRUCTURE INSTALLATION.



### CONCRETE SPREAD FOOTING

BASE DESIGNED FOR SOILS WITH A MINIMUM BEARING PRESSURE OF 75KPa

APPROXIMATE  
MASS

8000 kg

VOLUME OF  
CONCRETE

3.28 m<sup>3</sup>

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. MINIMUM 2 BASES REQUIRED PER BREAKAWAY SIGN INSTALLATION.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. SEE DRAWINGS SP635-1.1.33 AND 1.1.34 FOR ADDITIONAL DETAILS.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

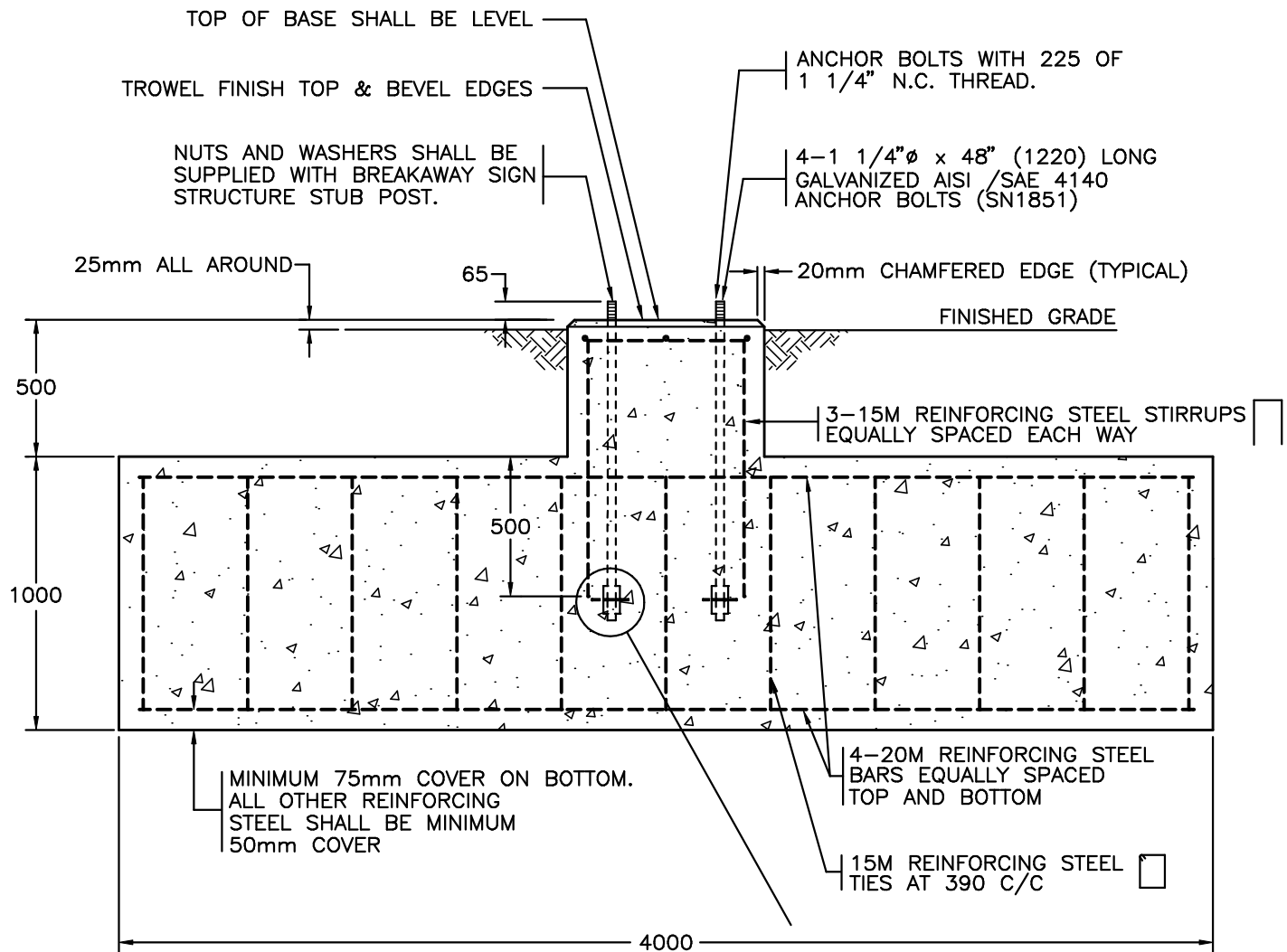


**BRITISH  
COLUMBIA**

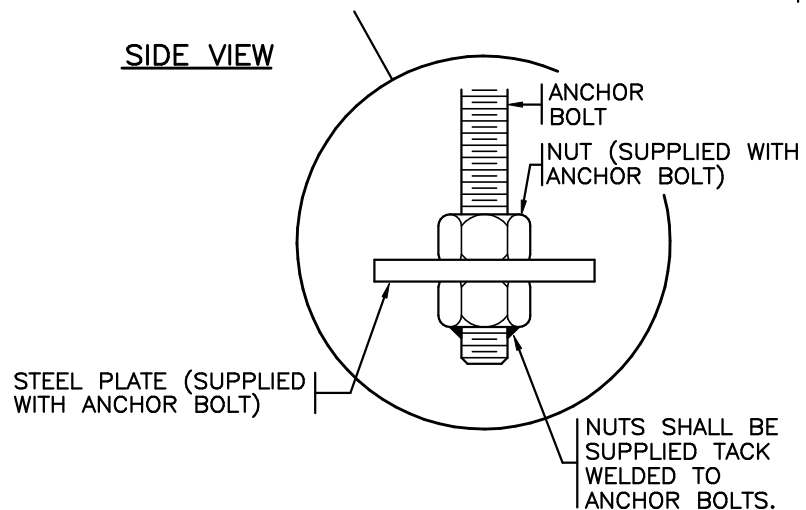
Ministry of  
Transportation

No.	Revision	Date	CONCRETE SPREAD FOOTING FOR BREAKAWAY SIGN STRUCTURE (POURED IN PLACE)	
F				
E			Date Approved	
D				
C			SPECIFICATION DRAWING No.	
B	DRAWING TITLE & NUMBER CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
			<b>SP635-1.1.32</b>	





SIDE VIEW



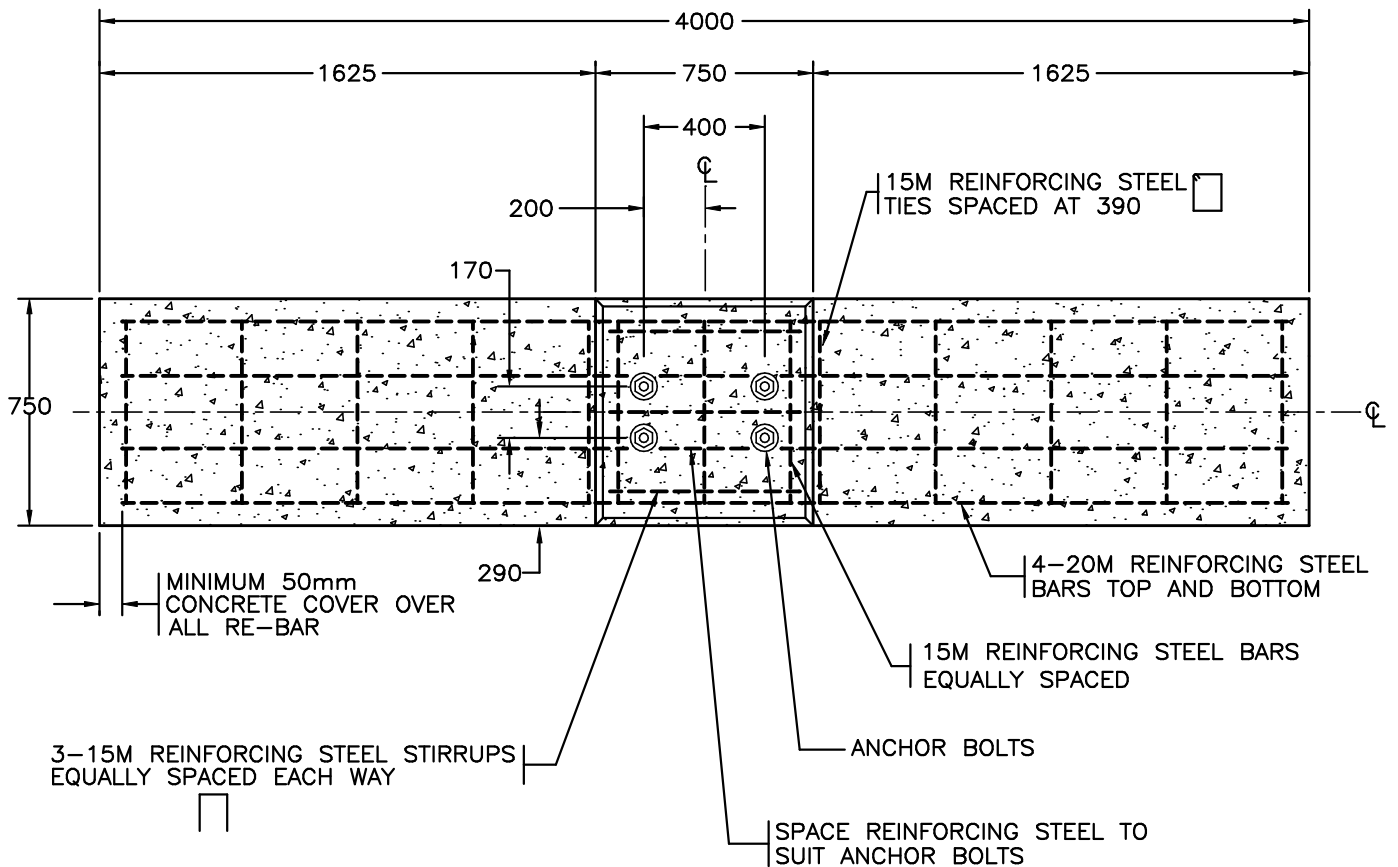
SEE DRAWING SP635-1.1.32 FOR NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



No.	Revision	Date	CONCRETE SPREAD FOOTING FOR BREAKAWAY SIGN STRUCTURE (POURED IN PLACE)	
F				
E			Date Approved	
D				
C			SPECIFICATION DRAWING No.	
B	DRAWING TITLE & NUMBER CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
			SP635-1.1.33	





TOP VIEW

SEE DRAWING SP635-1.1.32 FOR NOTES AND ADDITIONAL DETAILS

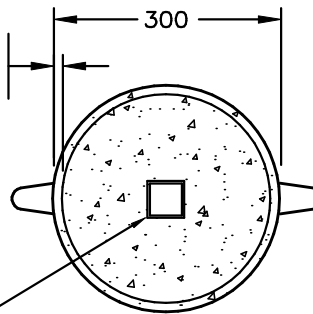
NOT TO SCALE



No.	Revision	Date	CONCRETE SPREAD FOOTING FOR BREAKAWAY SIGN STRUCTURE (POURED IN PLACE)	
F				
E			Date Approved	
D				
C			SPECIFICATION DRAWING No.	
B	DRAWING TITLE & NUMBER CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94	30/09/93 E.L. (Signature on File) Chief Highway Engineer	SP635-1.1.34



12mm CHAMFERED EDGE  
EXCEPT WHERE BASE IS  
INSTALLED IN A SIDEWALK



**TOP VIEW**

LOCATE SQUARE TUBING  
IN THE CENTRE OF BASE

INNER SLEEVE WHERE SPECIFIED  
(SEE DRAWING SP635-3.6.3  
FOR DETAILS)

TROWEL FINISH  
TOP OF BASE  
LEVEL

50

FINISHED GRADE

VARIES (SEE NOTE 3)

**SLEEVE SCHEDULE**

POST O.D.	INNER SLEEVE	SLEEVE SIZE IN CONCRETE
1 1/2"	YES	2"
1 3/4"	YES	2 1/4"
2"	YES	2 1/2"
2 1/4"	NO	2 1/2"

A

LIFTING STRAP (TYPICAL)

PERFORATED SQUARE GALVANIZED  
STEEL TUBING SLEEVE (COVER  
HOLES AND CAST IN CONCRETE)  
SIZE VARIES TO SUIT POST.  
SEE SLEEVE SCHEDULE.

CONCRETE SHALL HAVE ATTAINED  
A COMPRESSIVE STRENGTH OF 30MPa  
PRIOR TO POST INSTALLATION.

INSTALL PIPE SLEEVE PLUMB

MAINTAIN TUBING THRU  
CONCRETE FOR DRAINAGE

**SIDE VIEW**

BASE TYPE	APPLICATION	APPROXIMATE MASS	VOLUME OF CONCRETE	A
1	SINGLE POST SIGNS IN PAVED ISLANDS OR CONCRETE SIDEWALKS	100 kg	0.04 m <sup>3</sup>	600
2	SINGLE OR TWO POST SIGNS IN GRAVEL SHOULDER	147 kg	0.06 m <sup>3</sup>	800

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. BASE SHALL BE INSTALLED 25mm ABOVE FINISHED GRADE EXCEPT WHERE INSTALLED IN SIDEWALK IT SHALL BE FLUSH WITH TOP OF SIDEWALK WITH NO CHAMFERED EDGE.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

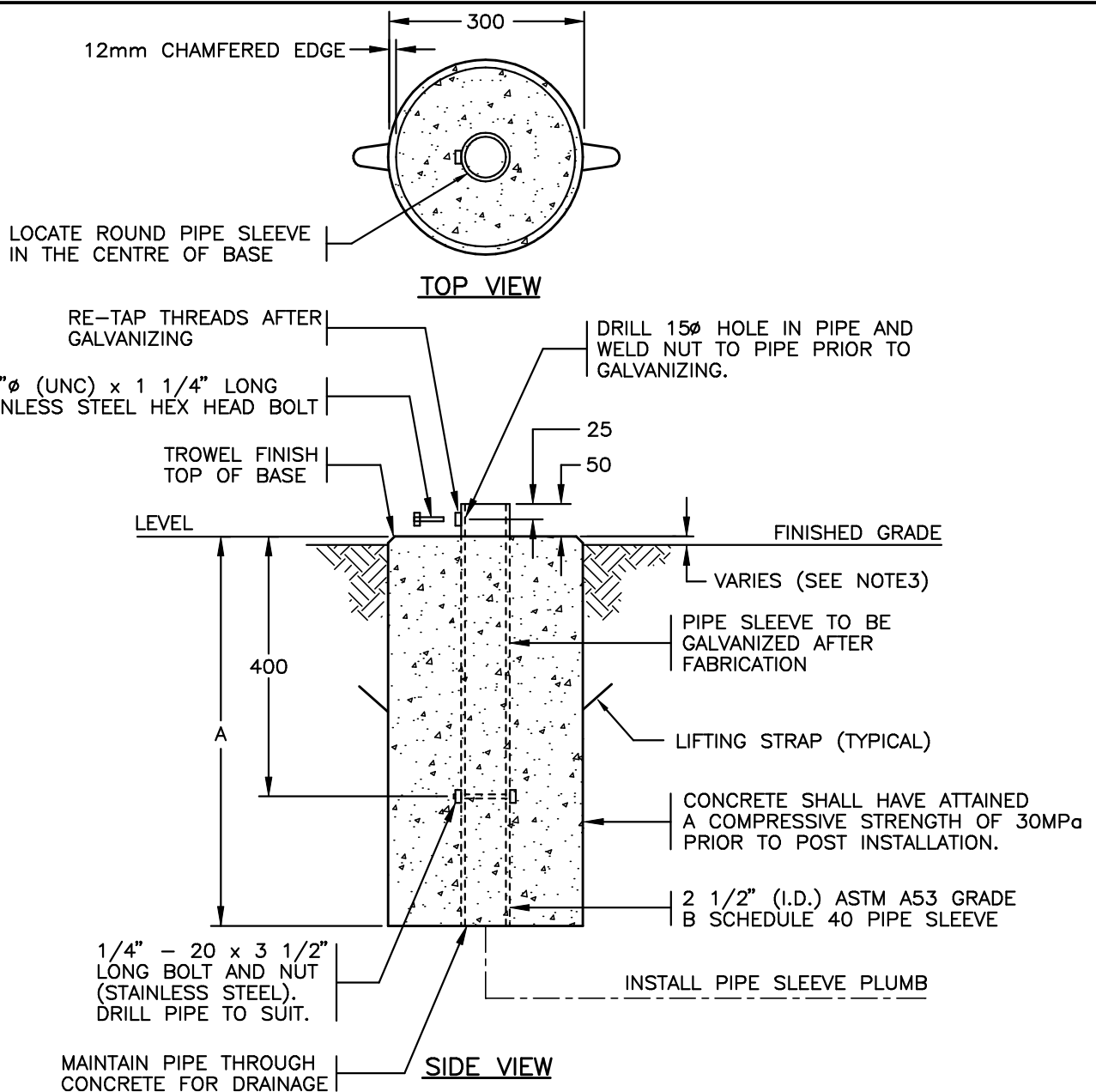
SEE MINISTRY PRE-APPROVED  
PRODUCT LIST FOR ALTERNATIVE  
BASE DESIGNS FOR SINGLE  
POST SIGNS



NOT TO SCALE

No.	Revision	Date	CONCRETE BASES FOR PERFORATED SQUARE STEEL SIGN POSTS (PRECAST OR POURED IN PLACE)	
F				
E				
D	NOTE IN BOX ADDED	NOV 98		
C	DRAWING NUMBER CHANGED	AUG 95	Date Approved <b>MAR 94 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.1.35</b>
B	GENERAL REVISIONS	AUG 94		
A	PIPE SLEEVE CHANGED	FEB 94		





BASE TYPE	APPLICATION	APPROXIMATE MASS	VOLUME OF CONCRETE	A
1	SINGLE POST SIGNS IN PAVED ISLANDS OR CONCRETE SIDEWALKS	100 kg	0.04 m <sup>3</sup>	600
2	SINGLE OR TWO POST SIGNS IN GRAVEL SHOULDER	147 kg	0.06 m <sup>3</sup>	800

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- 'SN' DENOTES MINISTRY STOCK NUMBER.
- BASE SHALL BE INSTALLED 25mm ABOVE FINISHED GRADE.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

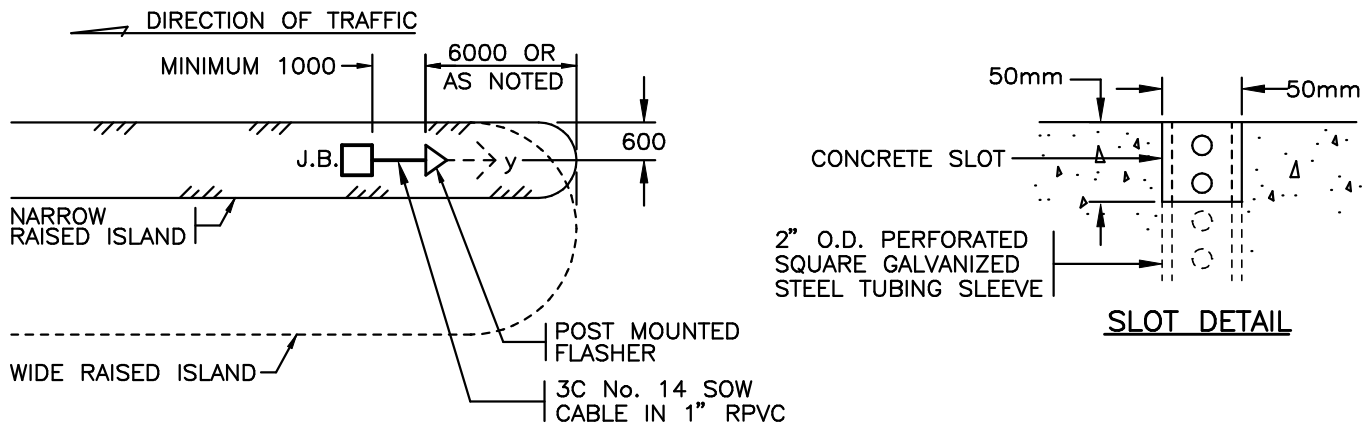
SEE MINISTRY PRE-APPROVED PRODUCT LIST FOR ALTERNATIVE BASE DESIGNS FOR SINGLE POST SIGNS



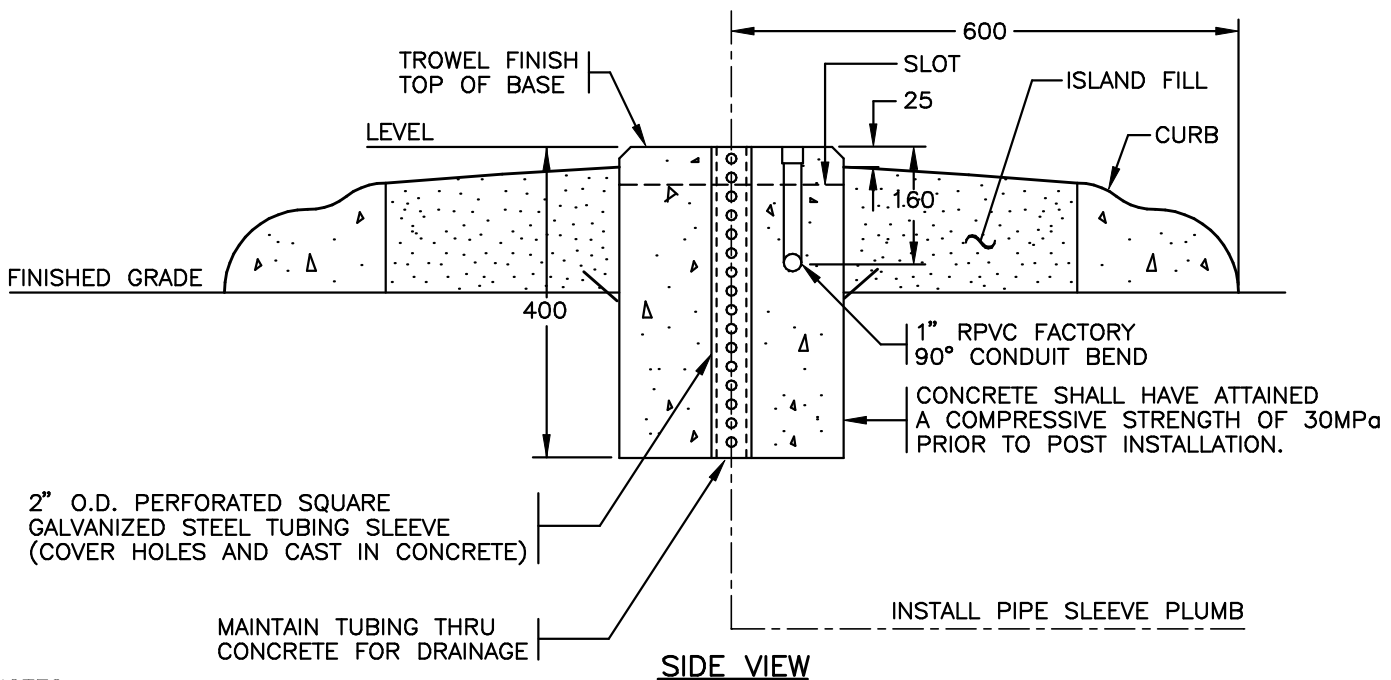
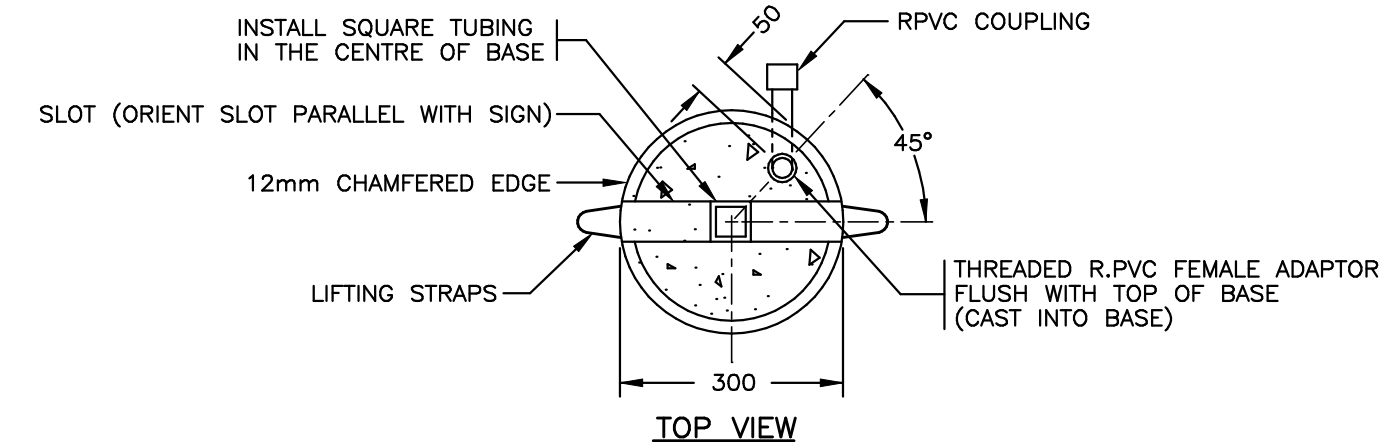
NOT TO SCALE

No.	Revision	Date	CONCRETE BASE FOR ROUND STEEL SIGN POSTS (PRECAST OR POURED IN PLACE)	
F				
E				
D				
C	NOTE IN BOX ADDED	NOV 98	Date	Approved
B	DRAWING NUMBER CHANGED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. <b>SP635-1.1.36</b>	





### SITE PLAN OF FLASHER IN ISLAND



### NOTES

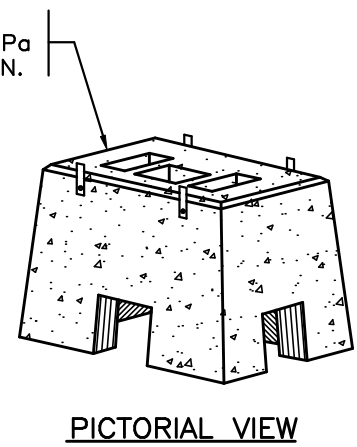
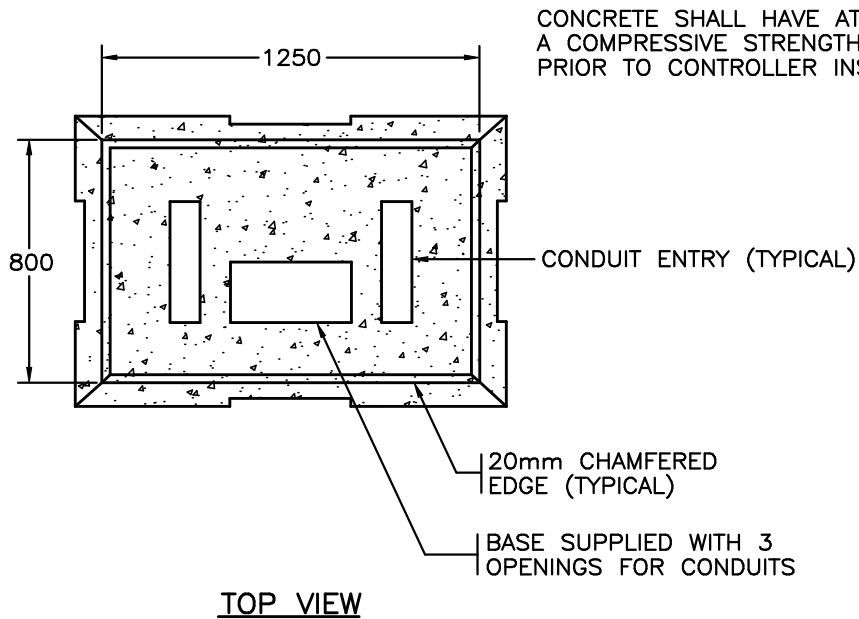
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE

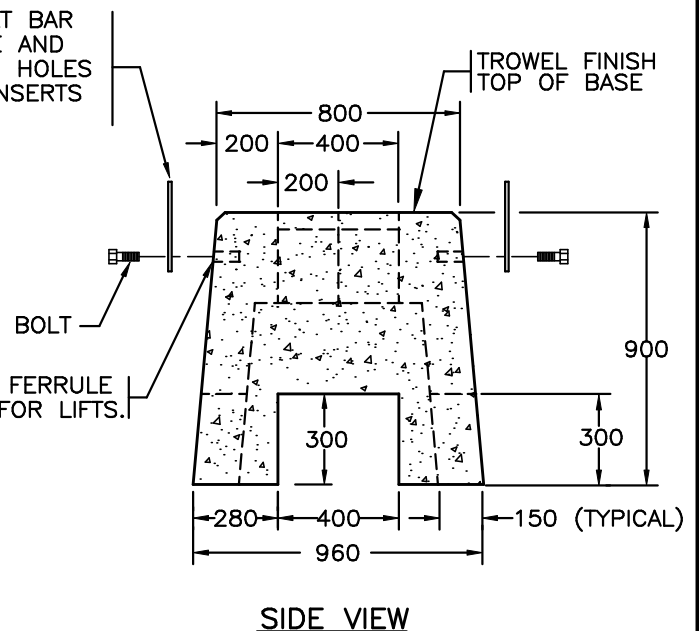
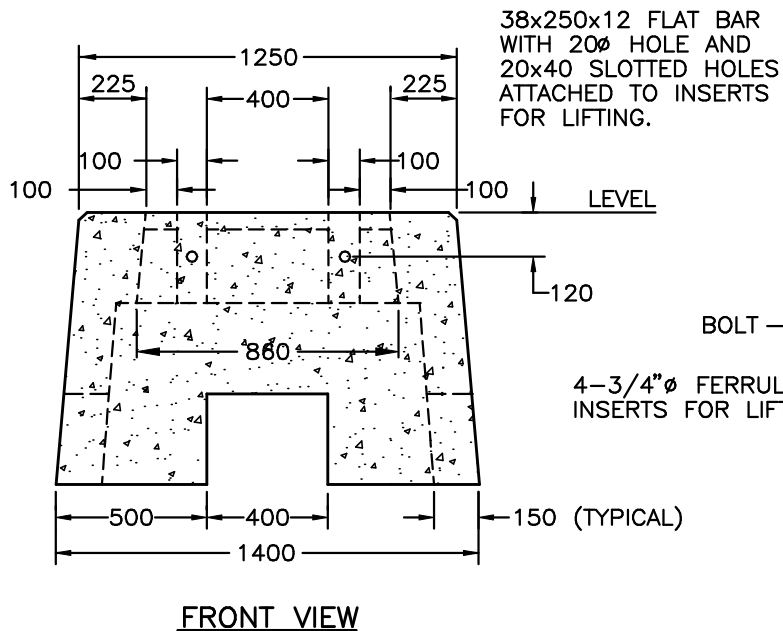


No.	Revision	Date	POST MOUNTED FLASHER CONCRETE BASE (PRECAST OR POURED IN PLACE)	
F				
E	LOCATION IN ISLAND REVISED	SEPT 00		
D	DIM'N FROM SIDE OF ISLAND ADDED	NOV 99		
C	NOTE 3 DELETED	AUG 96		
B	DRAWING NUMBER CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			<b>MAR 94 E.L. (Signature on File)</b>	Chief Highway Engineer
			SPECIFICATION DRAWING No. <b>SP635-1.1.37</b>	





APPROXIMATE MASS
1500 kg



#### NOTES

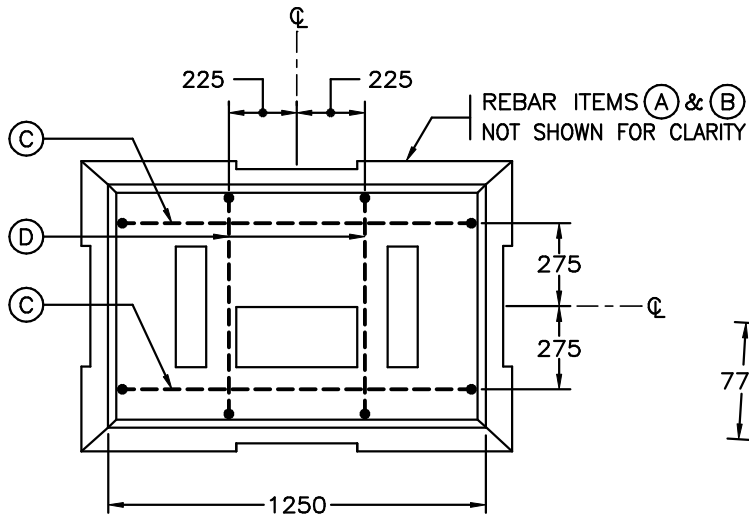
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-1.1.39 FOR REBAR DETAILS, AND DRAWINGS SP635-1.1.40 AND 1.1.41 FOR INSTALLATION DETAILS.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

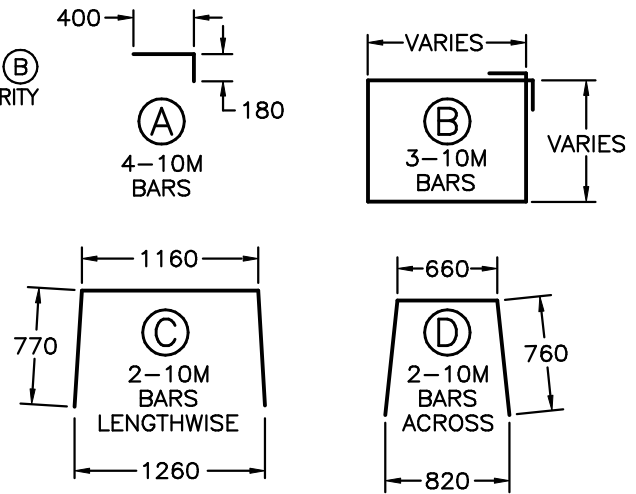


No.	Revision	Date	CONCRETE CONTROLLER BASE DETAILS (PRECAST)		
F			Date Approved		SPECIFICATION DRAWING No.  SP635—1.1.38
E					
D					
C	DRAWING REFERENCE NUMBERS REVISED	AUG 96			
B	DRAWING NUMBER CHANGED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		
A	GENERAL REVISIONS	AUG 94			

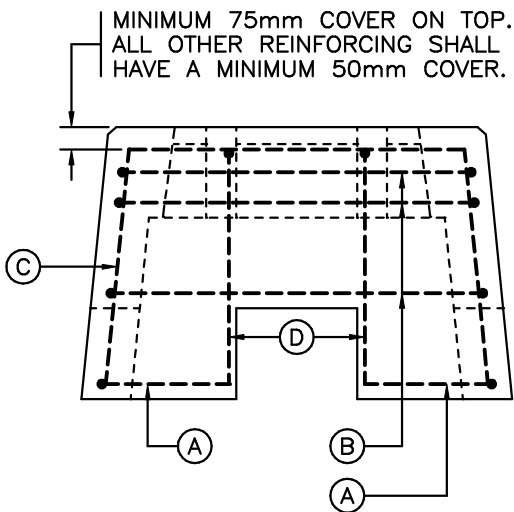




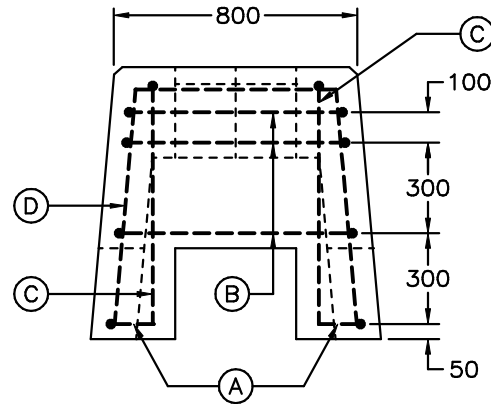
TOP VIEW



REINFORCEMENT DETAILS



FRONT VIEW



SIDE VIEW

SEE DRAWING SP635-1.1.38 FOR NOTES AND DETAILS

NOT TO SCALE

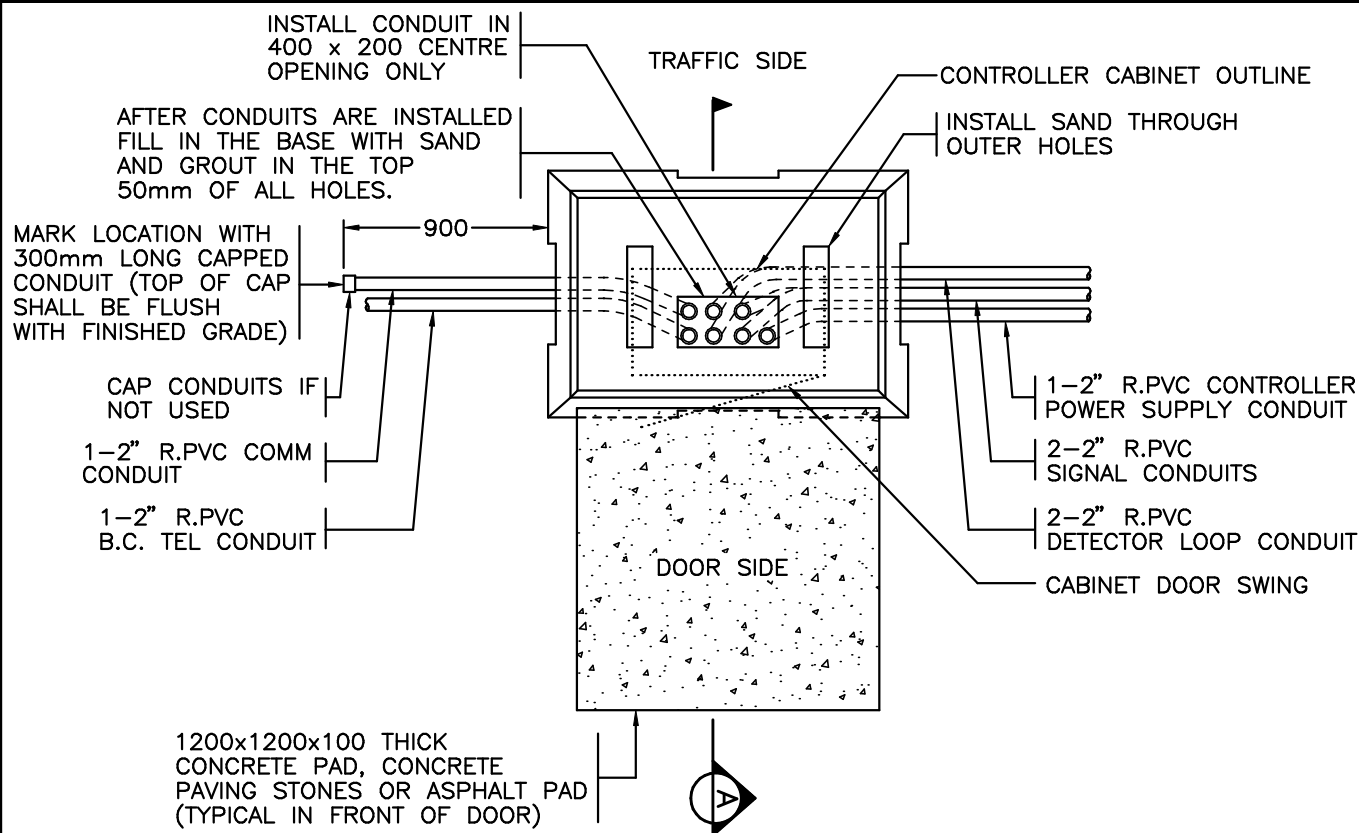


**BRITISH  
COLUMBIA**

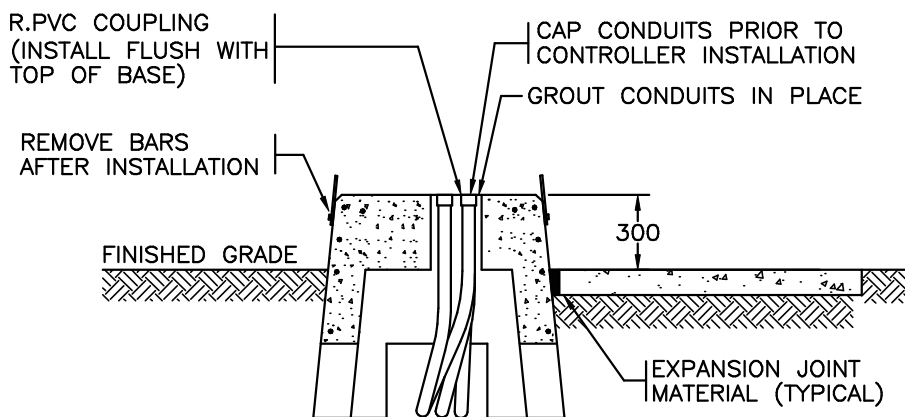
Ministry of  
Transportation

No.	Revision	Date	CONCRETE CONTROLLER BASE REBAR DETAILS (PRECAST)	
F			Date	Approved
E				
D			<b>30/09/93</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.1.39</b>
C				
B	DRAWING NUMBER CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94		





### CONDUIT FIELD INSTALLATION



### SECTION A

#### NOTES

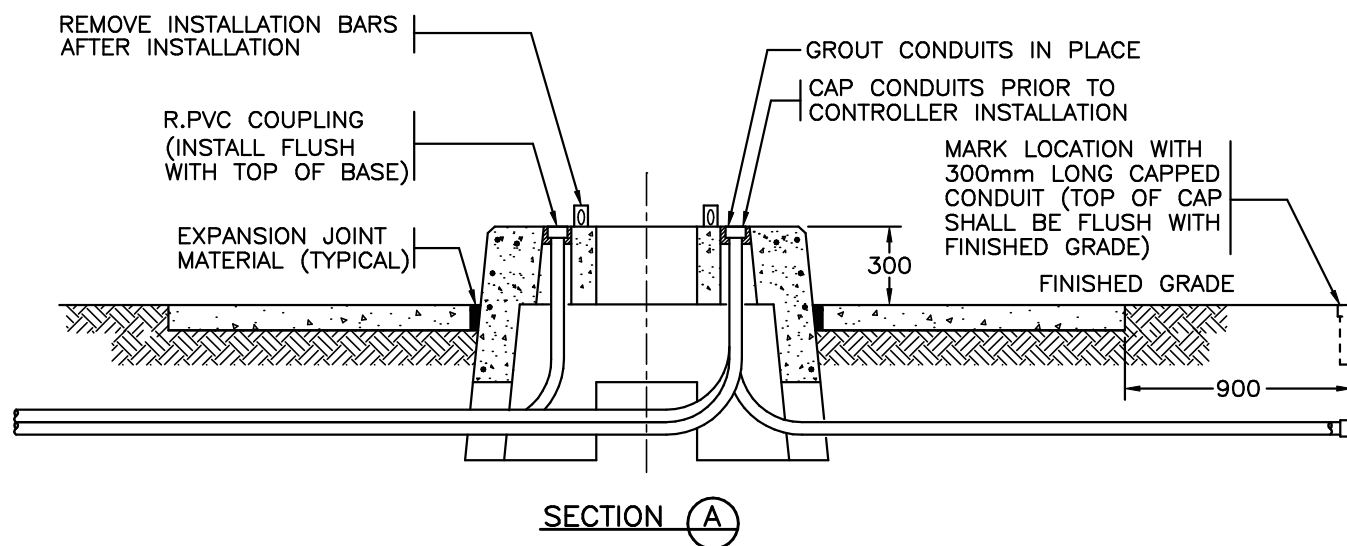
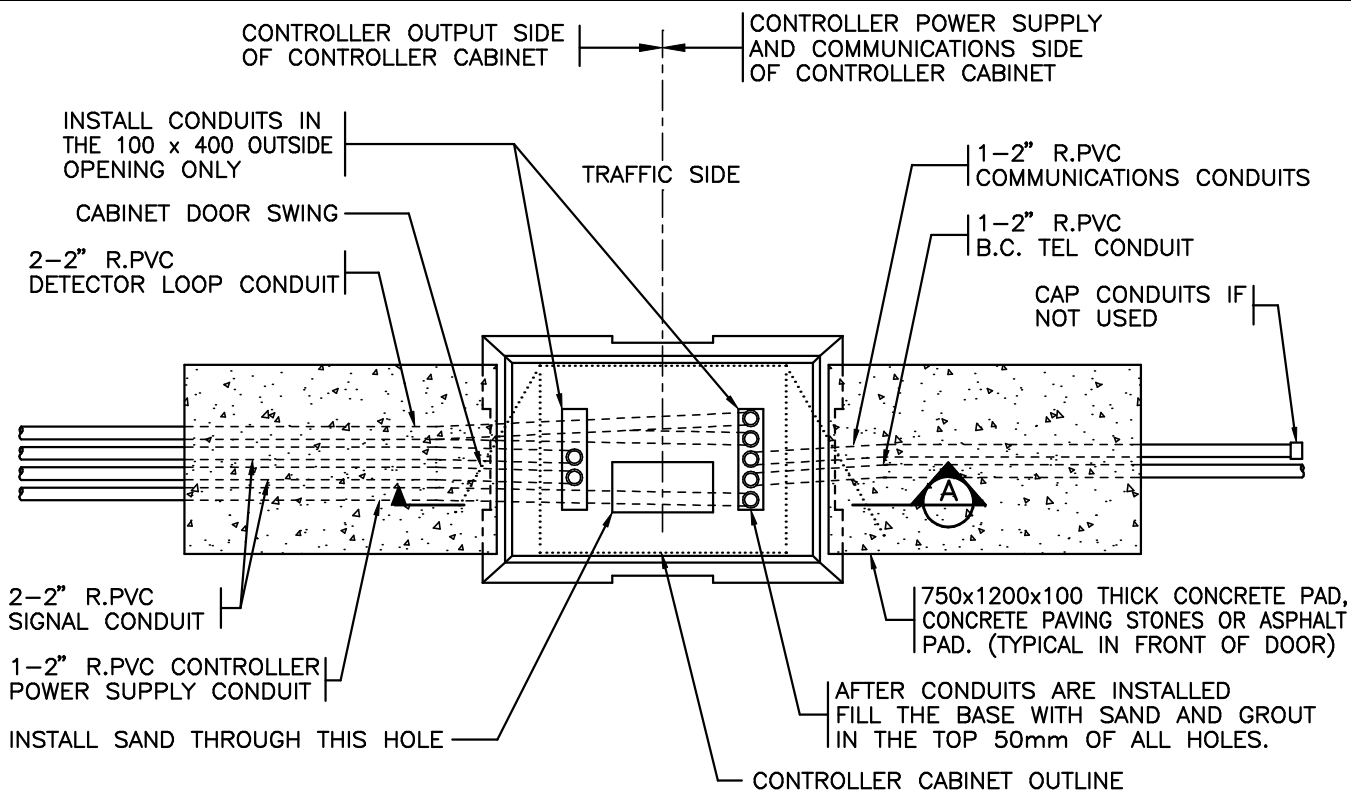
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. INSTALL CONDUITS AND GROUT PRIOR TO CONTROLLER INSTALLATION.
3. CONDUITS AND ROUTING MAY VARY. EXACT CONDUIT ROUTING SHALL BE AS INDICATED ON THE TRAFFIC SIGNAL DESIGN DRAWINGS.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	CONTROLLER BASE INSTALLATION DETAILS (FOR TYPE M CABINET)	
F				
E				
D				
C				
B	MARKER ADDED TO LOCATE CONDUIT STUBS	AUG 95	Date	Approved
A	GENERAL REVISIONS	AUG 94	30/09/93 E.L. (Signature on File)	SPECIFICATION DRAWING No. SP635-1.1.40
			Chief Highway Engineer	





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. INSTALL CONDUITS AND GROUT PRIOR TO CONTROLLER INSTALLATION.
3. CONDUITS AND ROUTING MAY VARY. EXACT CONDUIT ROUTING SHALL BE AS INDICATED ON THE PLANS.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	CONTROLLER BASE INSTALLATION DETAILS (FOR TYPE S CABINET)		
F			Date Approved  <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635—1.1.41
E					
D					
C					
B	MARKER ADDED TO LOCATE CONDUIT STUBS	AUG 95			
A	GENERAL REVISIONS	AUG 94			



# ANCHOR BOLT REPAIR PROCEDURES

## 1.0 GENERAL

ANCHOR BOLT DAMAGE IS CLASSED AS THE BENDING OR STRETCHING OF THE BOLTS TO THE POINT THAT A POLE CAN NOT BE REMOVED OR INSTALLED.

## 2.0 REPAIR PROCEDURE

REPAIR OF ANCHOR BOLTS SHALL BE AS DETAILED ON DRAWING SP635-1.1.43.

WHERE AN ANCHOR BOLT REQUIRES REPAIR, THE BOLT SHALL BE CUT OFF AND A COUPLER INSTALLED. ANCHOR BOLT COUPLERS SHALL BE USED AS FOLLOWS:

- A) 4 ANCHOR BOLT BASE – MAXIMUM 1 COUPLER PER BASE
- B) 6 TO 8 ANCHOR BOLT BASE – MAXIMUM 2 COUPLERS PER BASE
- C) 10 TO 12 ANCHOR BOLT BASE – MAXIMUM 3 COUPLERS PER BASE

WHERE THE NUMBER OF COUPLERS REQUIRED PER BASE EXCEEDS THE NUMBER ALLOWED, THE BASE MUST BE REPLACED.

ANY DEVIATIONS FROM THESE PROCEDURES MUST BE APPROVED BY THE "MINISTRY ELECTRICAL REPRESENTATIVE" PRIOR TO CONSTRUCTION.

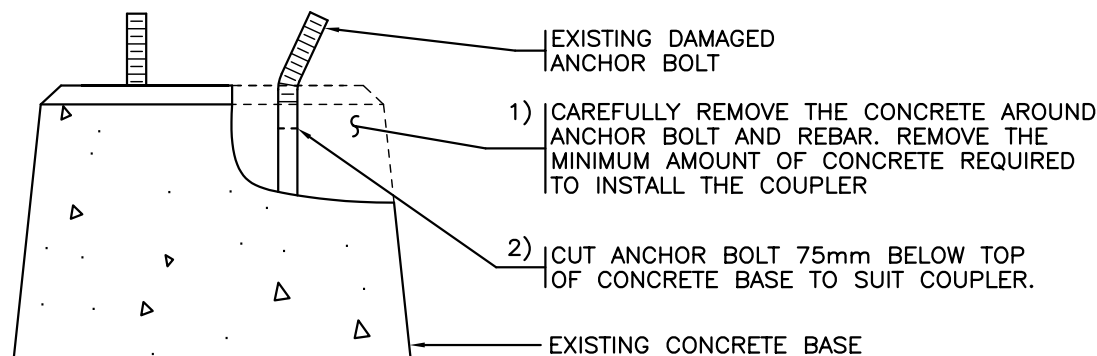


**BRITISH  
COLUMBIA**

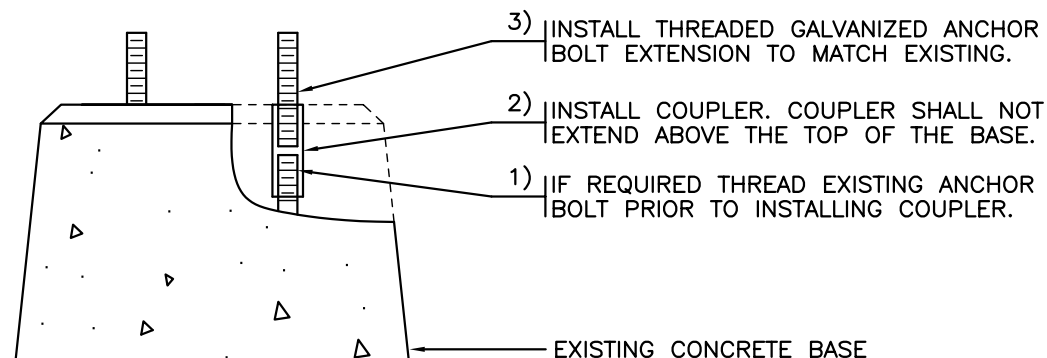
Ministry of  
Transportation

No.	Revision	Date	ANCHOR BOLT REPAIR PROCEDURES		
F			<div>Date18/11/94</div> <div>ApprovedE.L. (Signature on File)</div> <div>Chief Highway Engineer</div> <div>SPECIFICATION DRAWING No. SP635-1.1.42</div>		
E					
D					
C					
B	REFERENCE CHANGED TO "MINISTRY ELECTRICAL REPRESENTATIVE"	OCT 03			
A	DRAWING NUMBER CHANGED	AUG 95			

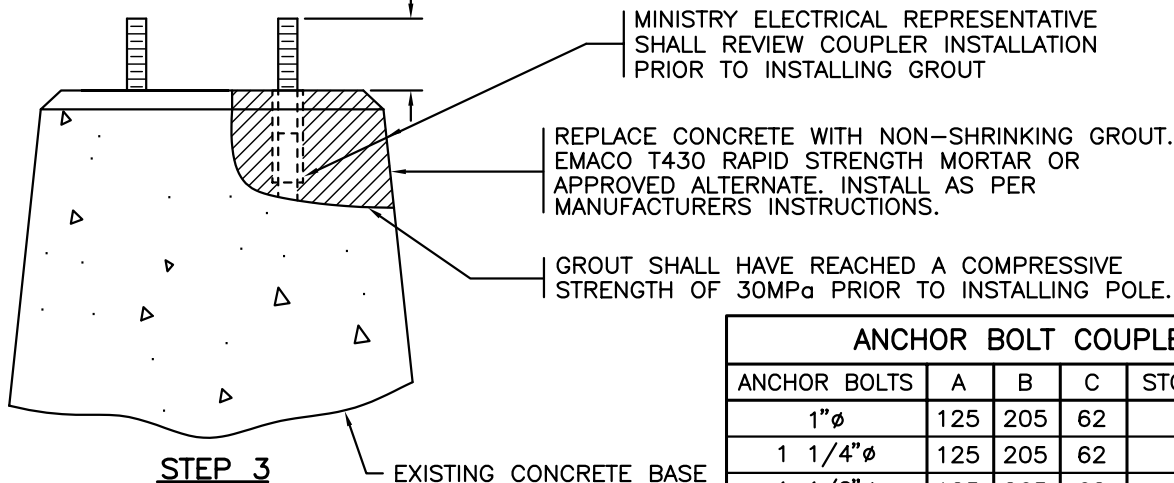




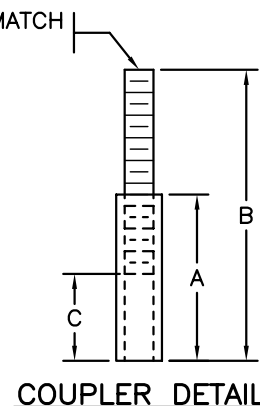
### STEP 1



### STEP 2



### STEP 3



### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-1.1.42 FOR ADDITIONAL INFORMATION.

NOT TO SCALE

### ANCHOR BOLT COUPLERS

ANCHOR BOLTS	A	B	C	STOCK NUMBER
1"Ø	125	205	62	SN2125
1 1/4"Ø	125	205	62	SN2126
1 1/2"Ø	125	265	62	SN2127
1"Ø (DYWIDAG)	150	310	75	SN2128

ALL COUPLERS SHALL HAVE A MINIMUM OF 125% OF THE SPECIFIED ANCHOR BOLT YIELD STRENGTH



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E		
D		
C		
B	MINISTRY ELECTRICAL REPRESENTATIVE ADDED	OCT 03
A	DRAWING NUMBER CHANGED	AUG 95

### ANCHOR BOLT REPAIR PROCEDURES

Date Approved  
**18/11/94 E.L. (Signature on File)**  
 Chief Highway Engineer

SPECIFICATION  
 DRAWING No.  
**SP635-1.1.43**



No.	Revision	Date	<div style="text-align: center;"> <b>TYPE 6 RECTANGULAR PLASTIC JUNCTION BOX INSTALLATION DETAILS</b> </div>		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	<div style="text-align: center;"> <b>SPECIFICATION DRAWING No. SP635-1.2.1</b> </div>
B	LID STOCK NUMBER REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		
A	GENERAL REVISIONS	AUG 94	<div style="text-align: center;"> Chief Highway Engineer </div>		



NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)

1"Ø x 390 LONG R.PVC CONDUCTOR  
SUPPORT BARS (2 REQUIRED)

GALVANIZED STEEL J.B. LID

LID HOLD DOWN BOLT

INSTALL ANTI-SEIZE  
LUBRICANT ON BOLT  
THREADS

BONDING TAB

FINISHED GRADE

150

300

MID BRACE

CONCRETE COLLAR TO SUIT THE  
SHAPE OF JUNCTION BOX (USE  
JUNCTION BOX AS FORM WHEN  
POURING COLLAR

J.B. SECTION

75

100

150

25mm WELL GRADED  
BASE COURSE AGGREGATE

PLASTIC DRAIN PLATE  
(BOLT TO JUNCTION BOX)

R.PVC END BELL AND COUPLING

### \* TYPE 6 'SPECIAL' JUNCTION BOX

TWO J.B. SECTIONS (SN1847)  
ONE LID (SN1850)  
ONE MID BRACE (SN1857)  
ONE DRAIN PLATE (SN1859)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. PLACE LID ON BOX & MID BRACE INSIDE BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

DENOTED AS 6\*  
ON DRAWINGS

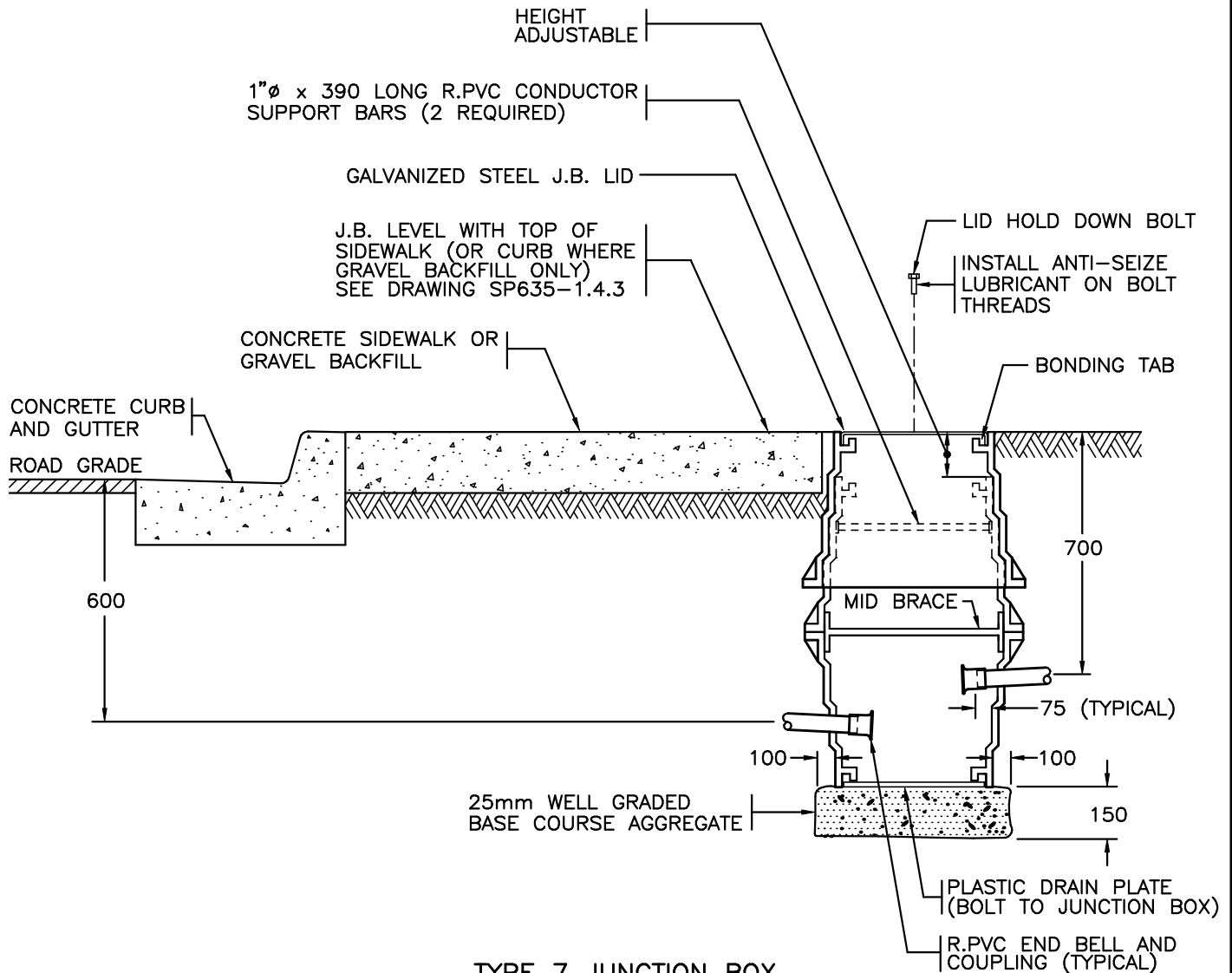
NOT TO SCALE



No.	Revision	Date	TYPE 6 'SPECIAL' RECTANGULAR PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	LID STOCK NUMBER REVISED	AUG 96	30/09/93	E.L. (Signature on File)	SP635-1.2.2
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		



NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)



### TYPE 7 JUNCTION BOX

THREE JUNCTION BOX SECTIONS (SN1847)  
ONE LID (SN1850)  
ONE MID BRACE (SN1857)  
ONE DRAIN PLATE (SN1859)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. PLACE LID ON BOX & MID BRACE INSIDE BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

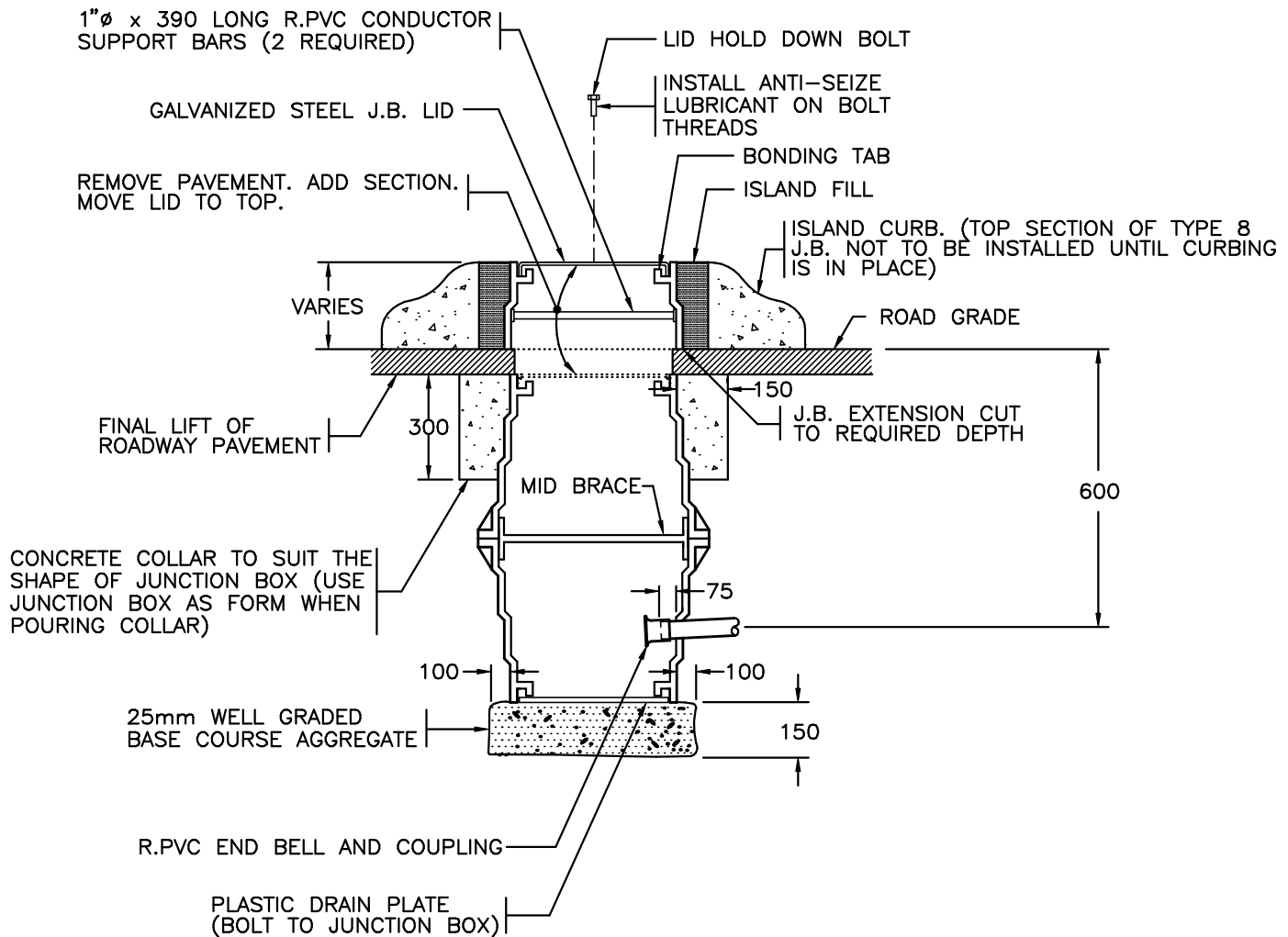
NOT TO SCALE



No.	Revision	Date	TYPE 7 RECTANGULAR PLASTIC JUNCTION BOX INSTALLATION DETAILS	
E				
D				
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved
B	LID STOCK NUMBER REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>	
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer	
			SPECIFICATION DRAWING No. <b>SP635-1.2.3</b>	



NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)



### TYPE 8 JUNCTION BOX

THREE JUNCTION BOX SECTIONS (SN 1847)  
ONE LID (SN1850)  
ONE MID BRACE (SN1857)  
ONE DRAIN PLATE (SN1859)

#### NOTES

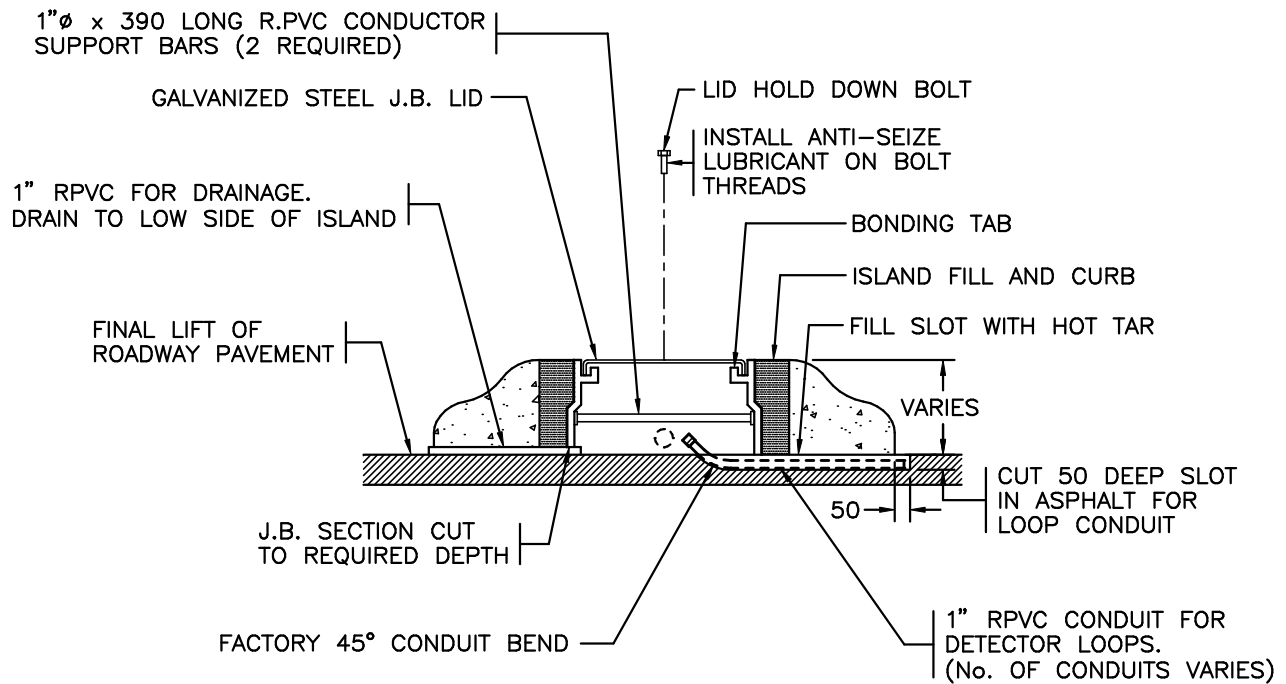
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. PLACE LID ON BOX & MID BRACE INSIDE BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TYPE 8 RECTANGULAR PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	LID STOCK NUMBER REVISED	AUG 96	30/09/93	E.L. (Signature on File)	SP635-1.2.4
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





**TYPE 9 JUNCTION BOX**  
ONE JUNCTION BOX SECTION (SN1847)  
ONE LID (SN1850)

**NOTES**

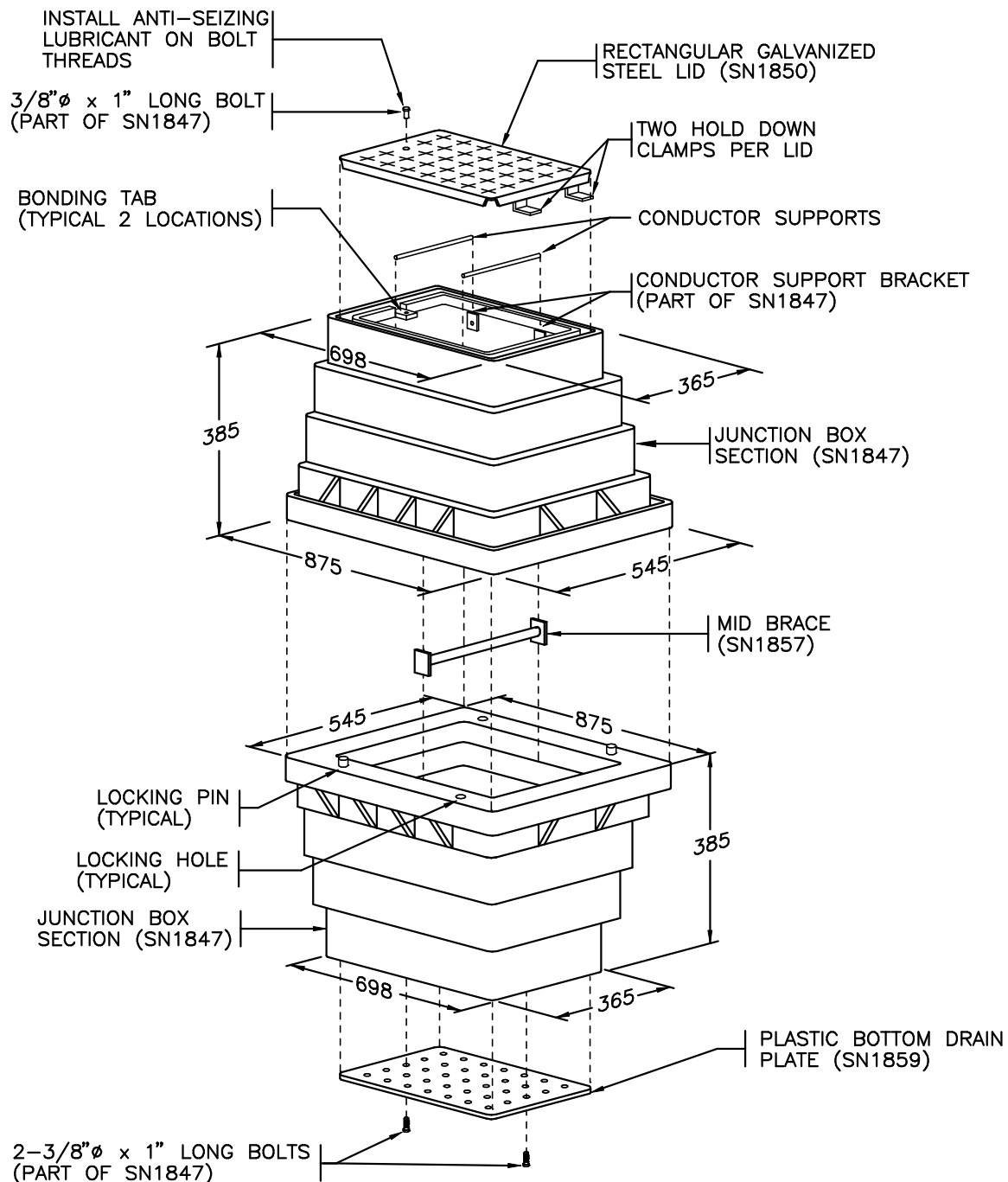
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. PLACE LID ON BOX & MID BRACE INSIDE BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TYPE 9 RECTANGULAR PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	LID STOCK NUMBER REVISED	AUG 96	<b>30/09/93</b>	<b>E.L. (Signature on File)</b>	SP635-1.2.5
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. PLACE LID ON BOX & MID BRACE INSIDE BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

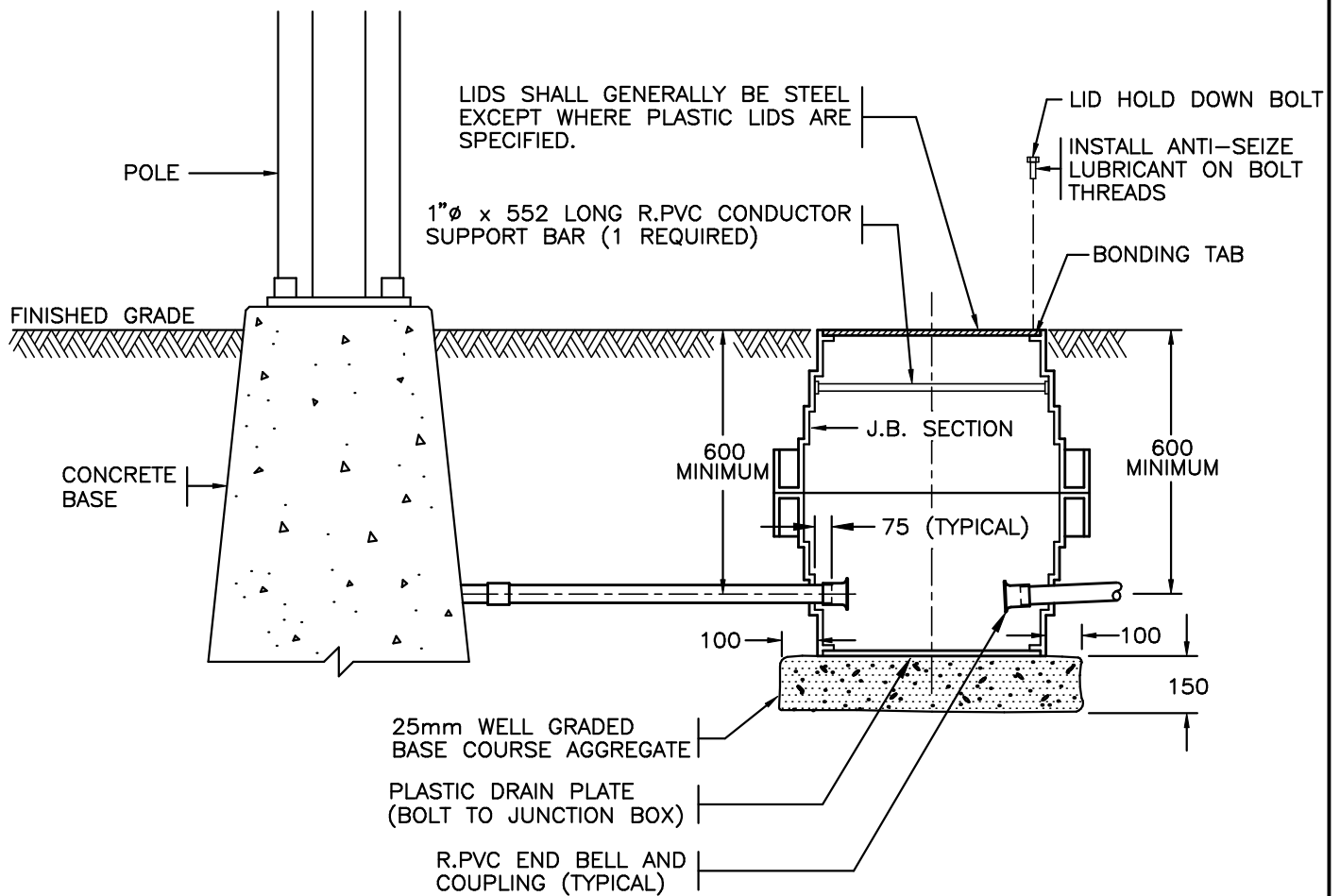
NOT TO SCALE



No.	Revision	Date	RECTANGULAR PLASTIC JUNCTION BOX DETAILS	
F				
E				
D				
C	ANTI-SEIZING LUBRICANT NOTED	NOV 98	Date	Approved
B	LID STOCK NUMBER REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. <b>SP635-1.2.6</b>	



NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)



### TYPE 10 JUNCTION BOX

TWO J.B. SECTIONS (SN1847R)  
ONE PLASTIC LID (SN1850R) OR ONE STEEL LID (SN1848)  
ONE DRAIN PLATE (SN1849)

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

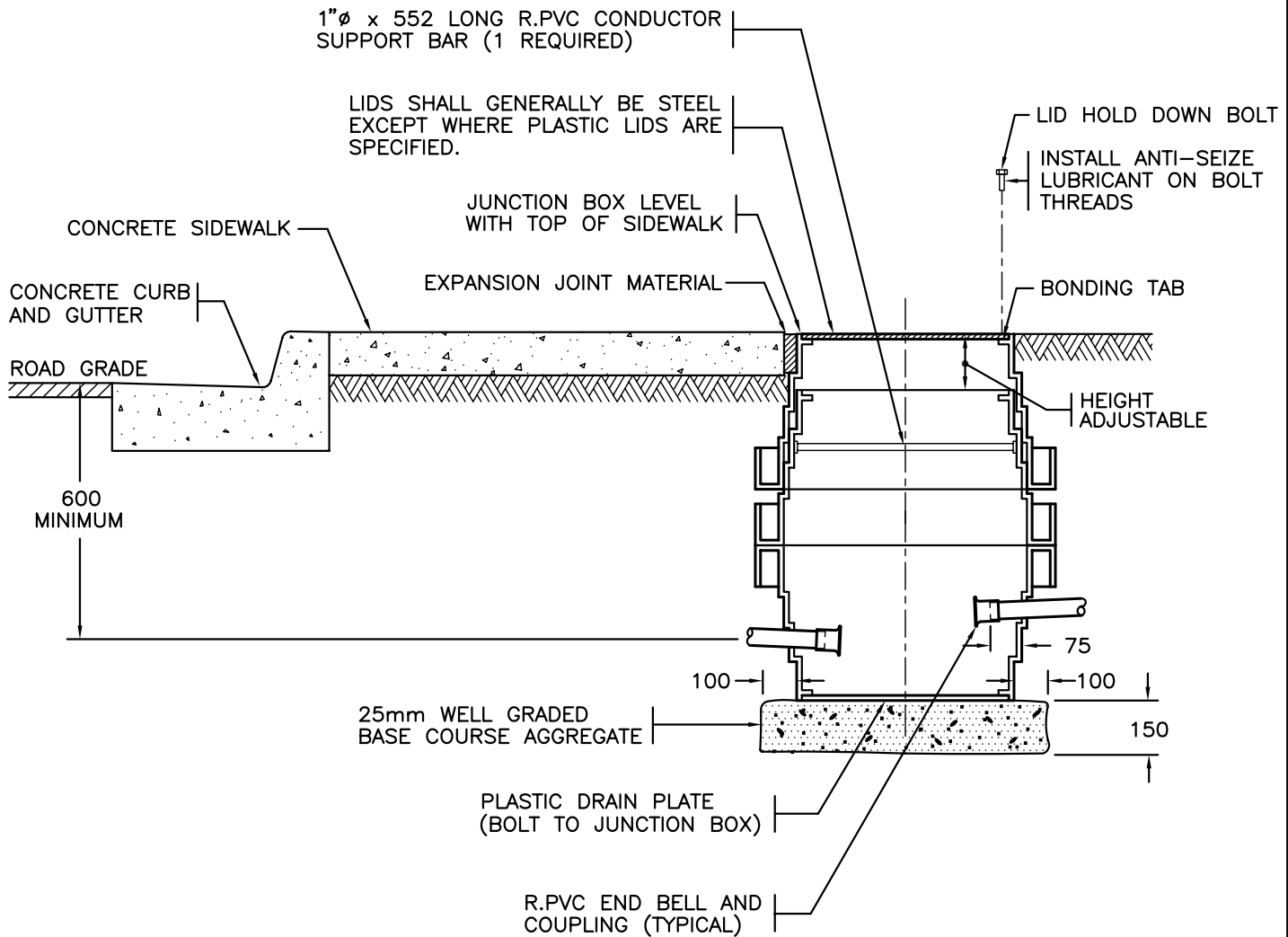
NOT TO SCALE



No.	Revision	Date	TYPE 10 ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI—SEIZE LUBRICANT NOTED	NOV 98			
B	LID & DRAIN PLATE STOCK NUMBER REVISED	AUG 96	Date	Approved	SPECIFICATION DRAWING No.
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SP635—1.2.7



NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)

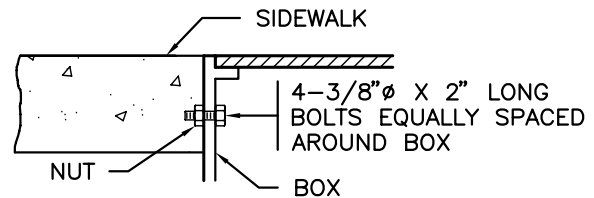


### TYPE 11 JUNCTION BOX

THREE JUNCTION BOX SECTIONS (SN1847R)  
ONE PLASTIC LID (SN1850R) OR ONE STEEL LID (SN1848)  
ONE DRAIN PLATE (SN1849)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.



### JUNCTION BOX IN SIDEWALK



**BRITISH COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

No.	Revision	Date	TYPE 11 ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS	
E				
D	DETAIL ADDED	OCT 03		
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved
B	LID & DRAIN PLATE STOCK NUMBER REVISED	AUG 96		
A	GENERAL REVISIONS	AUG 94		
			30/09/93 E.L. (Signature on File)	SPECIFICATION DRAWING No. SP635-1.2.8
			Chief Highway Engineer	

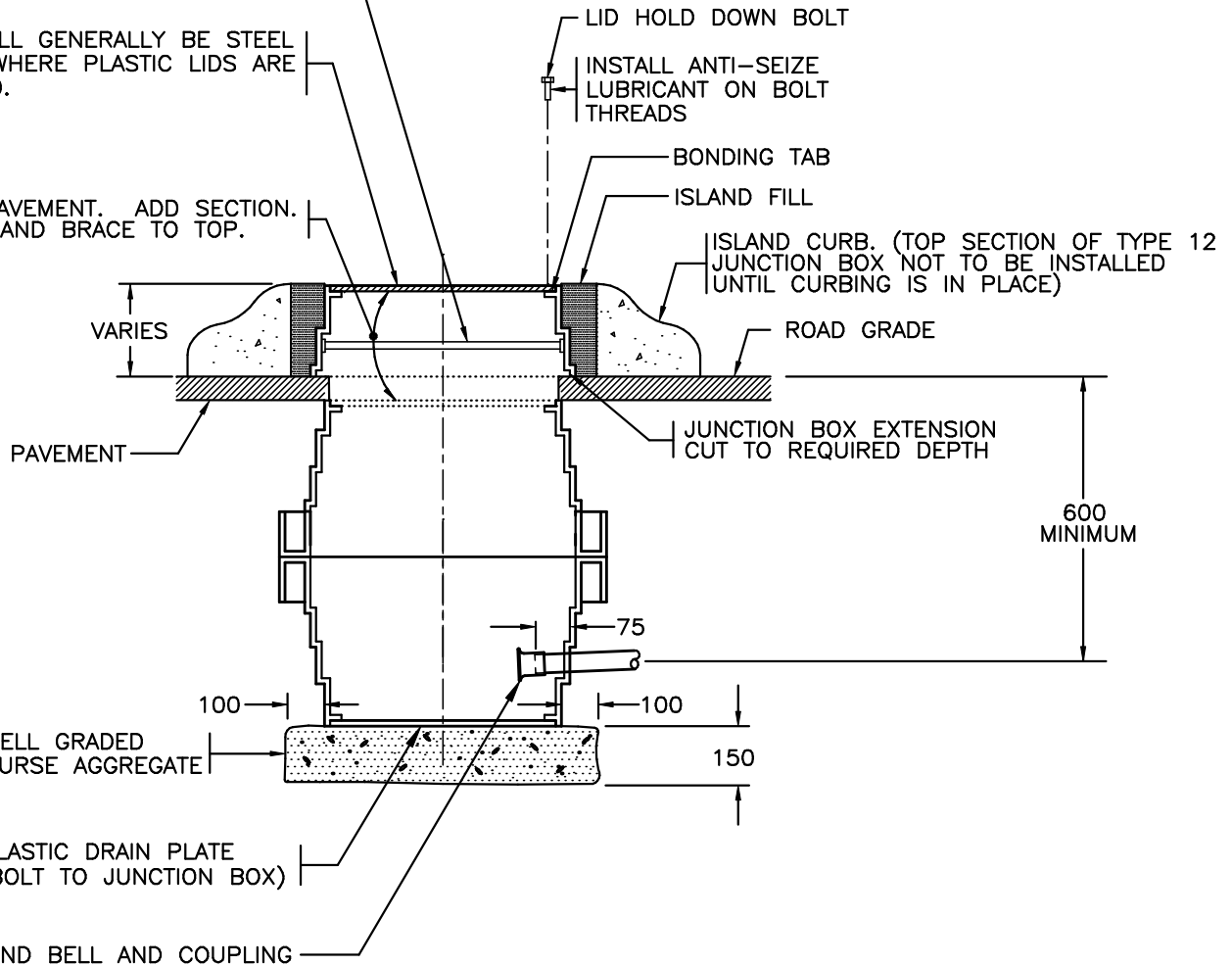


NUMBER OF CONDUITS ENTERING  
JUNCTION BOX NOT TO EXCEED 10  
(UNLESS OTHERWISE NOTED)

1"Ø x 552 LONG R.PVC CONDUCTOR  
SUPPORT BAR (1 REQUIRED)

LIDS SHALL GENERALLY BE STEEL  
EXCEPT WHERE PLASTIC LIDS ARE  
SPECIFIED.

REMOVE PAVEMENT. ADD SECTION.  
MOVE LID AND BRACE TO TOP.



### TYPE 12 JUNCTION BOX

THREE JUNCTION BOX SECTIONS (SN1847R)  
ONE PLASTIC LID (SN1850R) OR ONE STEEL LID (SN1848)  
ONE DRAIN PLATE (SN1849)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TYPE 12 ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI—SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	LID & DRAIN PLATE STOCK NUMBER REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		SP635—1.2.9
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		



1"Ø x 552 LONG R.PVC CONDUCTOR  
SUPPORT BAR (1 REQUIRED)

LIDS SHALL GENERALLY BE STEEL  
EXCEPT WHERE PLASTIC LIDS ARE  
SPECIFIED.

1" R.PVC FOR DRAINAGE.  
DRAIN TO LOW SIDE OF ISLAND

LID HOLD DOWN BOLT

INSTALL ANTI-SEIZE  
LUBRICANT ON BOLT  
THREADS

BONDING TAB

ISLAND FILL AND CURB

VARIES

CUT 50 DEEP SLOT  
IN ASPHALT FOR  
LOOP CONDUIT

50

J.B. SECTION CUT  
TO REQUIRED DEPTH

FACTORY 45° CONDUIT BEND

1" RPVC CONDUIT FOR  
DETECTOR LOOPS.  
(No. OF CONDUITS VARIES)

### TYPE 13 JUNCTION BOX

ONE JUNCTION BOX SECTION (SN1847R)  
ONE PLASTIC LID (SN1850R) OR ONE STEEL LID (SN1848)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. SEE DRAWINGS SP635-1.4.1, 1.4.2 & 1.4.3 FOR J.B. INSTALLATION DETAILS.
4. ALL CONDUITS SHALL DRAIN TO J.B.'S
5. 'SN' DENOTES MINISTRY STOCK NUMBER.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH  
COLUMBIA**

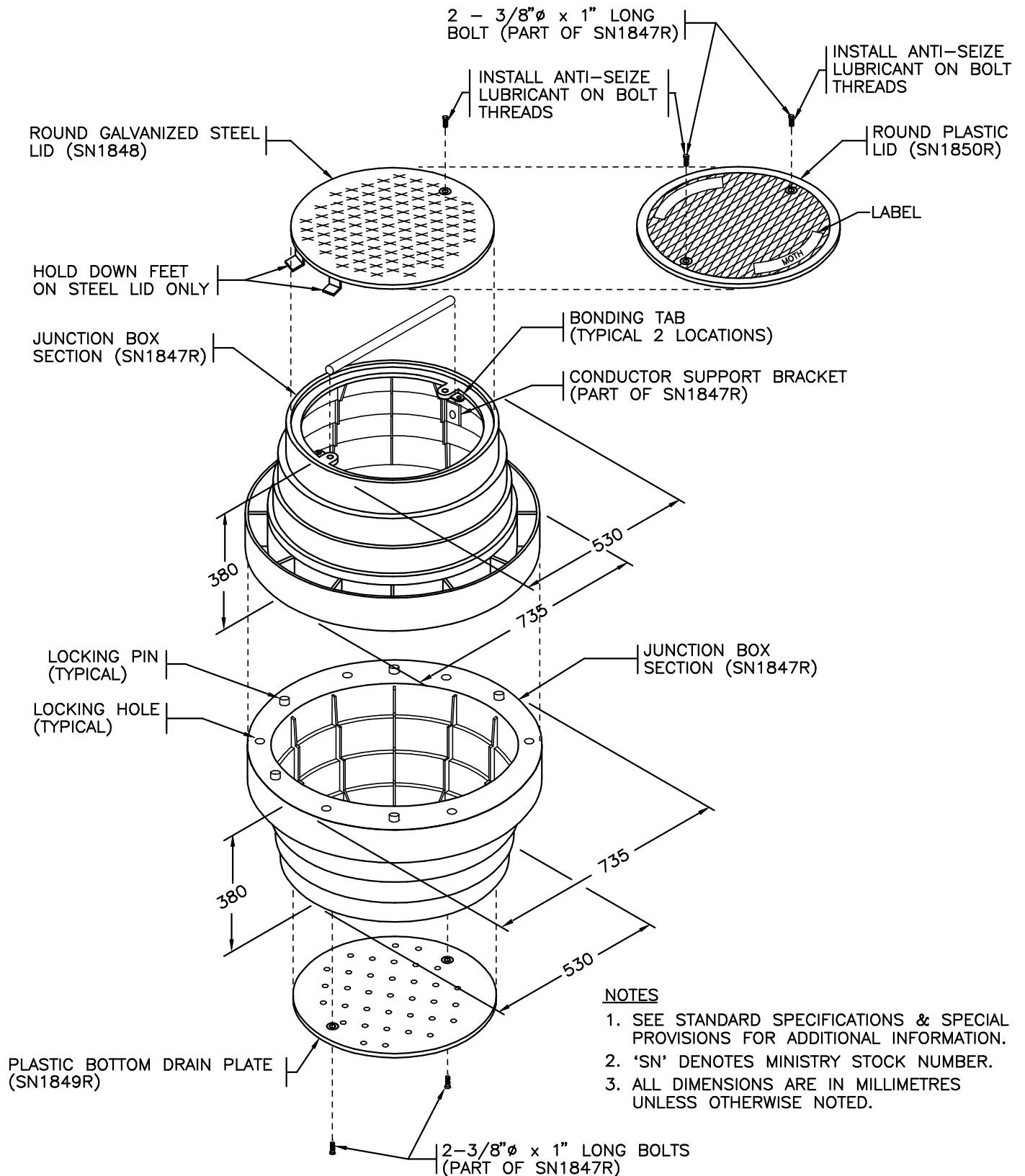
Ministry of  
Transportation

No.	Revision	Date	TYPE 13 ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS	
E			Date	Approved
D	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	SPECIFICATION DRAWING No.	
C	STEEL LID STOCK NUMBER REVISED	AUG 96	SP635-1.2.10	
B	STEEL LID TYPE NOTE CHANGED	AUG 95		
A	GENERAL REVISIONS	AUG 94		

**30/09/93 E.L. (Signature on File)**

Chief Highway Engineer





NOT TO SCALE

No.	Revision	Date	ROUND PLASTIC JUNCTION BOX DETAILS		
F			<div>Date<div>Approved</div></div> <div><b>30/09/93 E.L. (Signature on File)</b><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. <b>SP635—1.2.11</b></div>		
E					
D	ANTI—SEIZING LUBRICANT NOTED	NOV 98			
C	STEEL LID STOCK NUMBER REVISED	AUG 96			
B	STEEL LID REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94			



LIDS SHALL GENERALLY BE STEEL  
EXCEPT WHERE PLASTIC LIDS ARE  
SPECIFIED.

1"Ø x 552 LONG R.PVC CONDUCTOR  
SUPPORT BAR (1 REQUIRED)

LID HOLD DOWN BOLT

INSTALL ANTI-SEIZE  
LUBRICANT ON BOLT  
THREADS

BONDING TAB

FINISHED GRADE

LARGE ROUND J.B. SECTION  
(SN1847R)

J.B. ADAPTOR PLATE  
(SN1847A)

R.PVC

RECTANGULAR  
J.B. SECTION

BRICKS

R.PVC COUPLING  
(TYPICAL)

### JUNCTION BOX

ONE J.B. SECTION (SN1847R)  
ONE PLASTIC LID (SN1850R) OR ONE STEEL LID (SN1848)  
ONE J.B. ADAPTOR (SN1847A)

### NOTES

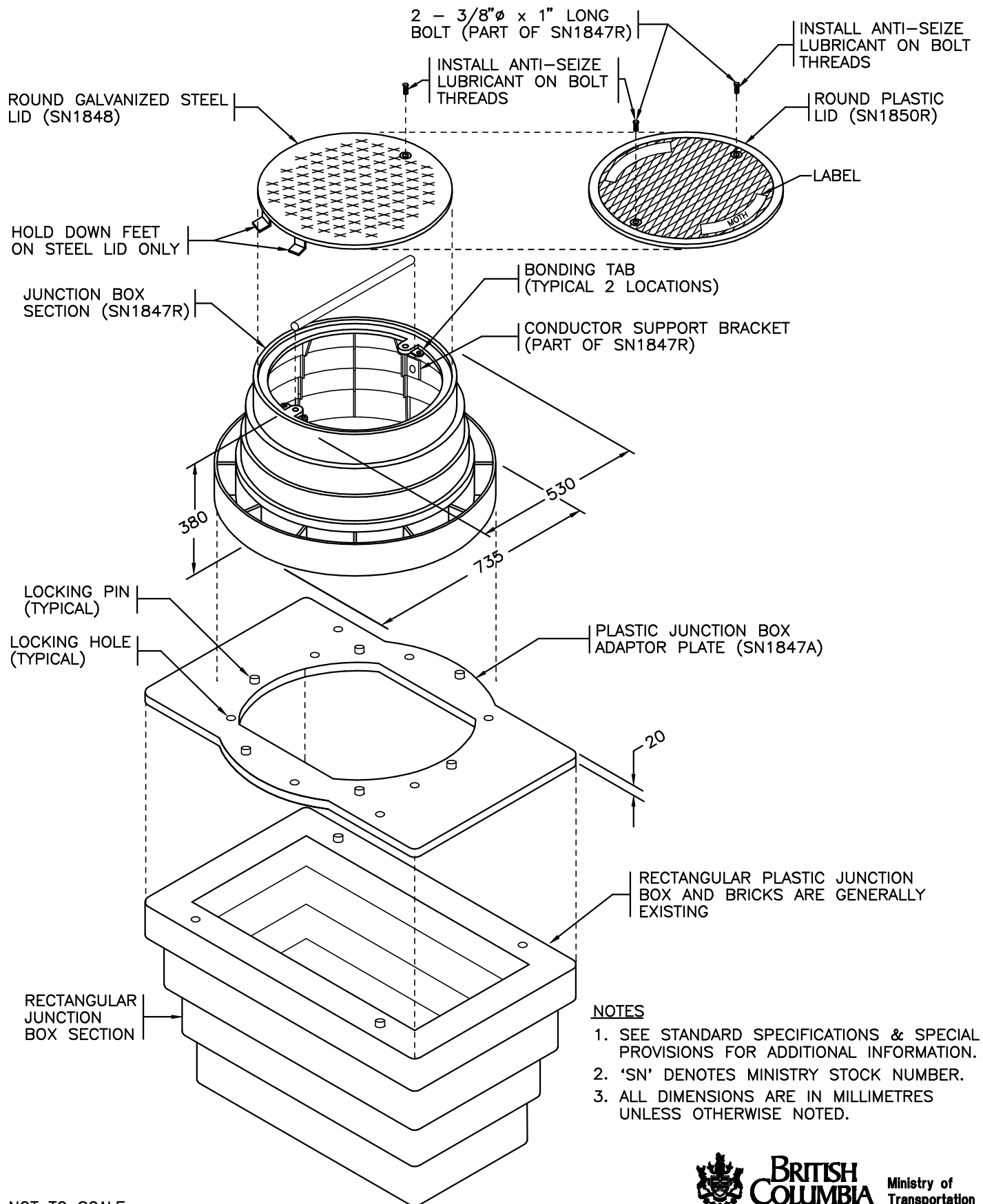
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	RECTANGULAR TO ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	LID & JUNCTION BOX STOCK NUMBER REVISED	AUG 96	30/09/93	E.L. (Signature on File)	SP635-1.2.12
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		

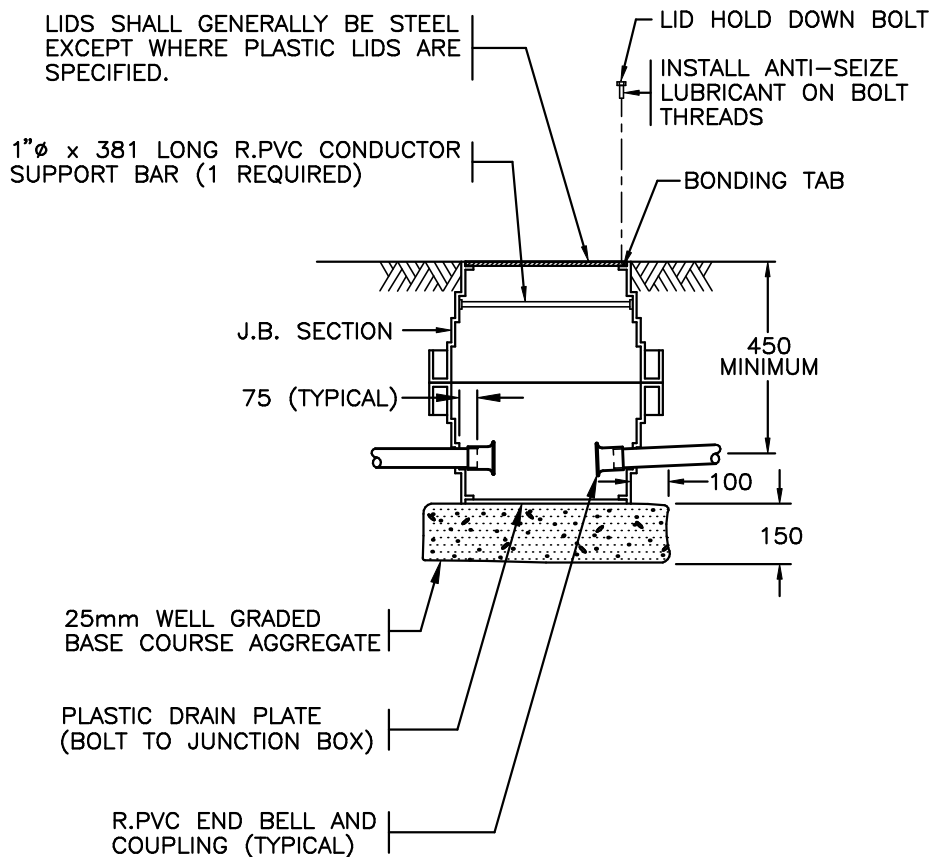




NOT TO SCALE

No.	Revision	Date	RECTANGULAR TO ROUND PLASTIC JUNCTION BOX ADAPTOR DETAILS		
F			Date Approved  <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635-1.2.13
E					
D	ANTI-SEIZING LUBRICANT NOTED	NOV 98			
C	LID STOCK NUMBER REVISED	AUG 96			
B	STEEL LID REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94			





### TYPE 14 JUNCTION BOX

TWO J.B. SECTIONS (SN1853)  
ONE PLASTIC LID (SN1853A) OR ONE STEEL LID (SN1853B)  
ONE DRAIN PLATE (SN1853C)

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. BOLT DOWN LID ON BOX BEFORE BACKFILLING, TAMPING & PAVING OPERATIONS.
3. ALL CONDUITS SHALL DRAIN TO J.B.'S
4. 'SN' DENOTES MINISTRY STOCK NUMBER.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

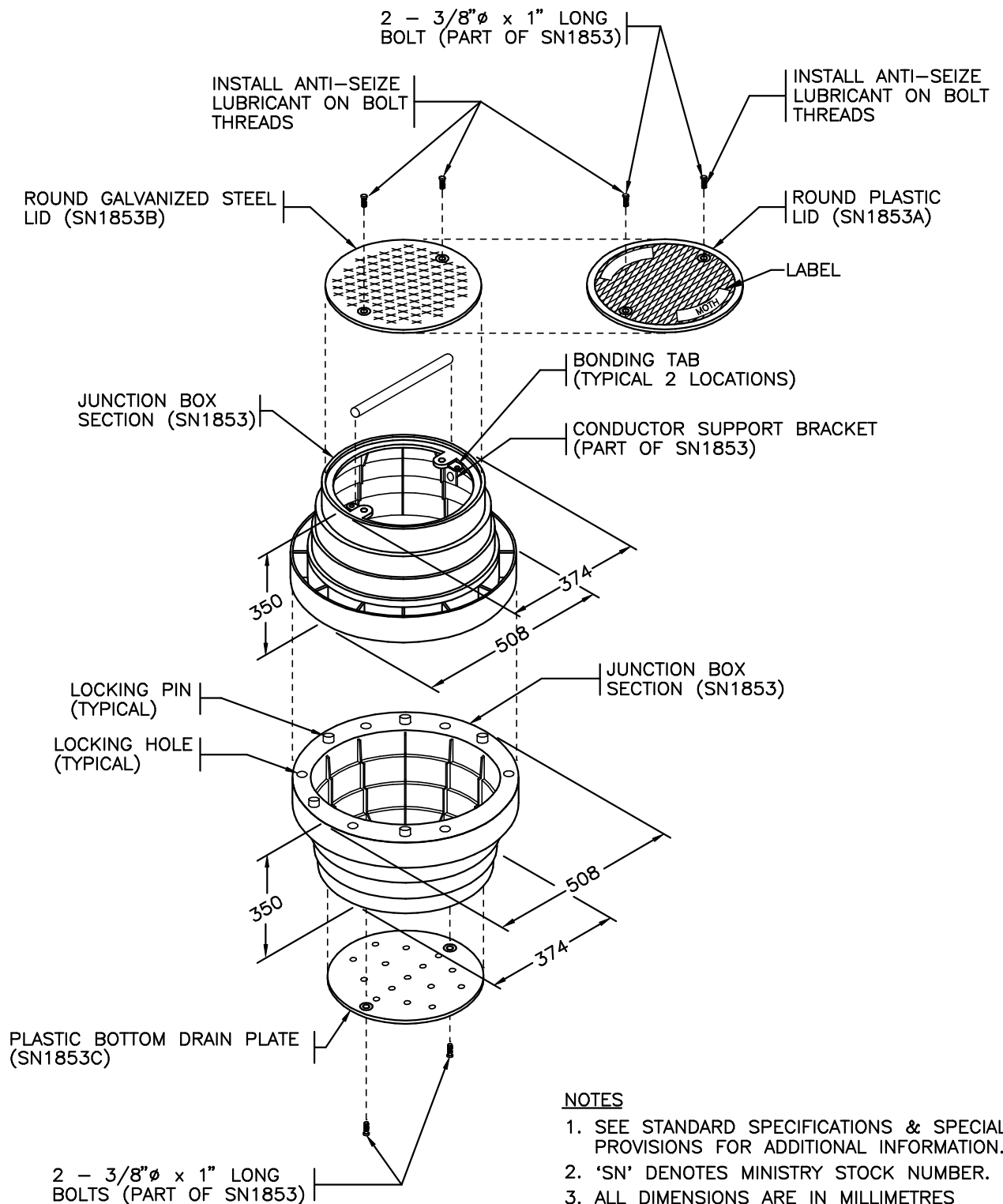


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE 14 SMALL ROUND PLASTIC JUNCTION BOX INSTALLATION DETAILS	
E			Date	Approved
D				
C				
B				
A	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	17/11/94 <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-1.2.14





#### NOTES

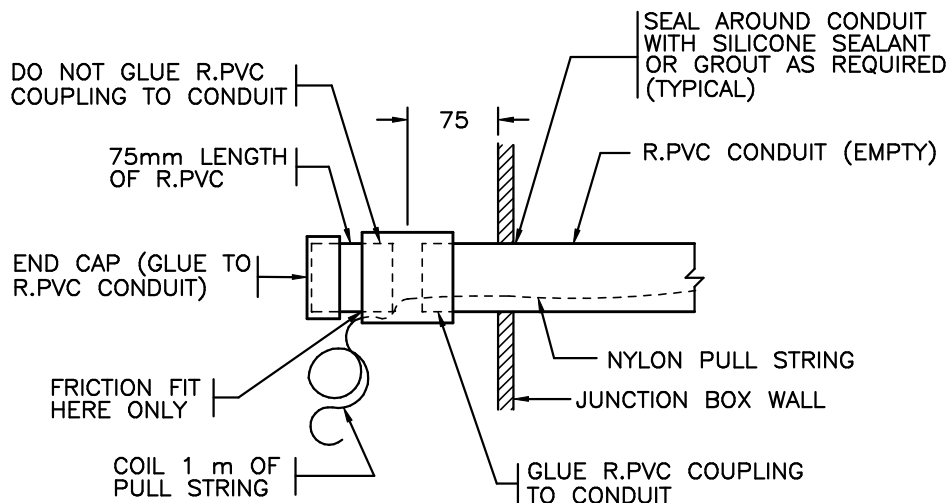
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

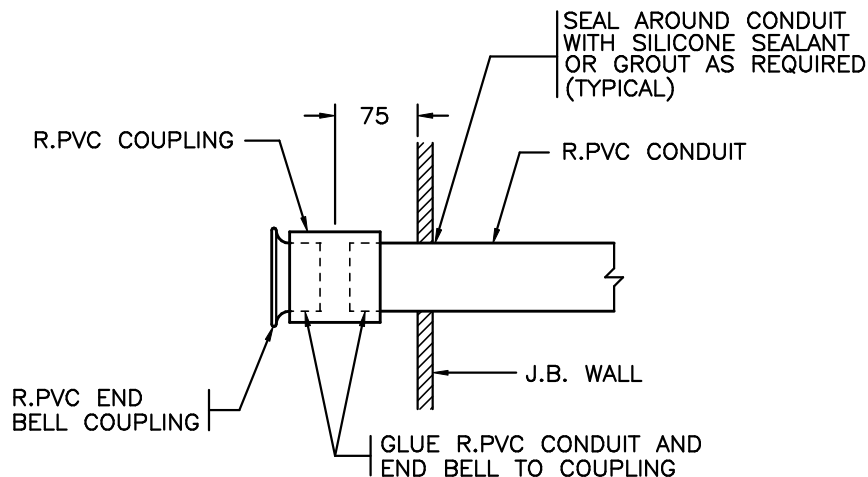


No.	Revision	Date	SMALL ROUND PLASTIC JUNCTION BOX DETAILS	
E				
D				
C				
B				
A	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date <b>17/11/94</b> Chief Highway Engineer	Approved <b>E.L. (Signature on File)</b> SPECIFICATION DRAWING No. <b>SP635-1.2.15</b>





### CAPPED EMPTY CONDUIT ENTRY TO JUNCTION BOX



NOTE: ALL CONDUITS TO DRAIN TO J.B.

### CONDUIT ENTRY TO J.B.

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. PULL STRING SHALL BE POLYPROPYLENE WITH A MINIMUM TENSILE STRENGTH OF 1.1kN. (BC HYDRO SPEC.)

NOT TO SCALE



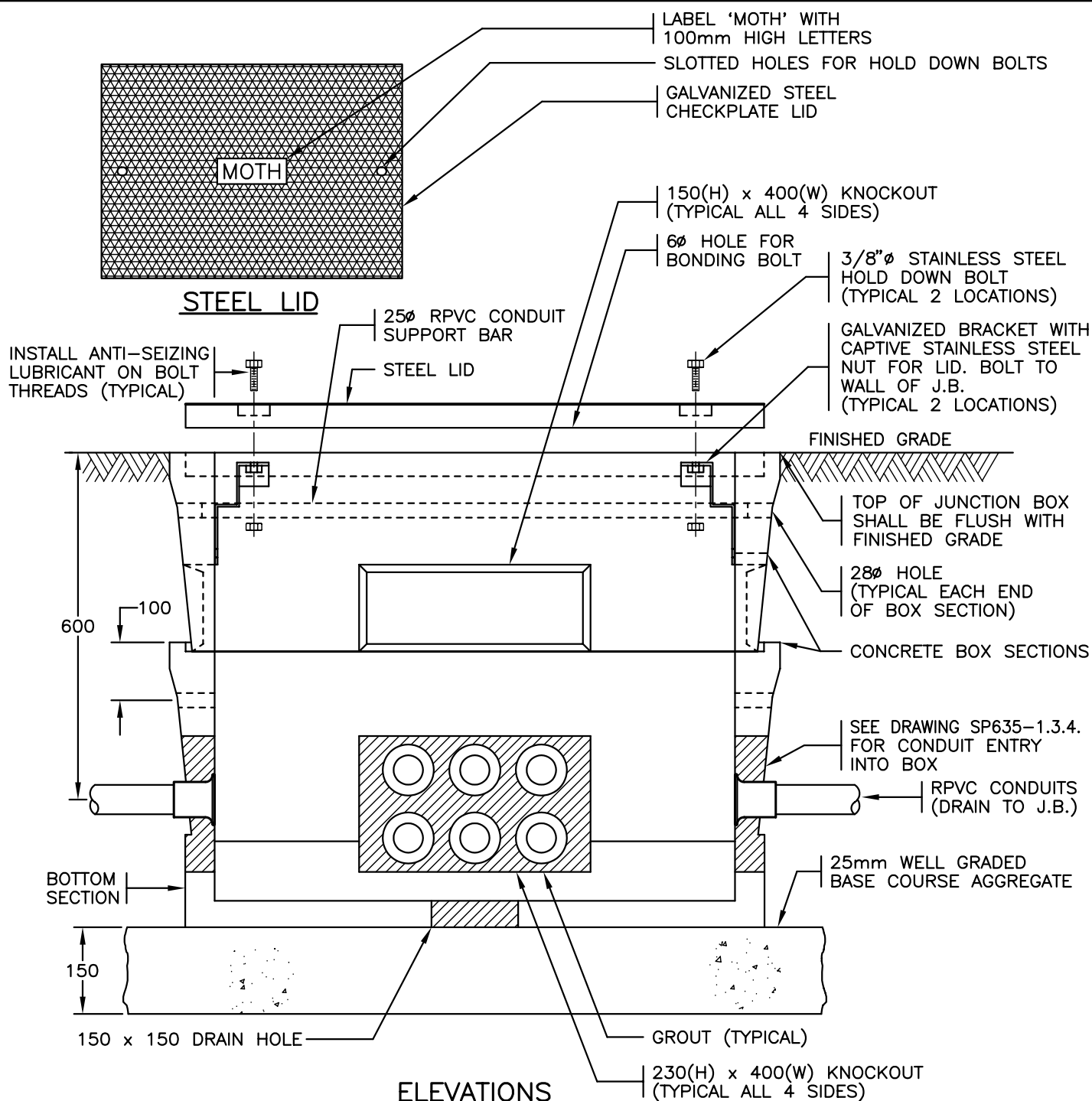
**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	CONDUIT ENTRY INTO PLASTIC JUNCTION BOXES	
F				
E				
D				
C	NOTE 3 ADDED	NOV 98	Date	Approved
B	CONDUIT GLUING CLARIFIED	OCT 97		
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. SP635-1.2.16	

**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
  2. JUNCTION BOX SHALL BE 'A.E. CONCRETE PRODUCTS LTD' No. MOTH 5686 OR APPROVED ALTERNATIVE.
  3. JUNCTION BOX SHALL BE DESIGNED FOR 5000kg STATIC LOADING.
  4. VAULTS SHALL BE PRE-CAST CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 35 MPa AT 28 DAYS.
  5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- NOT TO SCALE

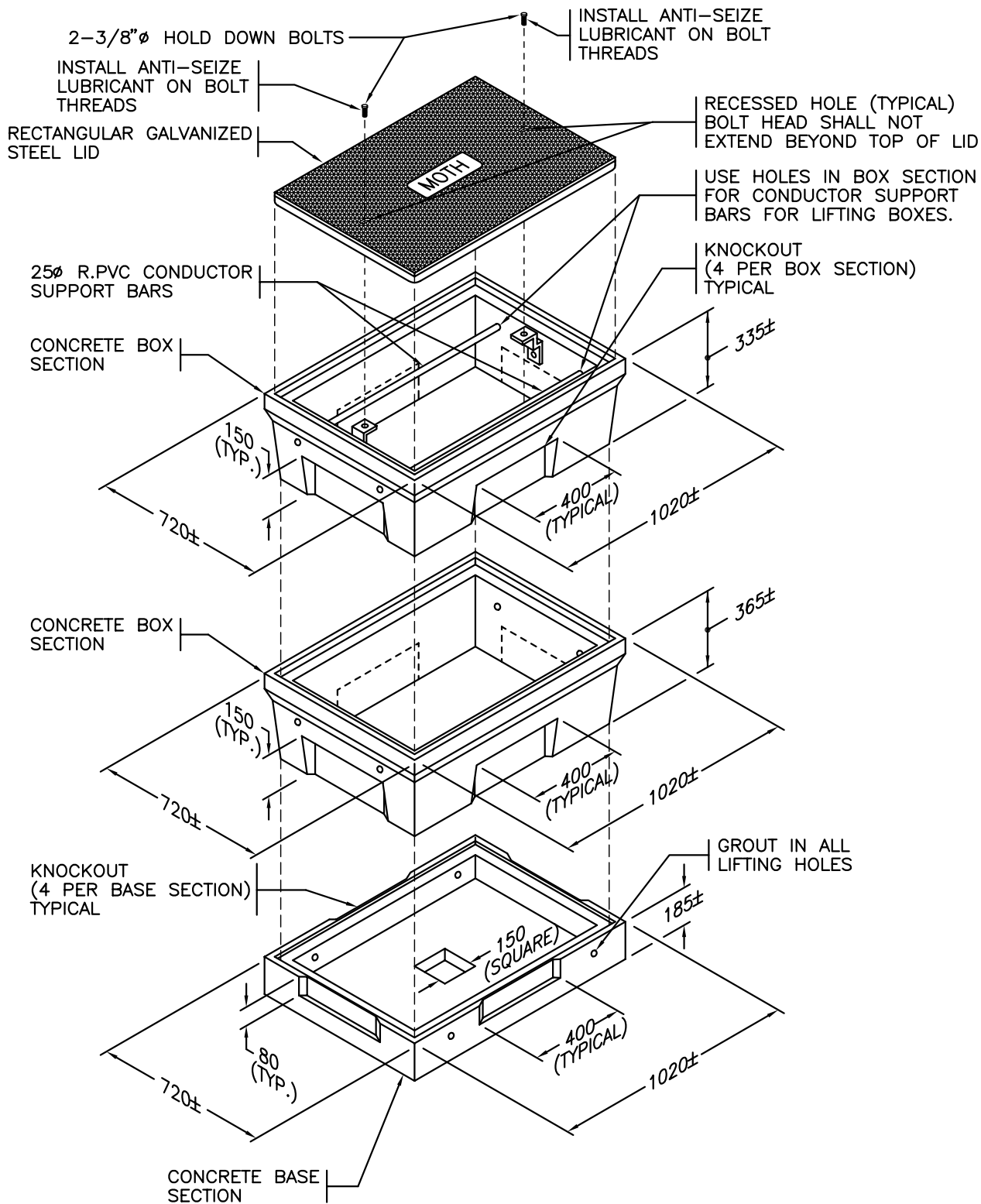


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	CONCRETE JUNCTION BOX DETAILS		
F					
E					
D	KON KAST PRODUCT DELETED	OCT 03	Date	Approved	SPECIFICATION DRAWING No.  SP635—1.3.1
C	ANTI—SEIZING LUBRICANT NOTED	NOV 98	<b>18/11/94      E.L. (Signature on File)</b>		
B	LID HOLD DOWN REVISED	AUG 96			
A	STEEL INSERTS ADDED	AUG 95	Chief Highway Engineer		





SEE DRAWING SP635-1.3.1 FOR NOTES



**BRITISH COLUMBIA**

Ministry of Transportation

NOT TO SCALE

No.	Revision	Date
E		
D	KON KAST PRODUCT DELETED	OCT 03
C	A.E. CONCRETE DIMS. REVISED & ANTI-SEIZE LUBRICANT NOTED	NOV 98
B	LID HOLD DOWN & BOX SIZES REVISED	AUG 96
A	BOLTS & STEEL INSERTS ADDED	AUG 95

## CONCRETE JUNCTION BOX DETAILS

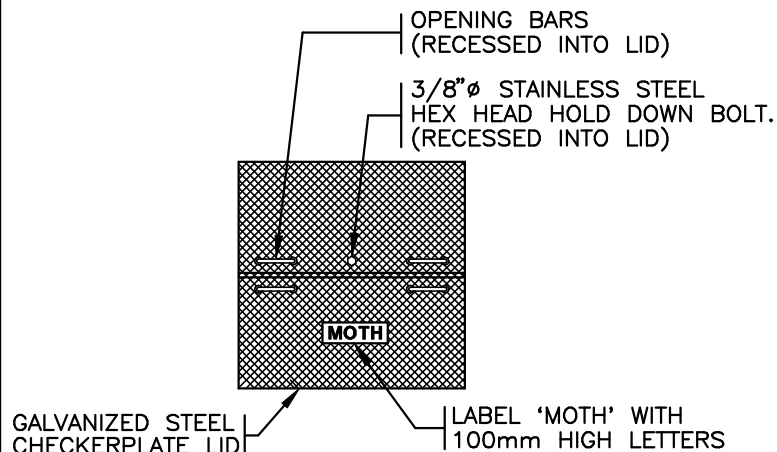
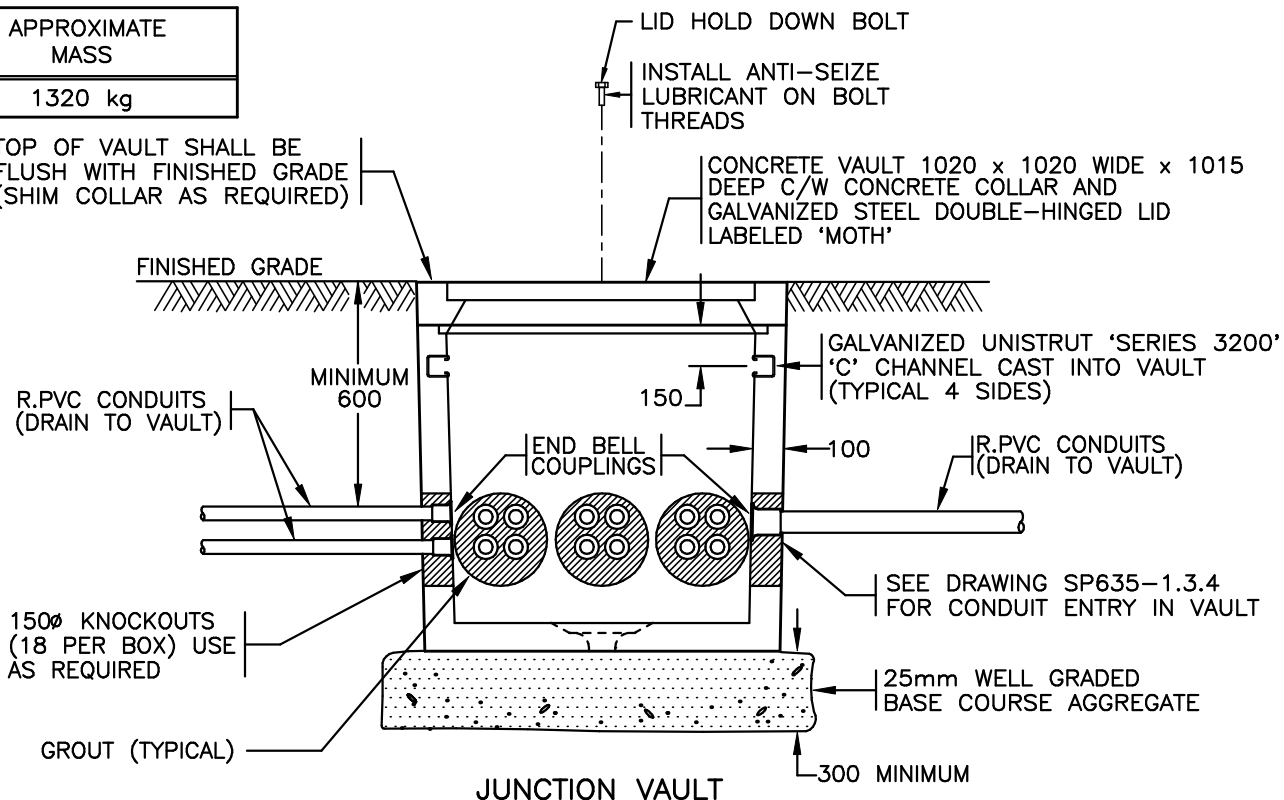
Date **18/11/94** Approved **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-1.3.2**

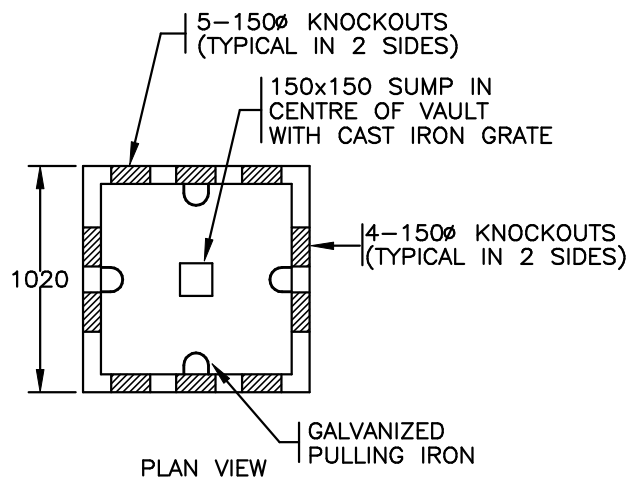


APPROXIMATE MASS
1320 kg

TOP OF VAULT SHALL BE  
FLUSH WITH FINISHED GRADE  
(SHIM COLLAR AS REQUIRED)



**LID DETAIL**



**KNOCKOUT & SUMP LOCATIONS**

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- VAULT SHALL BE 'A.E. CONCRETE PRE-CAST PRODUCTS LTD' TYPE, 'KON KAST PRODUCTS LTD.' OR APPROVED ALTERNATIVE.
- VAULT SHALL BE DESIGNED FOR H-20 STATIC LOADING.
- LIDS SHALL BE SUPPLIED GALVANIZED.
- VAULTS SHALL BE PRE-CAST CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 35 MPa AT 28 DAYS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

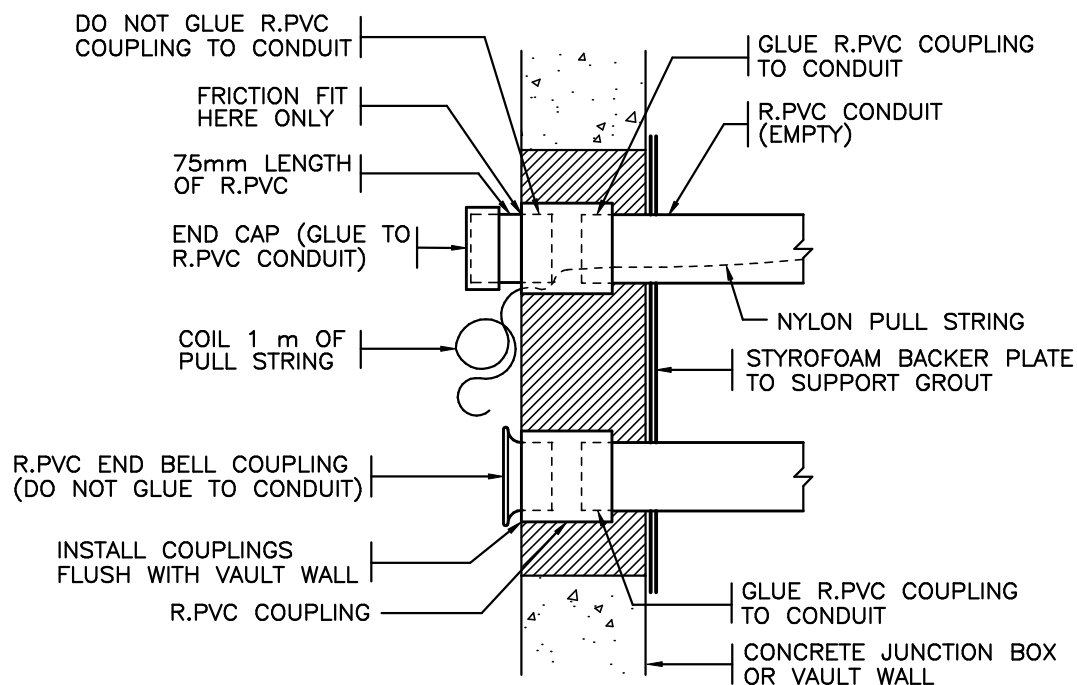


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	SMALL CONCRETE VAULT DETAILS (1020 SQUARE X 1015 DEEP)		
E					
D					
C	LID HOLD DOWN BOLT & ANTI-SEIZE LUBRICANT NOTED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	NOTE 2 REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635-1.3.3
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





### CONDUIT ENTRY TO VAULT OR CONCRETE JUNCTION BOX

#### NOTES

1. SEE DRAWINGS SP635-1.3.1 TO -1.3.3 FOR NOTES AND ADDITIONAL DETAILS.
2. PULL STRING SHALL BE POLYPROPYLENE WITH A MINIMUM TENSILE STRENGTH OF 1.1kN. (BC HYDRO SPEC.)

NOT TO SCALE



No.	Revision	Date	CONDUIT ENTRY INTO CONCRETE VAULT OR JUNCTION BOX	
F				
E				
D				
C	NOTES 1 & 2 ADDED	NOV 98	Date	Approved
B	CONDUIT GLUING CLARIFIED	OCT 97		
A	GENERAL REVISIONS	AUG 94		
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.3.4</b>



# **NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. OFFSET SHOWN MAY VARY WHERE NOTED ON THE PLANS OR DIRECTED BY THE MINISTRY REPRESENTATIVE.
4. EXCAVATED MATERIAL SHALL BE USED AS BACKFILL WHERE IT CONSISTS OF CLEAN WELL GRADED GRANULAR SOIL HAVING A MAXIMUM FINES CONTENT OF 8% (SILT AND CLAY SIZE PARTICLES) AND A MAXIMUM AGGREGATE SIZE OF 100mm.
5. WHERE EXCAVATED MATERIAL IS UNACCEPTABLE OR EXTRA FILL IS REQUIRED AROUND POLE BASE & JUNCTION BOXES, USE 25mm WELL GRADED BASE COURSE AGGREGATE.
6. BACKFILL MATERIAL SHALL BE INSTALLED AND FULLY COMPACTED IN ACCORDANCE WITH SUBSECTION 635.07.01 FOR THE MINIMUM AREA ALL AROUND THE BASE AS SHOWN ABOVE.

LARGE ROUND PLASTIC JUNCTION BOX

FILL MINIMUM 300mm ALL AROUND

TRAFFIC FLOW

1300 TO 1800

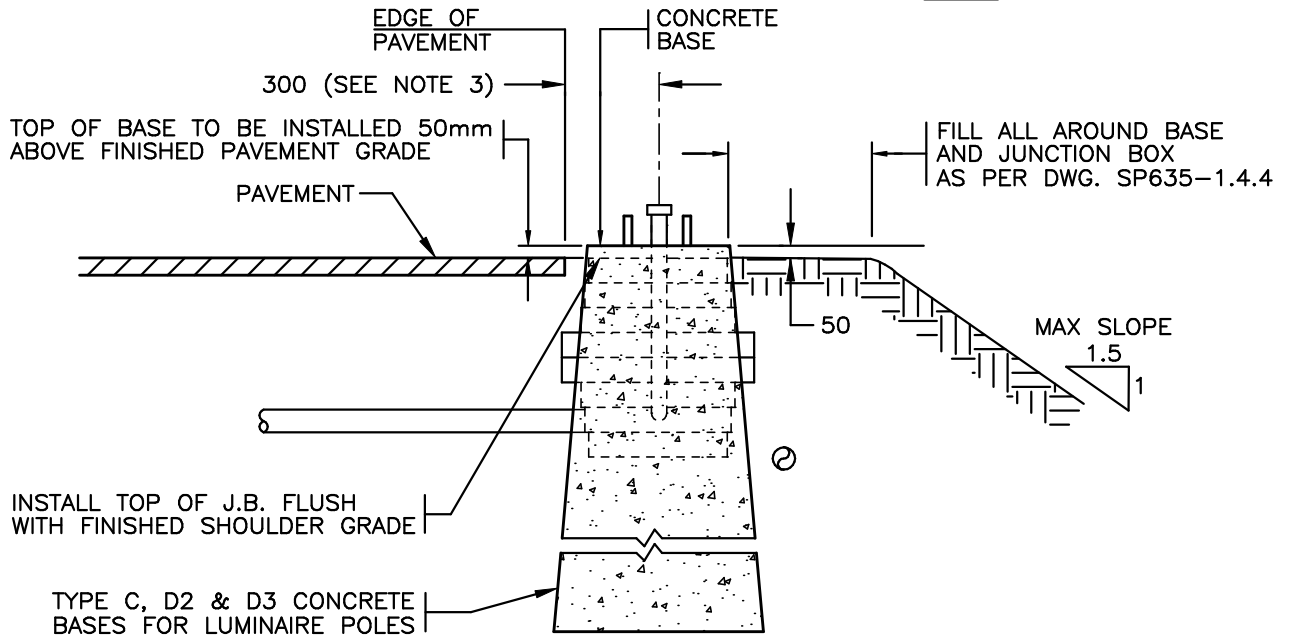
400 (UNLESS OTHERWISE NOTED)

EDGE OF PAVEMENT

TOP OF BASE

PAVEMENT

**PLAN**



**ELEVATION**

NOT TO SCALE

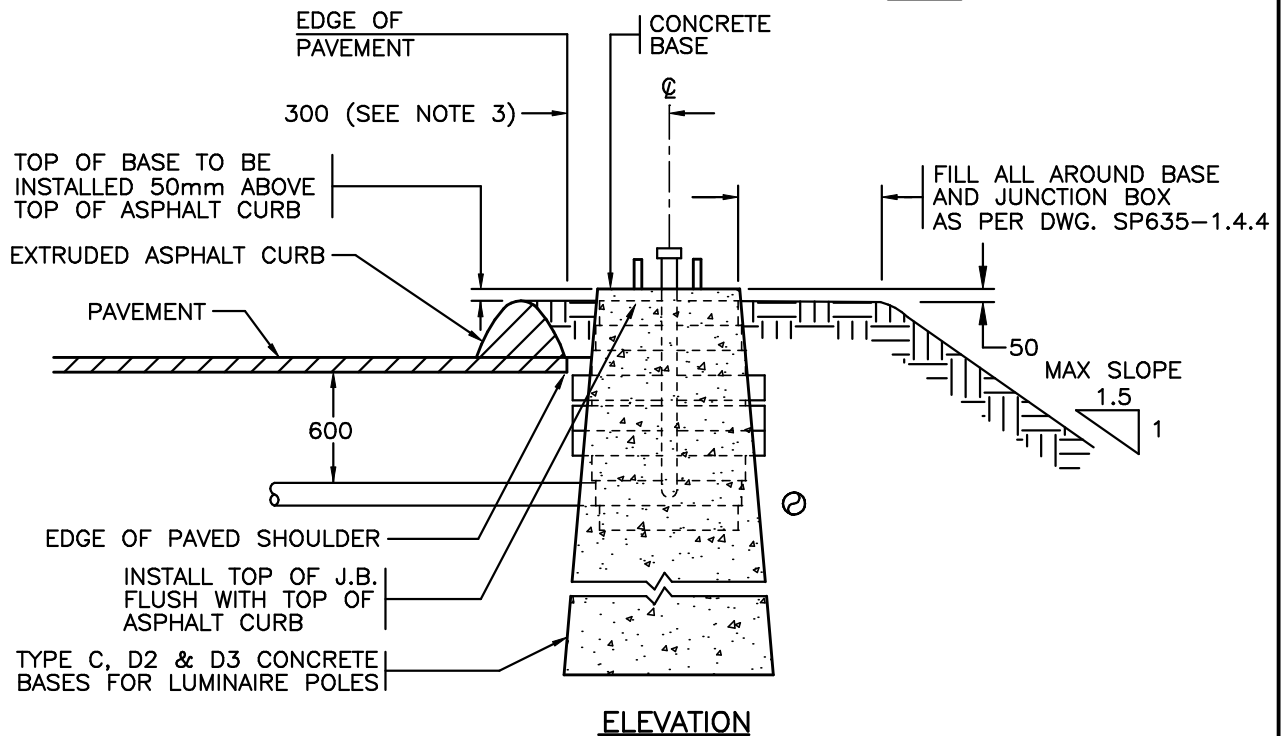
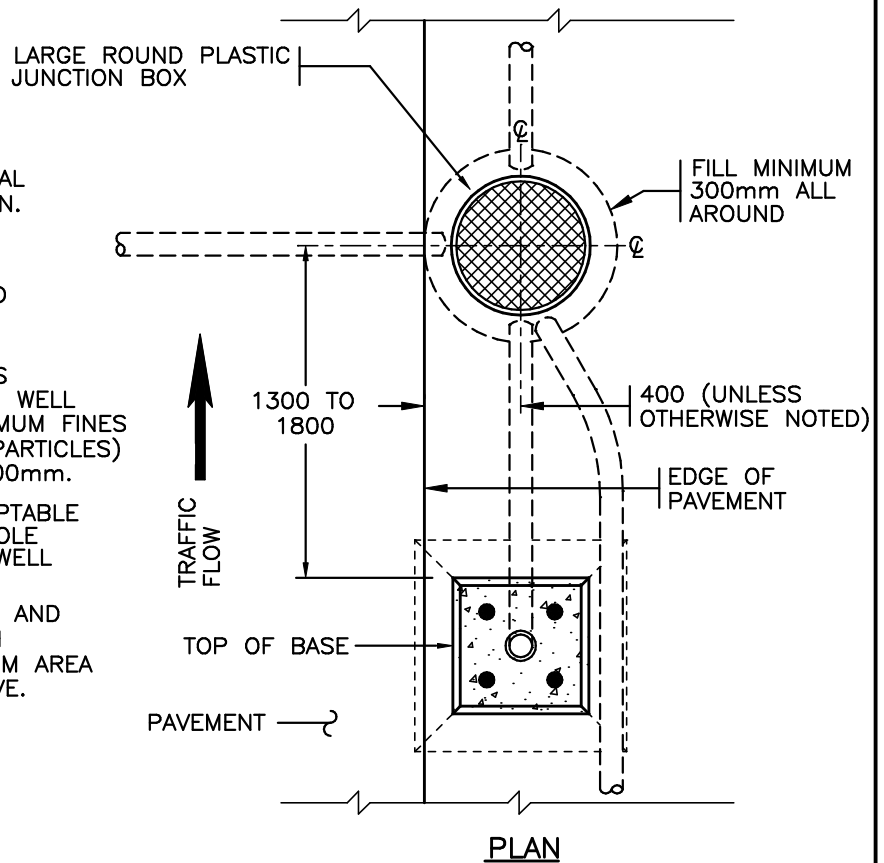


No.	Revision	Date	LUMINAIRE POLE BASE AND JUNCTION BOX INSTALLATION DETAIL FOR STANDARD ROADWAY	
F				
E				
D	NOTES 4, 5 & 6 REVISED	OCT 97	Date	Approved
C	REVISED TO SUIT ONLY LUMINAIRE POLE BASES	AUG 96		
B	BACKFILL REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.4.1</b>



# **NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. OFFSET SHOWN MAY VARY WHERE NOTED ON THE PLANS OR DIRECTED BY THE MINISTRY REPRESENTATIVE.
4. EXCAVATED MATERIAL SHALL BE USED AS BACKFILL WHERE IT CONSISTS OF CLEAN WELL GRADED GRANULAR SOIL HAVING A MAXIMUM FINES CONTENT OF 8% (SILT AND CLAY SIZE PARTICLES) AND A MAXIMUM AGGREGATE SIZE OF 100mm.
5. WHERE EXCAVATED MATERIAL IS UNACCEPTABLE OR EXTRA FILL IS REQUIRED AROUND POLE BASE & JUNCTION BOXES, USE 25mm WELL GRADED BASE COURSE AGGREGATE.
6. BACKFILL MATERIAL SHALL BE INSTALLED AND FULLY COMPACTED IN ACCORDANCE WITH SUBSECTION 635.07.01 FOR THE MINIMUM AREA ALL AROUND THE BASE AS SHOWN ABOVE.



NOT TO SCALE



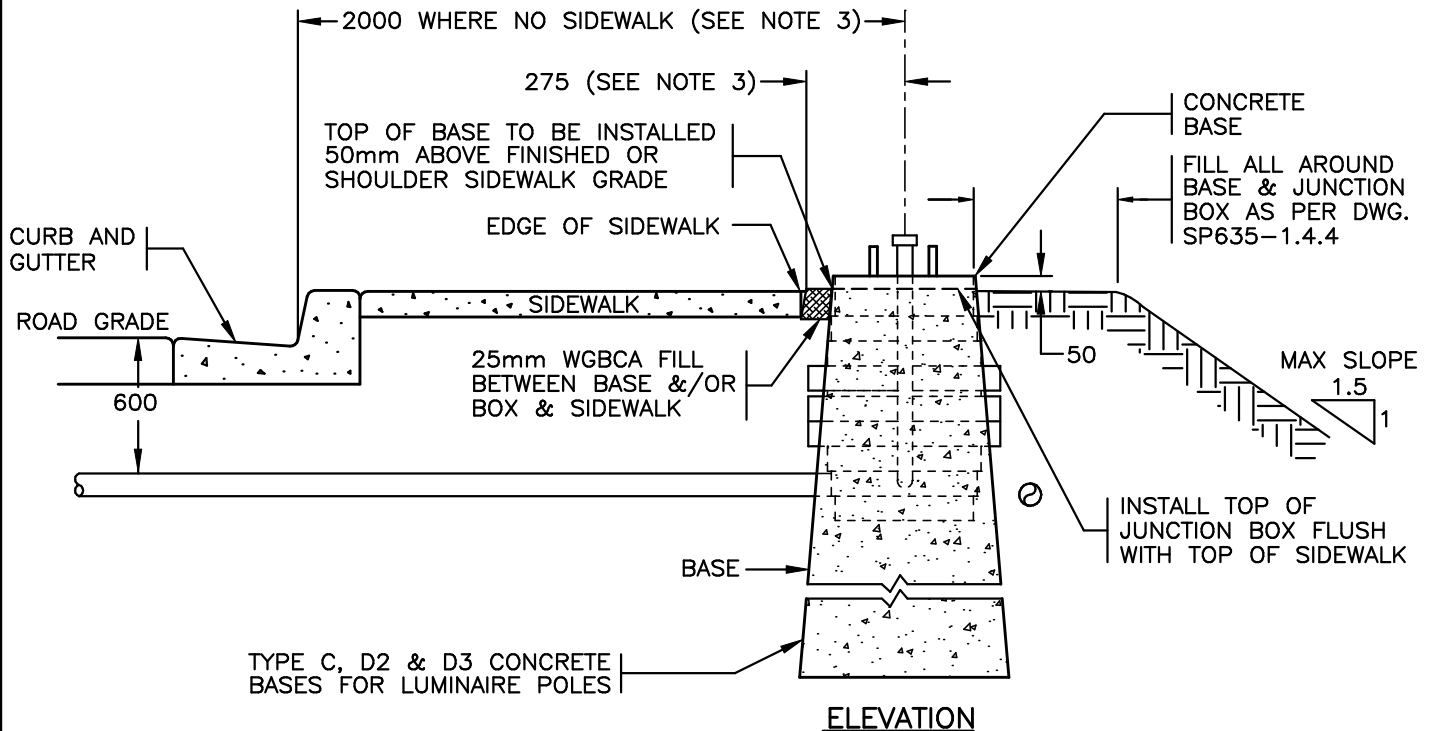
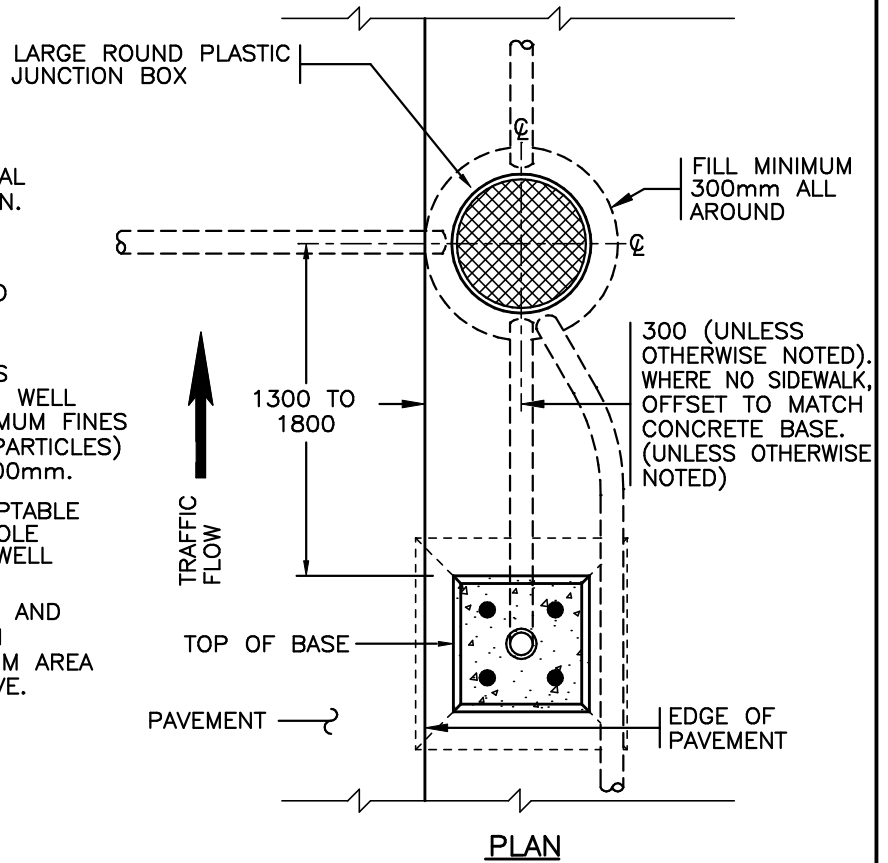
No.	Revision	Date	LUMINAIRE POLE BASE AND JUNCTION BOX INSTALLATION DETAIL FOR ASPHALT CURB	
F				
E				
D	NOTES 4, 5 & 6 REVISED	OCT 97	Date	Approved
C	REVISED TO SUIT ONLY LUMINAIRE POLE BASES	AUG 96		
B	BACKFILL REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. SP635-1.4.2	

30/09/93 E.L. (Signature on File)  
Chief Highway Engineer



# **NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. OFFSET SHOWN MAY VARY WHERE NOTED ON THE PLANS OR DIRECTED BY THE MINISTRY REPRESENTATIVE.
4. EXCAVATED MATERIAL SHALL BE USED AS BACKFILL WHERE IT CONSISTS OF CLEAN WELL GRADED GRANULAR SOIL HAVING A MAXIMUM FINES CONTENT OF 8% (SILT AND CLAY SIZE PARTICLES) AND A MAXIMUM AGGREGATE SIZE OF 100mm.
5. WHERE EXCAVATED MATERIAL IS UNACCEPTABLE OR EXTRA FILL IS REQUIRED AROUND POLE BASE & JUNCTION BOXES, USE 25mm WELL GRADED BASE COURSE AGGREGATE.
6. BACKFILL MATERIAL SHALL BE INSTALLED AND FULLY COMPACTED IN ACCORDANCE WITH SUBSECTION 635.07.01 FOR THE MINIMUM AREA ALL AROUND THE BASE AS SHOWN ABOVE.



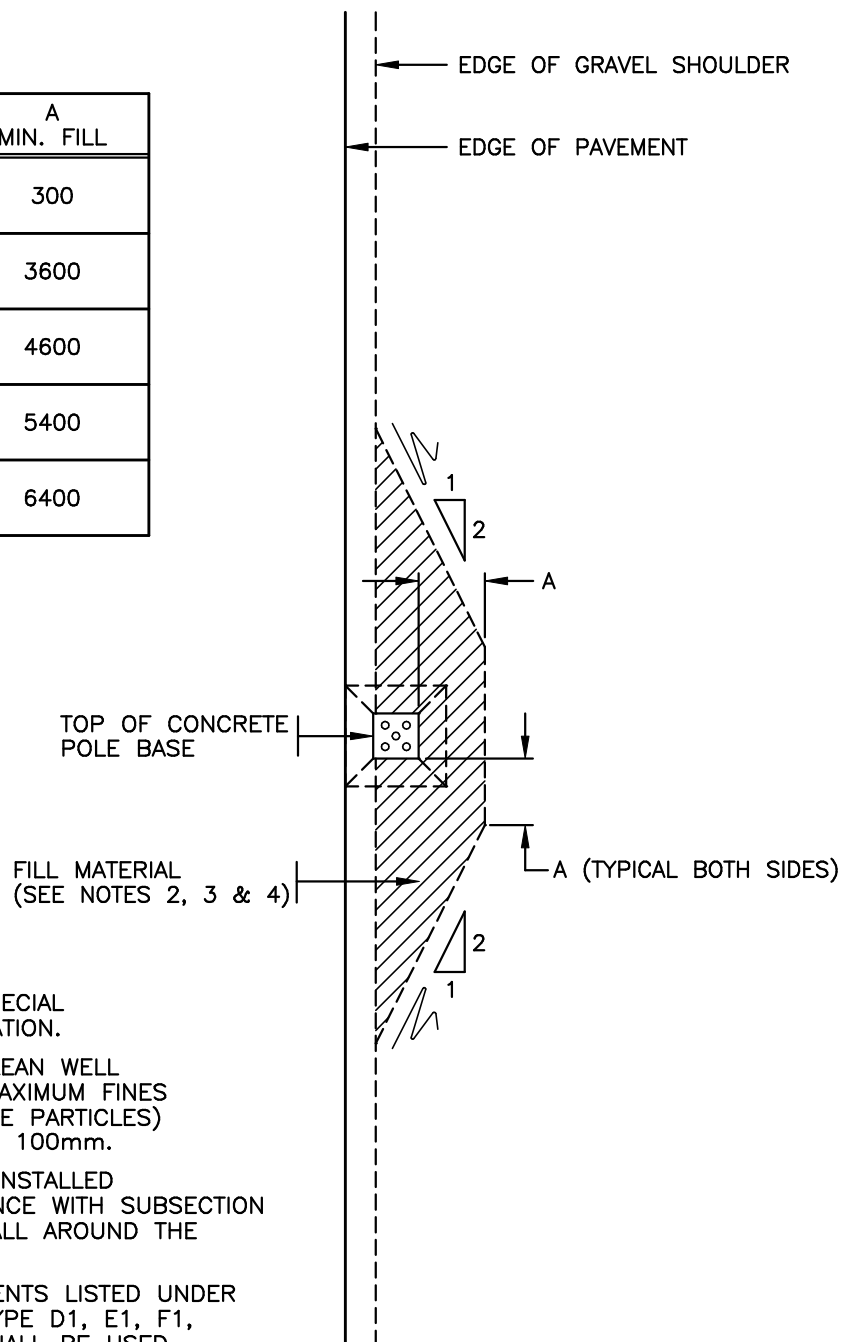
NOT TO SCALE



No.	Revision	Date	LUMINAIRE POLE BASE AND JUNCTION BOX INSTALLATION DETAIL FOR SIDEWALK	
F				
E				
D	NOTES 4, 5 & 6 REVISED	OCT 97	Date	Approved
C	REVISED TO SUIT ONLY LUMINAIRE POLE BASES	AUG 96		
B	BACKFILL REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.4.3</b>



BASE TYPES	A MIN. FILL
TYPES A, B AND C CONCRETE BASES	300
TYPES D2, D3, E2 AND E3 CONCRETE BASES	3600
TYPES F2, F3, L2 AND L3 CONCRETE BASES	4600
TYPE M2 CONCRETE BASES	5400
TYPE H2 CONCRETE BASES	6400



#### NOTES

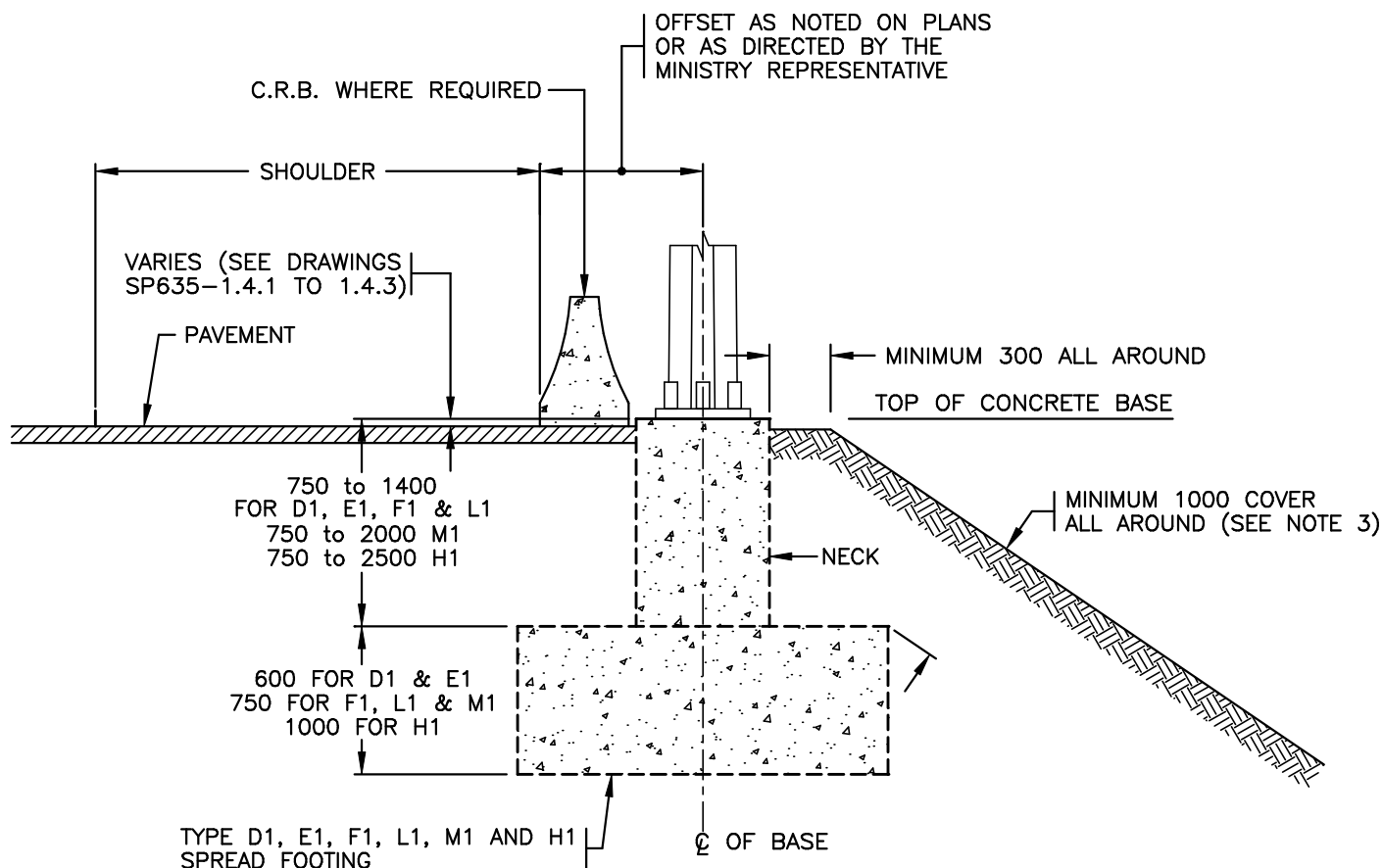
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- FILL MATERIAL SHALL CONSIST OF CLEAN WELL GRADED GRANULAR SOIL HAVING A MAXIMUM FINES CONTENT OF 8% (SILT AND CLAY SIZE PARTICLES) AND A MAXIMUM AGGREGATE SIZE OF 100mm.
- FILL MATERIAL SHALL BE SUPPLIED, INSTALLED AND FULLY COMPACTED IN ACCORDANCE WITH SUBSECTION 635.07.01 FOR THE MINIMUM AREA ALL AROUND THE BASE AS SHOWN ABOVE.
- WHERE THE MINIMUM FILL REQUIREMENTS LISTED UNDER NOTES 2 AND 3 CANNOT BE MET, TYPE D1, E1, F1, L1, M1 OR H1 SPREAD FOOTINGS SHALL BE USED.
- TYPICAL OFFSETS OF TYPE C, D2 & D3 LUMINAIRE POLE BASES ARE SHOWN ON DRAWINGS SP635-1.4.1 TO 1.4.3  
OFFSETS OF TYPE A, B, E2, E3, F2, F3, L2, L3, M2 & H2 SIGNAL & SIGN POLE BASES SHALL BE NOTED ON PLANS OR AS DIRECTED BY THE MINISTRY REPRESENTATIVE.

NOT TO SCALE



No.	Revision	Date	BACKFILL REQUIREMENTS FOR TYPE A, B, C, D2, D3, E2, E3, F2, F3, L2, L3, M2 & H2 CONCRETE BASES	
F			<div>Date Approved</div> <div>15/11/95    M.C. (Signature on File)</div> <div>Chief Highway Engineer</div>	<div>SPECIFICATION DRAWING No.</div> <div>SP635—1.4.4</div>
E				
D				
C				
B				
A	NOTE 5 ADDED	AUG 96		





## ELEVATION

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. VARY NECK HEIGHT UP TO THE MAXIMUMS SHOWN TO PROVIDE COVER AROUND SPREAD FOOTING.
4. BACKFILL MATERIAL SHALL BE INSTALLED & FULLY COMPACTED IN ACCORDANCE WITH SUBSECTION 635.07.01 TO PROVIDE THE MINIMUM COVER OVER THE SPREAD FOOTING.

NOT TO SCALE

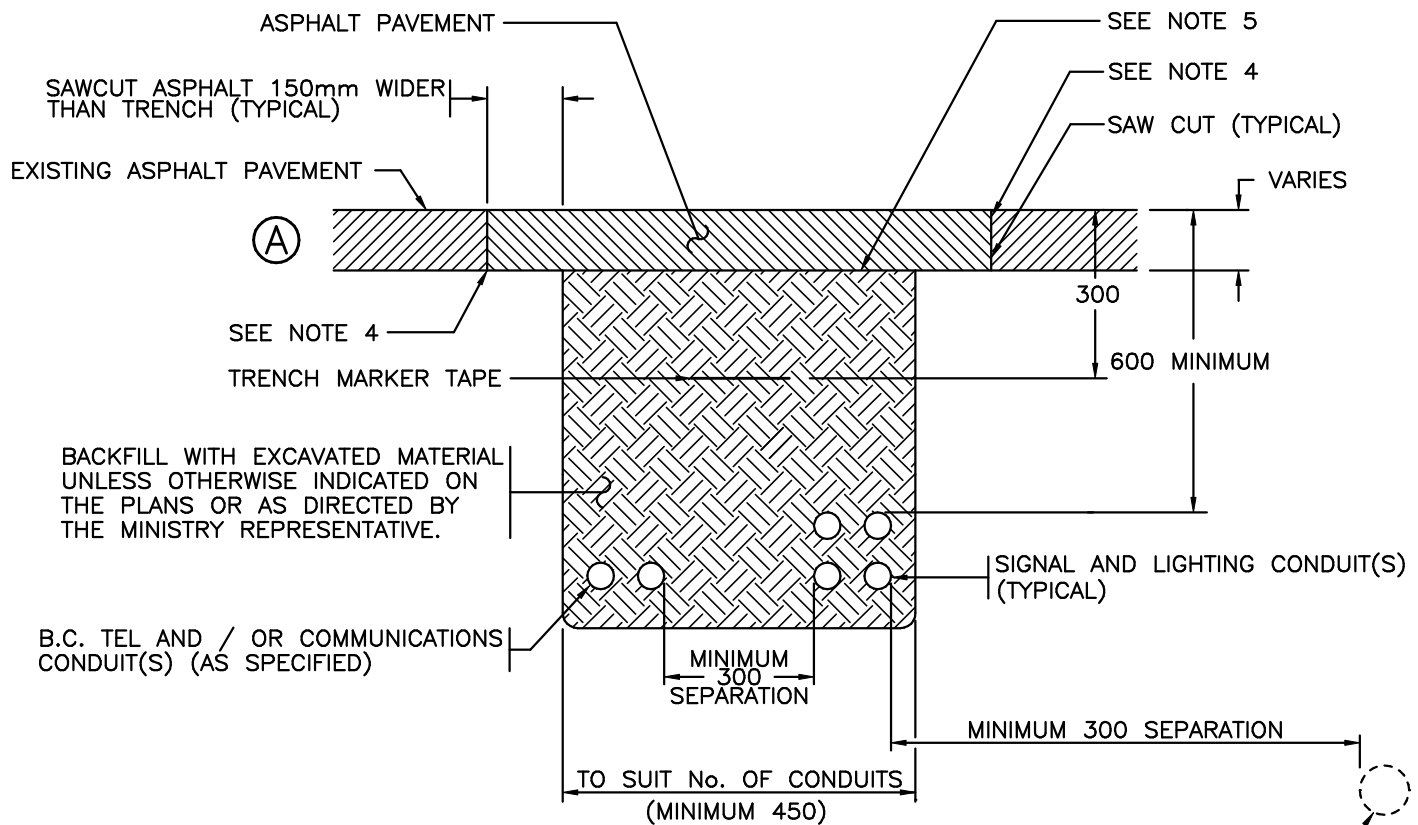


**BRITISH COLUMBIA**

Ministry of  
Transportation

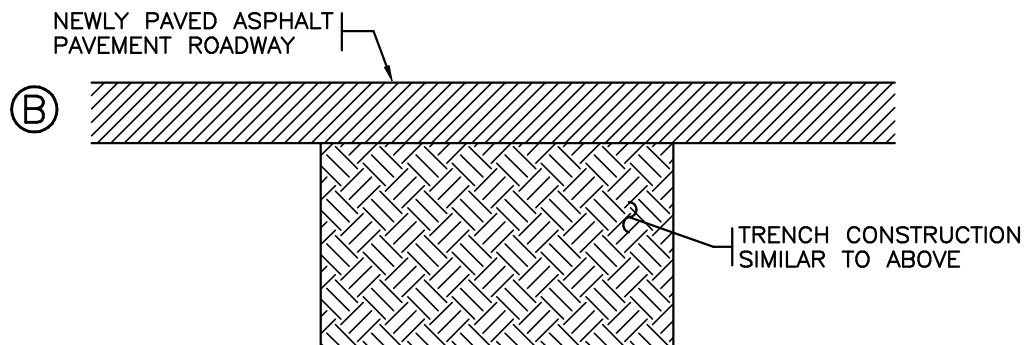
No.	Revision	Date	BACKFILL REQUIREMENTS FOR TYPE D1, E1, F1, L1, M1 & H1 CONCRETE SPREAD FOOTINGS		
F			<div><div>Date</div><div>Approved</div><div><div>15/11/95</div><div>M.C. (Signature on File)</div><div>Chief Highway Engineer</div></div></div> <div><div>SPECIFICATION</div><div>DRAWING No.</div><div>SP635-1.4.5</div></div>		
E					
D					
C					
B					
A	MAX. SLOPE DELETED & NECK HEIGHT REV'D	AUG 96			





(A) TRENCHES IN EXISTING ASPHALT PAVEMENT ROADWAY

(B) TRENCHES IN NEWLY PAVED ASPHALT PAVEMENT ROADWAY



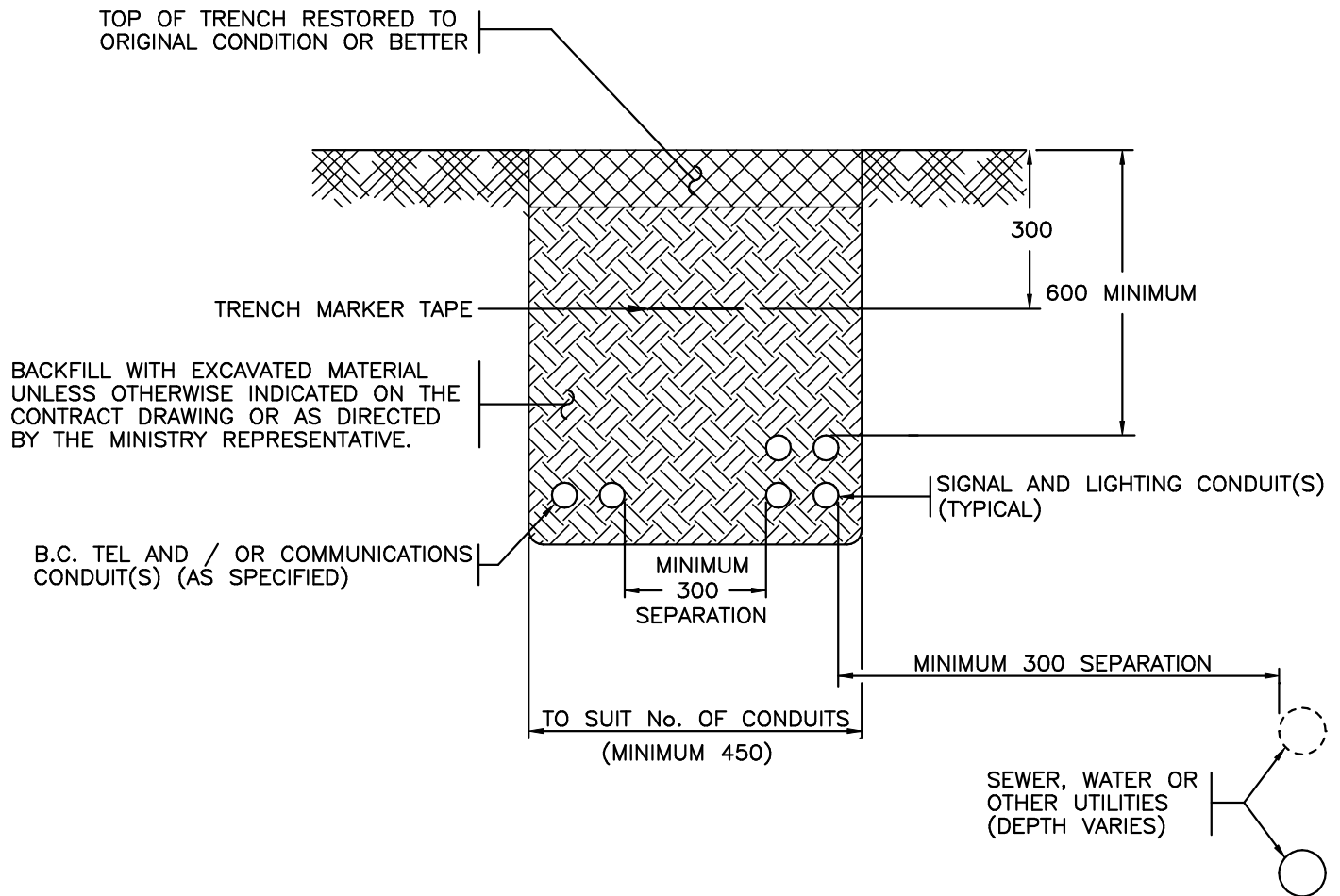
#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. WHERE MINIMUM CLEARANCES FROM UTILITIES CAN NOT BE MAINTAINED, NOTIFY THE MINISTRY REPRESENTATIVE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. APPLY 0.25 L/m<sup>2</sup> OF RM-20 SEALANT TO THE EDGE OF EXISTING ASPHALT.
5. APPLY 1.5 L/m<sup>2</sup> OF RM-20 SEALANT TO THE GRAVEL BASE.

NOT TO SCALE

No.	Revision	Date	CONDUIT INSTALLATION IN PAVED AREAS	
F			Date	Approved
E				
D			<b>30/09/93</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.5.1</b>
C				
B				
A	GENERAL REVISIONS	AUG 94		





#### NOTES

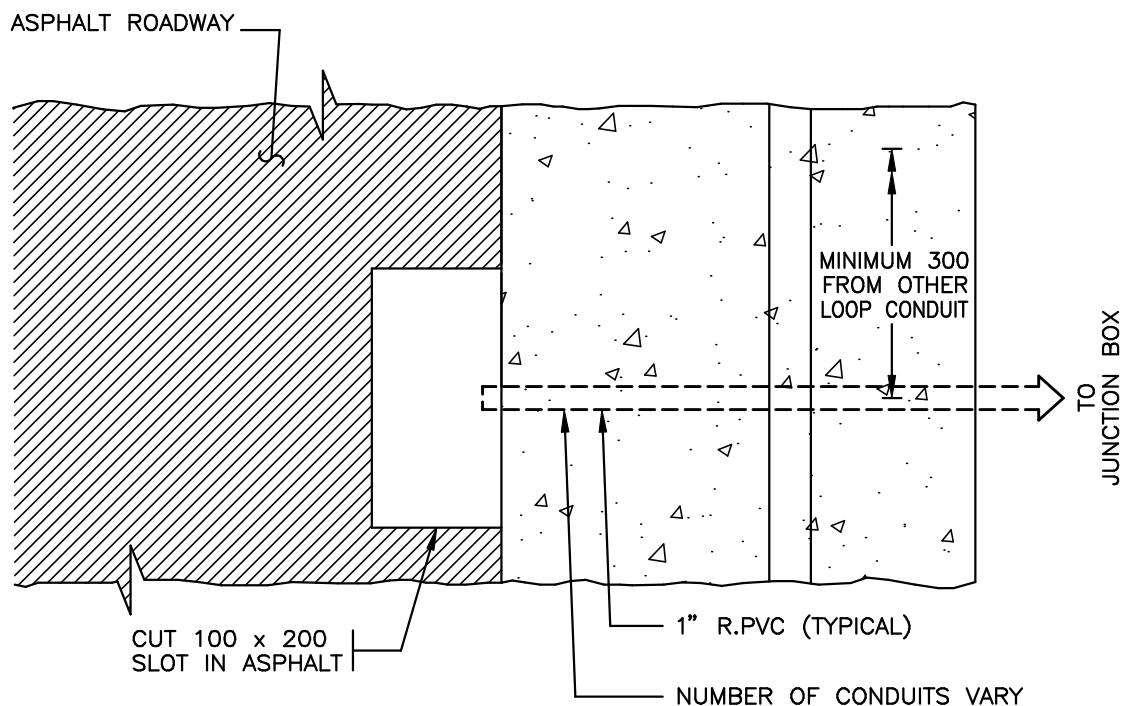
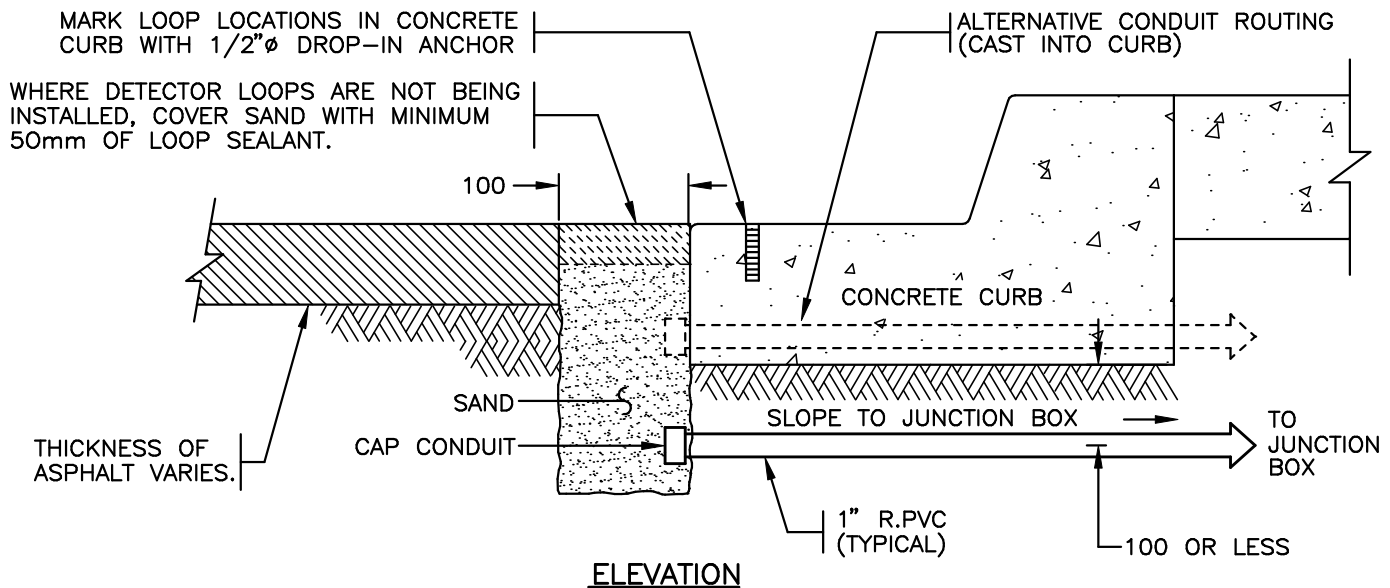
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. WHERE MINIMUM CLEARANCES FROM UTILITIES CAN NOT BE MAINTAINED, NOTIFY THE MINISTRY REPRESENTATIVE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	CONDUIT INSTALLATION IN NON-PAVED AREAS	
F			Date	Approved
E				
D			<b>30/09/93</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-1.5.2</b>
C				
B				
A	GENERAL REVISIONS	AUG 94		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOCATE LOOP CONDUIT IN ASPHALT TO SUIT LOOP LOCATIONS AND TO MINIMIZE THE LENGTH OF HOME RUN SLOTS IN THE ASPHALT.

NOT TO SCALE

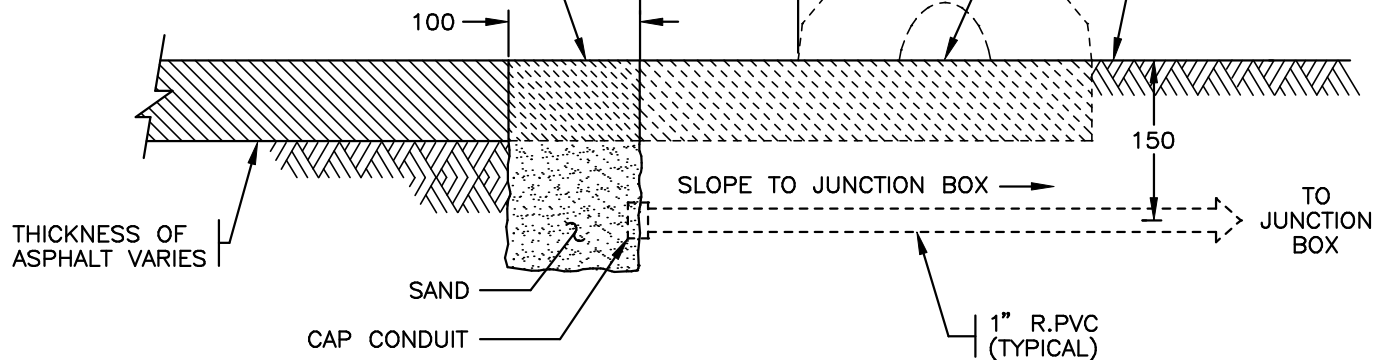


No.	Revision	Date	LOOP CONDUIT INSTALLATION DETAILS AT CONCRETE CURB	
F				
E				
D				
C				
B	CONDUIT SLOT REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			30/09/93	E.L. (Signature on File)
			Chief Highway Engineer	
			SPECIFICATION DRAWING No.	
			SP635-1.6.1	

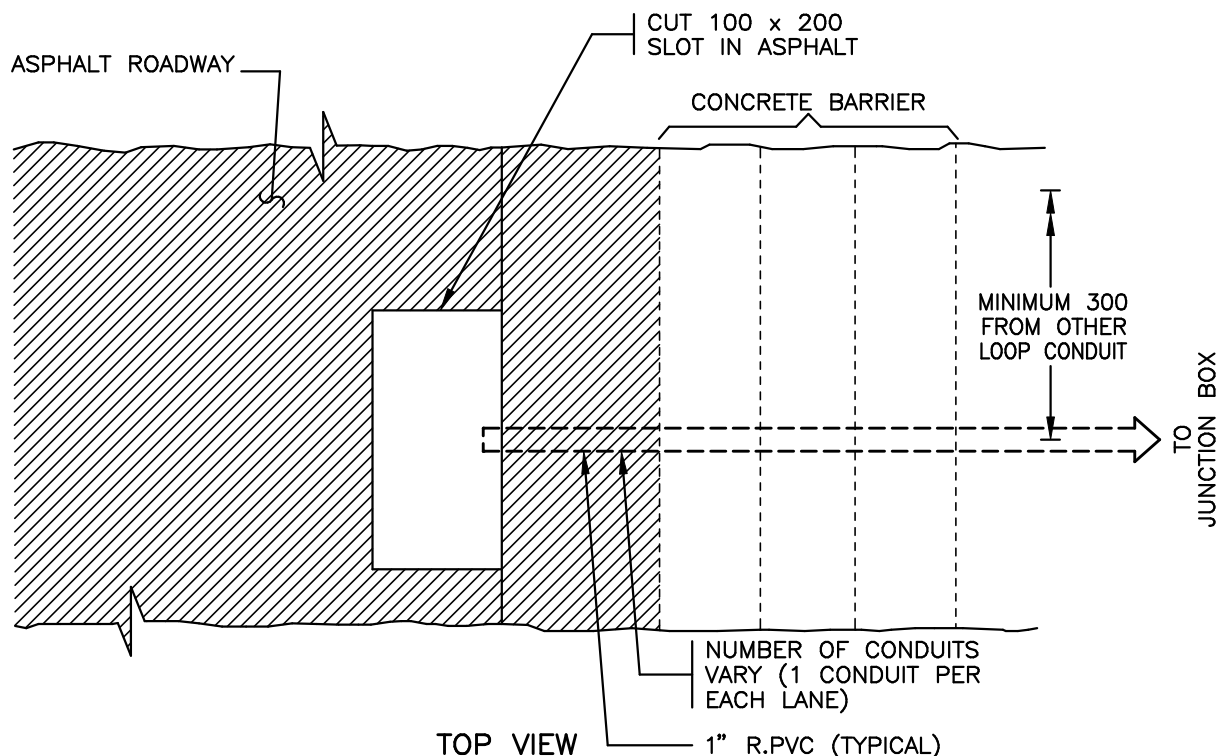


CUT LOOP SLOT 300mm FROM EDGE OF ASPHALT  
OR WHERE CONCRETE BARRIERS ARE PROPOSED  
OR EXISTING CUT SLOT 150mm IN FRONT OF BARRIER

WHERE DETECTOR LOOPS ARE NOT BEING  
INSTALLED, COVER SAND WITH MINIMUM  
50mm OF LOOP SEALANT.



**ELEVATION**



**TOP VIEW**

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOCATE LOOP CONDUIT IN ASPHALT TO SUIT LOOP LOCATIONS AND TO MINIMIZE THE LENGTH OF HOME RUN SLOTS IN THE ASPHALT.

NOT TO SCALE

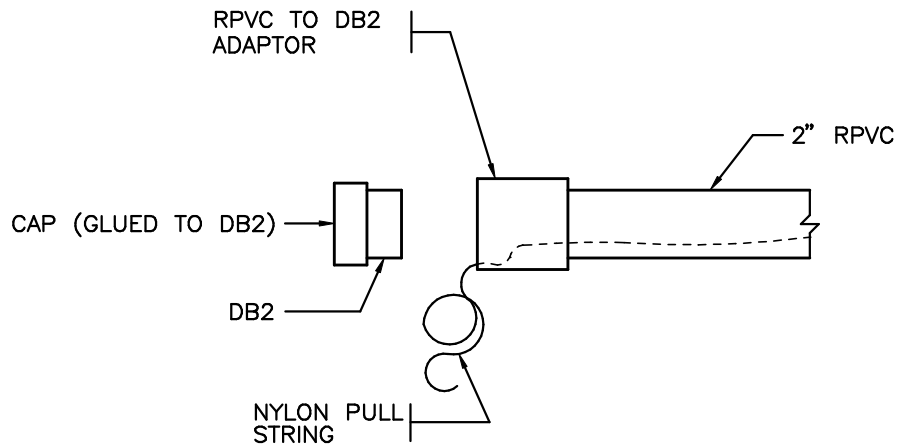


**BRITISH COLUMBIA**

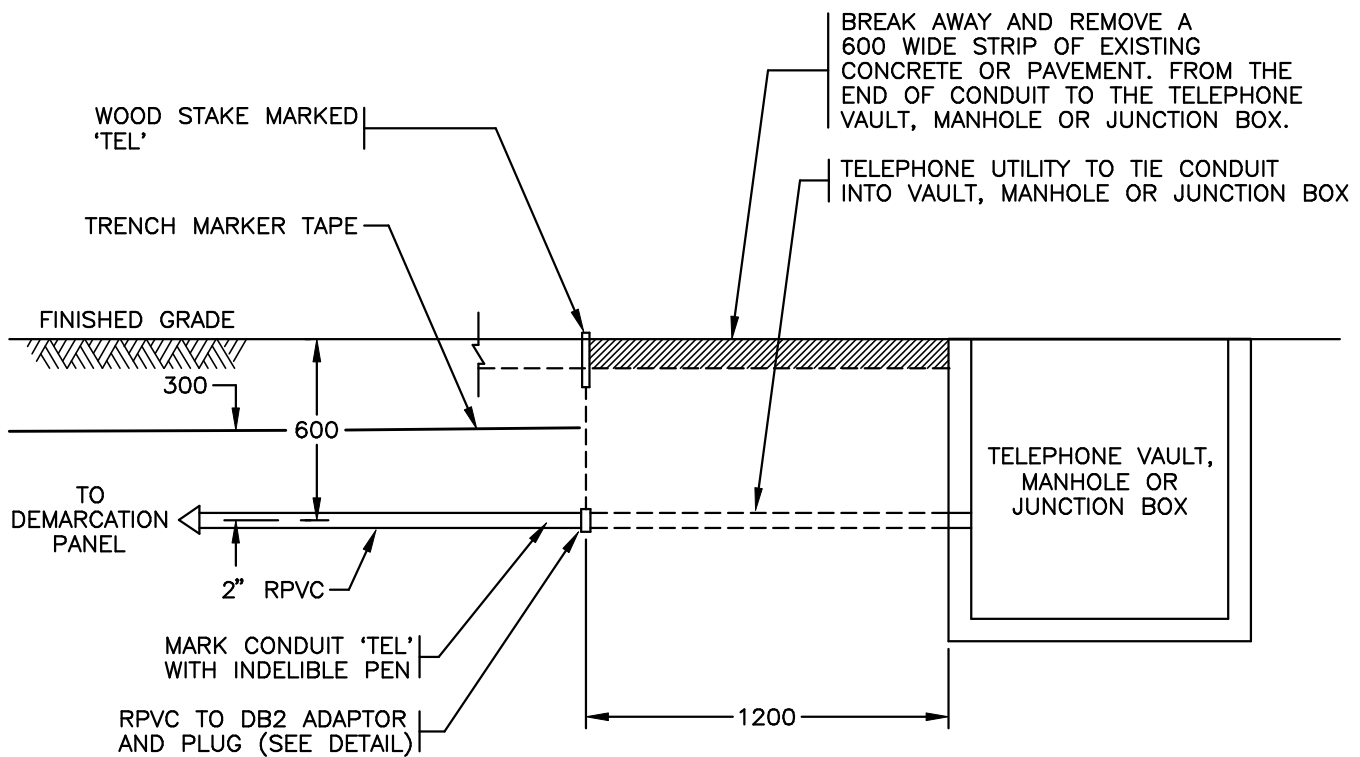
Ministry of  
Transportation

No.	Revision	Date	LOOP CONDUIT INSTALLATION DETAILS IN GRAVEL SHOULDER		
F			Date Approved  <b>18/11/94     E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  <b>SP635—1.6.2</b>
E					
D					
C					
B	CONCRETE BARRIER SHOWN	NOV 98			
A	CONDUIT SLOT REVISED	AUG 95			





CONDUIT ADAPTOR AND  
PLUG DETAIL



ELEVATION

NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



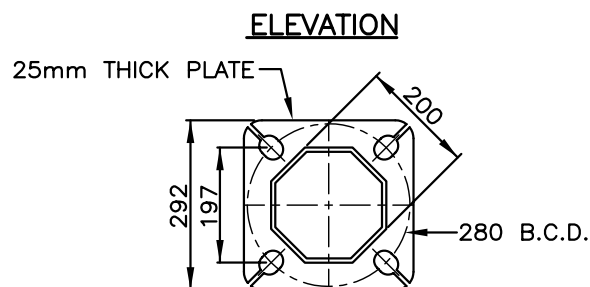
No.	Revision	Date	CONDUIT TIE-IN TO TELEPHONE VAULT, MANHOLE OR JUNCTION BOX	
F			Date  <b>17/11/94</b>  Chief Highway Engineer	Approved  <b>E.L. (Signature on File)</b>  SPECIFICATION DRAWING No. <b>SP635-1.7.1</b>
E				
D				
C				
B				
A				



**PART C**

**ELECTRICAL  
DRAWINGS**



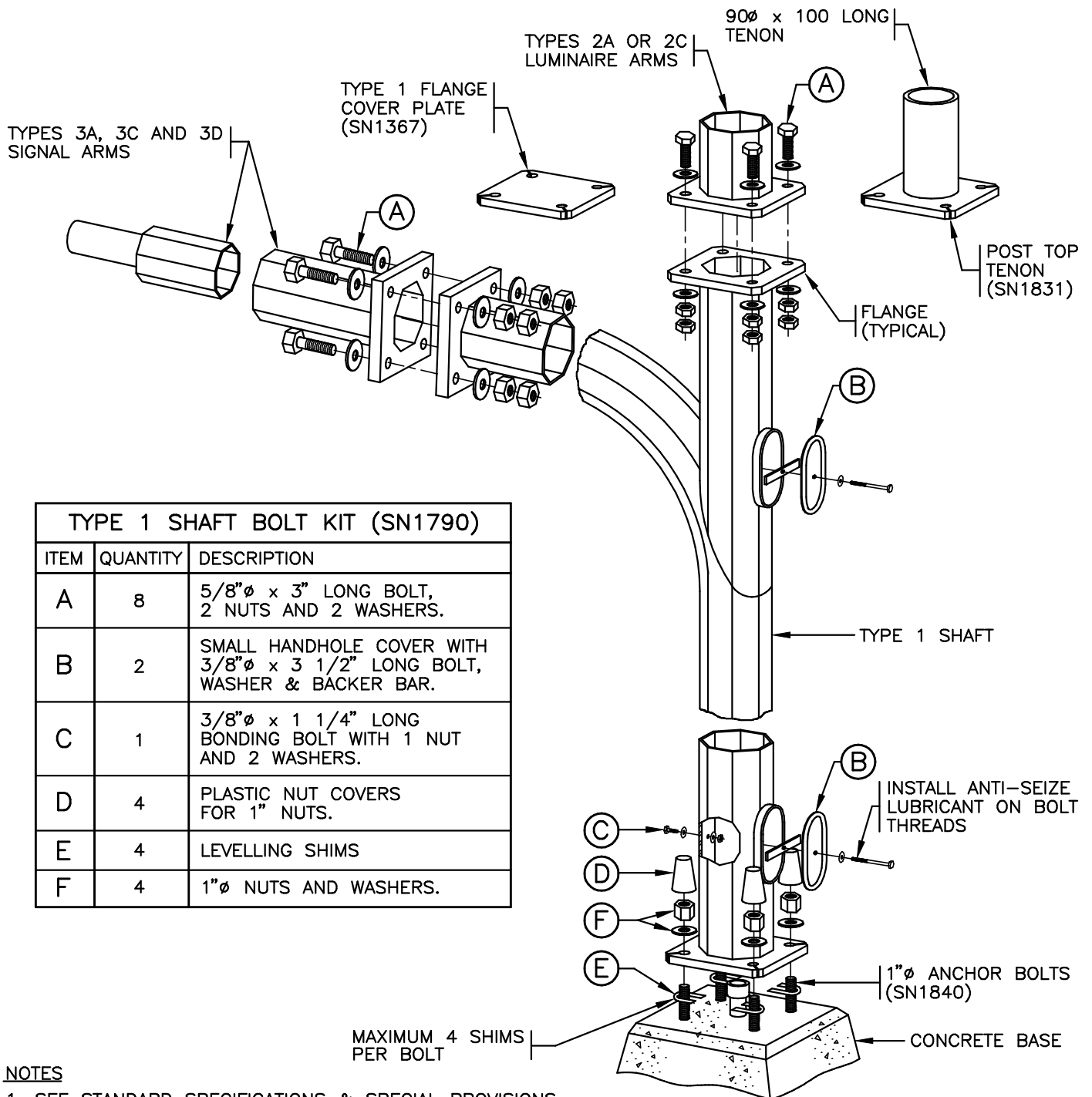


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE 1 SHAFT INSTALLATION DETAILS (SIGNAL POLE)		
F					
E					
D	SIGNAL HEAD MOUNTING REVISED	OCT 03	Date	Approved	SPECIFICATION DRAWING No.  SP635—2.1.1
C	3F ARM ADDED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		
B	SIGNAL HEAD REVISED	AUG 95	Chief Highway Engineer		
A	GENERAL REVISIONS	AUG 94			





TYPE 1 SHAFT BOLT KIT (SN1790)		
ITEM	QUANTITY	DESCRIPTION
A	8	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	2	SMALL HANDHOLE COVER WITH 3/8"Ø x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS
F	4	1"Ø NUTS AND WASHERS.

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

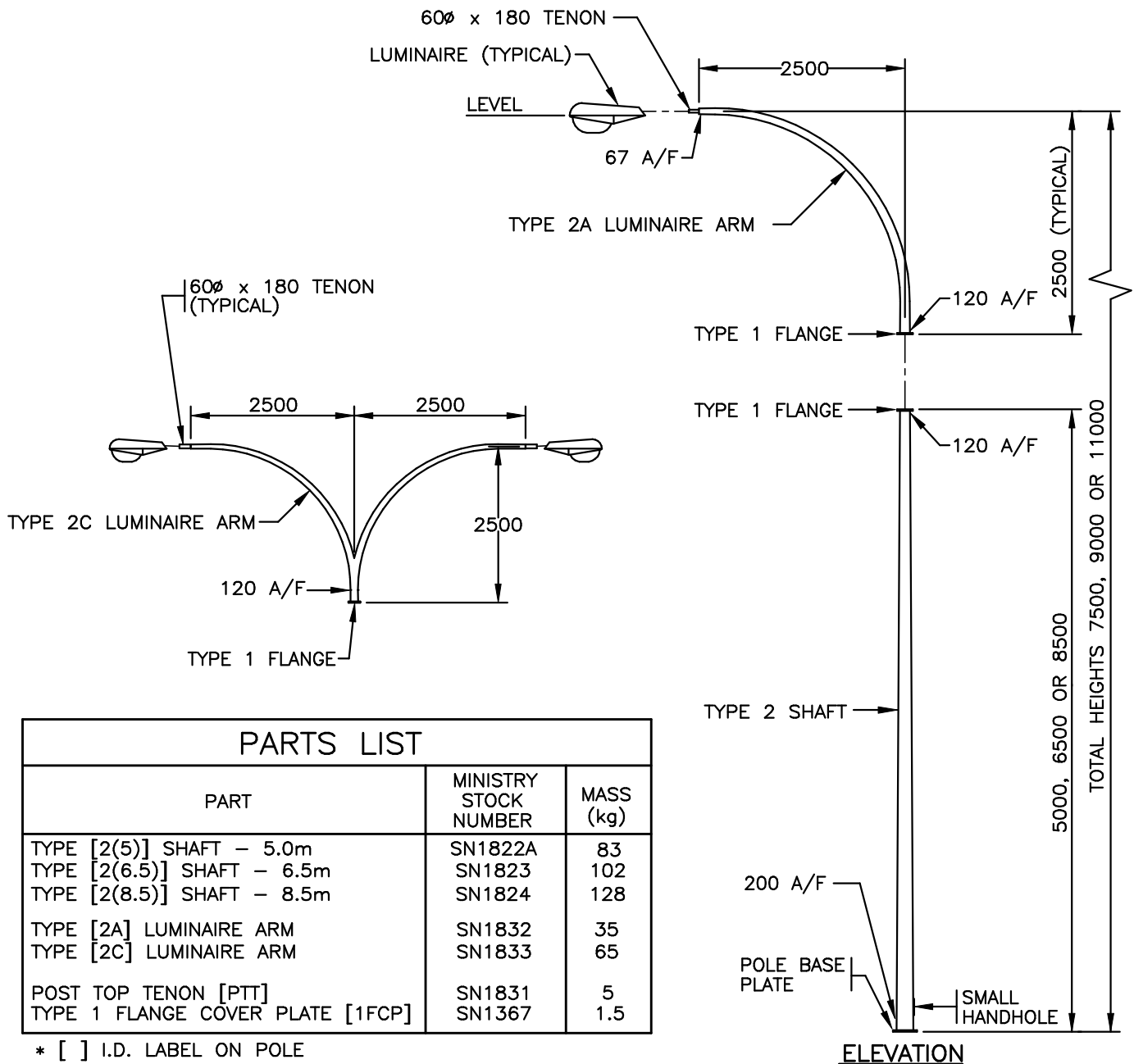
NOT TO SCALE

#### POLE ASSEMBLY DETAIL



No.	Revision	Date	TYPE 1 SHAFT INSTALLATION DETAILS (SIGNAL POLE)		
E					
D					
C	ANTI—SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	HANDHOLE BOLT LENGTH REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		SP635—2.1.2
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		

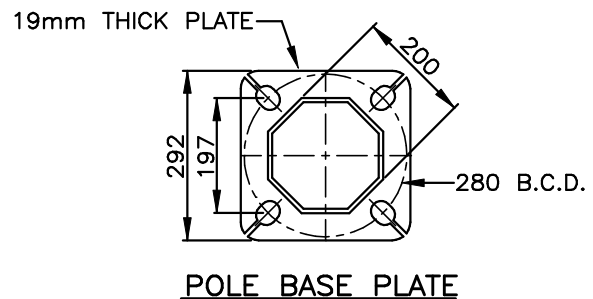




#### NOTES

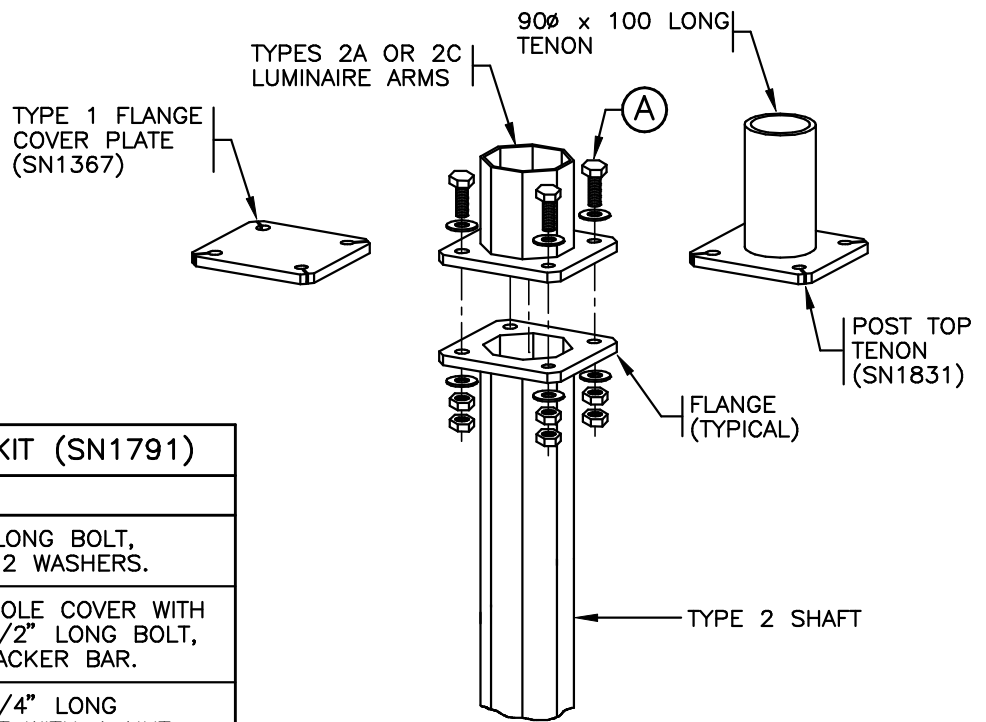
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.1.4 FOR TYPE 2 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

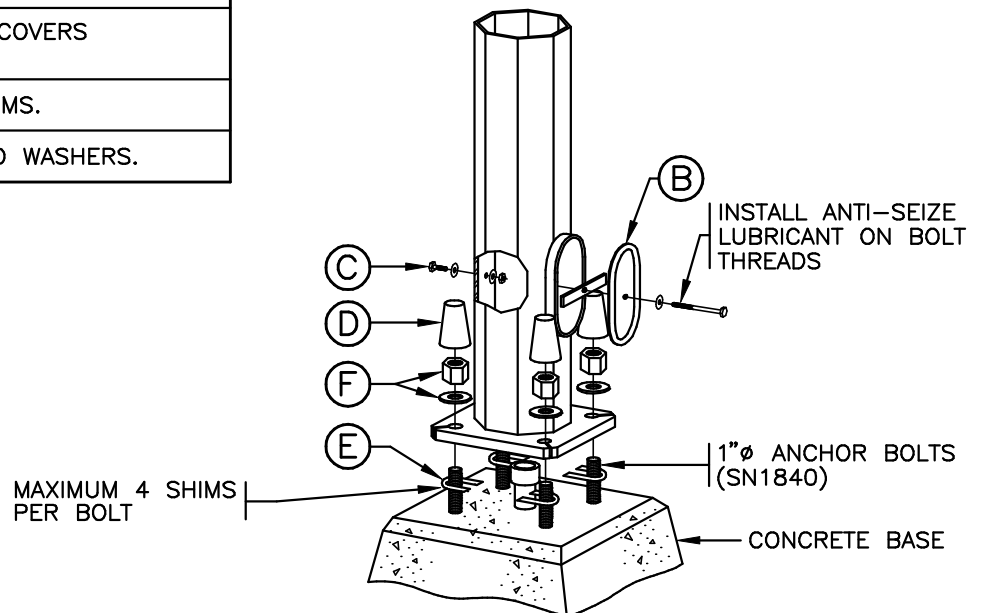


No.	Revision	Date	TYPE 2 SHAFT INSTALLATION DETAILS (7.5 m, 9.0 m AND 11.0 m LUMINAIRE POLES)	
F				
E				
D			Date	Approved
C				
B				
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
			SPECIFICATION DRAWING No. <b>SP635-2.1.3</b>	





TYPE 2 SHAFT BOLT KIT (SN1791)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8"Ø x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"Ø NUTS AND WASHERS.



### POLE ASSEMBLY DETAIL

#### NOTES

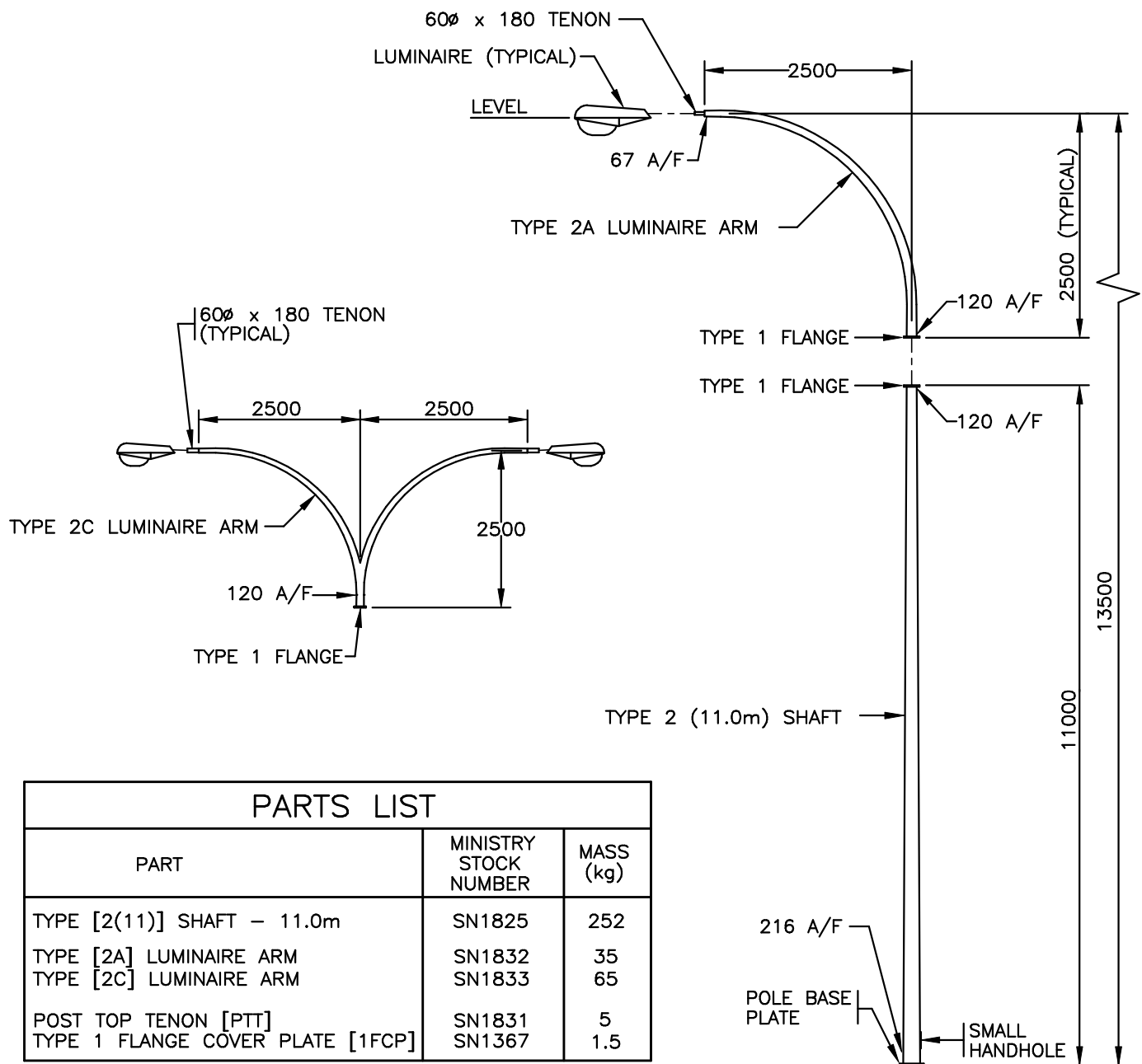
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE



No.	Revision	Date	TYPE 2 SHAFT INSTALLATION DETAILS (7.5 m, 9.0 m AND 11.0 m LUMINAIRE POLES)	
E				
D				
C	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved
B	HANDHOLE BOLT LENGTH REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
A	GENERAL REVISIONS	AUG 94		
			SPECIFICATION DRAWING No. <b>SP635-2.1.4</b>	

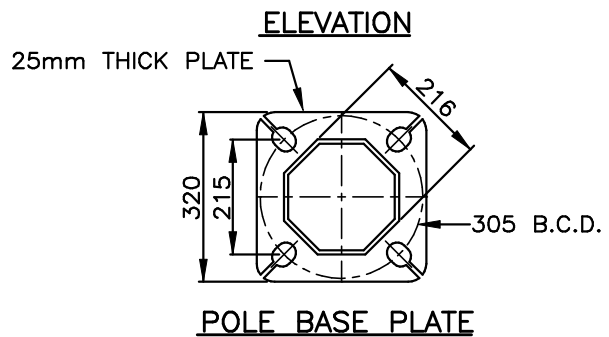




## PARTS LIST

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [2(11)] SHAFT - 11.0m	SN1825	252
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
POST TOP TENON [PTT]	SN1831	5
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5

\* [ ] I.D. LABEL ON POLE



## NOTES

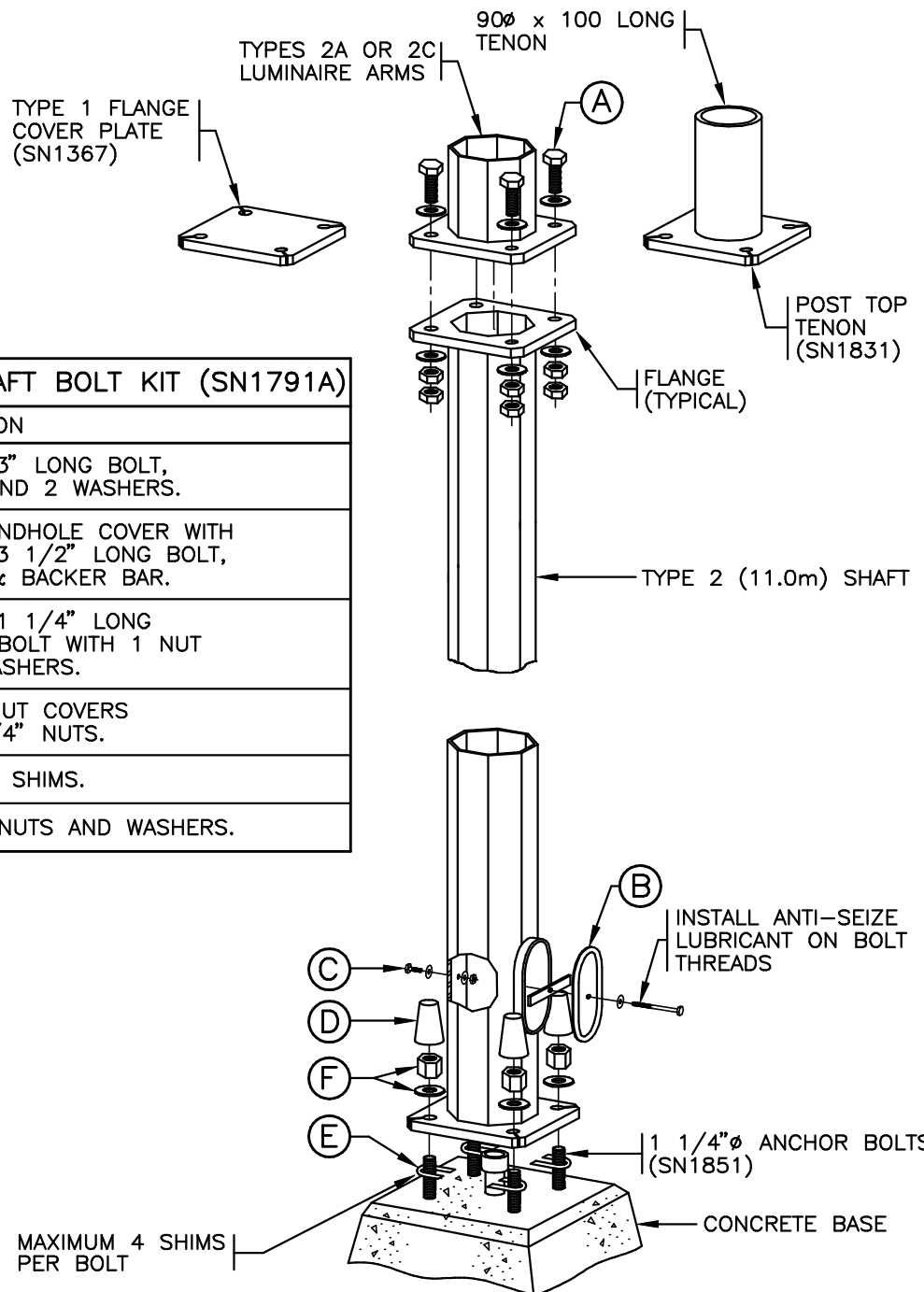
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.1.6 FOR TYPE 2 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TYPE 2 SHAFT INSTALLATION DETAILS (13.5 m LUMINAIRE POLE)	
F				
E				
D				
C				
B				
A	GENERAL REVISIONS	AUG 94		
			Date 30/09/93 E.L. (Signature on File) Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-2.1.5





TYPE 2 (11.0m) SHAFT BOLT KIT (SN1791A)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8" $\phi$ x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1 1/4" NUTS.
E	4	LEVELLING SHIMS.
F	4	1 1/4" $\phi$ NUTS AND WASHERS.

#### NOTES

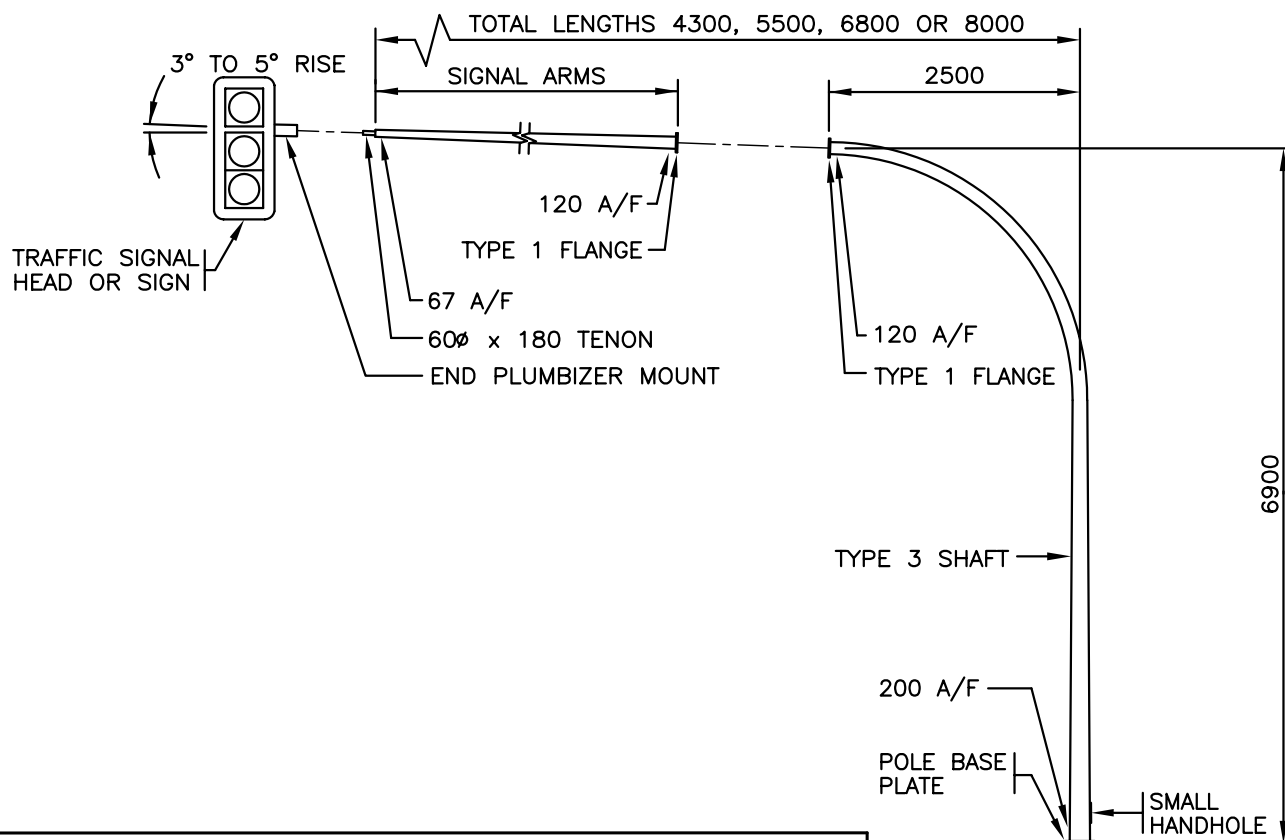
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- POLE SHAFT SHALL BE INSTALLED PLUMB.
- ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
- APPLY GREASE TO ANCHOR BOLT THREADS.
- TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE

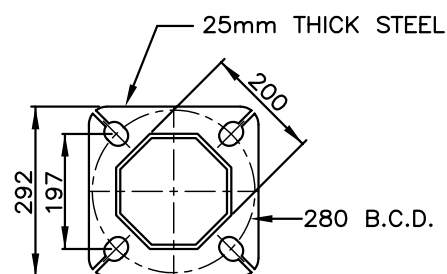


No.	Revision	Date	TYPE 2 SHAFT INSTALLATION DETAILS (13.5 m LUMINAIRE POLE)		
E					
D					
C	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	HANDHOLE BOLT LENGTH REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		SP635-2.1.6
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





**ELEVATION**



**POLE BASE PLATE**

**PARTS LIST**

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [3] SHAFT	SN1826	186
TYPE [3C] SIGNAL ARM - 1.8m	SN1836	18
TYPE [3A] SIGNAL ARM - 3.0m	SN1834	27
TYPE [3D] SIGNAL ARM - 4.3m	SN1837	54
TYPE [3E] SIGNAL ARM - 5.5m	SN1838	68
TYPE [3F] SIGNAL ARM - 0.3m to 3.0m (LENGTH VARIES)	SN1836A	9 PER METRE

\* [ ] I.D. LABEL ON POLE

**NOTES**

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.1.8 FOR TYPE 3 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE 3 SHAFT INSTALLATION DETAILS (SIGNAL POLE)		
F					
E					
D	SIGNAL HEAD MOUNTING REVISED	OCT 03	Date	Approved	SPECIFICATION DRAWING No.  SP635—2.1.7
C	3F ARM ADDED	AUG 96			
B	SIGNAL HEAD REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94			
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		



**TYPE 3 SHAFT BOLT KIT (SN1791)**

ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8"Ø x 3 1/2" LONG BOLT, WASHER & BACKER BAR.

TYPE 3 SHAFT BOLT KIT (SN1791)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8"Ø x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8"Ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"Ø NUTS AND WASHERS.

- TYPE 3 SHAFT

INSTALL ANTI-SEIZE  
LUBRICANT ON BOLT  
THREADS

1"Ø ANCHOR BOLTS  
(SN1840)

- CONCRETE BASE

MAXIMUM 4 SHIMS  
PER BOLT

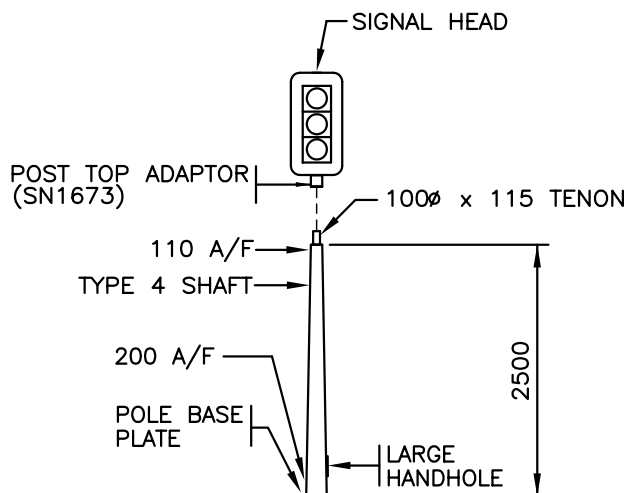
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

## POLE ASSEMBLY DETAIL



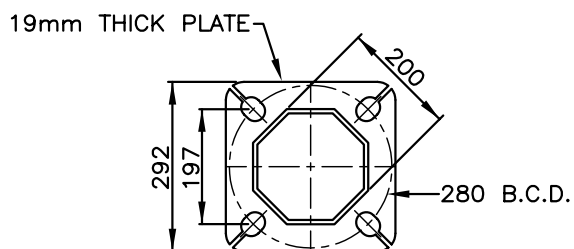
No.	Revision	Date	TYPE 3 SHAFT INSTALLATION DETAILS (SIGNAL POLE)		
E					
D					
C	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved	SPECIFICATION DRAWING No.  SP635-2.1.8
B	HANDHOLE BOLT LENGTH REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b>		
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





**TYPE 4 SHAFT**

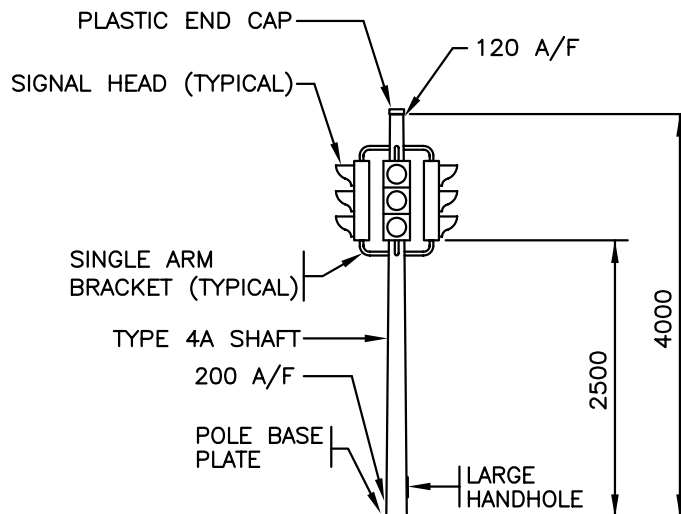
**FOR REFERENCE ONLY**  
USE TYPE 4A SHAFT IN PLACE OF  
TYPE 4 SHAFT AND MOUNT SIGNAL  
HEADS WITH SINGLE ARM BRACKETS



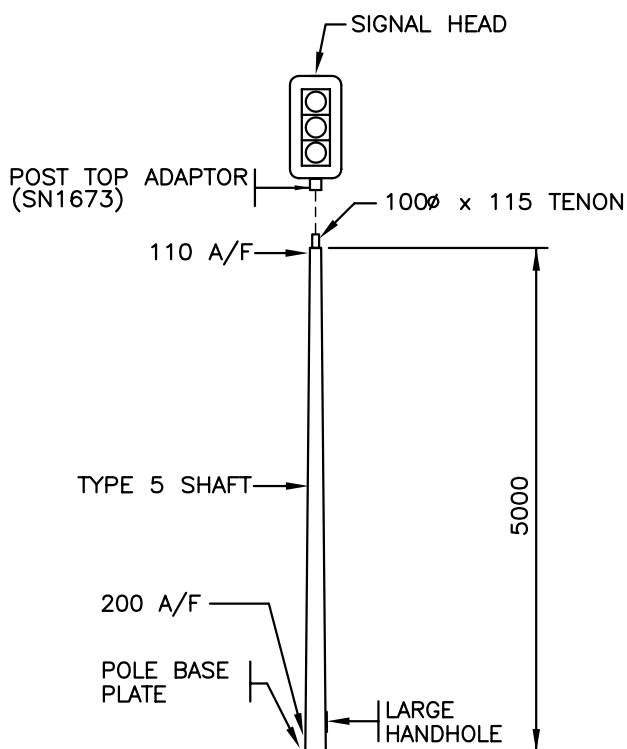
**POLE BASE PLATE**

PARTS LIST		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [4] SHAFT	SN1827	45
TYPE [4A] SHAFT	SN1827A	66
TYPE [5] SHAFT	SN1828	77

\* [ ] I.D. LABEL ON POLE



**TYPE 4A SHAFT**



**TYPE 5 SHAFT**

**FOR REFERENCE ONLY**

USE TYPE 2-6.5m SHAFT IN PLACE OF  
TYPE 5 SHAFT AND MOUNT SIGNAL  
HEADS WITH SINGLE ARM BRACKETS

**NOTES**

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.1.10 FOR TYPE 4, 4A AND 5 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSION ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E		
D		
C		
B	ALTERNATES NOTED	OCT 03
A	GENERAL REVISIONS	AUG 94

**TYPE 4, 4A AND 5 SHAFT  
INSTALLATION DETAILS**

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.1.9**

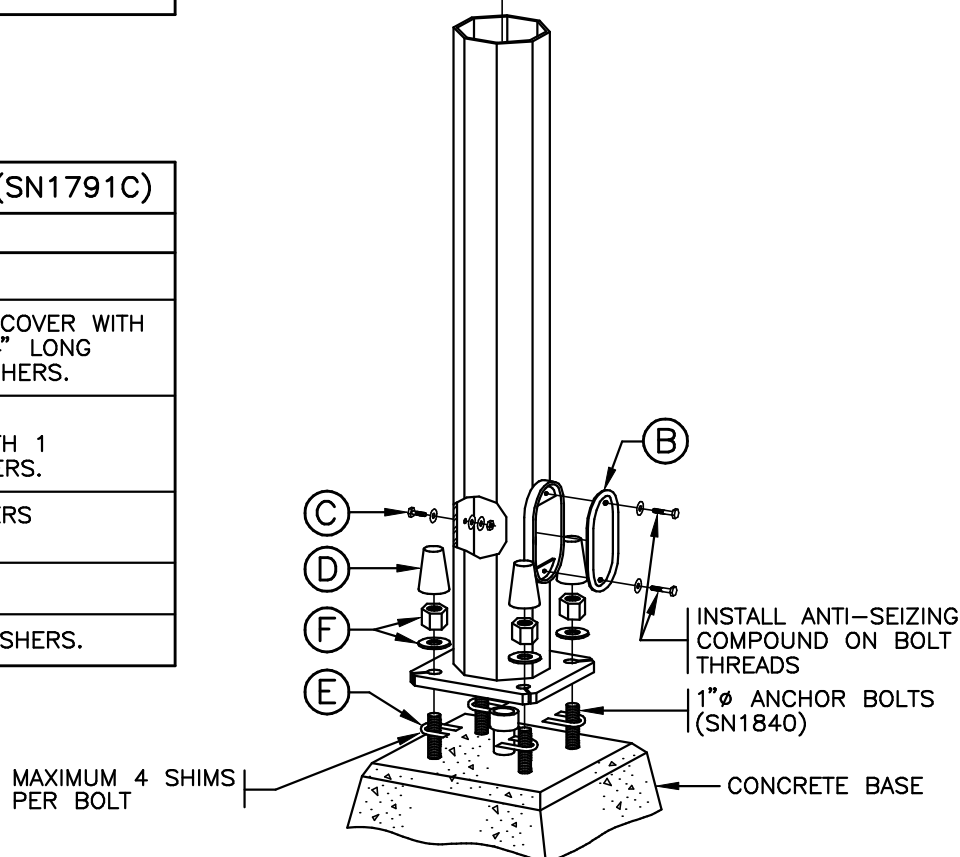
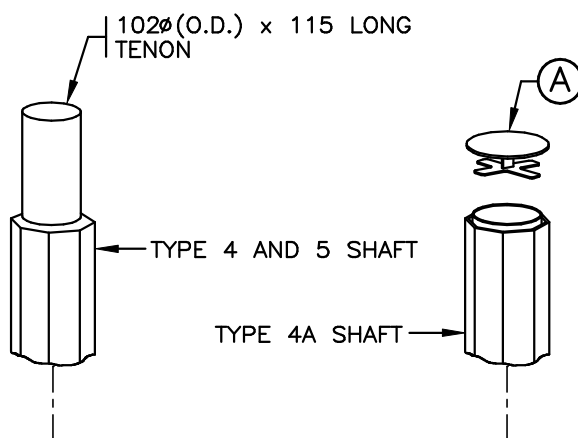


# TYPE 4 & 5 SHAFT BOLT KIT (SN1791B)

ITEM	QUANTITY	DESCRIPTION
B	1	LARGE HANDHOLE COVER WITH 2-3/8"ø x 1 1/4" LONG BOLTS AND 2 WASHERS.
C	1	3/8"ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 3 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"ø NUTS AND WASHERS.

# TYPE 4A SHAFT BOLT KIT (SN1791C)

ITEM	QUANTITY	DESCRIPTION
A	1	PLASTIC END CAP
B	1	LARGE HANDHOLE COVER WITH 2-3/8"ø x 1 1/4" LONG BOLTS AND 2 WASHERS.
C	1	3/8"ø x 1" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1"ø NUTS AND WASHERS.



POLE ASSEMBLY DETAIL

## NOTES

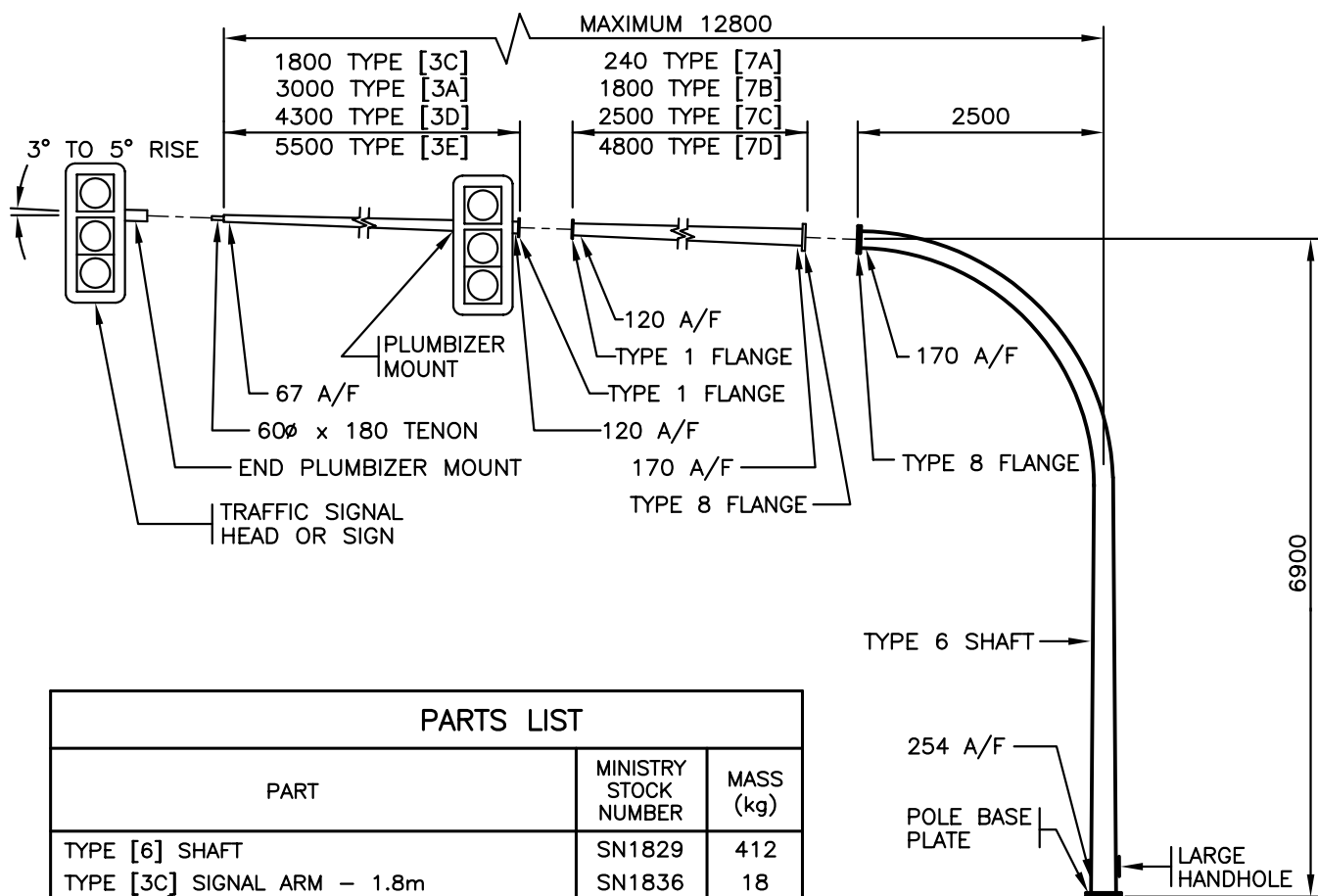
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE



No.	Revision	Date	TYPE 4, 4A AND 5 SHAFT INSTALLATION DETAILS (SIGNAL POSTS)		
E					
D					
C	ANTI-SEIZING COMPOUND NOTED ON HANDHOLE BOLTS	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	HANDHOLE BOLT LENGTH REVISED	AUG 95	30/09/93	E.L. (Signature on File)	SP635-2.1.10
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		



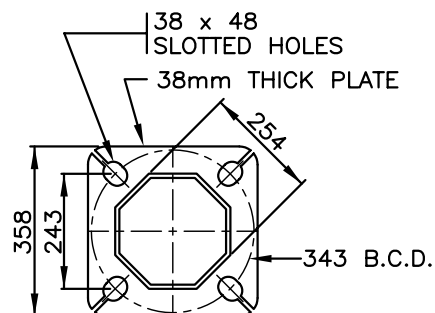


### PARTS LIST

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [6] SHAFT	SN1829	412
TYPE [3C] SIGNAL ARM - 1.8m	SN1836	18
TYPE [3A] SIGNAL ARM - 3.0m	SN1834	27
TYPE [3D] SIGNAL ARM - 4.3m	SN1837	54
TYPE [3E] SIGNAL ARM - 5.5m	SN1838	68
TYPE [3F] SIGNAL ARM - 0.3m to 3.0m (LENGTH VARIES)	SN1836A	9 PER METRE
TYPE [7A] EXTENSION - 0.24m	SN1890A	20
TYPE [7B] EXTENSION - 1.8m	SN1890B	69
TYPE [7C] EXTENSION - 2.5m	SN1890C	86
TYPE [7D] EXTENSION - 4.8m	SN1890D	154
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 8 FLANGE COVER PLATE [8FCP]	SN2089	2.5

\* [ ] I.D. LABEL ON POLE

### ELEVATION



### POLE BASE PLATE

### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.1.12 FOR TYPE 6 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

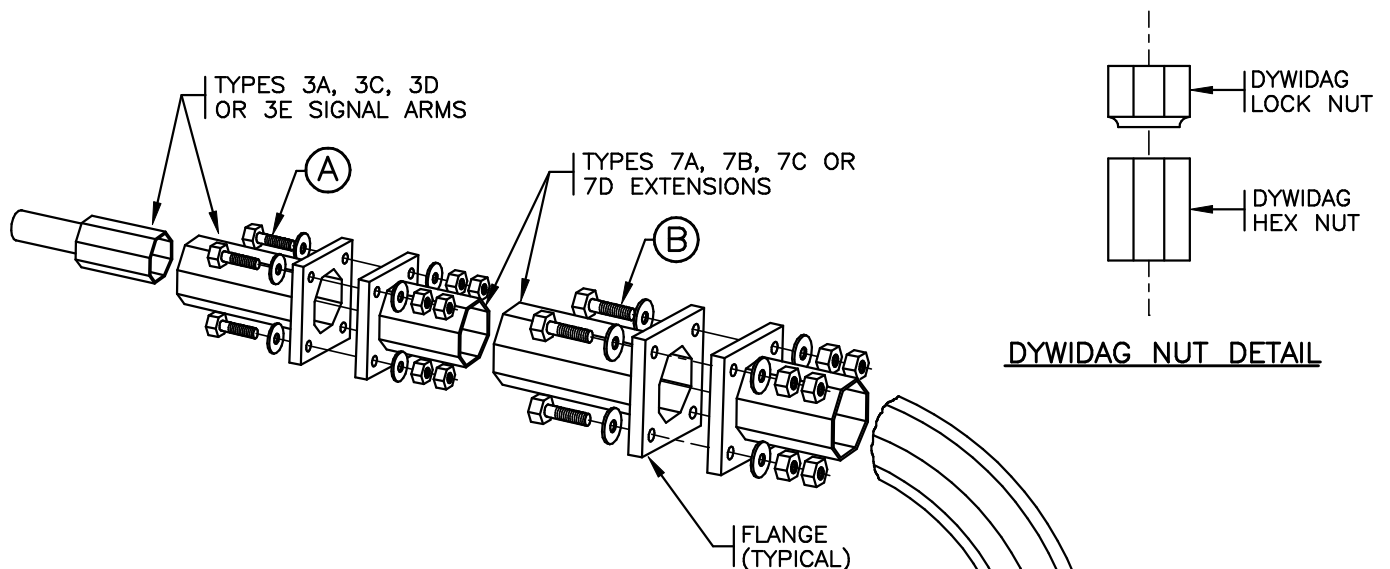


**BRITISH COLUMBIA**

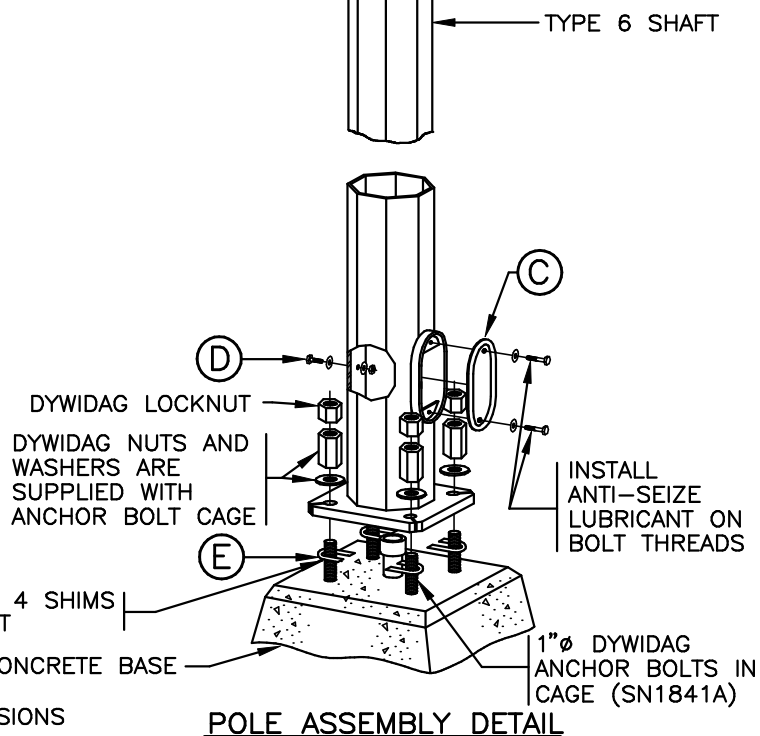
Ministry of Transportation

No.	Revision	Date	TYPE 6 SHAFT INSTALLATION DETAILS (SIGNAL POLE)	
F				
E				
D	SIGNAL HEAD MOUNTING REVISED	OCT 03		
C	3F ARM ADDED	AUG 96		
B	SIGNAL HEAD REVISED & PLATE HOLE SIZE ADDED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			30/09/93	E.L. (Signature on File)
			Chief Highway Engineer	
			SPECIFICATION DRAWING No. SP635-2.1.11	





TYPE 6 SHAFT BOLT KIT (SN1792)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	4	1" $\phi$ x 5" LONG BOLT, 2 NUTS AND 2 WASHERS.
C	1	LARGE HANDHOLE COVER WITH 2-3/8" $\phi$ x 1" LONG BOLTS AND 2 WASHERS.
D	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
E	4	LEVELLING SHIMS.



#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS. TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

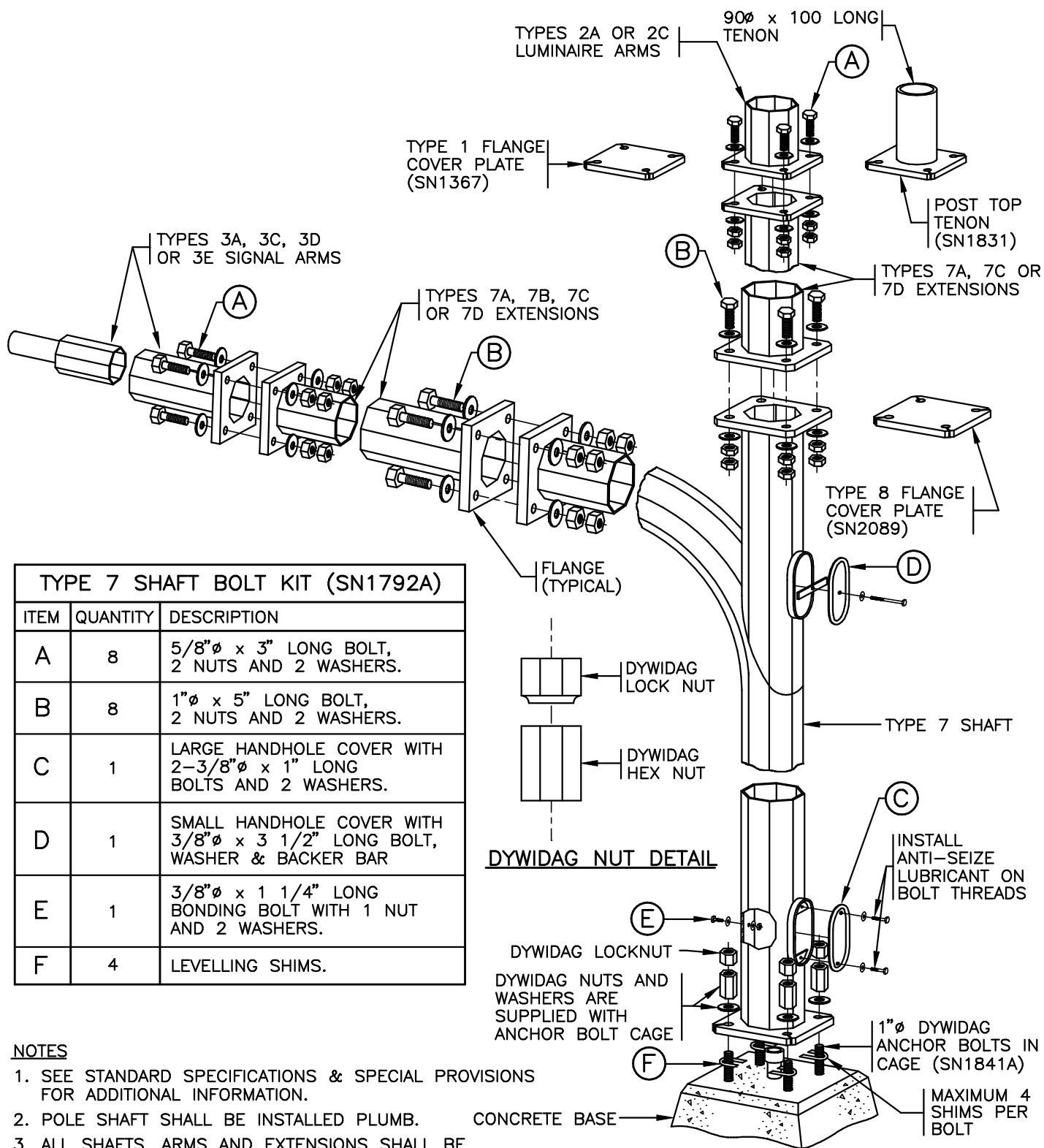
NOT TO SCALE

No.	Revision	Date	TYPE 6 SHAFT INSTALLATION DETAILS (SIGNAL POLE)		
E					
D					
C	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	HANDHOLE BOLT LENGTH REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635-2.1.12
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		









TYPE 7 SHAFT BOLT KIT (SN1792A)		
ITEM	QUANTITY	DESCRIPTION
A	8	5/8"ø x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	8	1"ø x 5" LONG BOLT, 2 NUTS AND 2 WASHERS.
C	1	LARGE HANDHOLE COVER WITH 2-3/8"ø x 1" LONG BOLTS AND 2 WASHERS.
D	1	SMALL HANDHOLE COVER WITH 3/8"ø x 3 1/2" LONG BOLT, WASHER & BACKER BAR
E	1	3/8"ø x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
F	4	LEVELLING SHIMS.

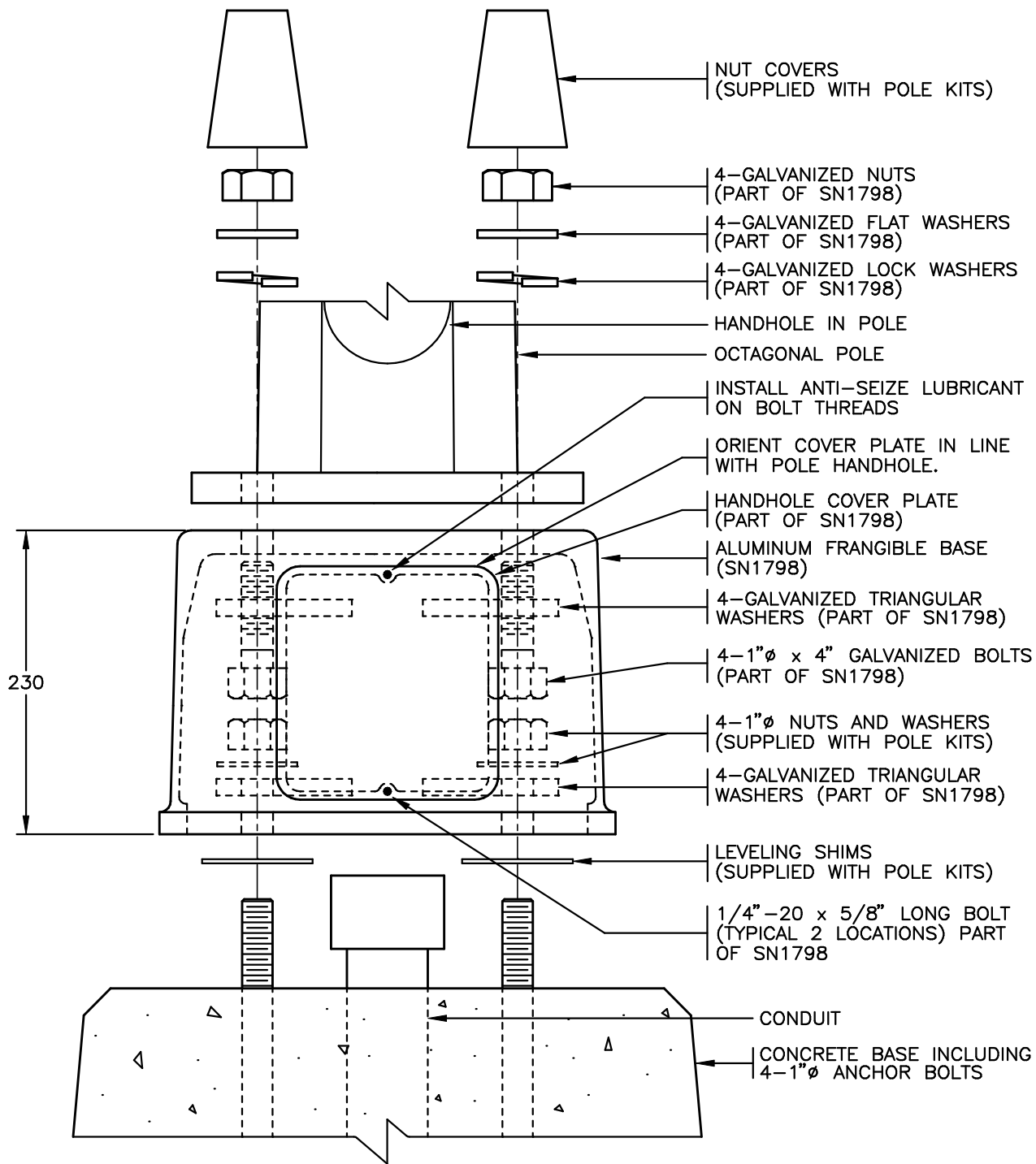
- NOTES**
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
  2. POLE SHAFT SHALL BE INSTALLED PLUMB.
  3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
  4. APPLY GREASE TO ANCHOR BOLT THREADS.
  5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE

No.	Revision	Date	TYPE 7 SHAFT INSTALLATION DETAILS (SIGNAL POLE)	
E				
D	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98		
C	SMALL HANDHOLE BOLT LENGTH REVISED	AUG 96		
B	HANDHOLE BOLT LENGTH REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			30/09/93 E.L. (Signature on File)	Chief Highway Engineer
			SPECIFICATION DRAWING No. SP635-2.1.14	







**FRANGIBLE BASE ASSEMBLY**  
(SN1798)

**NOTES:**

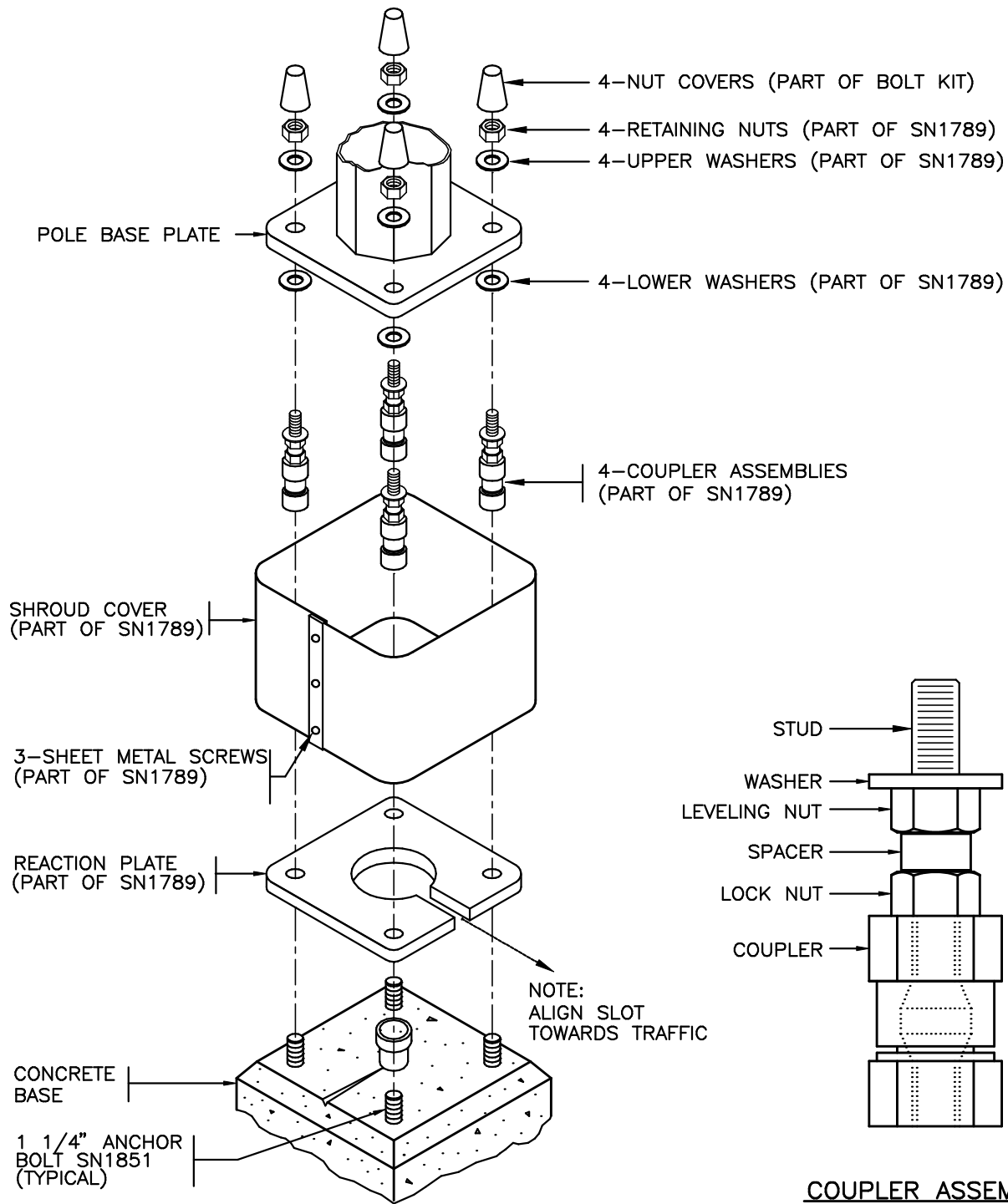
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

NOT TO SCALE



No.	Revision	Date	ALUMINUM FRANGIBLE BASE FOR 9.0 m AND 11.0 m LUMINAIRE POLES	
E				
D	LOCK WASHERS ADDED	SEPT 00		
C	ANTI-SEIZING LUBRICANT NOTED ON COVER PLATE BOLTS	NOV 98	Date	Approved
B	SPRING LOCK WASHERS REMOVED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			30/09/93 E.L. (Signature on File)	SPECIFICATION DRAWING No. SP635-2.1.15
			Chief Highway Engineer	





**BREAKAWAY BASE ASSEMBLY**  
(SN1789)

**COUPLER ASSEMBLY**  
(PART OF SN1789)

**NOTES:**

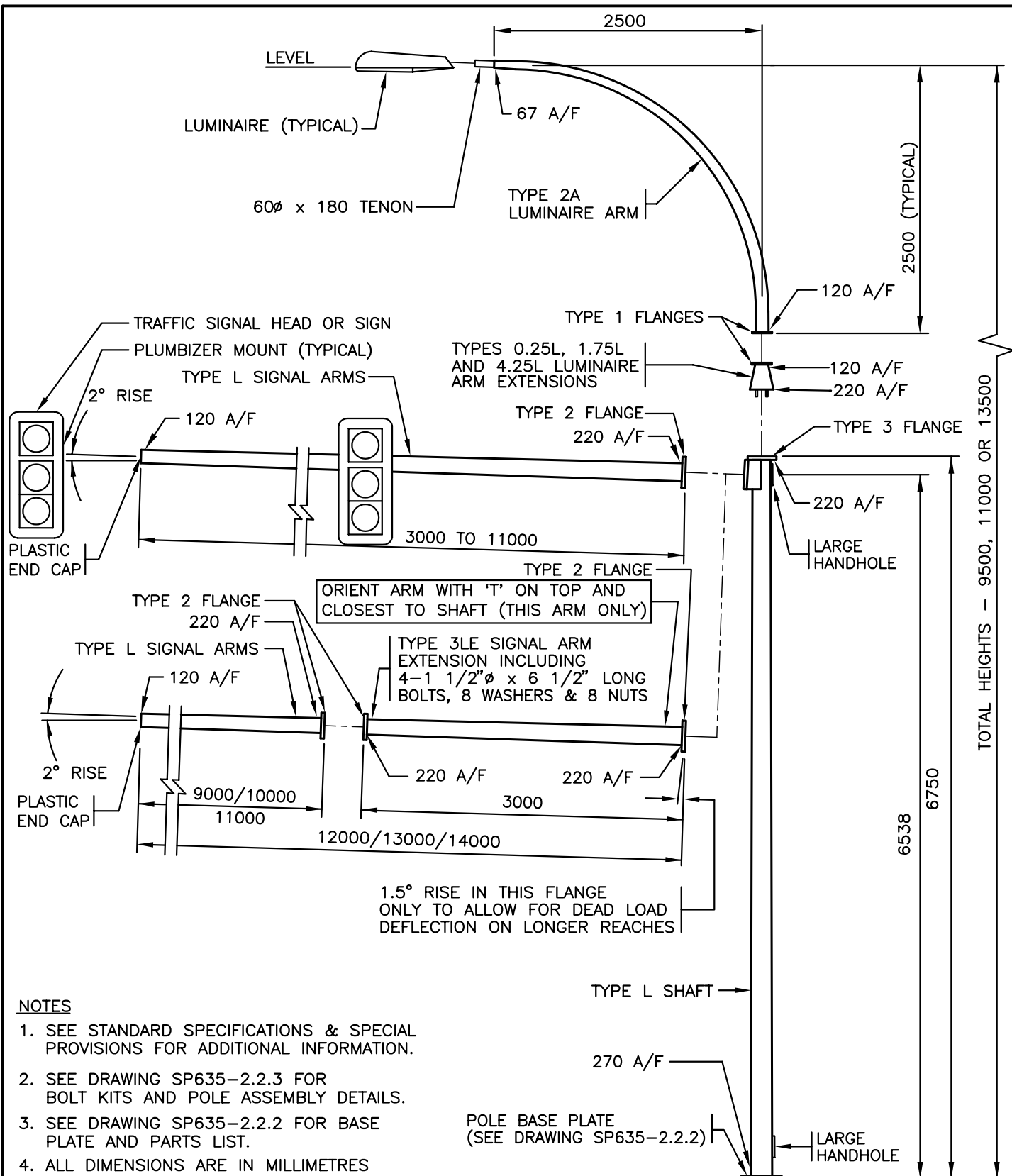
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. INSTALL BASE AND TIGHTEN BOLTS AS PER MANUFACTURERS INSTRUCTIONS.

NOT TO SCALE



No.	Revision	Date	BREAKAWAY BASE FOR 13.5 m LUMINAIRE POLES		
F			<div>Date<div>Approved</div></div> <div><div><div>30/09/93</div><div>E.L. (Signature on File)</div></div><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. SP635-2.1.16</div>		
E					
D					
C					
B	NOTE 2, COUPLERS & REACTION PLATE REV'D	JAN 97			
A	GENERAL REVISIONS	AUG 94			





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-2.2.3 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING SP635-2.2.2 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. SEE DRAWING SP635-2.2.2 FOR TYPE 2C LUMINAIRE ARM DETAILS.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

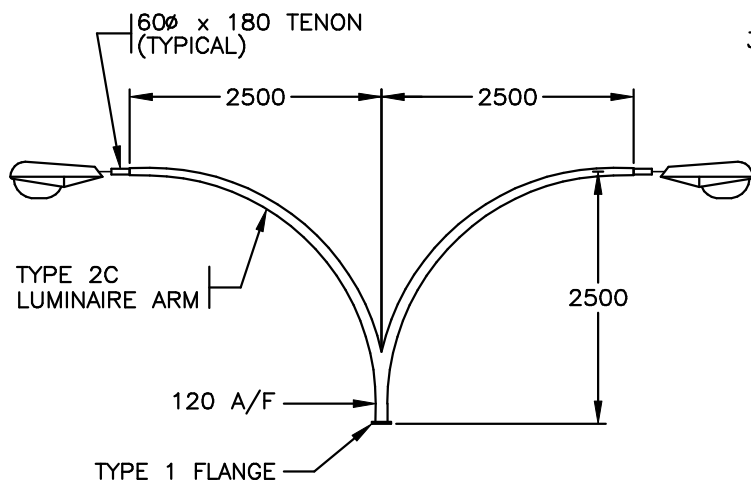
No.	Revision	Date
F		
E		
D	SIGNAL HEAD MOUNTING ADDED	OCT 03
C	BOLTS ON EXTENSION ARM REVISED	AUG 96
B	NOTE 5 ADDED & 3LE ARM REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

#### TYPE L SIGNAL POLE INSTALLATION DETAILS

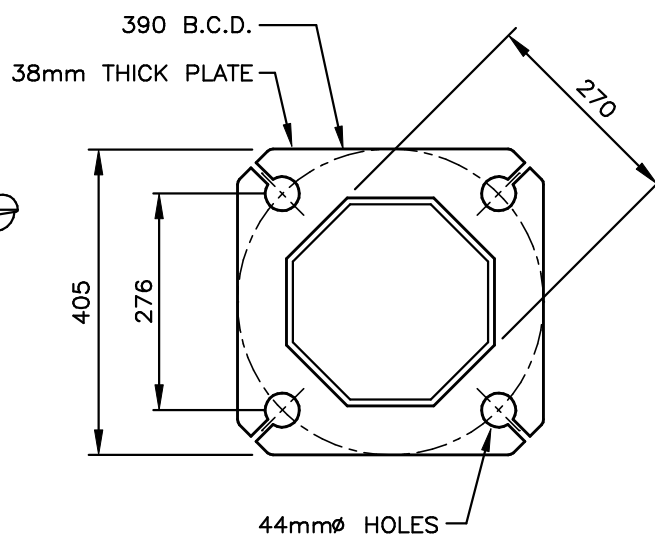
Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.2.1**





TYPE 2C LUMINAIRE ARM DETAILS



TYPE L POLE BASE PLATE

PARTS LIST FOR TYPE L SIGNAL POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [L] POLE SHAFT	SN2052	442
TYPE [3L] SIGNAL ARM - 3.0m	SN2053	97
TYPE [4L] SIGNAL ARM - 4.0m	SN2054	118
TYPE [5L] SIGNAL ARM - 5.0m	SN2055	173
TYPE [6L] SIGNAL ARM - 6.0m	SN2056	201
TYPE [7L] SIGNAL ARM - 7.0m	SN2057	229
TYPE [8L] SIGNAL ARM - 8.0m	SN2058	259
TYPE [9L] SIGNAL ARM - 9.0m	SN2059	284
TYPE [10L] SIGNAL ARM - 10.0m	SN2060	377
TYPE [11L] SIGNAL ARM - 11.0m	SN2061	410
TYPE [3LE] SIGNAL ARM EXTENSION - 3.0m	SN2065	114
TYPE [4.25L] LUMINAIRE ARM EXTENSION - 4.25m	SN2062	82
TYPE [1.75L] LUMINAIRE ARM EXTENSION - 1.75m	SN2063	29
TYPE [0.25L] LUMINAIRE ARM EXTENSION - 0.25m	SN2064	10
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
TYPE 1 FLANGE COVER PLATE [1 FCP]	SN1367	1.5
TYPE 2 FLANGE COVER PLATE [2 FCP]	SN2083	4
TYPE 3 FLANGE COVER PLATE [3 FCP]	SN2084	4
POST TOP TENON [PTT]	SN1831	5

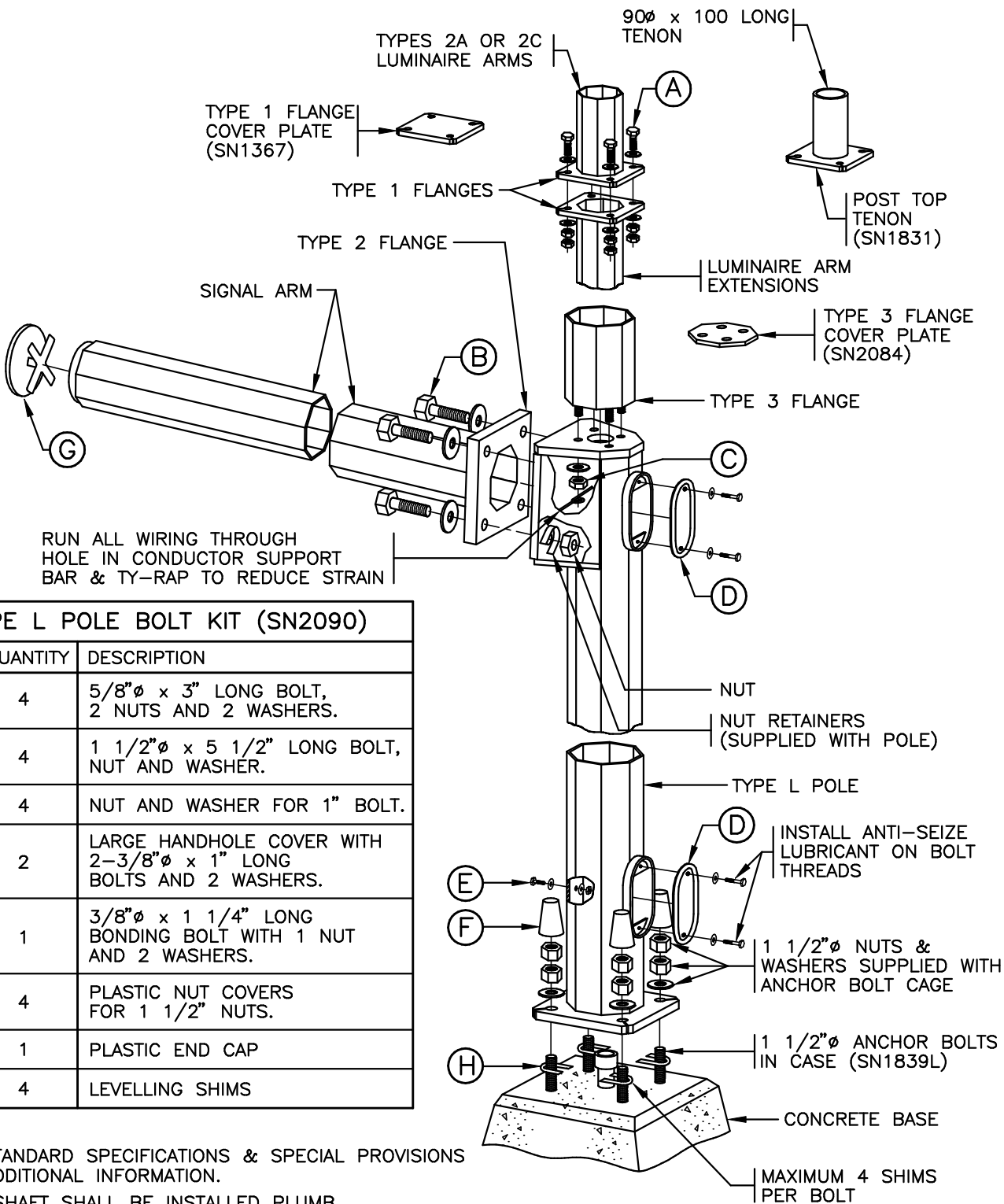
\* [ ] I.D. LABEL ON POLE

NOT TO SCALE



No.	Revision	Date	TYPE L SIGNAL POLE INSTALLATION DETAILS		
F			Date Approved		SPECIFICATION DRAWING No. SP635—2.2.2
E					
D					
C					
B	HOLE SIZE REVISED & 2C ARM ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		





### TYPE L POLE BOLT KIT (SN2090)

ITEM	QUANTITY	DESCRIPTION
A	4	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	4	1 1/2" $\phi$ x 5 1/2" LONG BOLT, NUT AND WASHER.
C	4	NUT AND WASHER FOR 1" BOLT.
D	2	LARGE HANDHOLE COVER WITH 2-3/8" $\phi$ x 1" LONG BOLTS AND 2 WASHERS.
E	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
F	4	PLASTIC NUT COVERS FOR 1 1/2" NUTS.
G	1	PLASTIC END CAP
H	4	LEVELLING SHIMS

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- POLE SHAFT SHALL BE INSTALLED PLUMB.
- ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
- APPLY GREASE TO ANCHOR BOLT THREADS.
- TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE

### POLE ASSEMBLY DETAIL



**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
E		
D	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98
C	CONDUCTOR SUPPORT BAR ADDED	AUG 96
B	HANDHOLE BOLT LENGTH REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

### TYPE L SIGNAL POLE INSTALLATION DETAILS

Date

Approved

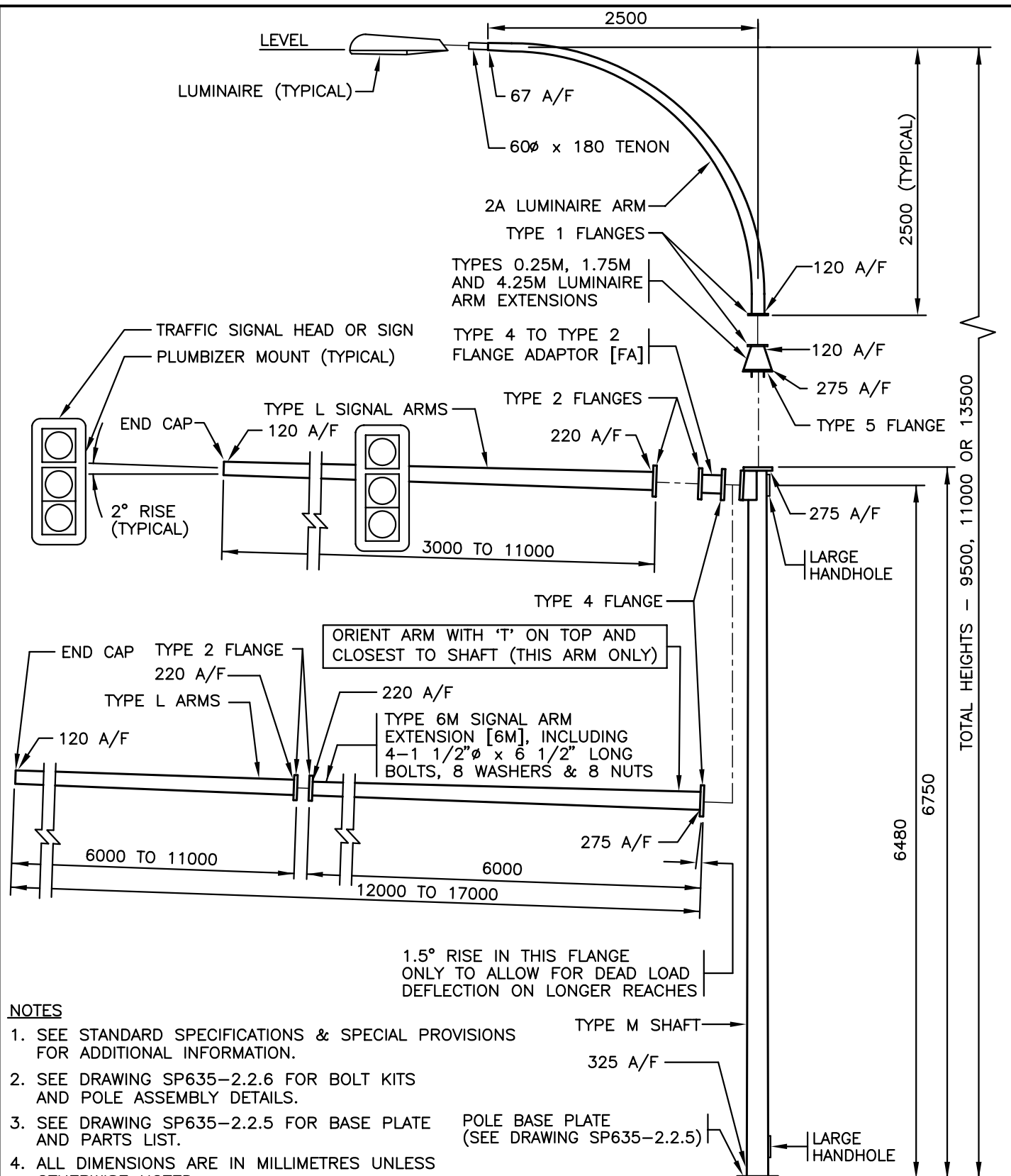
**30/09/93 E.L. (Signature on File)**

Chief Highway Engineer

SPECIFICATION  
DRAWING No.

**SP635-2.2.3**





#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-2.2.6 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
- SEE DRAWING SP635-2.2.5 FOR BASE PLATE AND PARTS LIST.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- SEE DRAWING SP635-2.2.2 FOR TYPE 2C LUMINAIRE ARM DETAILS.

POLE BASE PLATE  
(SEE DRAWING SP635-2.2.5)



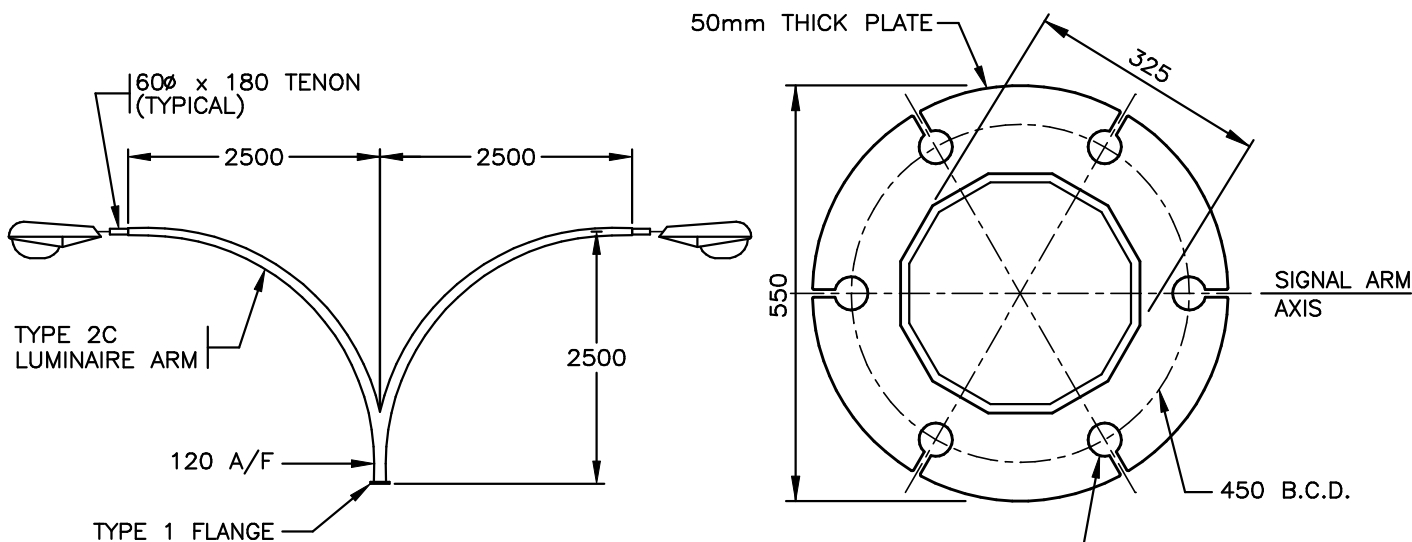
**BRITISH COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

No.	Revision	Date	TYPE M SIGNAL POLE INSTALLATION DETAILS		
F					
E					
D	SIGNAL HEAD MOUNTING ADDED	OCT 03			
C	TYPE 6M EXTENSION ARM NOTE REVISED	AUG 96			
B	6M ARM REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-2.2.4
			Chief Highway Engineer		





TYPE 2C LUMINAIRE ARM DETAILS

TYPE M POLE BASE PLATE

PARTS LIST FOR TYPE M SIGNAL POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [M] POLE SHAFT	SN2070	565
TYPE [6M] SIGNAL ARM EXTENSION - 6.0m	SN2071	360
TYPE [3L] SIGNAL ARM - 3.0m	SN2053	97
TYPE [4L] SIGNAL ARM - 4.0m	SN2054	118
TYPE [5L] SIGNAL ARM - 5.0m	SN2055	173
TYPE [6L] SIGNAL ARM - 6.0m	SN2056	201
TYPE [7L] SIGNAL ARM - 7.0m	SN2057	229
TYPE [8L] SIGNAL ARM - 8.0m	SN2058	257
TYPE [9L] SIGNAL ARM - 9.0m	SN2059	284
TYPE [10L] SIGNAL ARM - 10.0m	SN2060	377
TYPE [11L] SIGNAL ARM - 11.0m	SN2061	410
TYPE [4.25M] LUMINAIRE ARM EXTENSION - 4.25m	SN2072	115
TYPE [1.75M] LUMINAIRE ARM EXTENSION - 1.75m	SN2073	38
TYPE [0.25M] LUMINAIRE ARM EXTENSION - 0.25m	SN2074	14
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
TYPE 1 FLANGE COVER PLATE [1 FCP]	SN1367	1.5
TYPE 3 FLANGE COVER PLATE [3 FCP]	SN2084	4
TYPE 4 FLANGE COVER PLATE [4 FCP]	SN2085	8
TYPE 5 FLANGE COVER PLATE [5 FCP]	SN2086	4
TYPE 4 TO 2 FLANGE ADAPTOR [FA]	SN2080	75
POST TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABEL ON POLE

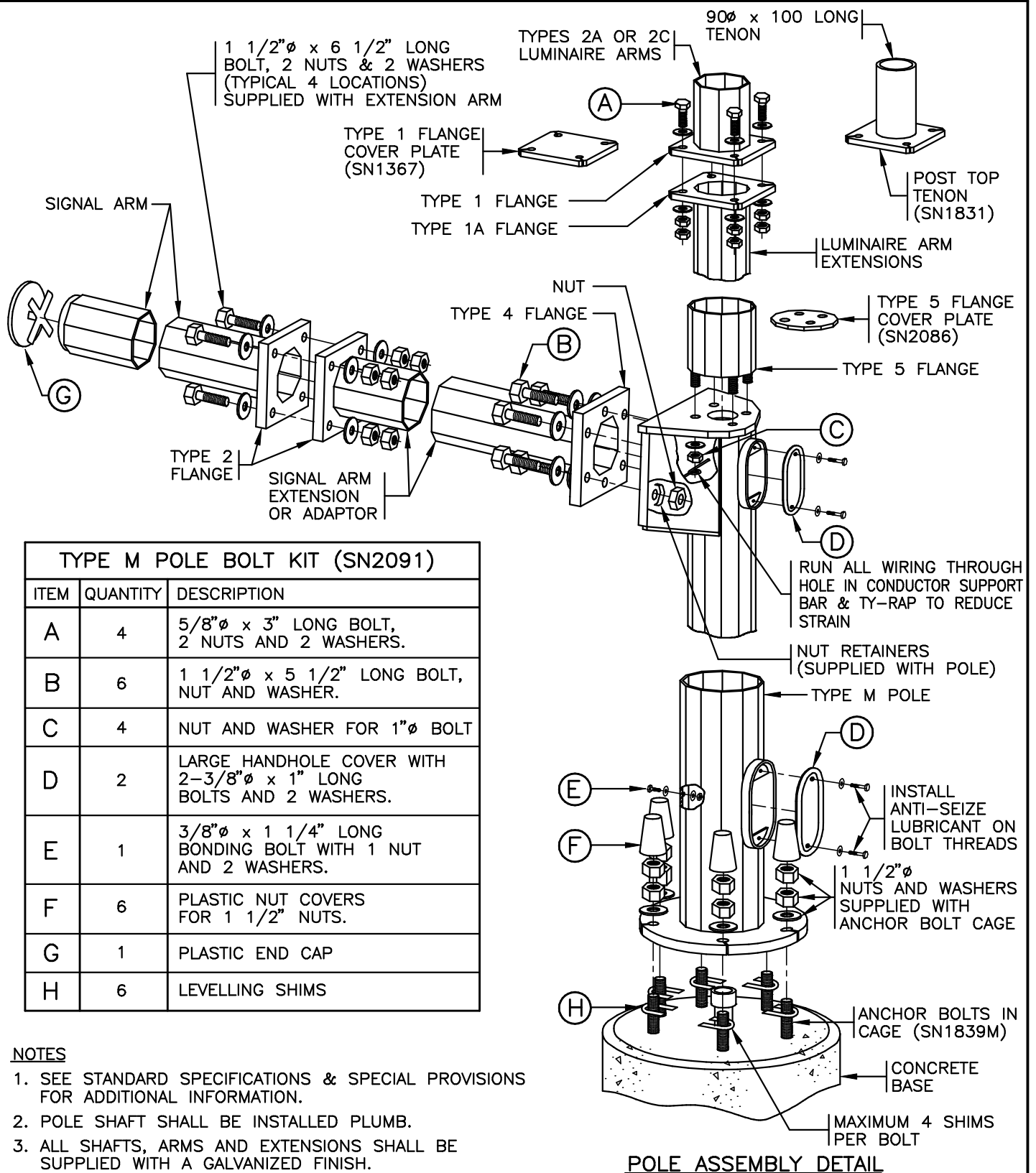
NOT TO SCALE



No.	Revision	Date	TYPE M SIGNAL POLE INSTALLATION DETAILS		
F			Date Approved		SPECIFICATION DRAWING No. SP635—2.2.5
E					
D					
C					
B	HOLE SIZE REVISED & 2C ARM ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94	30/09/93 E.L. (Signature on File) Chief Highway Engineer		

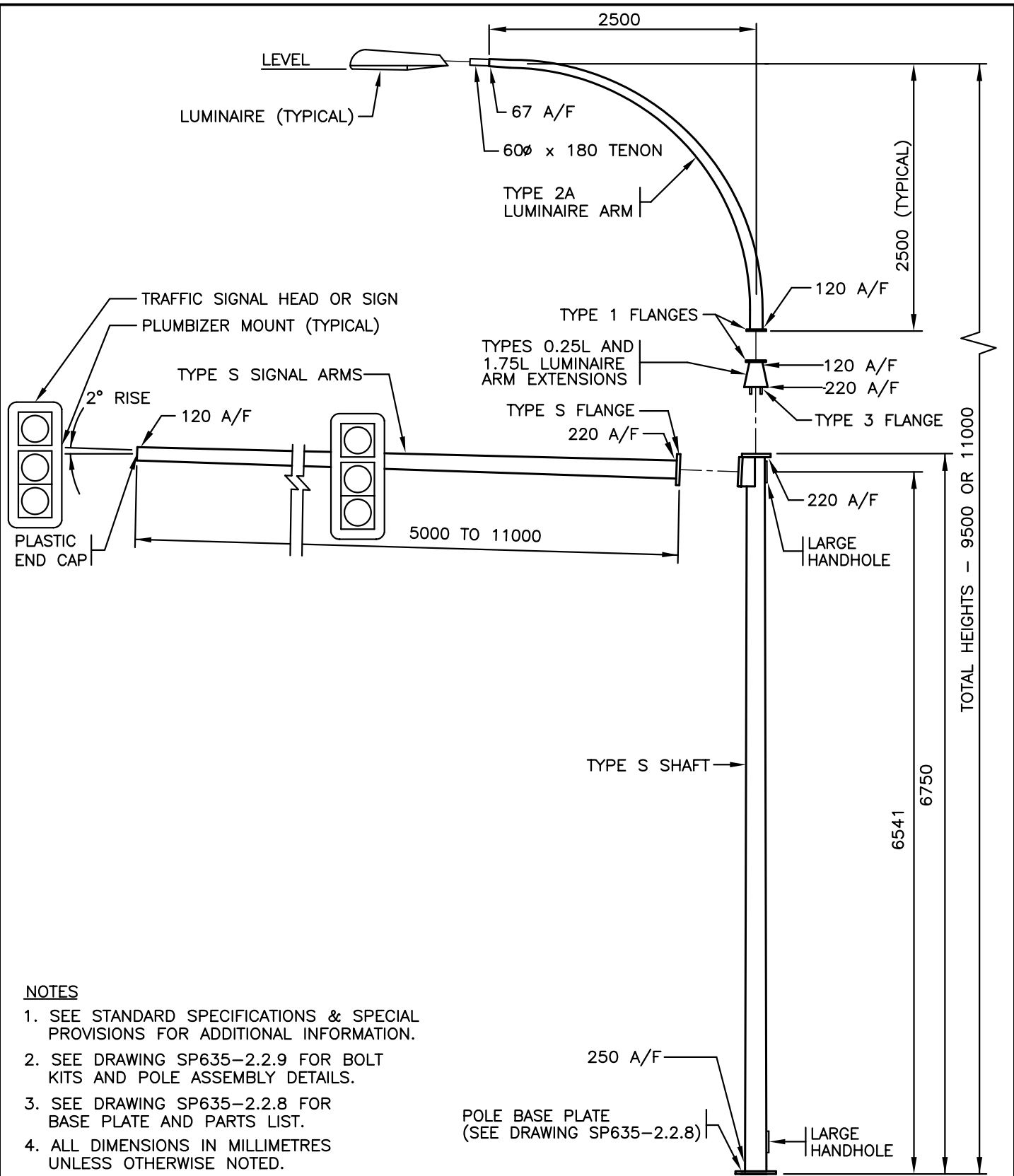
Chief Highway Engineer





No.	Revision	Date	TYPE M SIGNAL POLE INSTALLATION DETAILS	
E				
D	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98		
C	BOLT KIT LIST REVISED & CONDUCTOR SUPPORT ADDED	AUG 96		
B	HANDHOLE BOLT LENGTH REVISED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			<b>30/09/93 E.L. (Signature on File)</b>	SPECIFICATION DRAWING No. SP635-2.2.6
			Chief Highway Engineer	





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-2.2.9 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING SP635-2.2.8 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.

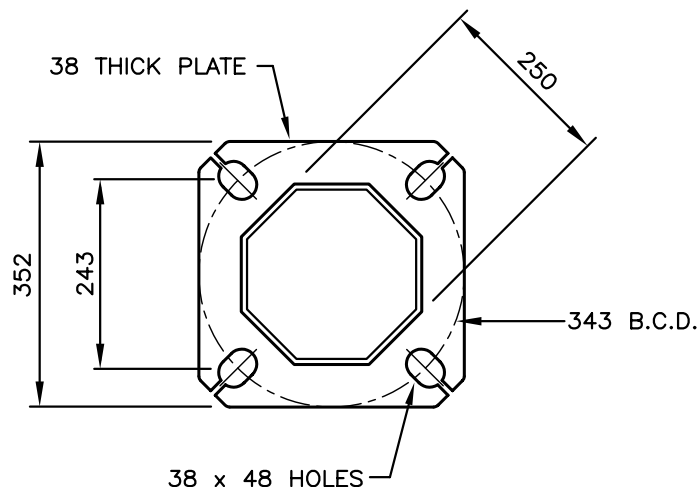
NOT TO SCALE



Ministry of Transportation

No.	Revision	Date	TYPE S SIGNAL POLE INSTALLATION DETAILS		
E					
D					
C					
B					
A	NEW DRAWING—PREVIOUS DRAWING 2.2.7 TO MOVED TO 2.2.10	OCT 03	Date	Approved	SPECIFICATION DRAWING No.
			14/11/03	D.N. (Signature on File) Chief Engineer	SP635-2.2.7





### TYPE S POLE BASE PLATE

1:10

PARTS LIST FOR TYPE S SIGNAL POLE			
PART		MINISTRY STOCK NUMBER	MASS (kg)
TYPE	[S] POLE SHAFT	SN3152	385
TYPE	[5S] SIGNAL ARM – 5.0m	SN3150	104
TYPE	[5.5S] SIGNAL ARM – 5.5m	SN3155	111
TYPE	[6S] SIGNAL ARM – 6.0m	SN3160	118
TYPE	[6.5S] SIGNAL ARM – 6.5m	SN3165	125
TYPE	[7S] SIGNAL ARM – 7.0m	SN3170	132
TYPE	[7.5S] SIGNAL ARM – 7.5m	SN3175	192
TYPE	[8S] SIGNAL ARM – 8.0m	SN3180	204
TYPE	[8.5S] SIGNAL ARM – 8.5m	SN3185	214
TYPE	[9S] SIGNAL ARM – 9.0m	SN3190	224
TYPE	[9.5S] SIGNAL ARM – 9.5m	SN3195	292
TYPE	[10S] SIGNAL ARM – 10.0m	SN3100	306
TYPE	[10.5S] SIGNAL ARM – 10.5m	SN3105	320
TYPE	[11S] SIGNAL ARM – 11.0m	SN3110	340
TYPE	[1.75L] LUMINAIRE ARM EXTENSION – 1.75m	SN2063	29
TYPE	[0.25L] LUMINAIRE ARM EXTENSION – 0.25m	SN2064	10
TYPE	[2A] LUMINAIRE ARM	SN1832	35
TYPE	1 FLANGE COVER PLATE [1 FCP]	SN1367	1.5
TYPE	S FLANGE COVER PLATE [S FCP]	SN1368	3
TYPE	3 FLANGE COVER PLATE [3 FCP]	SN2084	4
POST	TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABEL ON POLE

NOT TO SCALE

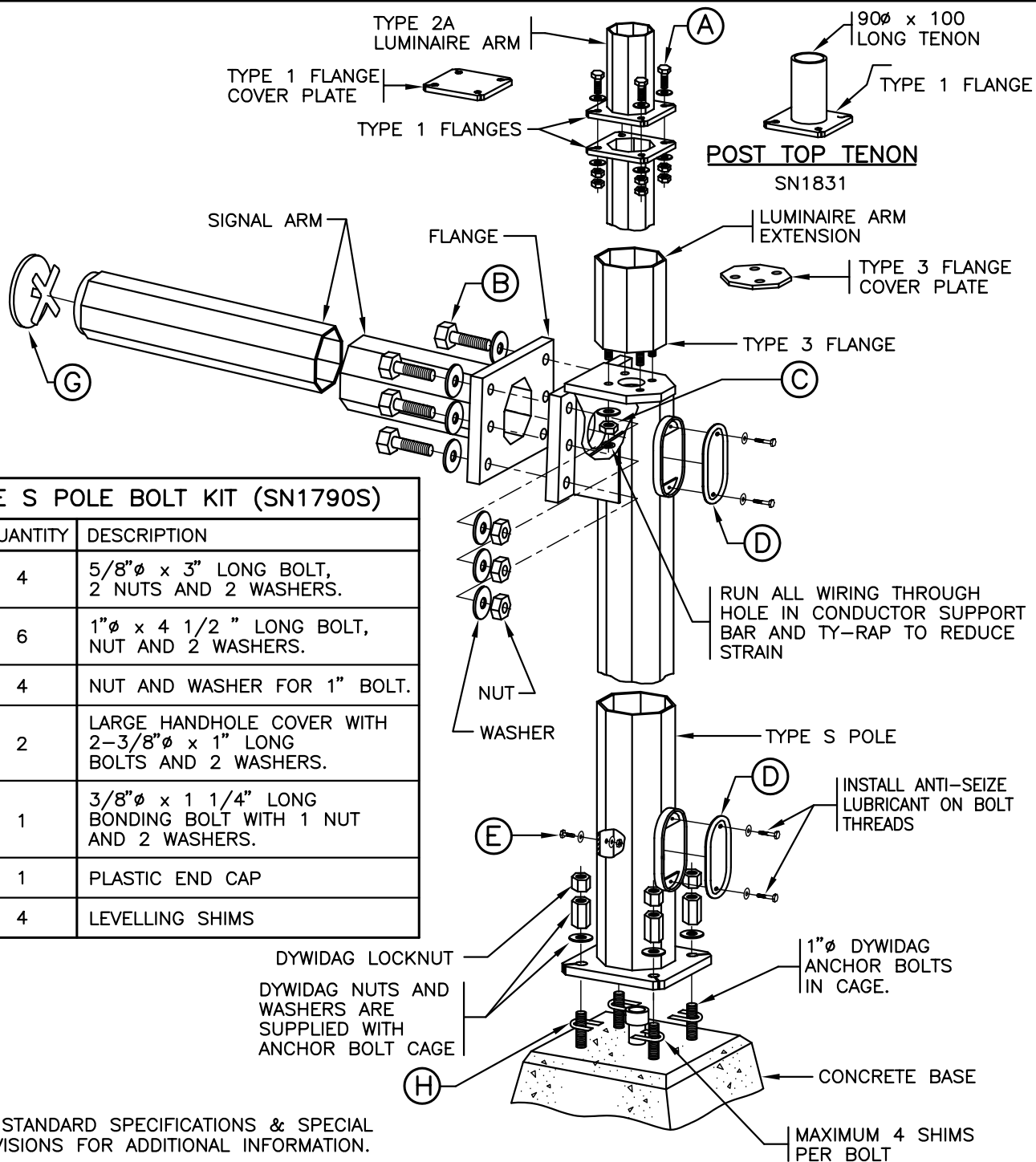


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPE S SIGNAL POLE INSTALLATION DETAILS	
F			<div><div>Date 14/11/03</div><div>Approved D.N. (Signature on File) Chief Engineer</div></div> <div>SPECIFICATION DRAWING No. SP635-2.2.8</div>	
E				
D				
C				
B				
A				





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SHAFTS TO BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS TO BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

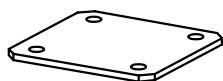
No.	Revision	Date
F		
E		
D		
C		
B		
A		

#### TYPE S SIGNAL POLE INSTALLATION DETAILS

Date: 14/11/03  
Approved: D.N. (Signature on File)  
Chief Engineer

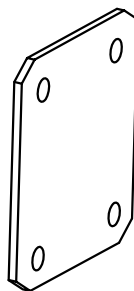
SPECIFICATION  
DRAWING No.  
SP635-2.2.9





**TYPE 1 FLANGE  
COVER PLATE**

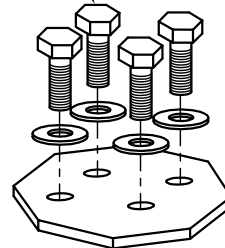
SN1367



**TYPE 2 FLANGE  
COVER PLATE**

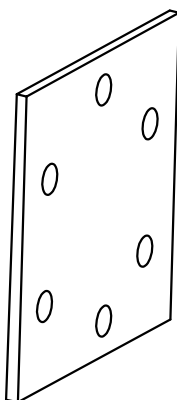
SN2083

4-1"  $\phi$  x 2 1/2" LONG  
BOLTS AND WASHERS  
(PART OF SN2084)



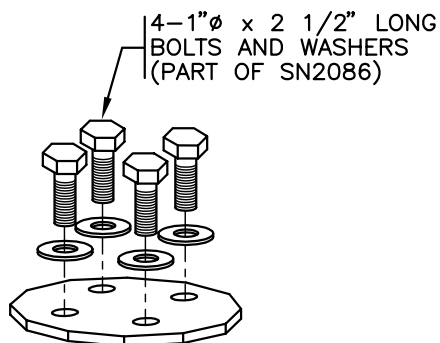
**TYPE 3 FLANGE  
COVER PLATE**

SN2084



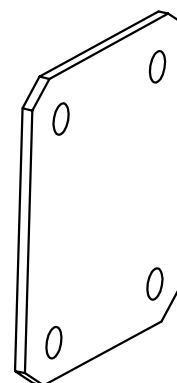
**TYPE 4 FLANGE  
COVER PLATE**

SN2085



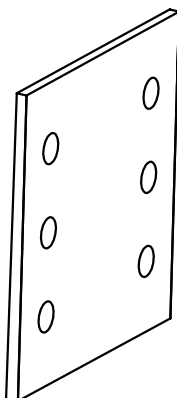
**TYPE 5 FLANGE  
COVER PLATE**

SN2086



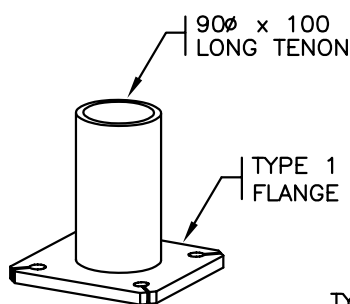
**TYPE 8 FLANGE  
COVER PLATE**

SN2089



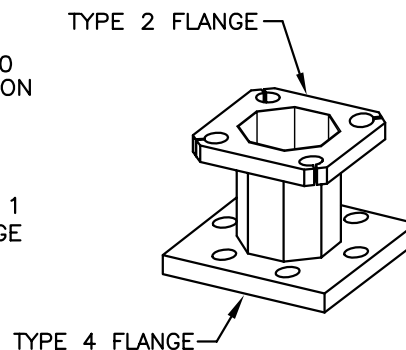
**TYPE S FLANGE  
COVER PLATE**

SN1368



**POST TOP  
TENON**

SN1831



**TYPE 4 TO TYPE 2  
FLANGE ADAPTOR**

SN2080

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	SIGNAL POLE ACCESSORIES		
F			Date		
E					
D			Approved		
C					
B			SPECIFICATION DRAWING No.		
A	TYPE S FLANGE COVER PLATE ADDED	OCT 03			
			14/11/03		SN635-2.2.10
			D.N. (Signature on File)		
			Chief Engineer		



LOCATE BOLT IN THE CENTER  
OF THE 50mm SLOTTED HOLE  
(TYPICAL)

SINGLE ARM BRACKET  
(T SECTION)  
(PART OF SN1665)

RETAINING WASHER  
(PART OF SN1665)

NUTS  
(PART OF SN1665)

RUBBER GASKET  
(PART OF SN1665)

POLE PLATE WITH NO NIPPLE  
& SLOTTED HOLES (SN1665)

GALVANIZED STEEL POLE  
(THICKNESS VARIES)

TRAFFIC SIGNAL OR  
PEDESTRIAN HEAD

FLAT WASHER (TYPICAL)

INTERIOR TOOTH  
WASHER (TYPICAL)

3/8"  $\phi$  x 1 1/2" BOLT, FLAT  
WASHER & LOCK WASHER  
(PART OF SN1665) TYPICAL

SINGLE ARM BRACKET  
(TUBULAR) WITH WIREWAY  
(PART OF SN1665)

DRILL AND TAP POLE  
TO SUIT (2 PLACES  
PER BRACKET) COAT  
HOLES WITH COLD  
GALVANIZING  
COMPOUND.

DRILL 32 $\phi$  HOLE  
IN POLE FOR POLE  
PLATE NIPPLE. COAT  
HOLE WITH COLD  
GALVANIZING  
COMPOUND.

2500

TO ROADWAY OR SIDEWALK

**ELEVATION**  
(SN1665)

POLE PLATE WITH NIPPLE  
(PART OF SN1665)

#### NOTES:

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. WHERE 3 OR MORE SIDE MOUNT SIGNAL HEADS ARE REQUIRED ON A POLE LOCATE THE 3rd AND 4th PEDESTRIAN HEAD ARM BRACKETS WITH WIREWAY AND POLE PLATE WITH THE NIPPLE TO THE TOP OF THE HEAD TO AVOID EXCESSIVE DRILLING OF THE POLE IN ONE AREA.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

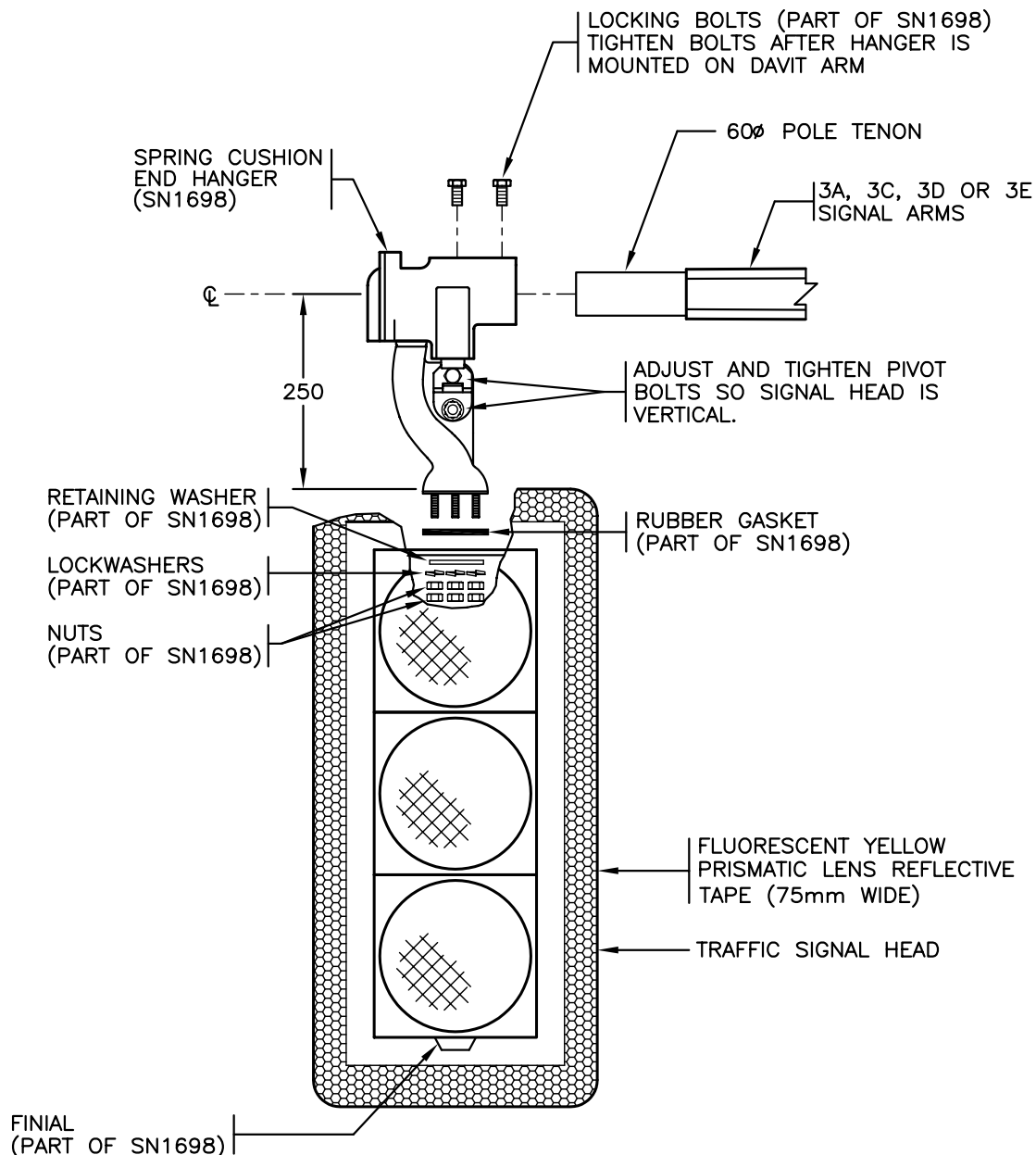
No.	Revision	Date
F		
E		
D	NOTE 2 REVISED	OCT 03
C	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99
B	SIGN MOUNTING HEIGHT ADDED	AUG 95
A	GENERAL REVISIONS	AUG 94

## SIGNAL AND PEDESTRIAN HEAD SIDE MOUNT INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.3.1**





**ELEVATION**

**FOR REFERENCE ONLY**

USE END PLUMBIZER FOR  
INSTALLATIONS UNLESS  
OTHERWISE NOTED

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE

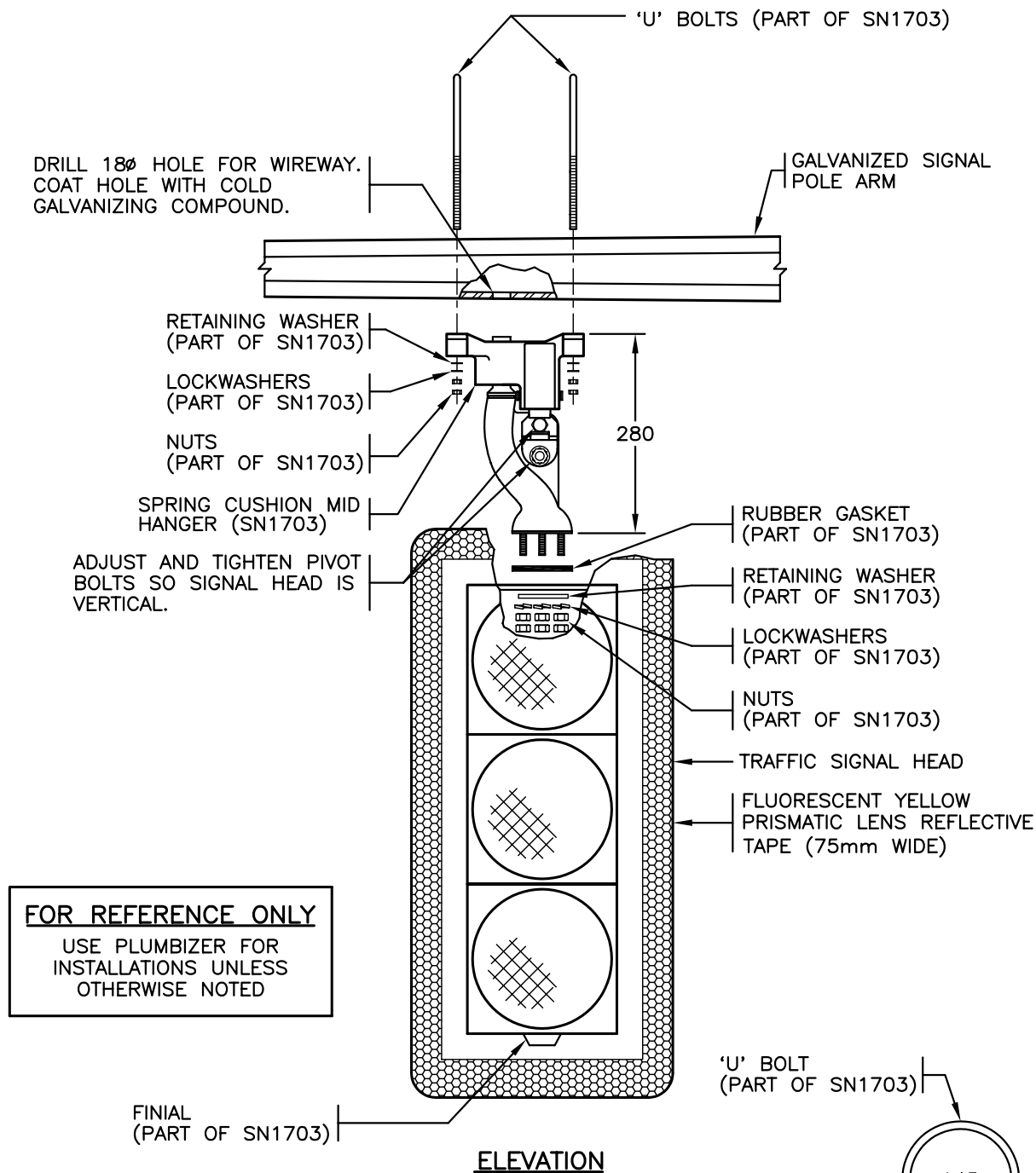


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	OVERHEAD SPRING CUSHION END SIGNAL HEAD HANGER INSTALLATION DETAILS		
F	NOTE 2 REVISED	OCT 03			
E	REFLECTIVE TAPE ADDED	NOV 01			
D	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99			
C	NEW DRAWING	OCT 97			
B	SIGNAL HEAD SIZE CHANGED	AUG 95			
A	GENERAL REVISIONS	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-2.3.2
			Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
F	NOTE 2 REVISED	OCT 03
E	REFLECTIVE TAPE ADDED	NOV 01
D	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99
C	NEW DRAWING NUMBER	OCT 97
B	SIGNAL HEAD SIZE CHANGED	AUG 95
A	GENERAL REVISIONS	AUG 94

## OVERHEAD SPRING CUSHION MID HANGER SIGNAL HEAD INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.3.3**



LOCKING BOLTS (PART OF SN1660)  
ADJUST AND TIGHTEN BOLTS SO SIGNAL  
HEAD IS PLUMB

DRILL POLE TO  
SUIT BOLTS

SEE NUT  
TIGHTENING  
DETAIL BELOW

POLE ARM

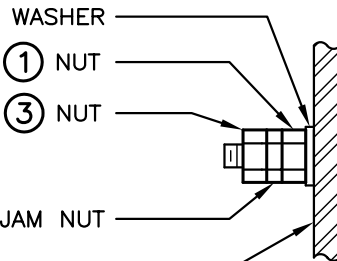
NYLOCK NUT  
(PART OF SN1660)

PLUMBIZER  
2-1/2"Ø-13" LONG BOLTS  
(PART OF SN1660) FIELD CUT TO  
SUIT SO NO MORE THAN 12mm  
OF BOLT PROTRUDES BEYOND NUT.

SIGNAL HEAD

JAM NUT  
(PART OF SN1660)

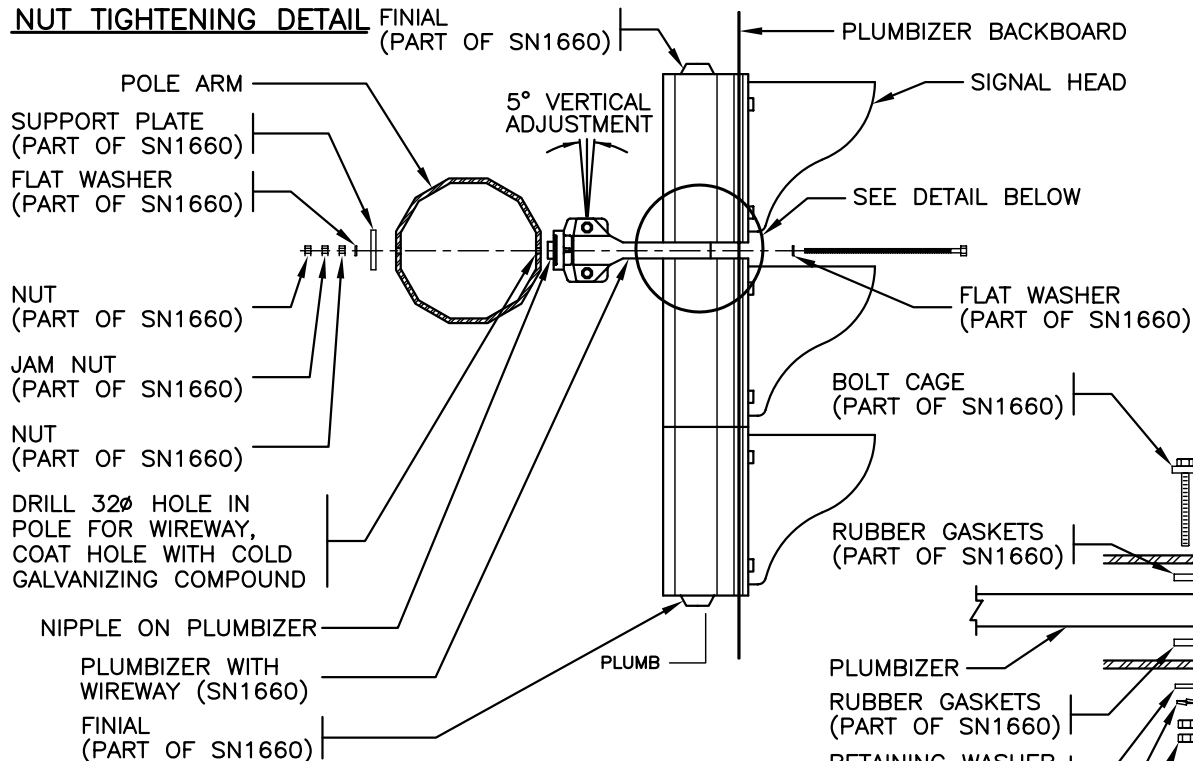
### TOP VIEW



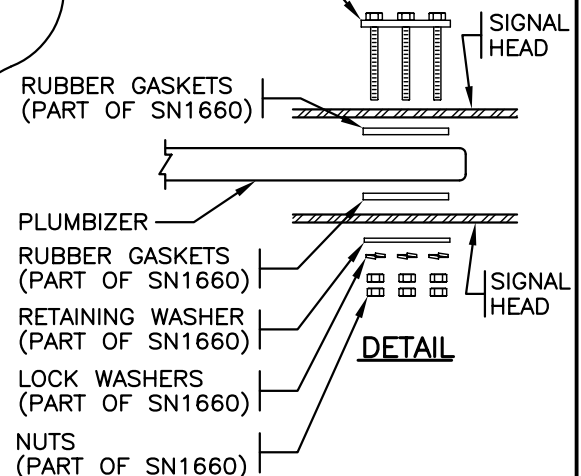
### NUT TIGHTENING DETAIL

FINIAL  
(PART OF SN1660)

- TIGHTEN NUT (1) AGAINST WASHER,
- TIGHTEN JAM NUT (2) AGAINST NUT (1),
- SNUG NUT (3) AGAINST JAM NUT (2)  
AND THEN TIGHTEN NUT (3) AND JAM NUT (2)  
INTO EACH OTHER.



### ELEVATION



### DETAIL

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

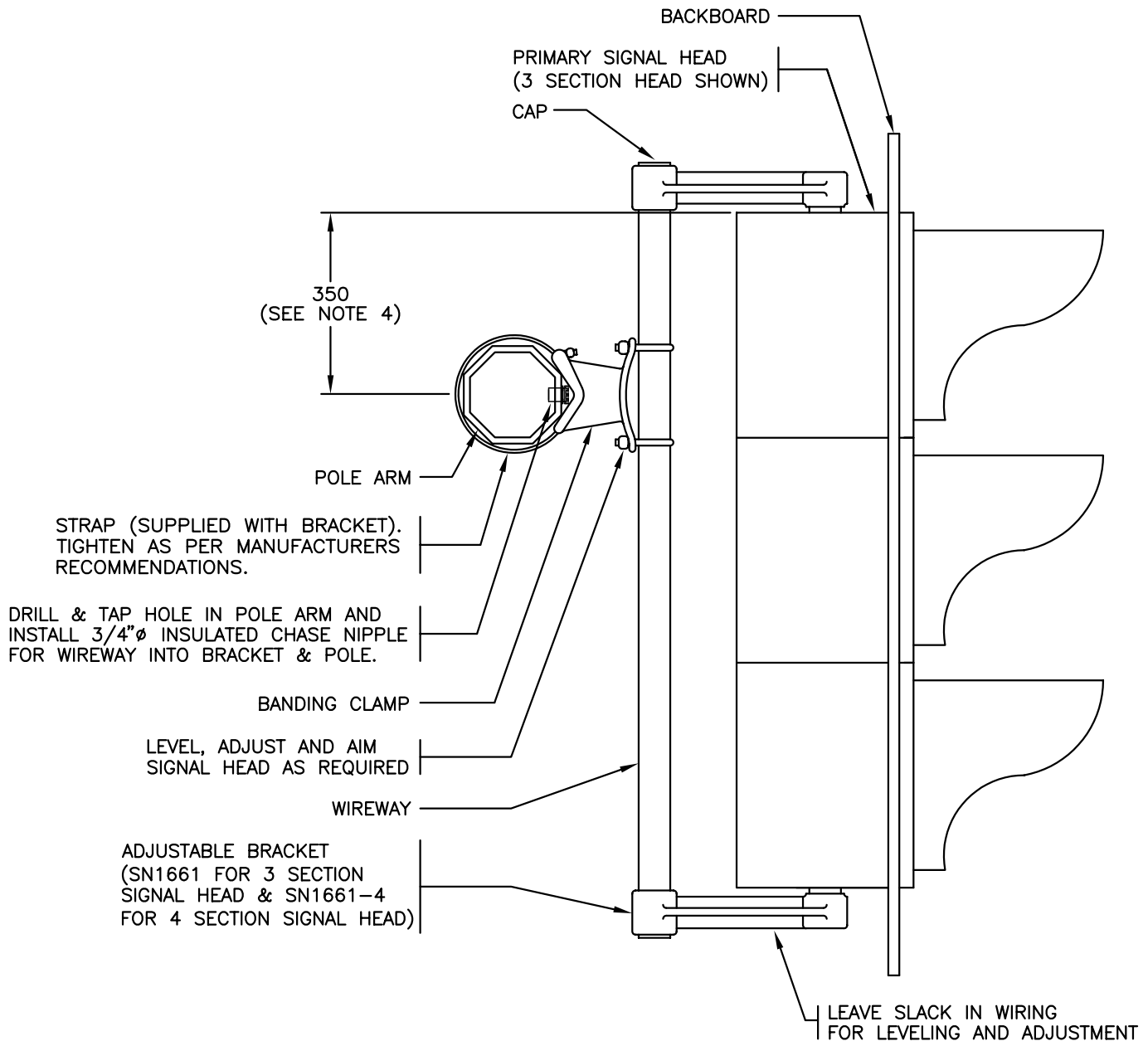
No.	Revision	Date
F	NOTE 2 REVISED	OCT 03
E	DETAILS FROM SP635-2.3.5 ADDED	NOV 01
D	NYLOCK NUTS REMOVED, DOUBLE NUTS ADDED	AUG 99
C	NEW DRAWING NUMBER	OCT 97
B	CONNECTION BOLTS REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

## SIGNAL HEAD PLUMBIZER INSTALLATION DETAILS

Date 30/09/93 Approved **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.3.4**





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ADJUST SIGNAL HEAD MOUNTING HEIGHT AS DIRECTED TO AVOID CONFLICTS.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
F		
E		
D		
C		
B		
A	NOTE 2 REVISED	OCT 03

## SIGNAL HEAD ADJUSTABLE BRACKET DETAILS

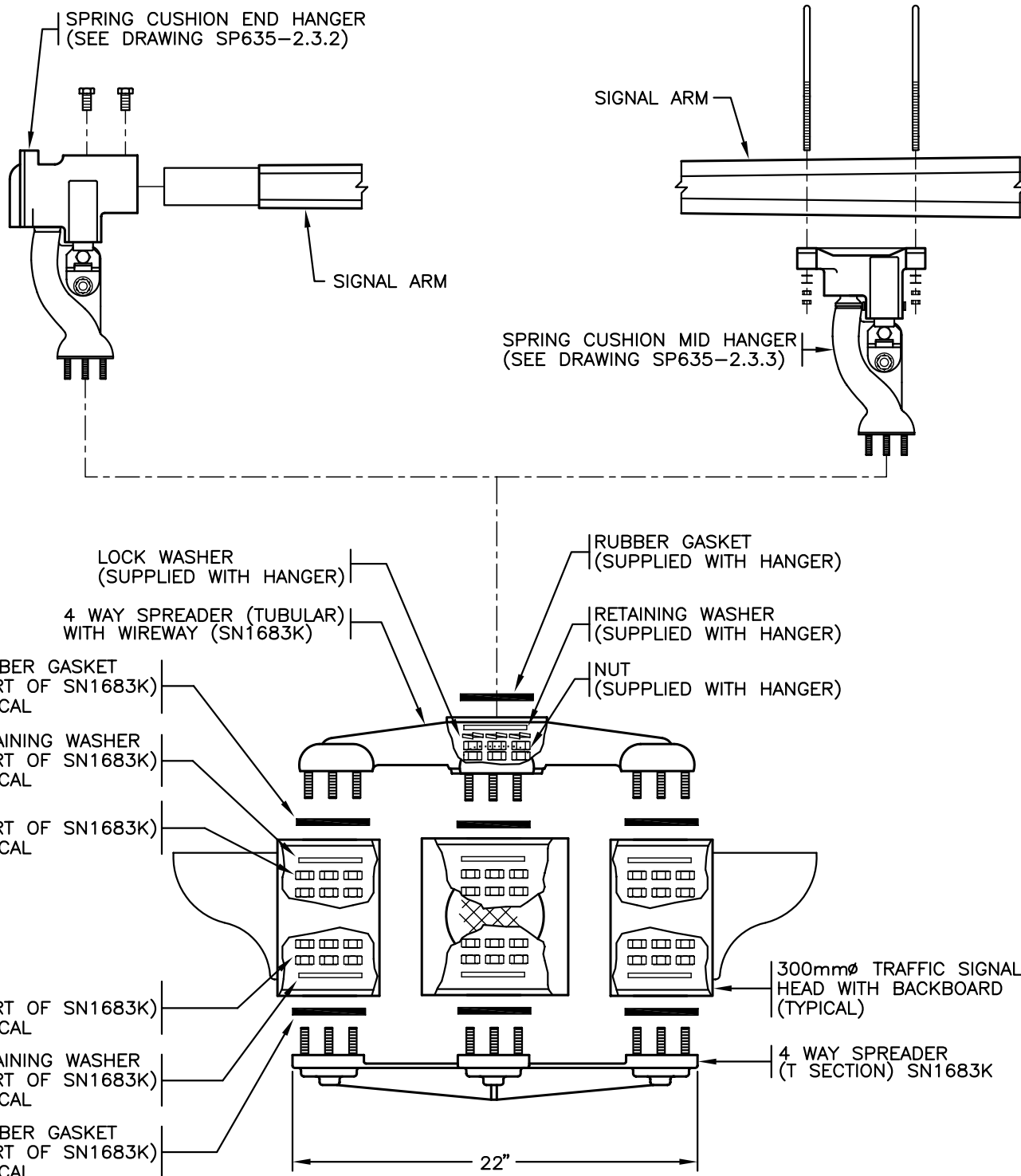
Date      Approved

**2001/12/13 D.N. (Signature on File)**

Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.3.5**





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11
3. 'SN' DENOTES MINISTRY STOCK NUMBER.

MOUNTING FOR 2, 3 AND 4  
WAY SPREADERS IDENTICAL

NOT TO SCALE

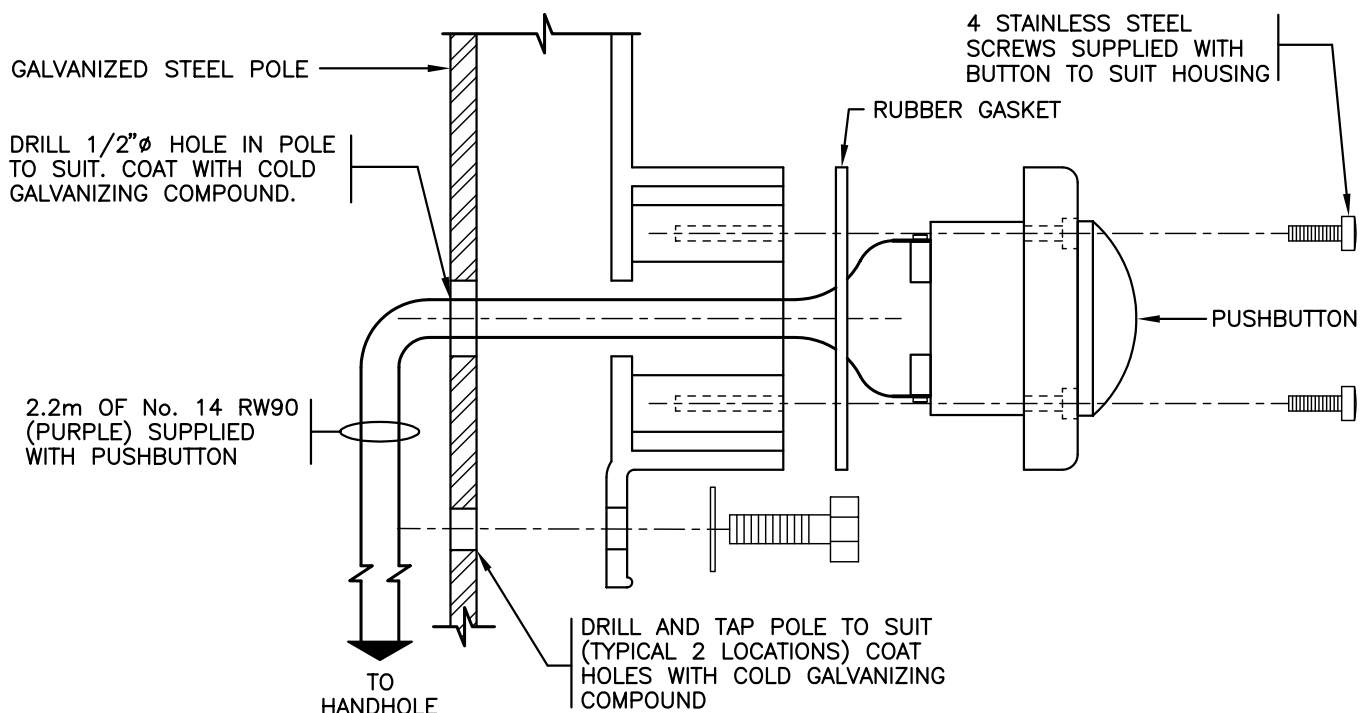


**BRITISH  
COLUMBIA**

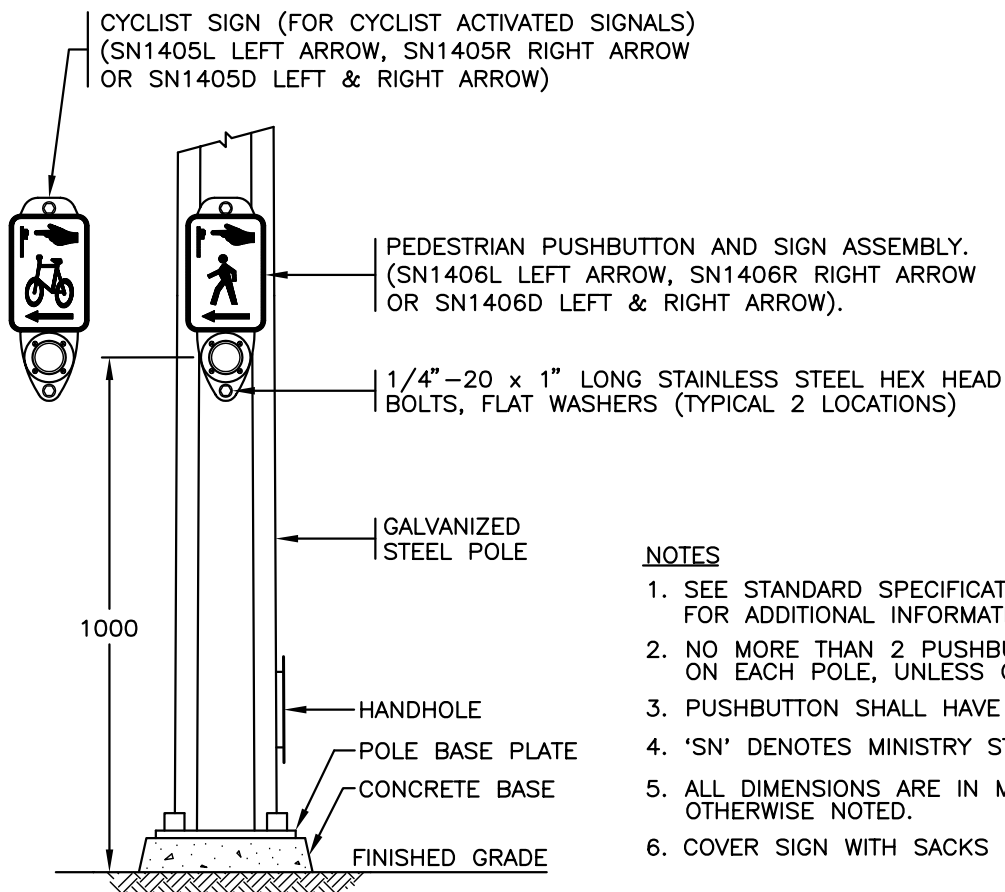
Ministry of  
Transportation

No.	Revision	Date	FOUR-WAY OVERHEAD FLASHING SIGNAL HEAD INSTALLATION DETAILS		
F	NOTE 2 REVISED	OCT 03			
E	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99			
D	NEW DRAWING NUMBER	OCT 97	Date	Approved	SPECIFICATION DRAWING No. <b>SP635-2.3.6</b>
C	STOCK NUMBERS REVISED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		
B	DRAWING NUMBER REVISED	AUG 95			
A	GENERAL REVISIONS	AUG 94			





**SIDE VIEW**



**ELEVATION**

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. NO MORE THAN 2 PUSHBUTTONS SHALL BE INSTALLED ON EACH POLE, UNLESS OTHERWISE NOTED.
3. PUSHBUTTON SHALL HAVE NORMALLY OPEN CONTACTS.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. COVER SIGN WITH SACKS UNTIL SIGNAL IS OPERATIONAL.



**BRITISH COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

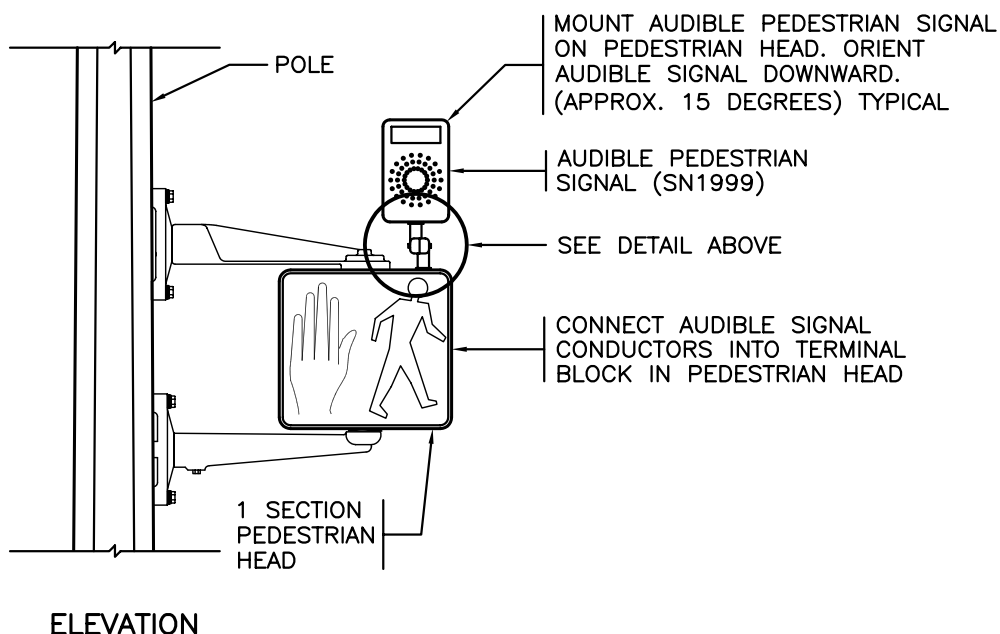
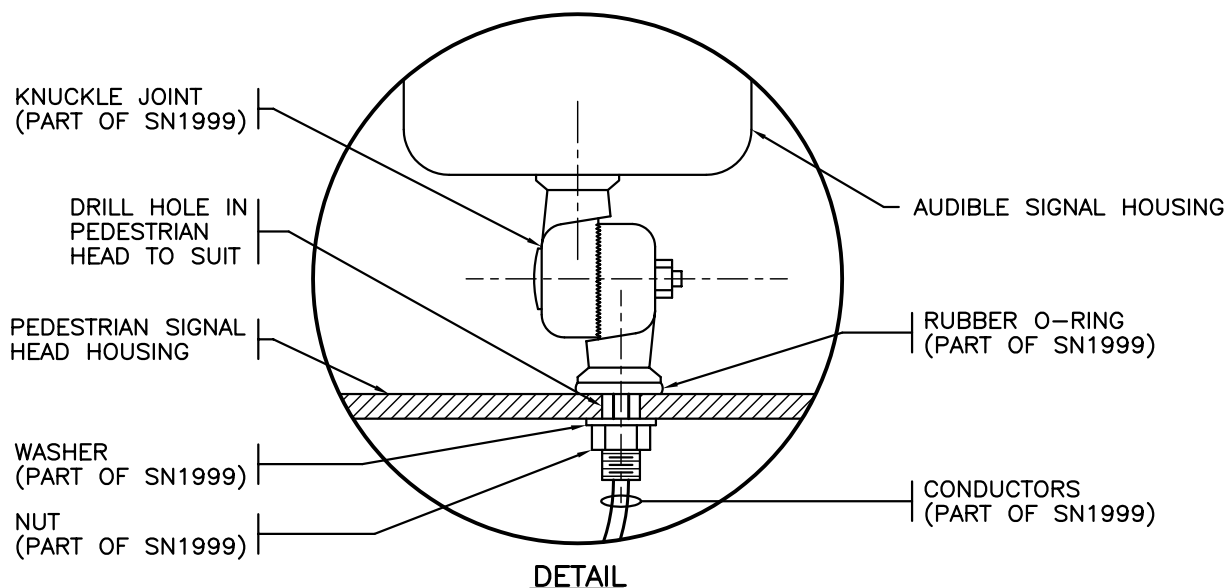
No.	Revision	Date
F		
E		
D	NEW PUSHBUTTON & SIGN	OCT 03
C	NEW DRAWING NUMBER	OCT 97
B	BOLTS AND DWG. No. REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

**PEDESTRIAN PUSHBUTTON WITH  
INTEGRAL SIGN INSTALLATION DETAILS**

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.3.7**





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM, ADJUST AND CONNECT AUDIBLE SIGNAL AS PER MANUFACTURERS INSTRUCTIONS TO THE SATISFACTION OF THE MINISTRY REPRESENTATIVE.
3. AUDIBLE SIGNAL SHALL 'CHIRP-CHIRP' FOR EAST TO WEST CROSSINGS AND 'CUCKOO' FOR NORTH TO SOUTH CROSSINGS. AT INTERSECTIONS WHERE NORTH/SOUTH AND EAST/WEST ARE NOT EASILY DEFINED CONTACT THE MINISTRY REPRESENTATIVE.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.



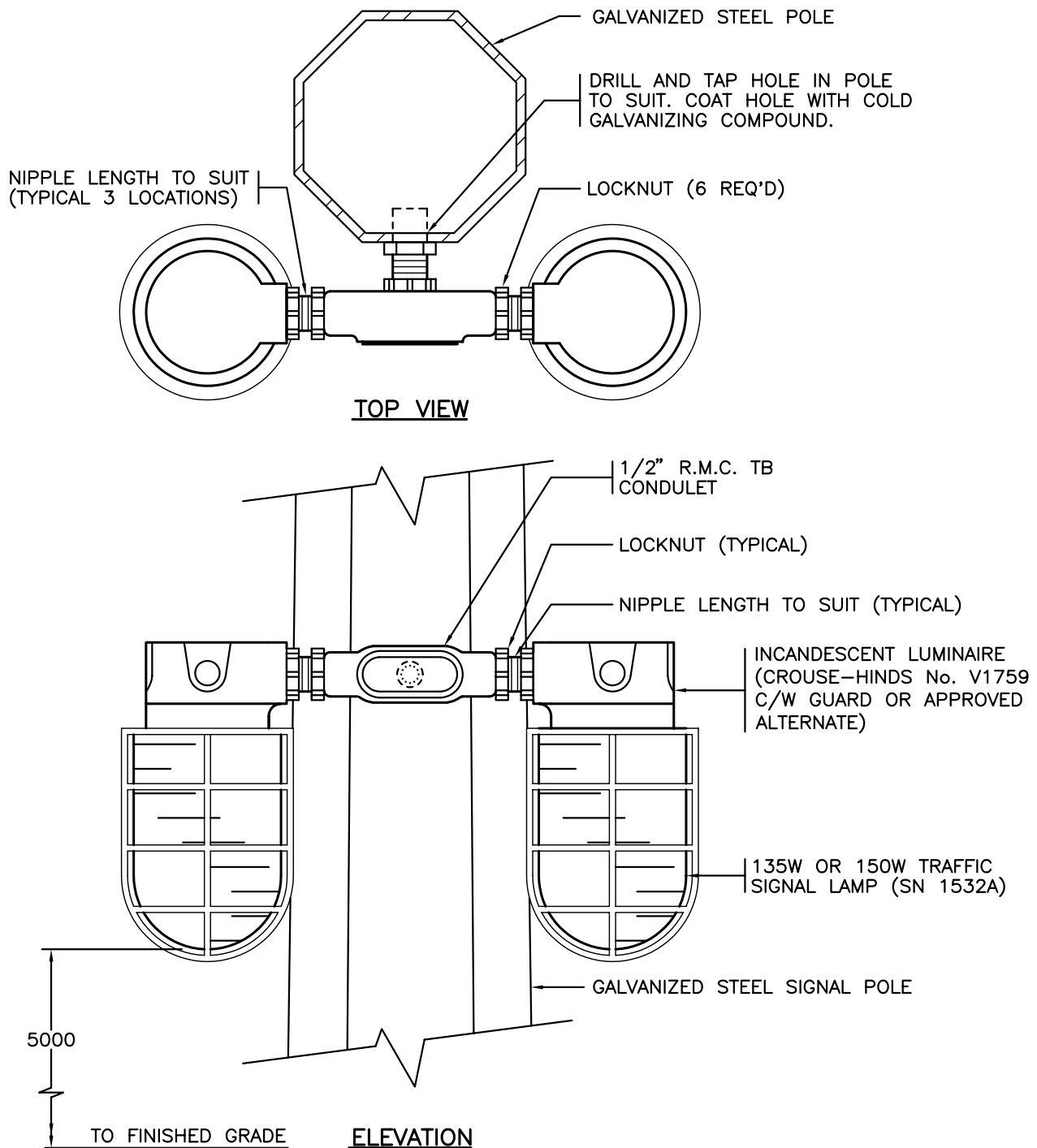
**BRITISH  
COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

No.	Revision	Date	AUDIBLE SIGNAL INSTALLATION DETAILS		
F					
E	GENERAL REVISIONS	OCT 03			
D	ALTERNATE SINGLE SECTION LED PED. HEAD ADDED	NOV 01			
C	NOTE 3 REVISED	NOV 98			
B	NEW DRAWING NUMBER	OCT 97			
A	N/S CROSSING SOUND & DWG. No. REVISED	AUG 95			
			Date	Approved	SPECIFICATION DRAWING No.
			21/11/94	E.L. (Signature on File)	SP635-2.3.8
			Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL NUTS, WASHERS, NIPPLES & BUSHINGS SHALL BE GALVANIZED.
3. ORIENT FIRE LIGHTS ON POLE SO VISIBLE BY FIRE TRUCK DRIVER.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE

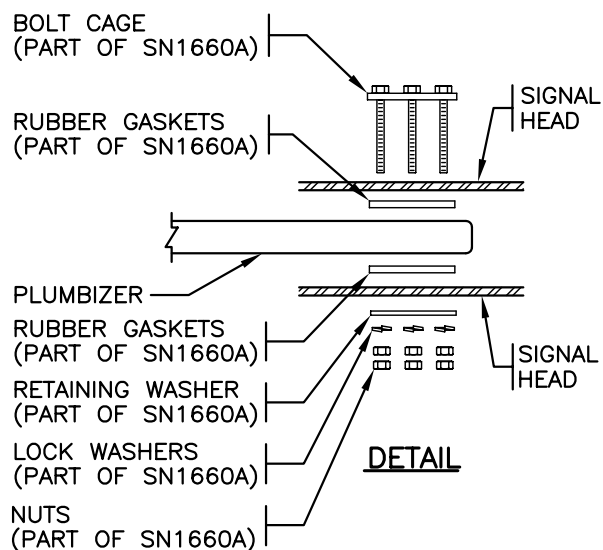
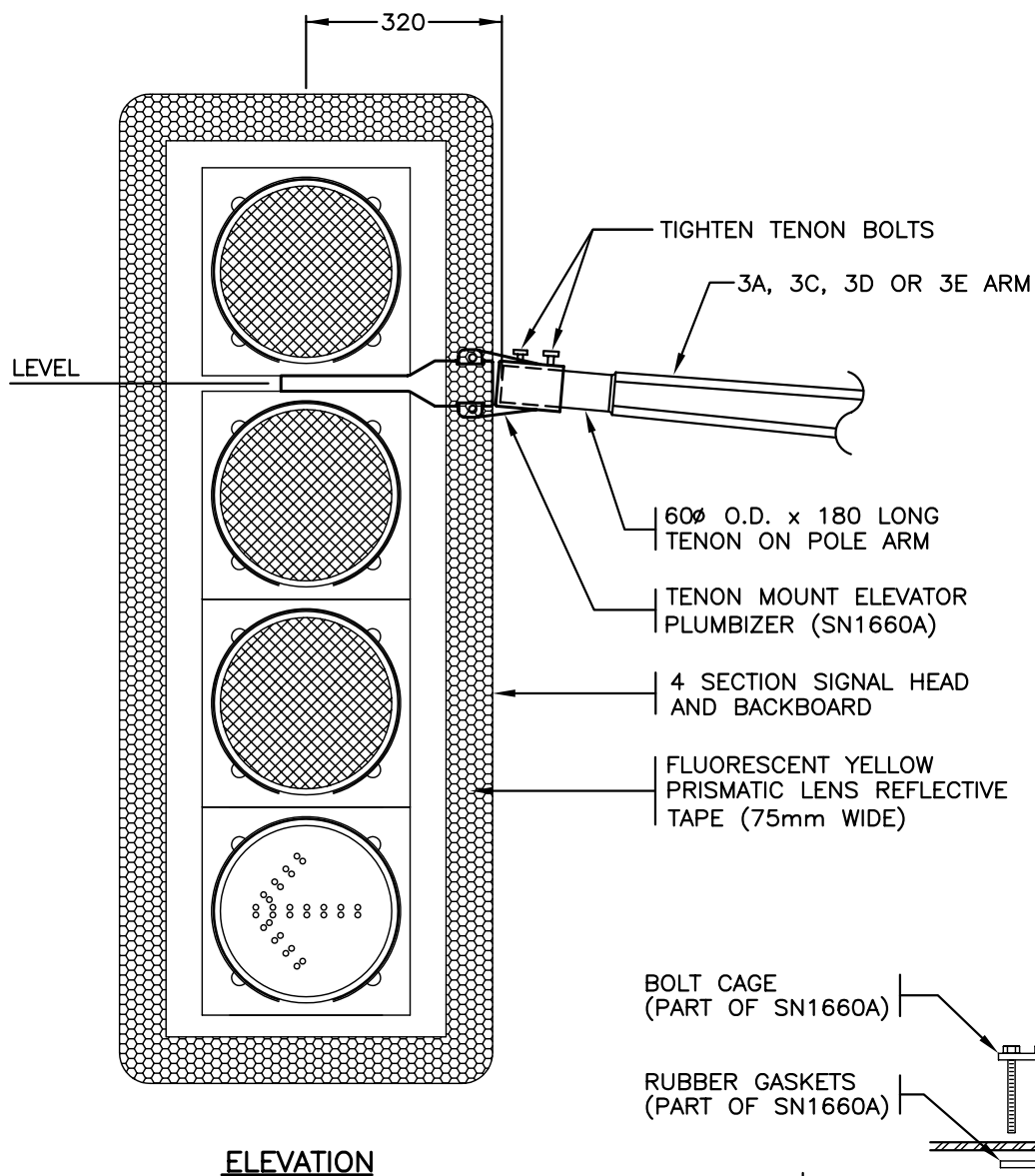


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	FIRE SIGNAL INDICATION LIGHT INSTALLATION DETAIL		
F			Date	Approved	SPECIFICATION DRAWING No.
E					
D			<b>18/11/94</b>	<b>E.L. (Signature on File)</b> Chief Highway Engineer	<b>SP635-2.3.9</b>
C	LUMINAIRE MODEL No. UPDATED	OCT 03			
B	NEW DRAWING NUMBER	OCT 97			
A	DRAWING NUMBER REVISED	AUG 95			





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNAL HEADS IN ACCORDANCE WITH DRAWING SP635-2.3.11.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE



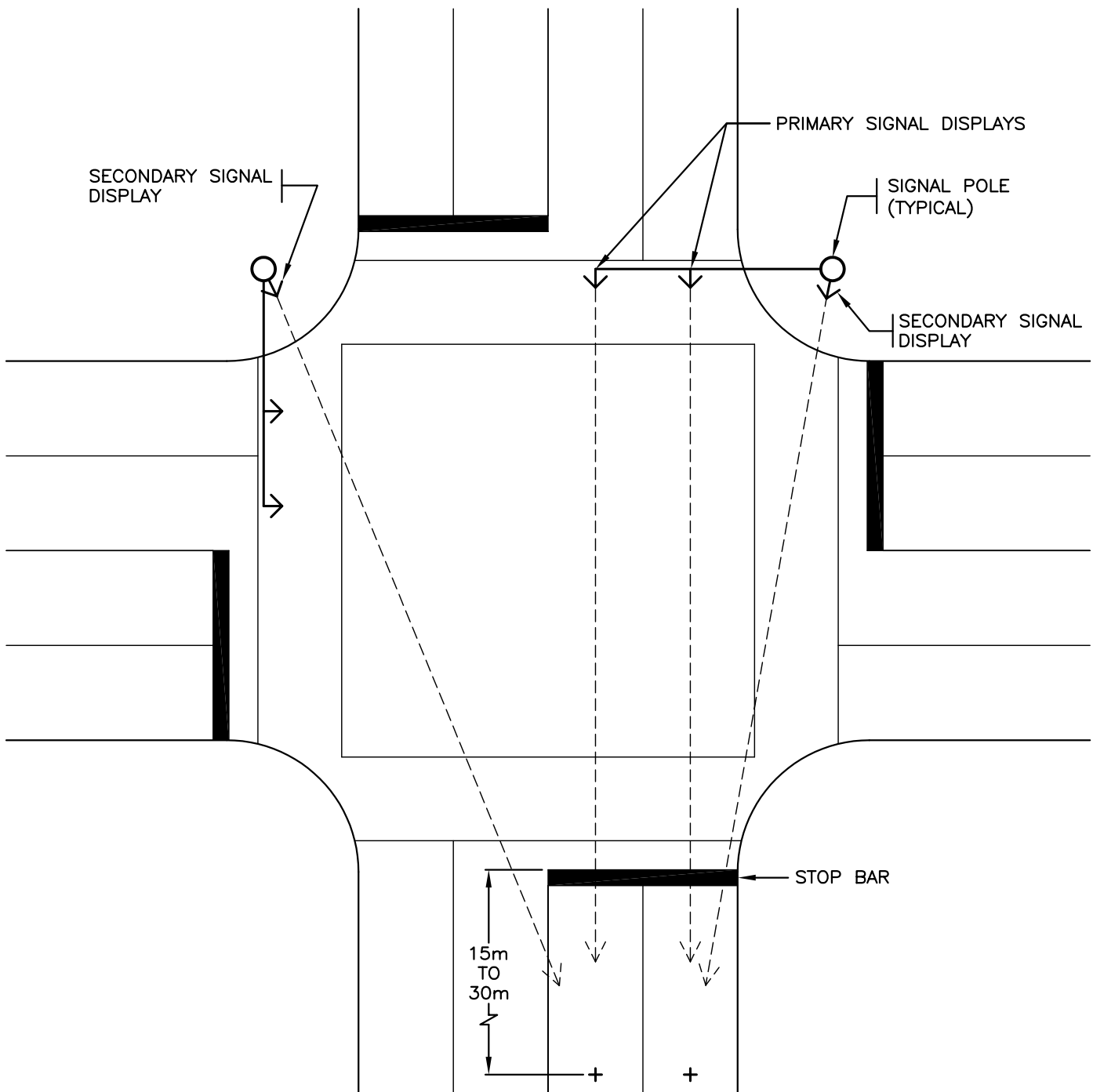
**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	SIGNAL HEAD PLUMBIZER INSTALLATION DETAILS (FOR TYPE 3 SIGNAL ARMS)	
F			Date	Approved
E			14/11/03	D.N. (Signature on File)
D				Chief Engineer
C				
B				
A				

SPECIFICATION  
DRAWING No.  
**SP635-2.3.10**





#### NOTES

1. DESIGNER SHALL REVIEW SIGNAL HEAD AIMING PRIOR TO SIGNAL START UP.
2. SIGNAL HEADS SHALL BE VISIBLE FROM THE MINIMUM DISTANCE SHOWN IN THE TAC MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

NOT TO SCALE



**BRITISH  
COLUMBIA**

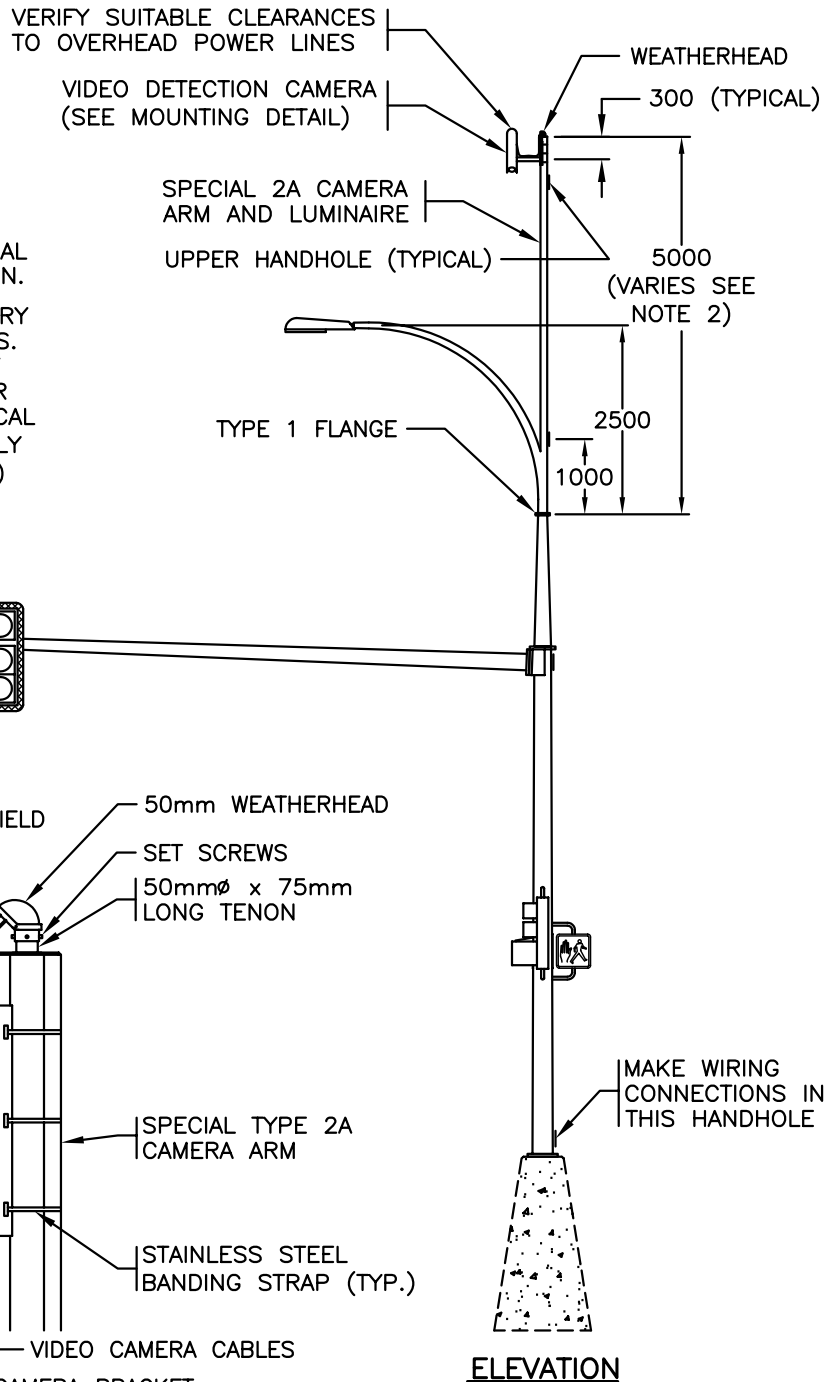
Ministry of  
Transportation

No.	Revision	Date	SIGNAL HEAD AIMING DIAGRAM		
F					
E					
D					
C					
B					
A					
			Date	Approved	SPECIFICATION DRAWING No.
			14/11/03	D.N. (Signature on File)	SP635-2.3.11
			Chief Engineer		



# **NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. EXACT HEIGHT OF CAMERA ARM WILL VARY AS SHOWN ON THE CONTRACT DRAWINGS. ARM SHALL BE DESIGNED & SEALED BY POLE SUPPLIER'S STRUCTURAL ENGINEER IN ACCORDANCE WITH MINISTRY ELECTRICAL & SIGNING MATERIAL STANDARDS (SUPPLY SHOP DRAWINGS PRIOR TO FABRICATION)



MOUNT & AIM  
CAMERA AS PER  
SUPPLIER'S  
RECOMMENDATIONS

**VIDEO DETECTION CAMERA  
POLE MOUNTING DETAIL**  
N.T.S.

NOT TO SCALE

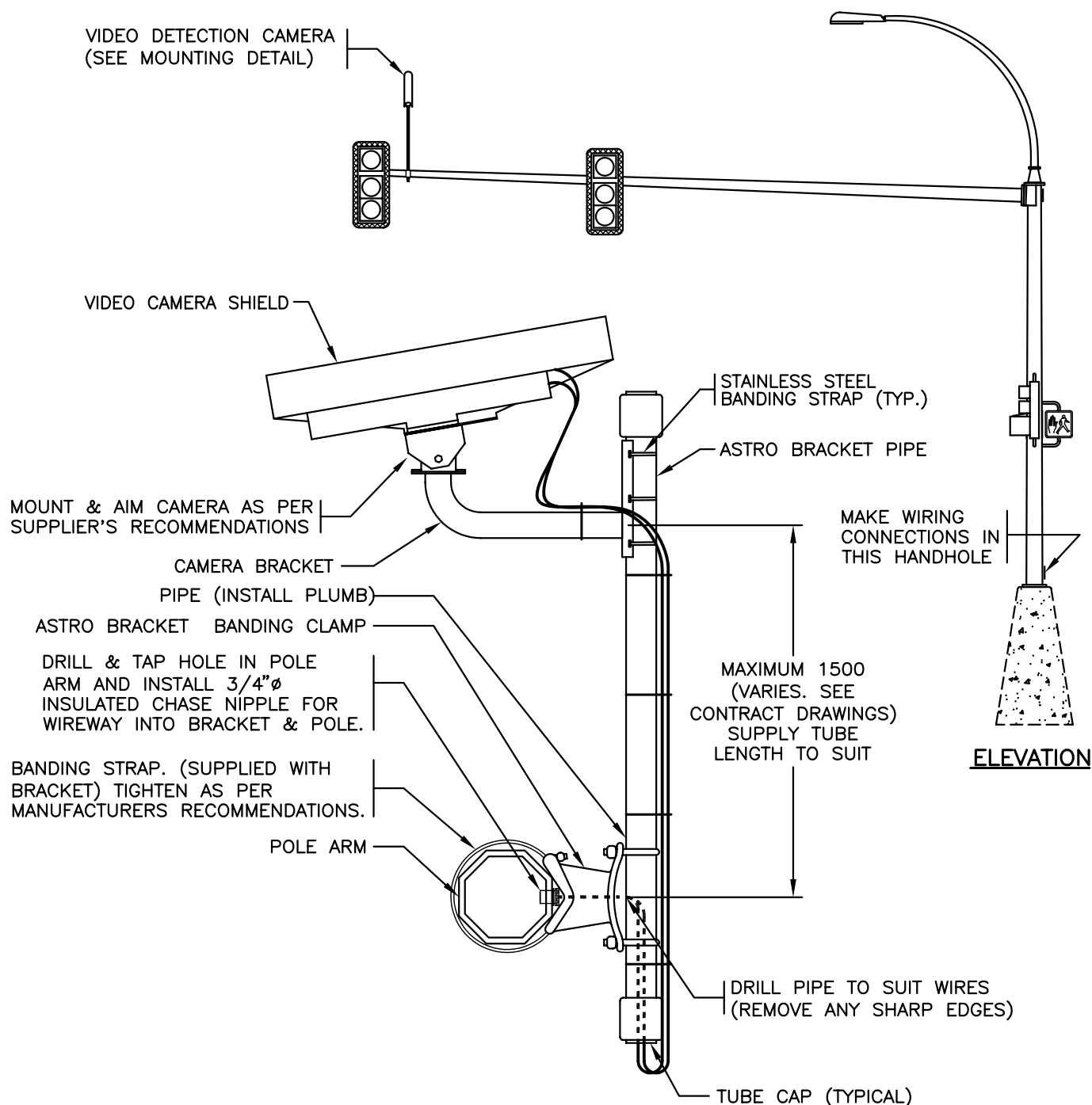


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	VIDEO DETECTION INSTALLATION DETAIL ON SPECIAL 2A ARM		
F			Date Approved  <b>14/11/03</b> <b>D.N. (Signature on File)</b> Chief Engineer		SPECIFICATION DRAWING No.  SP635-2.3.12
E					
D					
C					
B					
A					





**VIDEO DETECTOR CAMERA  
SIGNAL ARM MOUNTING DETAIL**

N.T.S.

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

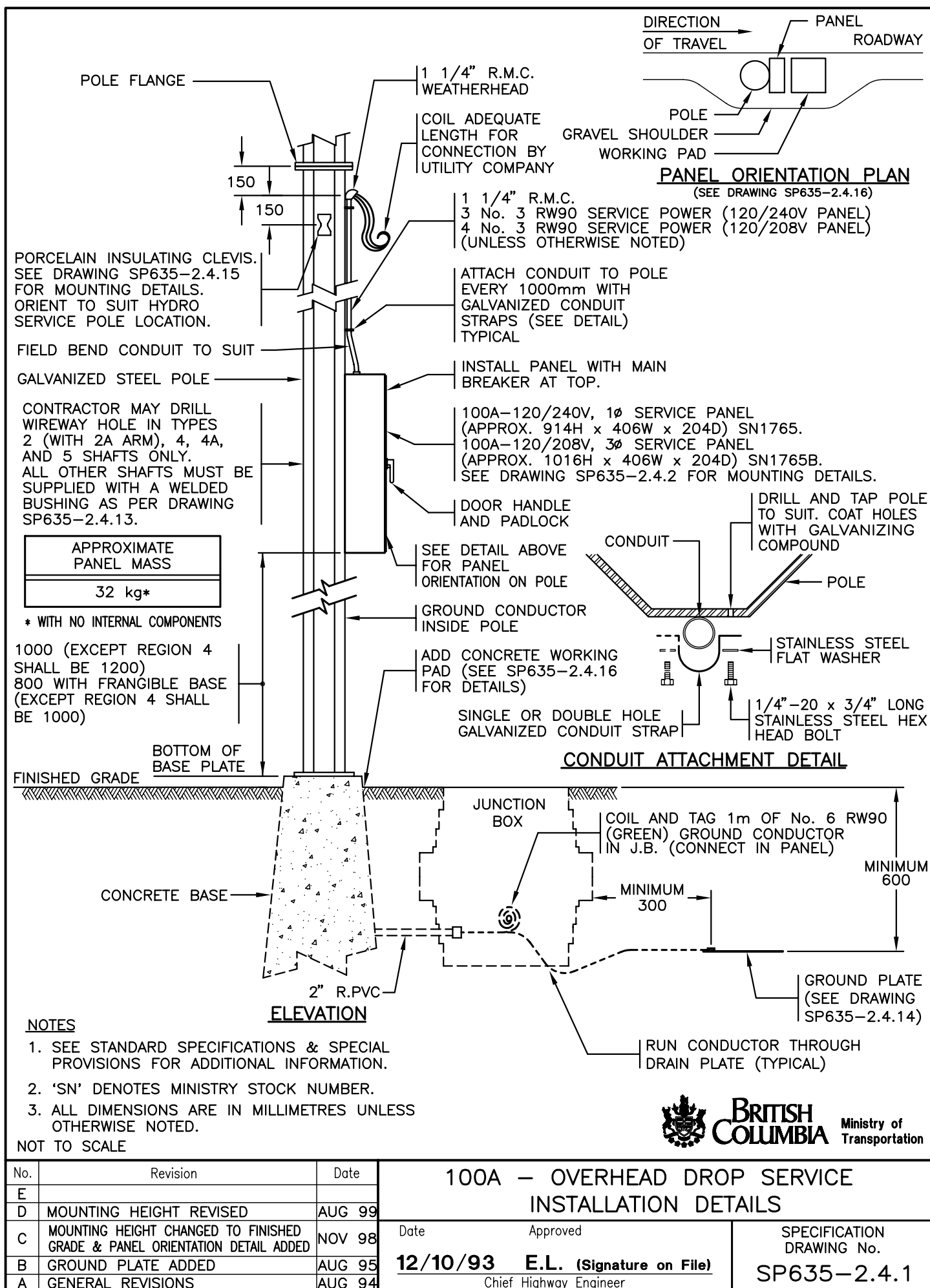
NOT TO SCALE



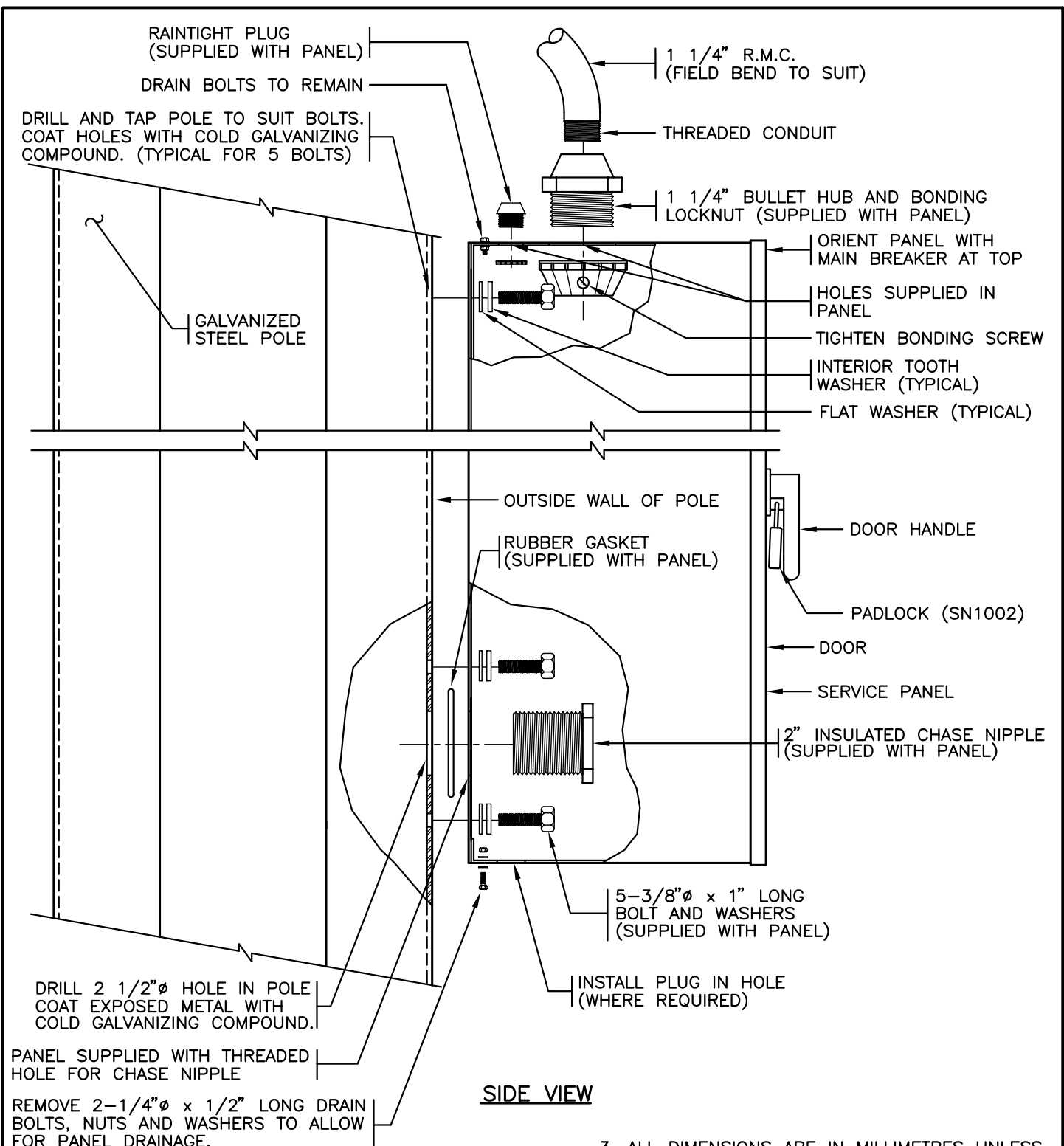
Ministry of  
Transportation

No.	Revision	Date	VIDEO DETECTION INSTALLATION DETAIL ON SIGNAL ARM	
F			Date  <b>14/11/03</b>  Chief Engineer	Approved  <b>D.N. (Signature on File)</b>  SPECIFICATION DRAWING No. <b>SP635-2.3.13</b>
E				
D				
C				
B				
A				









#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.

3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. PANEL ASSEMBLY AND INSTALLATION INSTRUCTIONS SUPPLIED WITH PANEL.

NOT TO SCALE



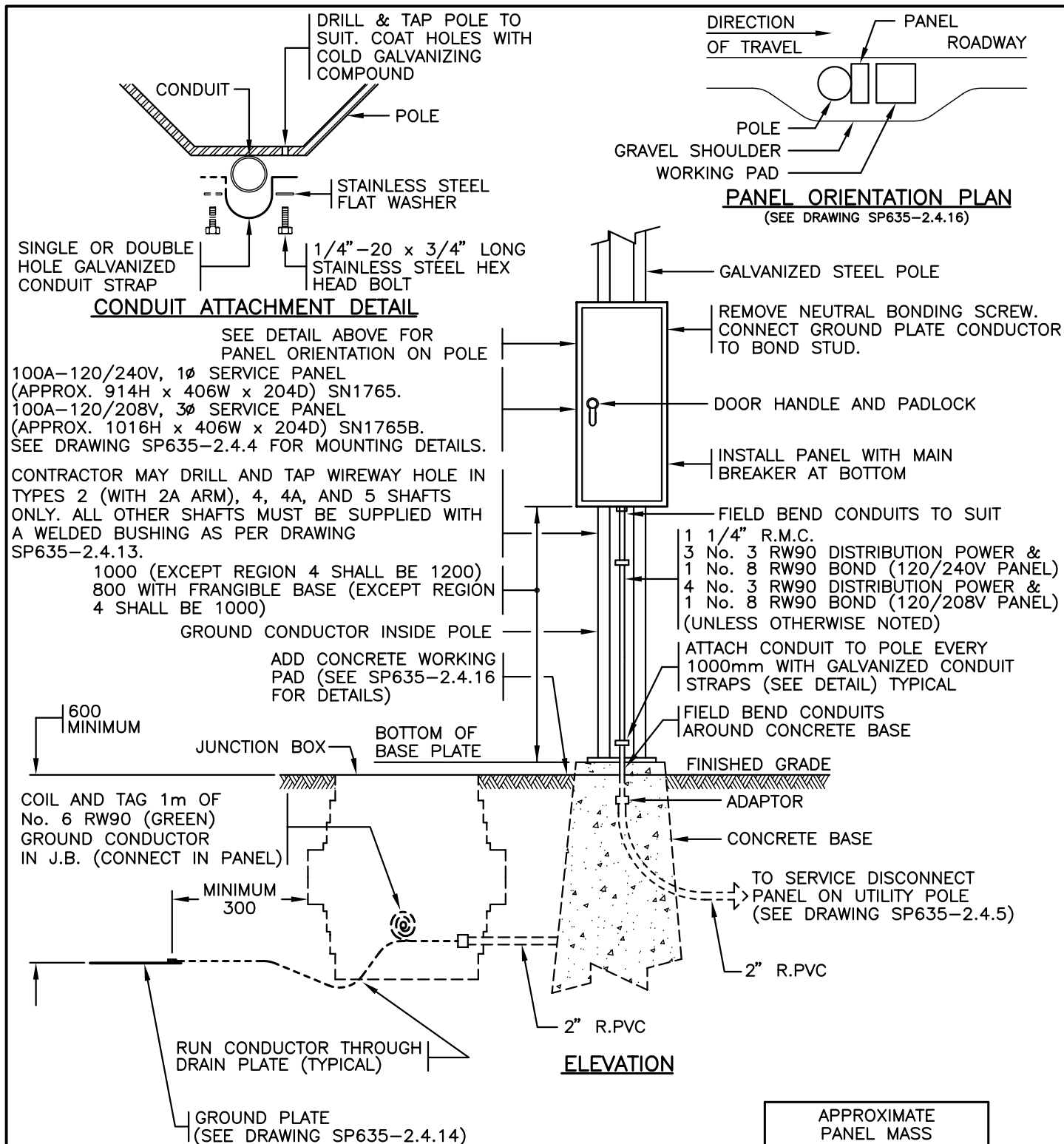
No.	Revision	Date
F		
E		
D		
C	BONDING LOCKNUT ADDED	AUG 96
B	GROUND CONDUIT DELETED	AUG 95
A	GENERAL REVISIONS	AUG 94

## 100A - SERVICE PANEL INSTALLATION DETAILS FOR OVERHEAD DROP SERVICE

Date **12/10/93** Approved **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.4.2**





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

APPROXIMATE PANEL MASS
30 kg*

\* WITH NO INTERNAL COMPONENTS

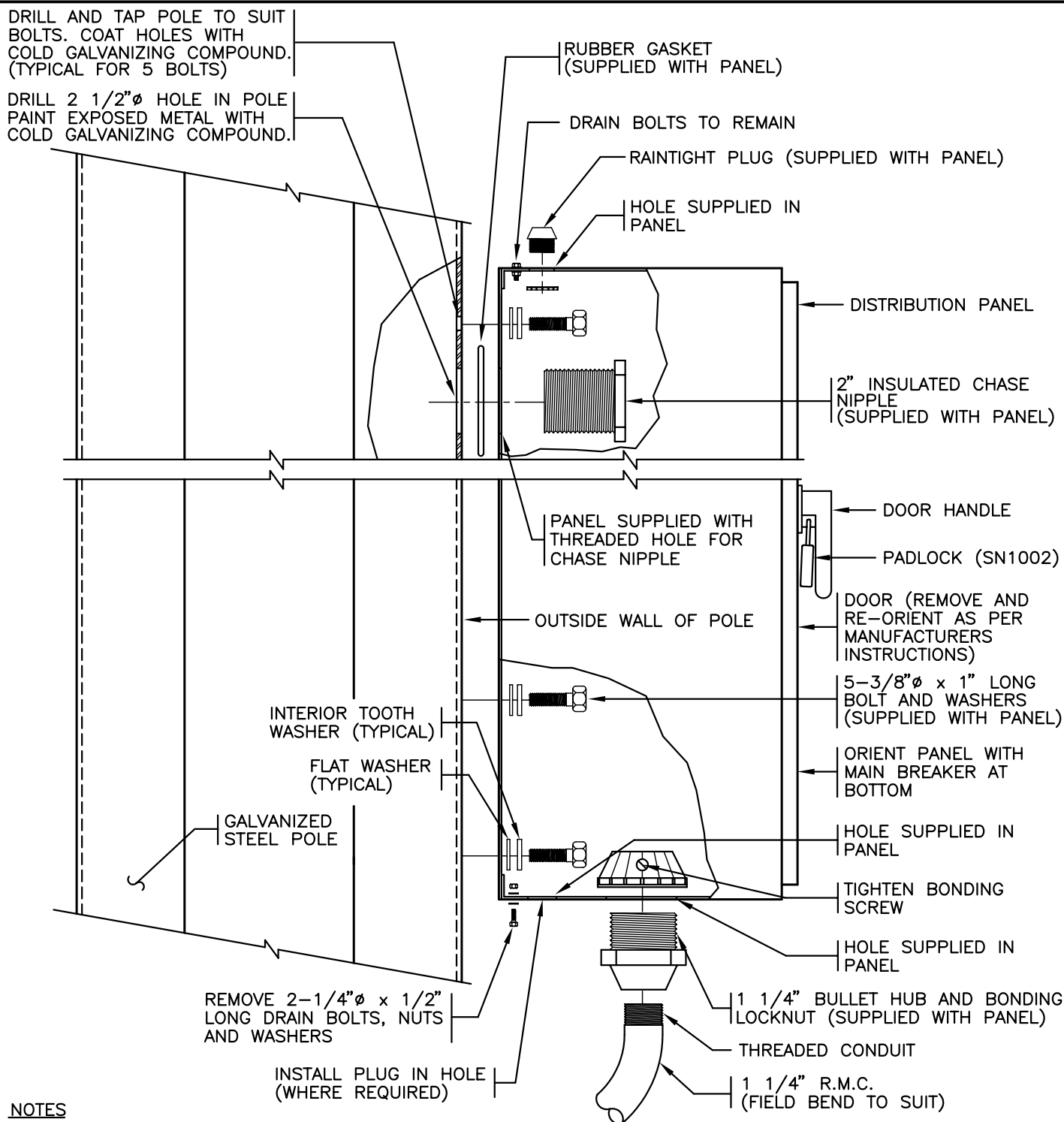


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	100A – UNDERGROUND DIP SERVICE INSTALLATION DETAILS		
D	BOND CONDUCTOR & GROUND PLATE CONDUCTOR CONNECTION CLARIFIED, MOUNTING HEIGHT REVISED	AUG 99			
C	MOUNTING HEIGHT CHANGED TO FINISHED GRADE & PANEL ORIENTATION DETAIL ADDED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	GROUND PLATE ADDED	AUG 95	12/10/93	E.L. (Signature on File)	SP635–2.4.3
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. PANEL ASSEMBLY AND INSTALLATION INSTRUCTIONS SUPPLIED WITH PANEL.

#### SIDE VIEW

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

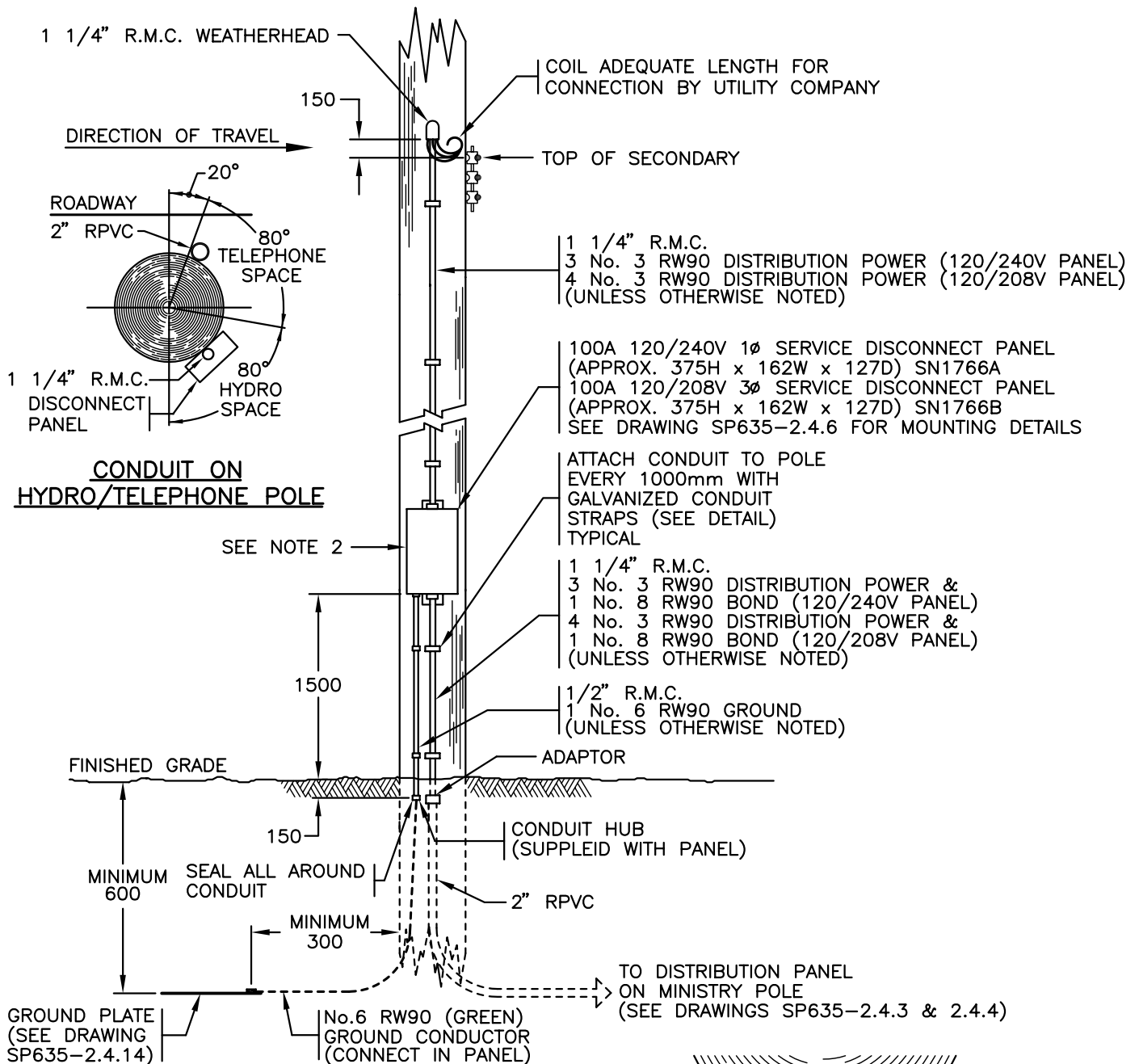
No.	Revision	Date
F		
E		
D		
C	BONDING LOCKNUT ADDED	AUG 96
B	GROUND CONDUIT DELETED	AUG 95
A	GENERAL REVISIONS	AUG 94

## 100A - DISTRIBUTION PANEL INSTALLATION DETAILS FOR UNDERGROUND DIP SERVICE

Date Approved  
**12/10/93 E.L. (Signature on File)**  
Chief Highway Engineer

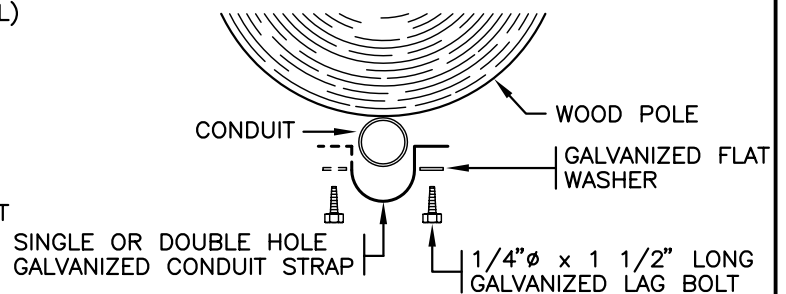
SPECIFICATION  
DRAWING No.  
**SP635-2.4.4**





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. CONTRACTOR TO OBTAIN PERMISSION FROM UTILITY COMPANY BEFORE INSTALLING EQUIPMENT ON POLE.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. MOUNT CONDUIT AND PANEL ON CONCRETE UTILITY POLE WITH 3/4" STAINLESS STEEL BANDING.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.



#### CONDUIT ATTACHMENT DETAIL

NOT TO SCALE

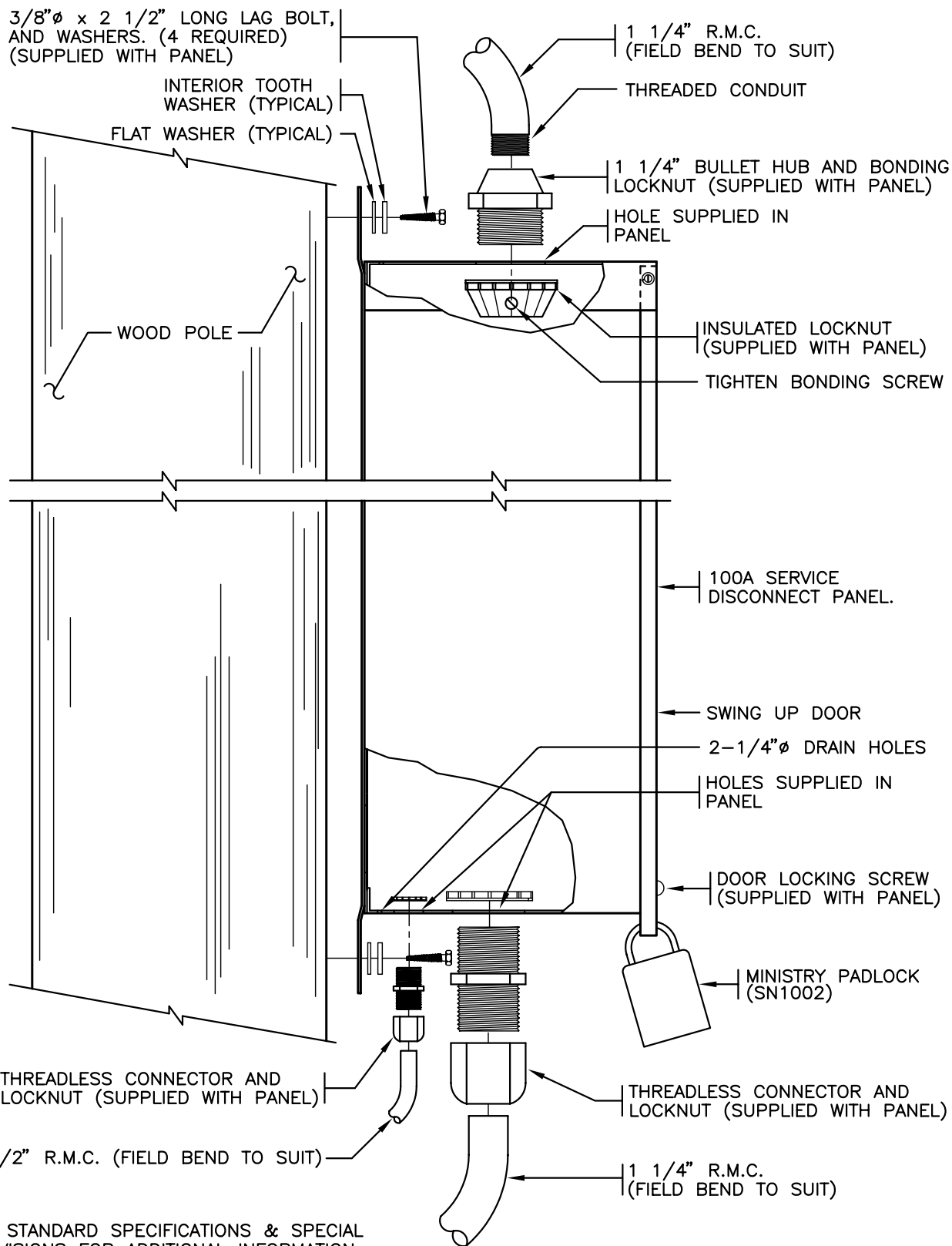


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	UNDERGROUND DIP SERVICE INSTALLATION DETAILS		
F			<div>DateApproved</div> <div>SPECIFICATION DRAWING No.</div>		
E					
D					
C	BOND CONDUCTORS ADDED	AUG 99			
B	GROUND PLATE ADDED	AUG 95	<div>30/09/93E.L. (Signature on File)</div> <div>Chief Highway Engineer</div>		
A	GENERAL REVISIONS	AUG 94			
			SP635-2.4.5		





**SIDE VIEW**

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. MOUNT ENCLOSURE ON TO CONCRETE POLES WITH 3/4" STAINLESS STEEL BANDING.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

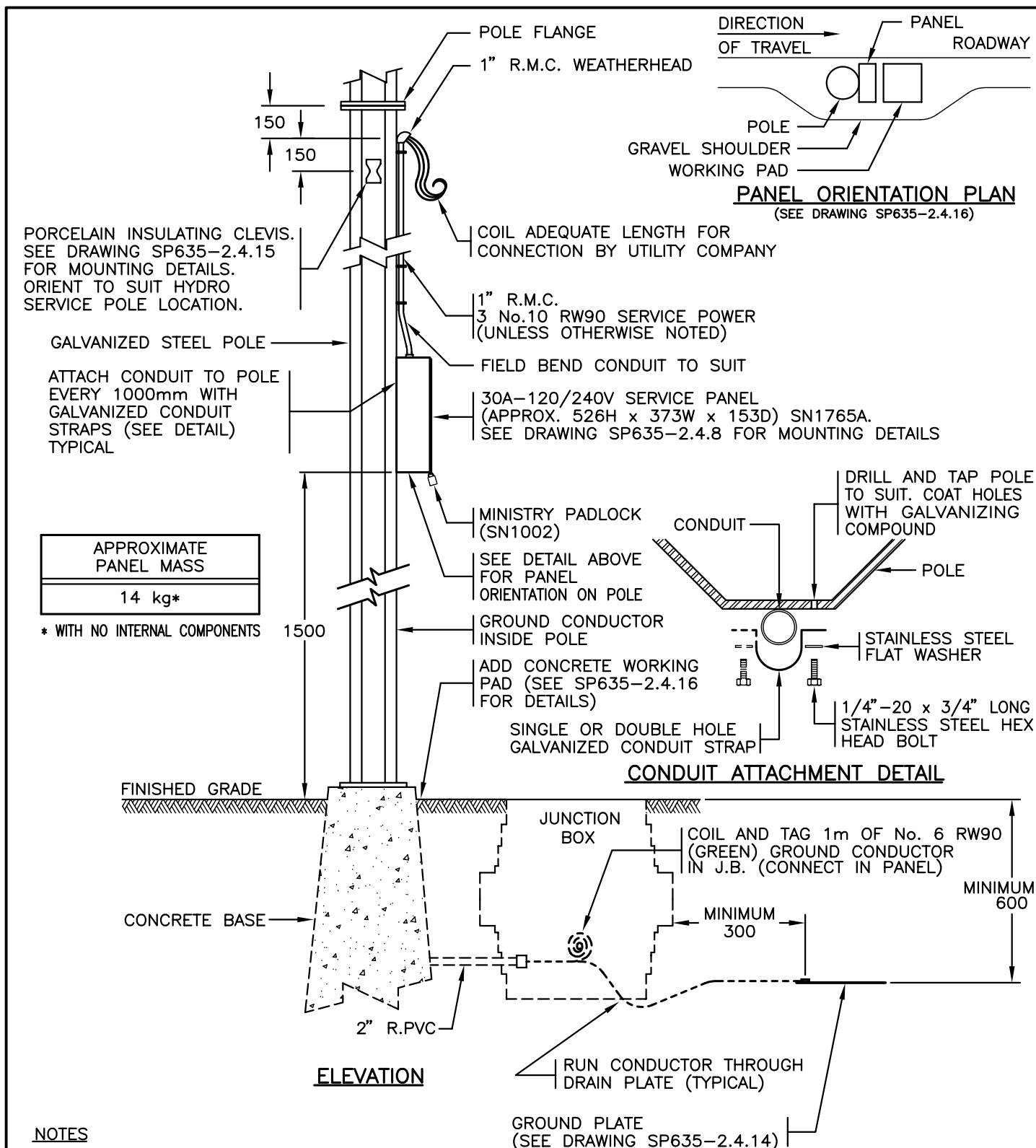
No.	Revision	Date
F		
E		
D		
C		
B	BONDING LOCKNUT ADDED	AUG 96
A	GENERAL REVISIONS	AUG 94

**100A – SERVICE DISCONNECT PANEL  
INSTALLATION DETAILS**

Date Approved  
**12/10/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635–2.4.6**

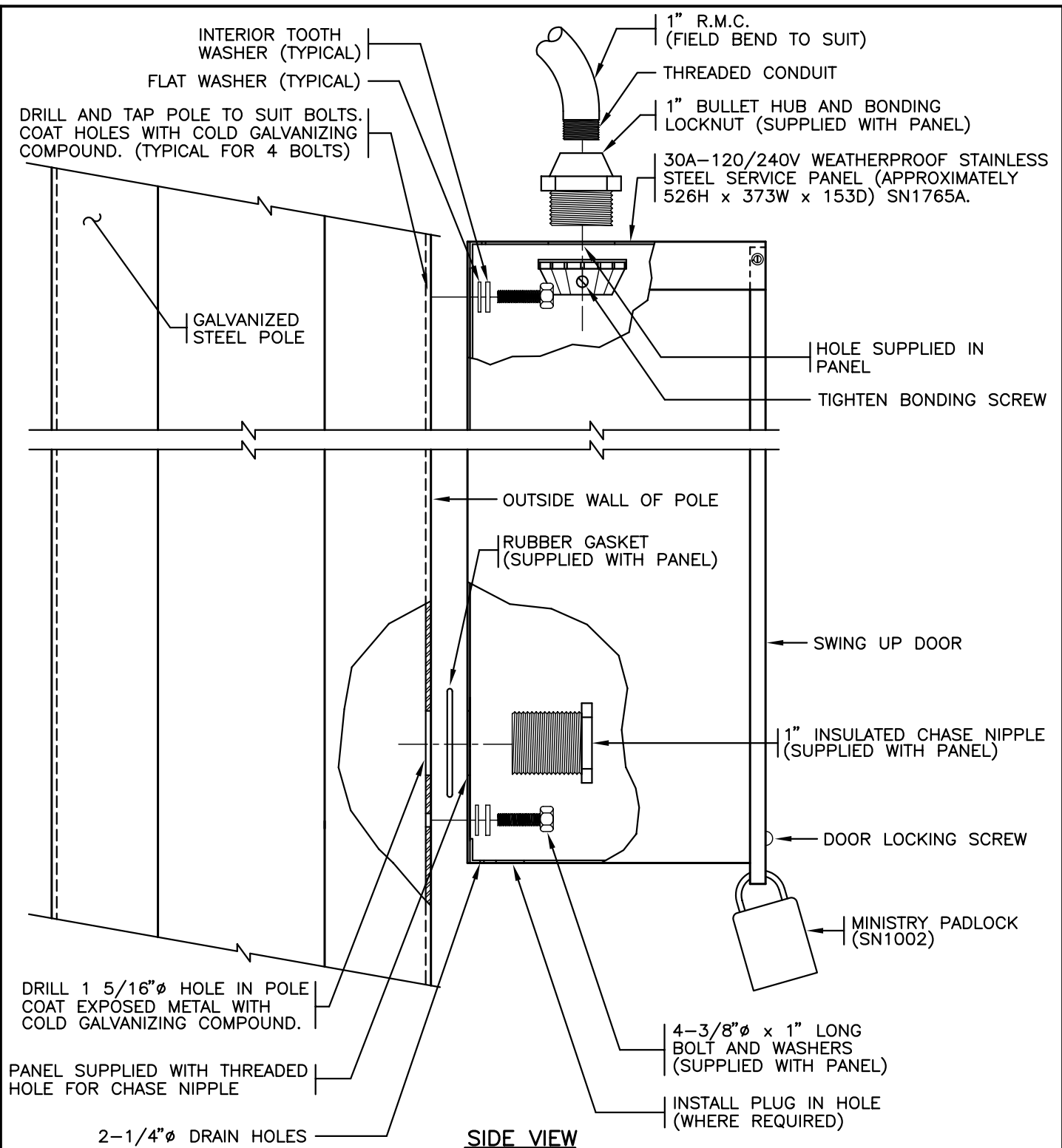




NOT TO SCALE

No.	Revision	Date	30A-120/240V OVERHEAD DROP SERVICE INSTALLATION DETAILS		
E					
D					
C					
B	MOUNTING HEIGHT CHANGED TO FINISHED GRADE & PANEL ORIENTATION DETAIL ADDED	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
A	GROUND PLATE ADDED	AUG 95	18/11/94	E.L. (Signature on File) Chief Highway Engineer	SP635-2.4.7





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date
F		
E		
D		
C		
B	BONDING LOCKNUT ADDED	AUG 96
A	GROUND CONDUIT DELETED	AUG 95

### 30A-120/240V SERVICE PANEL INSTALLATION DETAILS FOR OVERHEAD DROP SERVICE

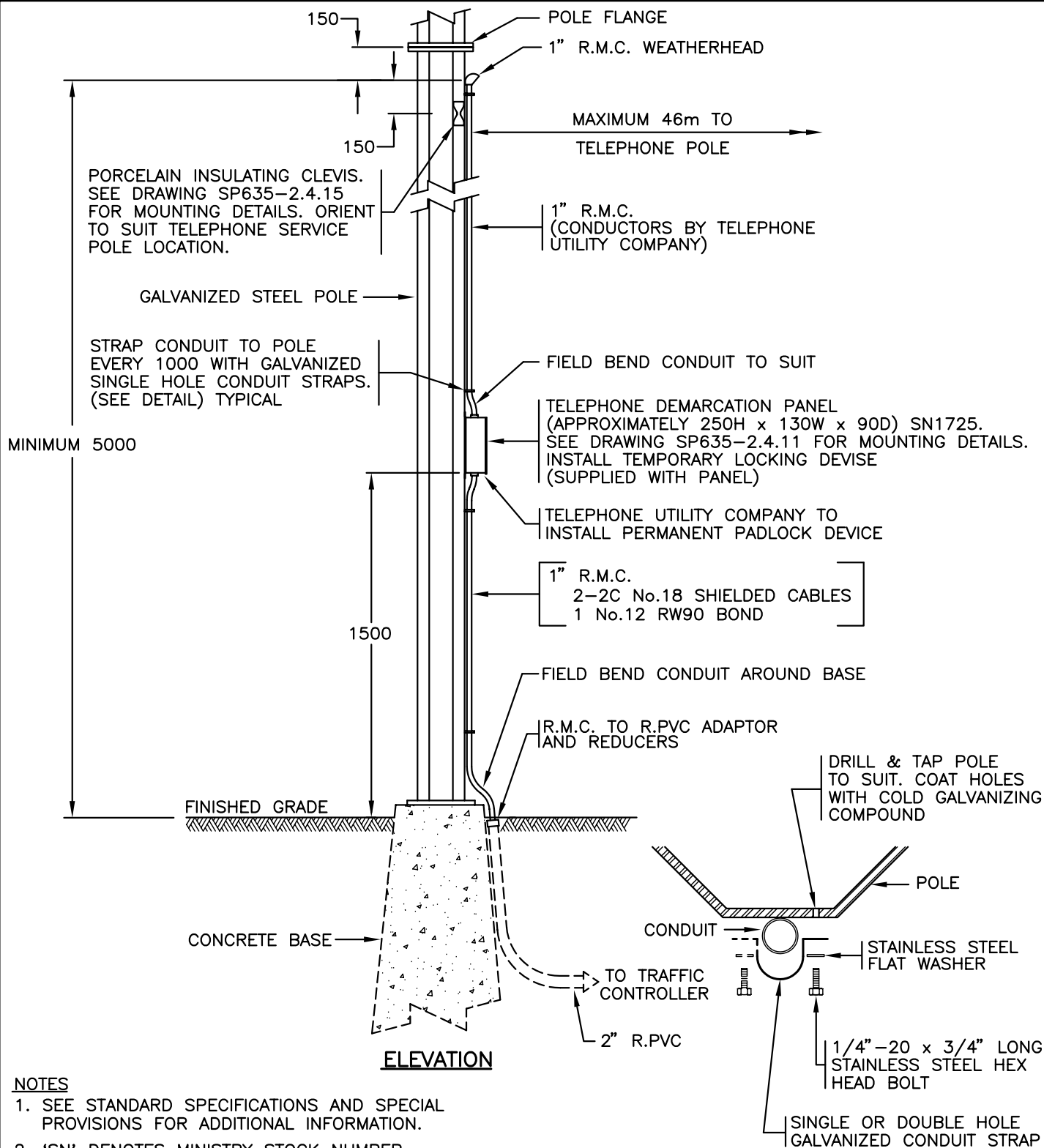
Date Approved

**18/11/94** **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.

**SP635-2.4.8**





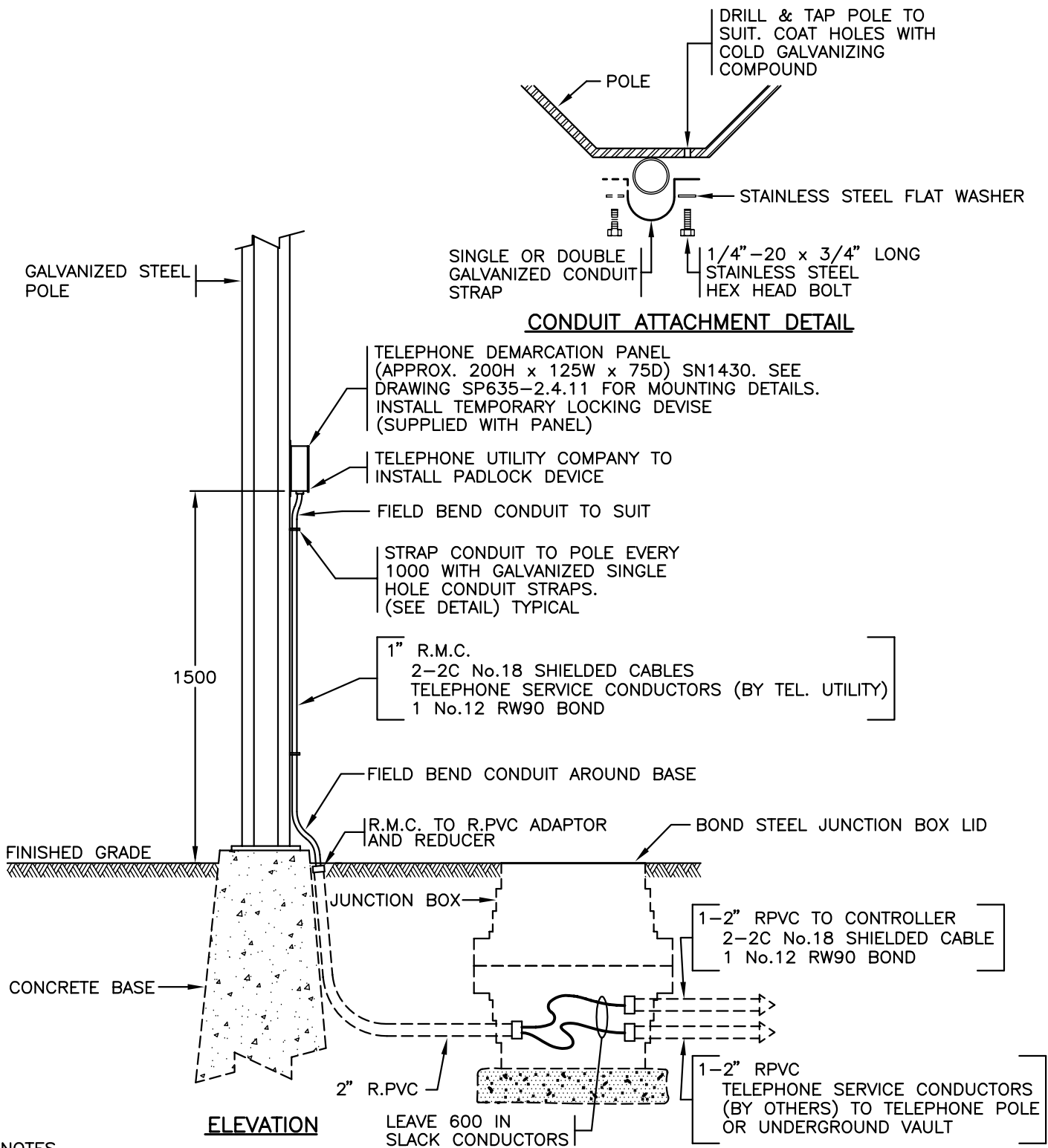
#### NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. WHERE PANEL AND CONDUITS ARE TO BE INSTALLED ON A TELEPHONE/POWER POLE THE INSTALLATION SHALL BE CARRIED OUT BY THE TELEPHONE UTILITY COMPANY.

NOT TO SCALE

TELEPHONE OVERHEAD DROP SERVICE INSTALLATION DETAILS			SPECIFICATION DRAWING No. SP635-2.4.9	
No.	Revision	Date		
F				
E				
D				
C	TEMPORARY LOCKING DEVICE NOTE ADDED	SEPT 00		
B	MOUNTING HEIGHT CHANGED TO FINISHED GRADE	NOV 98		
A	PANEL SIZE & STOCK NUMBER REVISED	AUG 96		
			Date	Approved
			18/11/94	E.L. (Signature on File)
			Chief Highway Engineer	





#### NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TELEPHONE UNDERGROUND SERVICE INSTALLATION DETAILS		
F					
E					
D					
C					
B	TEMPORARY LOCKING DEVICE NOTE ADDED	SEPT 00	Date	Approved	SPECIFICATION DRAWING No.
A	MOUNTING HEIGHT CHANGED TO FINISHED GRADE	NOV 98	18/11/94	E.L. (Signature on File) Chief Highway Engineer	SP635-2.4.10



2-3/8"Ø x 1" LONG BOLTS,  
AND WASHERS. (SUPPLIED WITH PANEL)  
TYPICAL TOP AND BOTTOM.

INTERIOR TOOTH  
WASHER (TYPICAL)  
FLAT WASHER (TYPICAL)

1" R.M.C. FOR OVERHEAD  
DROP SERVICE ONLY

INSTALL RAINTIGHT PLUG  
(SUPPLIED WITH PANEL) WHERE  
UNDERGROUND SERVICE IS USED

1" BULLET HUB (SUPPLIED WITH PANEL)

HOLE SUPPLIED IN PANEL

GALVANIZED  
STEEL POLE

LOCKNUT (PART OF SN1430)

SWING UP DOOR

TELEPHONE DEMARCATION  
PANEL (APPROXIMATELY  
200(H) x 125(W) x 75(D)) SN1430

COIL 300mm OF  
No. 12RW90 BONDING CONDUCTOR  
IN PANEL. TELEPHONE UTILITY  
TO CONNECT

TRACER TAPE ON SHIELDED  
CABLE IN THE CONTROLLER  
AND DEMARCATION PANEL.

COIL 300mm OF SHIELDED  
CABLES IN PANEL. TELEPHONE  
UTILITY TO CONNECT CONDUCTORS  
TO DEMARCATION BLOCK WIRE  
TO BOND STUD PROVIDED.

BOX LABELLED 'TEL'  
(SUPPLIED WITH PANEL)

INSTALL TEMPORARY LOCKING  
DEVICE (SUPPLIED WITH PANEL).  
PERMANENT TELEPHONE UTILITY  
LOCK MECHANISM INSTALLED BY  
TELEPHONE UTILITY.

LOCKNUT (SUPPLIED WITH PANEL)

HOLE SUPPLIED IN PANEL

1" THREADLESS CONNECTOR  
(SUPPLIED WITH PANEL)

1" R.M.C.  
(FIELD BEND TO SUIT)

DRILL AND TAP HOLES TO SUIT  
BOLTS. COAT HOLES WITH COLD  
GALVANIZING COMPOUND.  
(TYPICAL FOR 4 BOLTS)

DRAIN HOLE

#### NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

SIDE VIEW

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

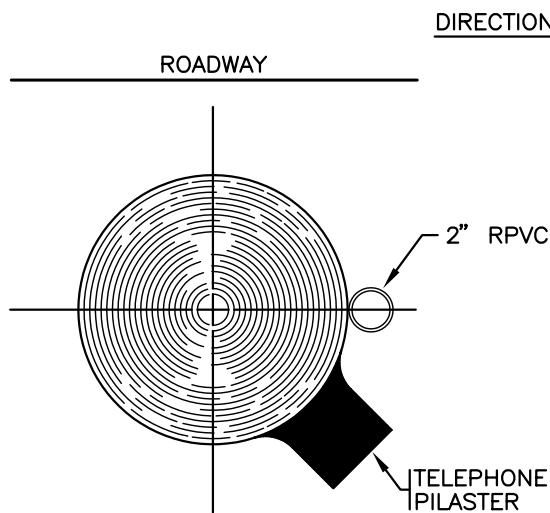
No.	Revision	Date
F		
E		
D		
C		
B		
A	TEMPORARY LOCKING DEVICE NOTE ADDED	SEPT 00

## TELEPHONE DEMARCATION PANEL INSTALLATION DETAILS

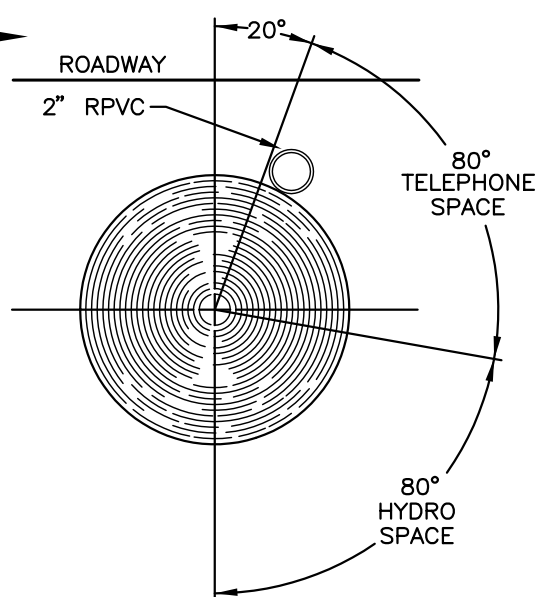
Date Approved  
**18/11/94** **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.4.11**



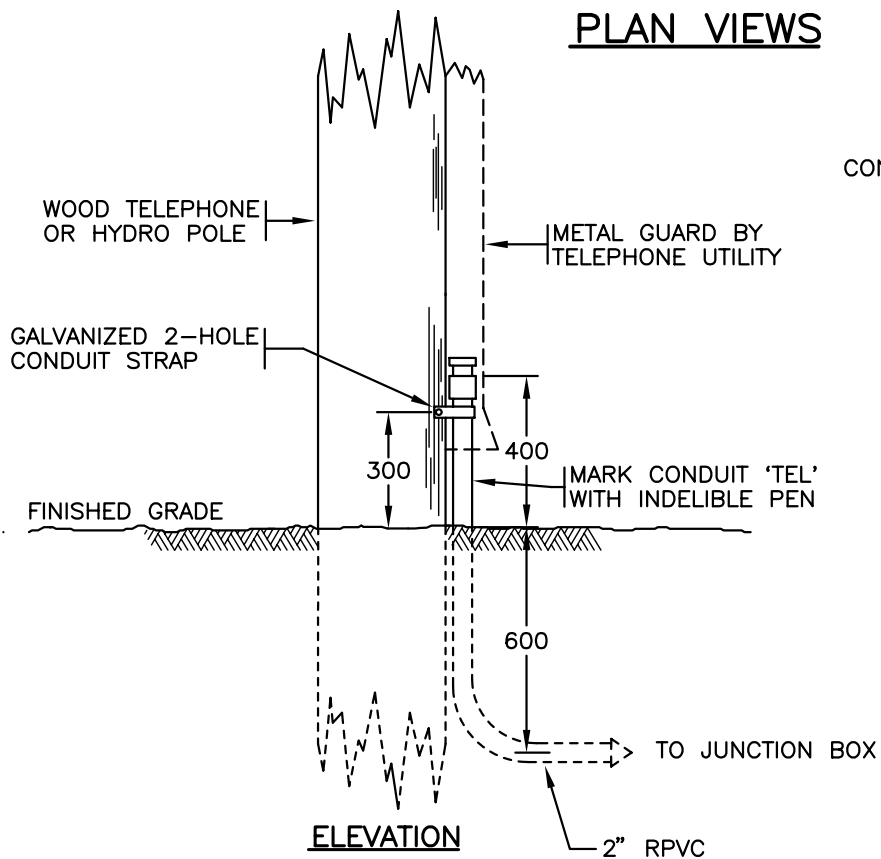


CONDUIT ON TELEPHONE POLE

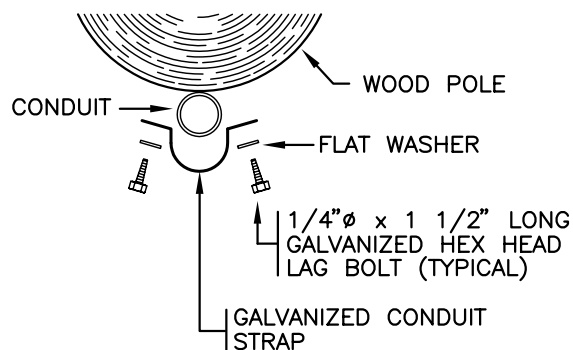


CONDUIT ON HYDRO/TELEPHONE POLE

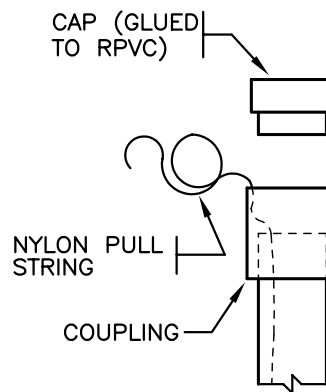
## PLAN VIEWS



ELEVATION



CONDUIT ATTACHMENT DETAIL



CAP DETAIL

### NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

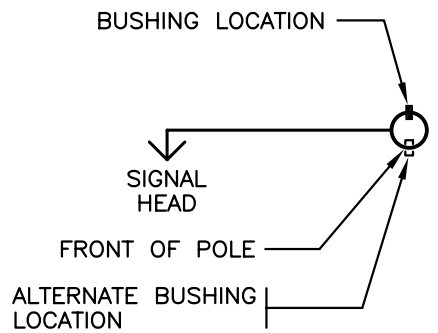
No.	Revision	Date
F		
E		
D		
C		
B		
A		

## TELEPHONE CONDUIT INSTALLATION DETAILS (WOOD POLE)

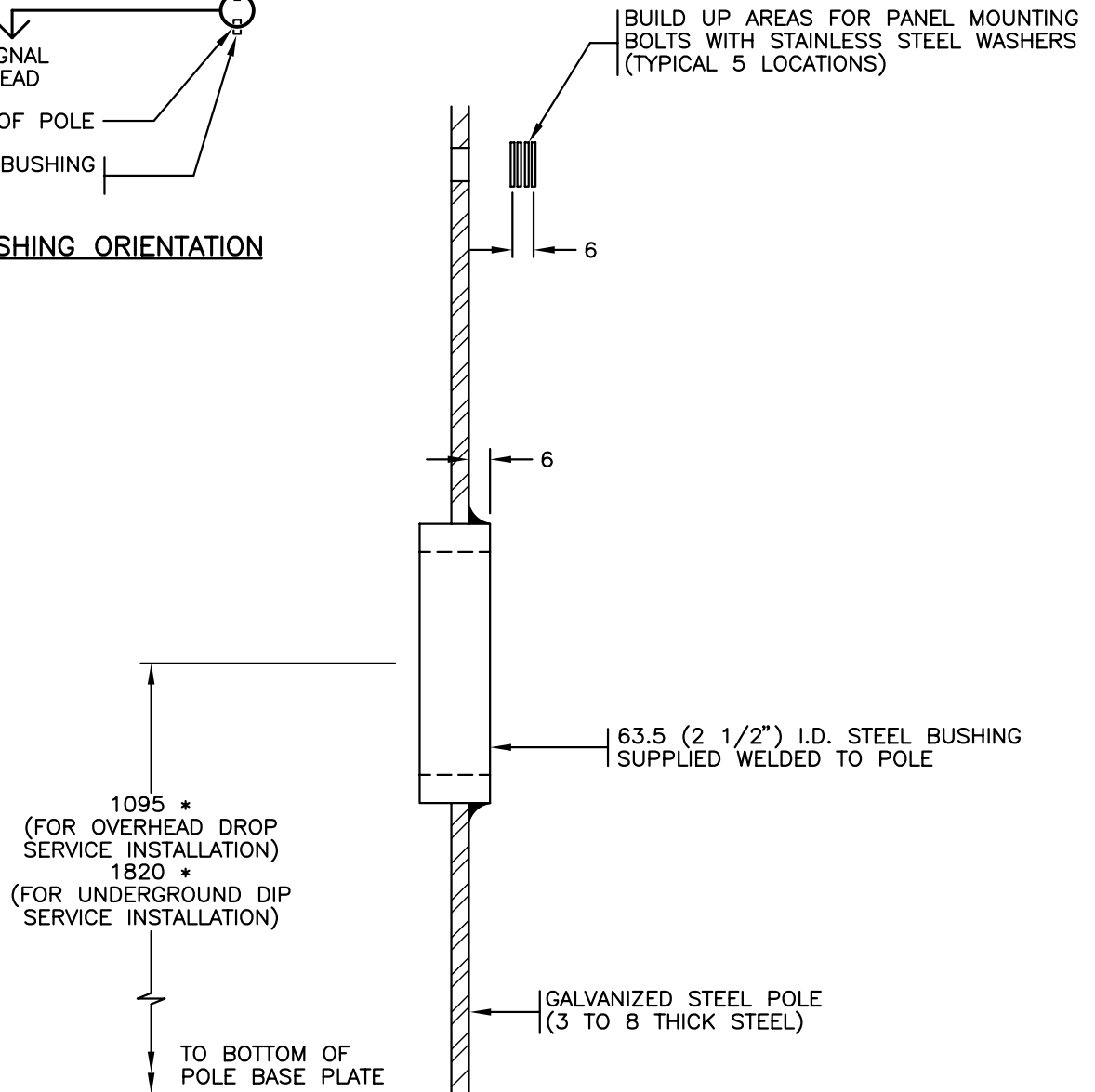
Date Approved  
**18/11/94** **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.4.12**





### BUSHING ORIENTATION



### \* ONLY IN REGION 3

1295 (FOR O/H DROP SERVICE INSTALLATION)  
2020 (FOR U/G DIP SERVICE INSTALLATION)

POLE SHALL BE SUPPLIED WITH BUSHING INSTALLED, UNLESS OTHERWISE NOTED

### NOTES

1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	SERVICE PANEL BUSHING DETAIL				
F							
E							
D	REGION 4 CHANGED TO 3	OCT 03					
C	BUSHING LOCATION REVISED	AUG 99	Date	Approved	SPECIFICATION DRAWING No.  SP635—2.4.13		
B	BUSHING LOCATION REVISED	AUG 96	18/11/94	E.L. (Signature on File) Chief Highway Engineer			
A	BUSHING ORIENTATION & MOUNTING HEIGHTS ADDED	AUG 95					



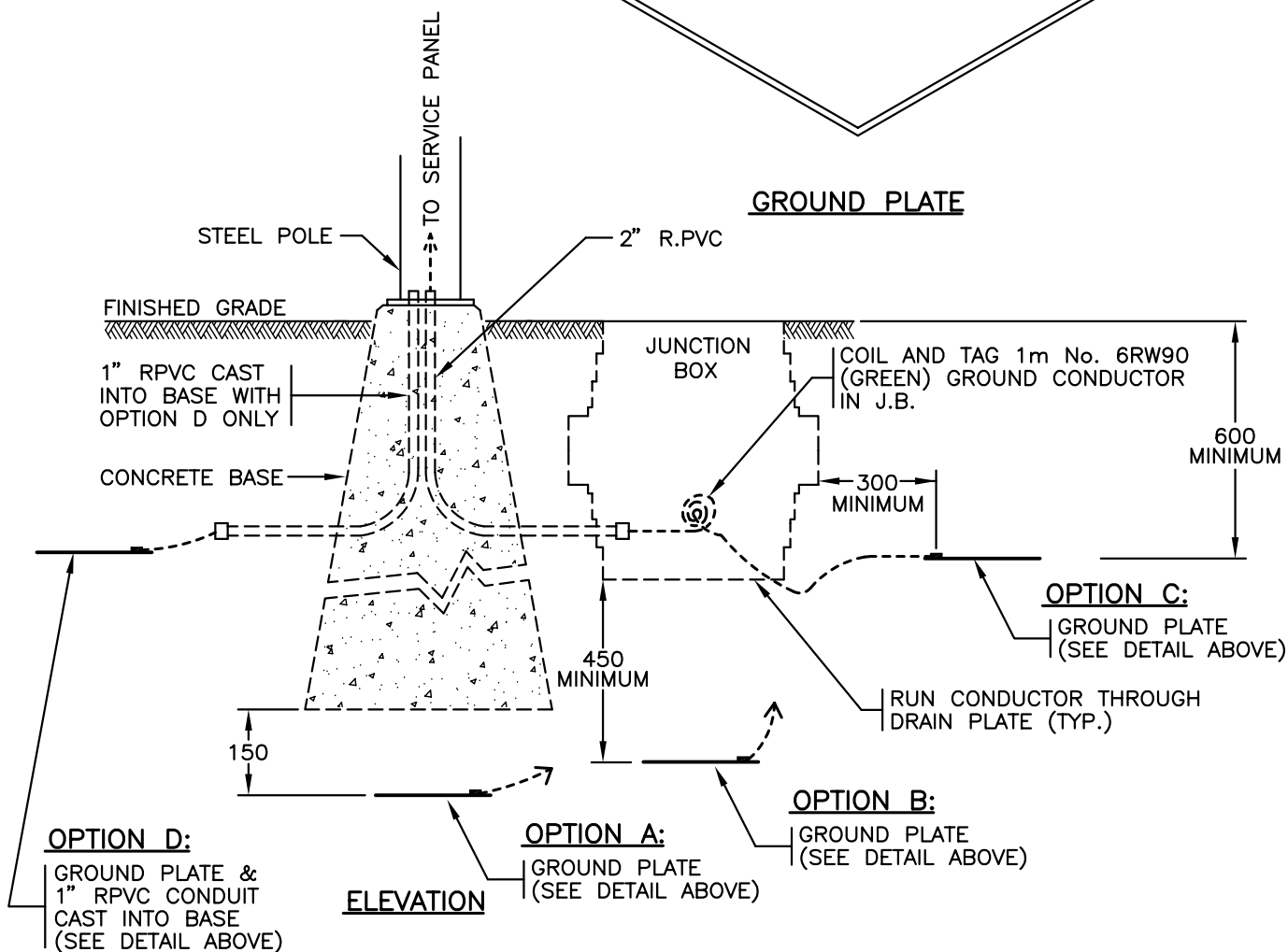
No. 6 RW90 (GREEN) GROUND CONDUCTOR FROM GROUND PLATE INTO SERVICE PANEL

GROUND CLAMP

20Ø STEEL ROD CAD WELDED TO PLATE

IRON OR STEEL PLATE, MINIMUM 6mm THICK WITH A MINIMUM SURFACE AREA OF 0.2m<sup>2</sup> TO EXTERIOR SOIL

### GROUND PLATE



### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. WHERE PLATE CAN NOT BE INSTALLED UNDER THE BASE IT SHALL BE INSTALLED AT A MINIMUM DEPTH OF 600mm BELOW FINISHED GRADE, BESIDE THE BASE

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

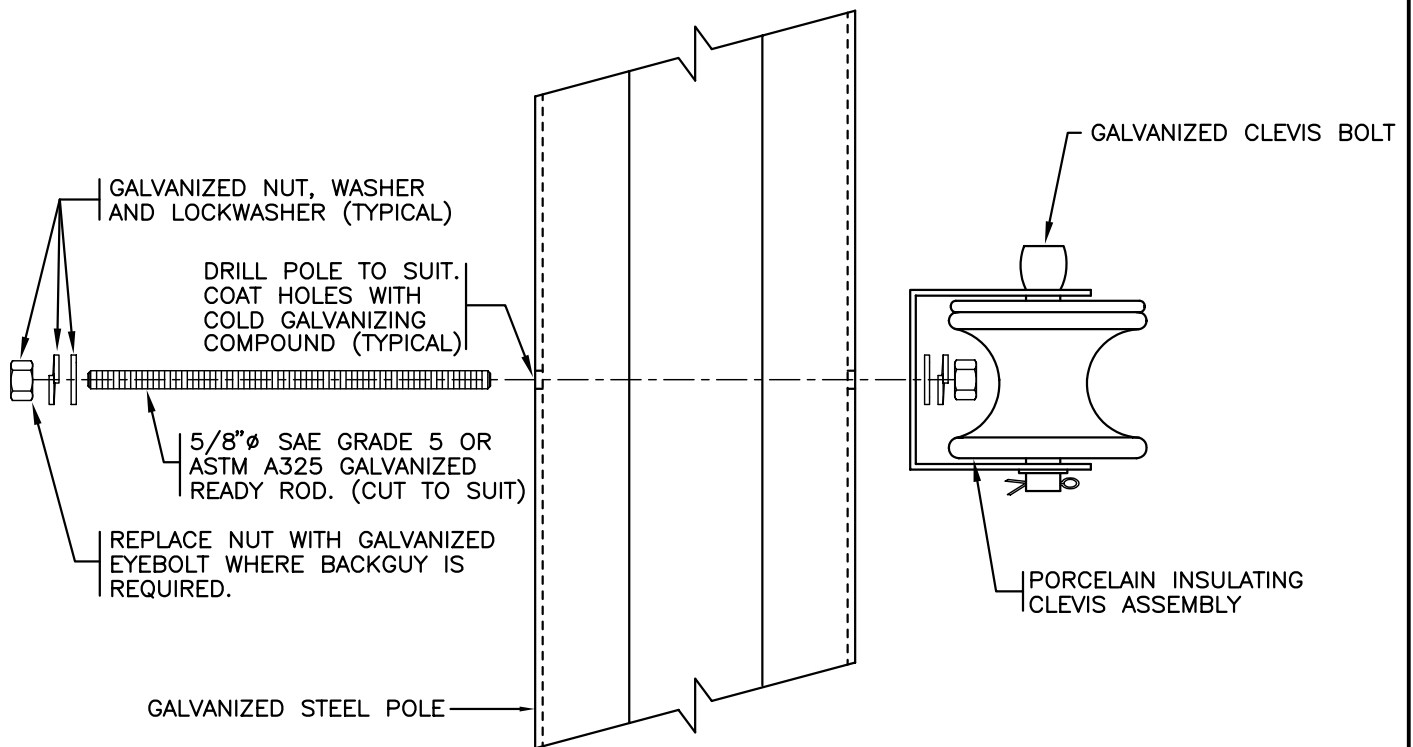
No.	Revision	Date
F		
E		
D		
C	GROUND PLATE REVISED	OCT 03
B	OPTION D ADDED	AUG 96
A	GENERAL REVISION	OCT 95

### GROUND PLATE INSTALLATION DETAIL

Date 18/11/94 Approved E.L. (Signature on File)  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
SP635-2.4.14





### ELEVATION

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

NOT TO SCALE



No.	Revision	Date	INSULATING CLEVIS INSTALLATION DETAILS	
F			Date	Approved
E				
D			30/09/93	E.L. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-2.4.15
A	GENERAL REVISIONS	AUG 94		



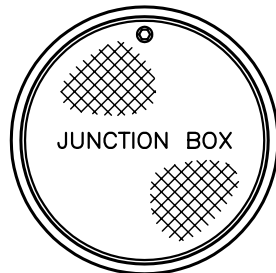
DIRECTION OF TRAVEL →

WORKING PAD (1-610mm x 610mm x 50mm THICK  
AND 1-610mm x 305mm x 50mm THICK  
PRE-CAST CONCRETE PATIO STONES)

SERVICE/DISTRIBUTION PANEL

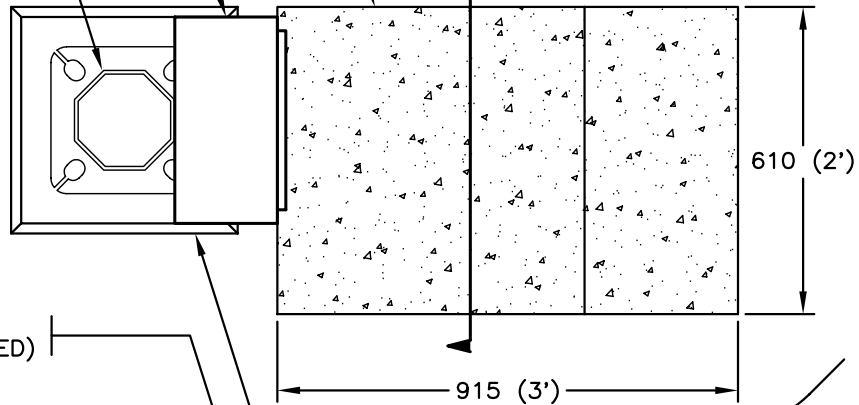
POLE

EDGE OF PAVEMENT



JUNCTION BOX

EDGE OF LEVEL FILL  
(ADD FILL AS REQUIRED)



PLAN

CONCRETE BASE

CONCRETE BASE

LEVEL WORKING PAD

MINIMUM 300

SLOPE

ASPHALT PAVEMENT

SECTION (A)

#### NOTES

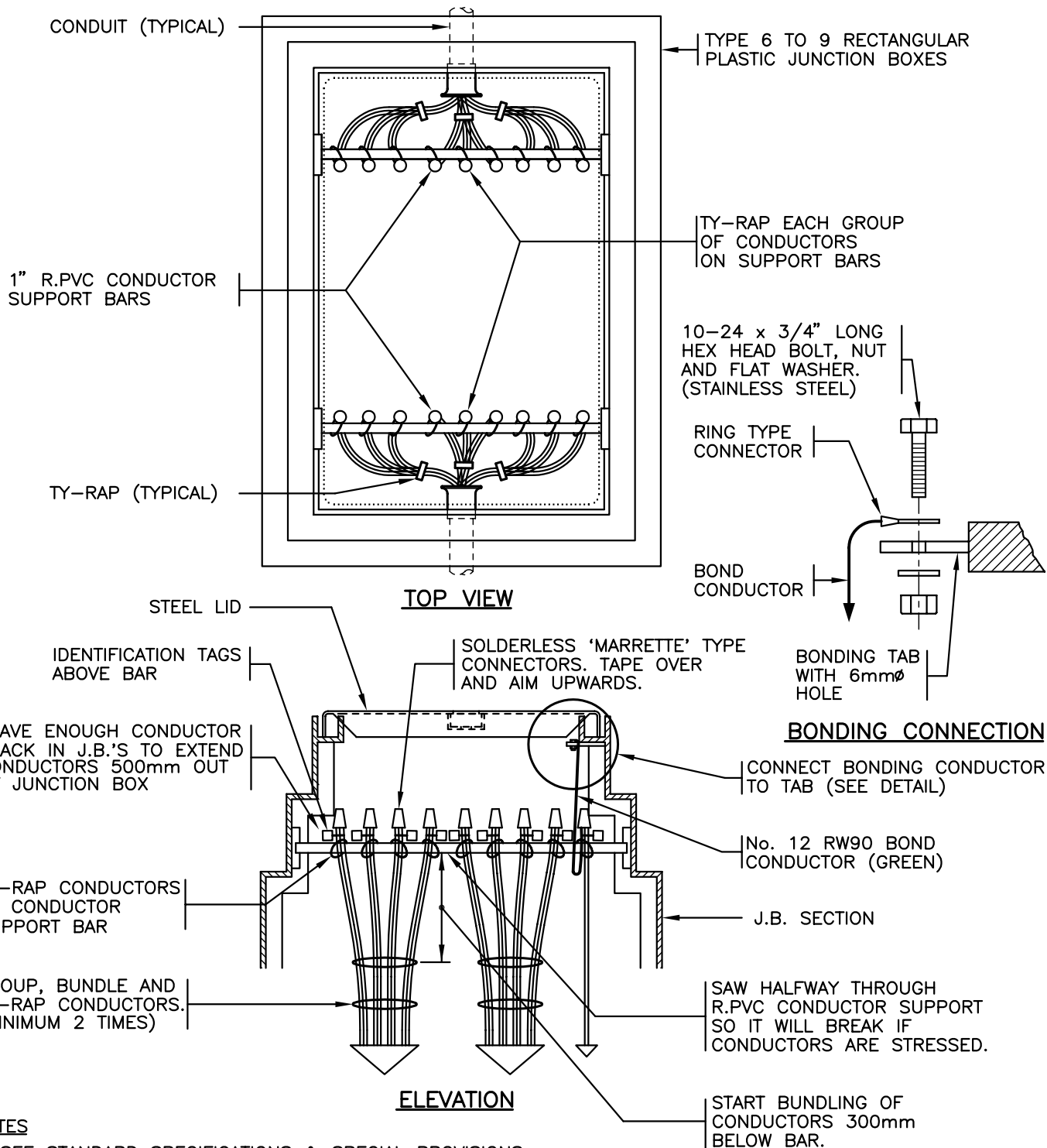
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	SERVICE PANEL WORKING PAD DETAIL		
F					
E					
D					
C					
B					
A	ORIENTATION REVISED	SEPT 00	Date <b>05/01/99</b>	Approved <b>M.C. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-2.4.16</b>





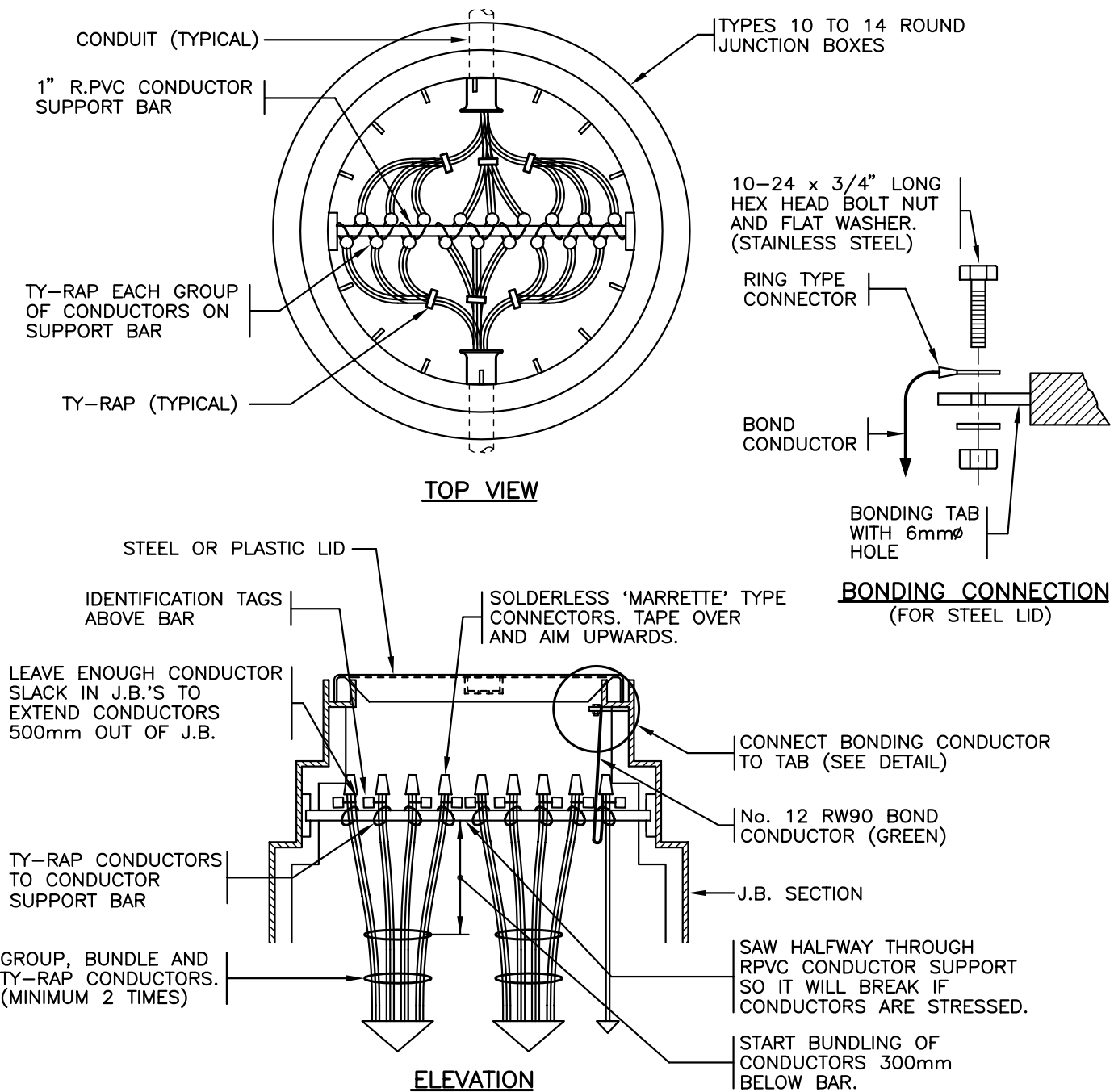
#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. GROUP, BUNDLE & LABEL ALL CONDUCTORS SEPARATELY AS FOLLOWS:
  - DETECTOR LOOP CONDUCTORS
  - SIGNAL CONDUCTORS
  - LIGHTING & MISC. CONDUCTORS
3. IDENTIFICATION TAGS SHALL BE NEATLY MARKED WITH A BLACK INDELIBLE PEN.
4. SEE DRAWING SP635-2.5.7 FOR I.D. TAG TYPES AND DESIGNATIONS.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE

No.	Revision	Date	WIRING INSIDE TYPES 6 TO 9 RECTANGULAR PLASTIC JUNCTION BOXES	
F				
E				
D				
C				
B				
A	GENERAL REVISIONS	AUG 94	Date <b>30/09/93</b> Approved <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-2.5.1</b>





#### NOTES

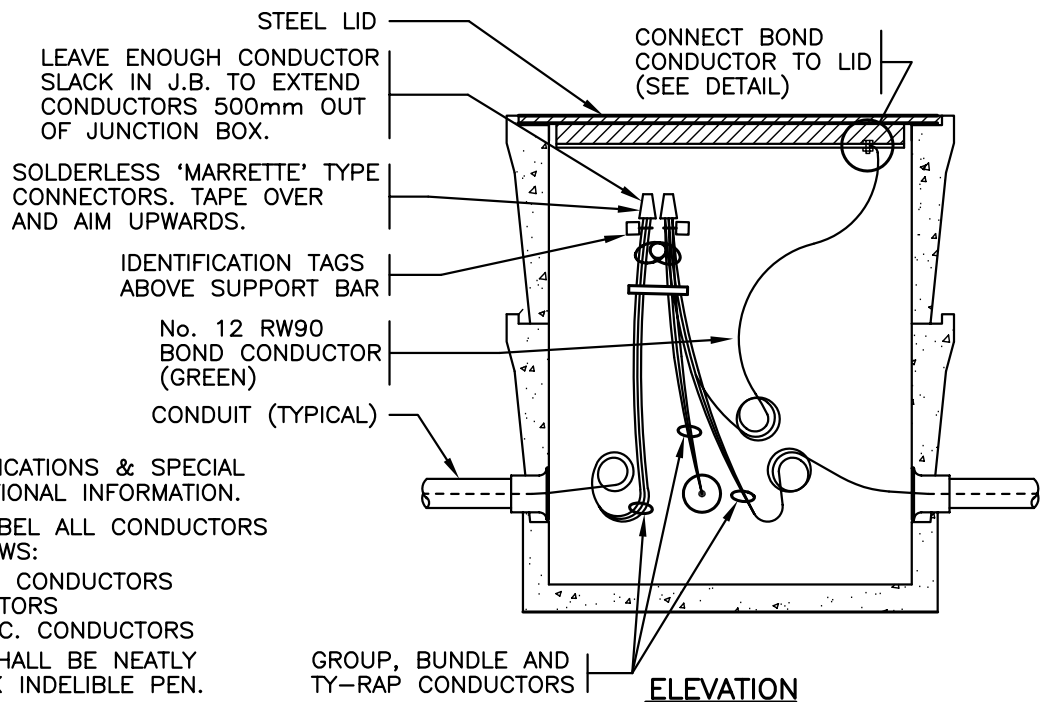
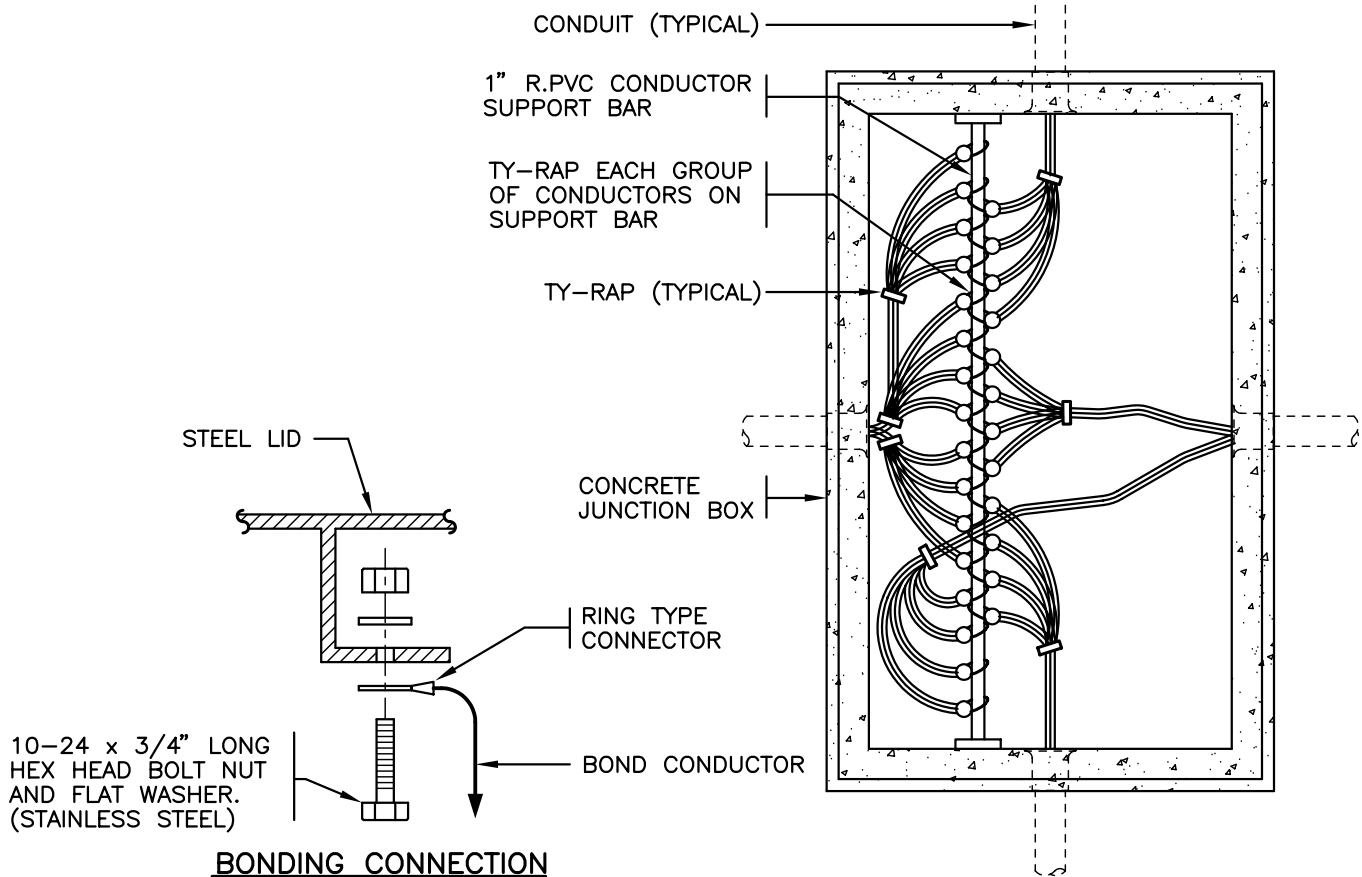
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- GROUP, BUNDLE AND LABEL ALL CONDUCTORS SEPARATELY AS FOLLOWS:
  - DETECTOR LOOP CONDUCTORS
  - SIGNAL CONDUCTORS
  - LIGHTING & MISC. CONDUCTORS
- IDENTIFICATION TAGS SHALL BE NEATLY MARKED WITH A BLACK INDELIBLE PEN.
- SEE DRAWING SP635-2.5.7 FOR I.D. TAG TYPES AND DESIGNATIONS.
- 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE



No.	Revision	Date	WIRING INSIDE TYPES 10 TO 14 ROUND PLASTIC JUNCTION BOXES	
F			Date	Approved
E			30/09/93	E.L. (Signature on File)
D			SPECIFICATION DRAWING No. SP635-2.5.2	
C			Chief Highway Engineer	
B				
A	GENERAL REVISIONS	AUG 94		





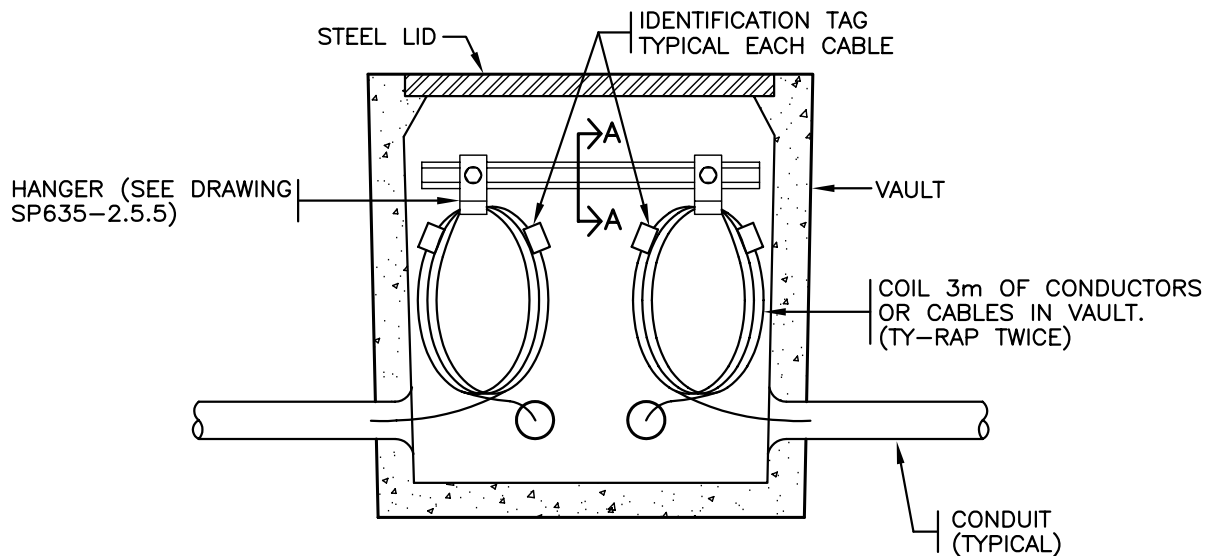
#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. GROUP, BUNDLE & LABEL ALL CONDUCTORS SEPARATELY AS FOLLOWS:
  - DETECTOR LOOP CONDUCTORS
  - SIGNAL CONDUCTORS
  - LIGHTING & MISC. CONDUCTORS
3. IDENTIFICATION TAGS SHALL BE NEATLY MARKED WITH A BLACK INDELIBLE PEN.
4. SEE DRAWING SP635-2.5.7 FOR I.D. TAG TYPES AND DESIGNATIONS.
5. 'SN' DENOTES MINISTRY STOCK NUMBER.

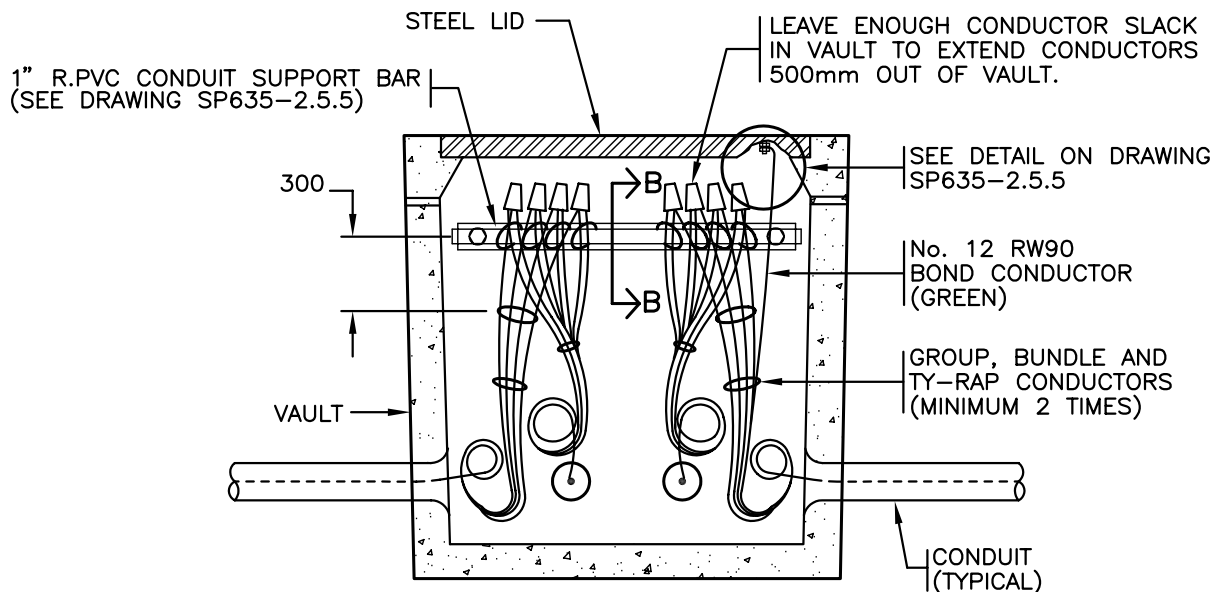
NOT TO SCALE

No.	Revision	Date	WIRING INSIDE CONCRETE JUNCTION BOX	
F				
E				
D				
C				
B				
A				
			Date	Approved
			21/11/94	E.L. (Signature on File)
			Chief Highway Engineer	
			SPECIFICATION DRAWING No. SP635-2.5.3	





**DETAIL OF CONDUCTORS OR  
CABLES IN VAULTS**  
(TYPICAL 2 SIDES OF VAULT)



**DETAIL OF CONDUCTOR SPLICES  
IN VAULTS**  
(TYPICAL 2 SIDES OF VAULT)

**NOTES**

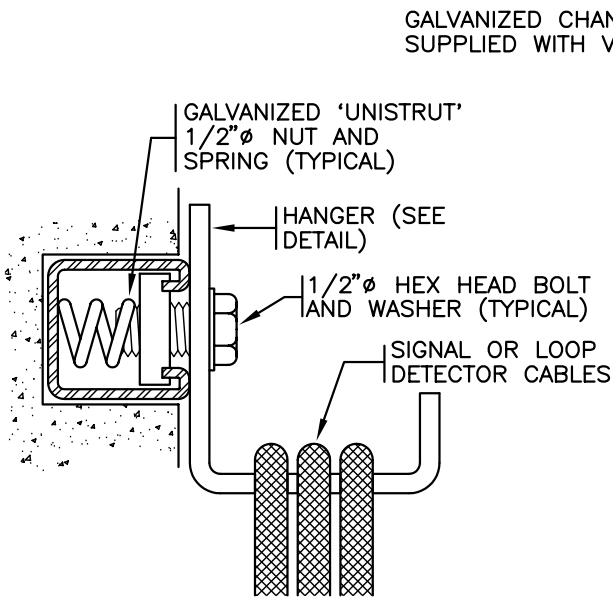
- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>SEE STANDARD SPECIFICATIONS &amp; SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.</li> <li>SEE DRAWING SP635-2.5.5 FOR ADDITIONAL NOTES AND DETAILS.</li> <li>GROUP &amp; BUNDLE ALL CONDUCTORS SEPARATELY AS FOLLOWS: <ul style="list-style-type: none"> <li>- DETECTOR LOOP CONDUCTORS</li> <li>- SIGNAL CONDUCTORS</li> <li>- LIGHTING &amp; MISC. CONDUCTORS</li> </ul> </li> </ol> | <ol style="list-style-type: none"> <li>IDENTIFICATION TAGS SHALL BE NEATLY MARKED WITH A BLACK INDELIBLE PEN.</li> <li>ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.</li> <li>SEE DRAWING SP635-2.5.7 FOR I.D. TAG TYPES AND DESIGNATIONS.</li> <li>'SN' DENOTES MINISTRY STOCK NUMBER.</li> </ol> |
|---|--|

NOT TO SCALE

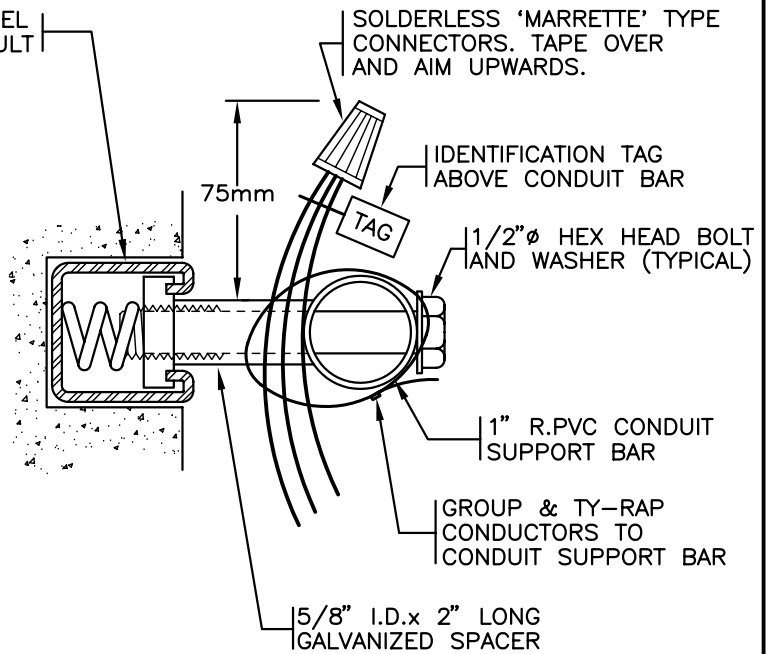


No.	Revision	Date	WIRING INSIDE CONCRETE VAULTS	
F			<div>Date</div> <div>Approved</div> <div><b>30/09/93</b></div> <div><b>E.L. (Signature on File)</b></div> <div>Chief Highway Engineer</div>	<div>SPECIFICATION</div> <div>DRAWING No.</div> <div><b>SP635-2.5.4</b></div>
E				
D				
C				
B				
A	GENERAL REVISIONS	AUG 94		

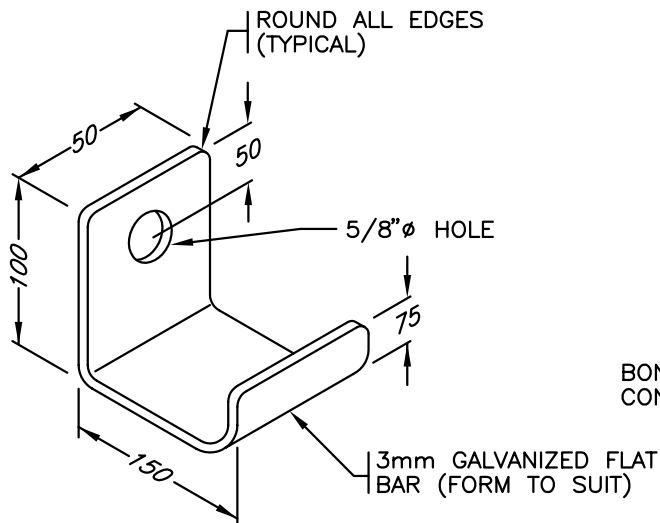




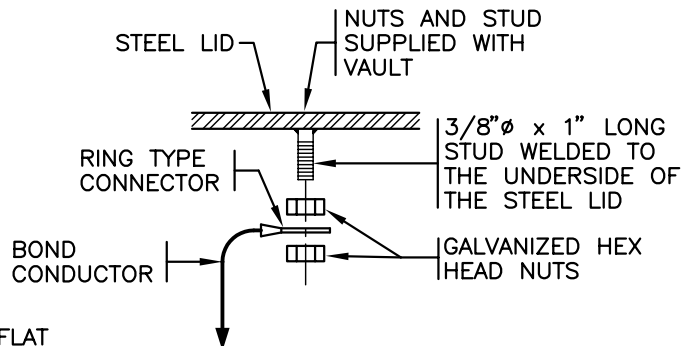
**SECTION A-A**



**SECTION B-B**



**HANGER**



**BONDING DETAIL**

**NOTES**

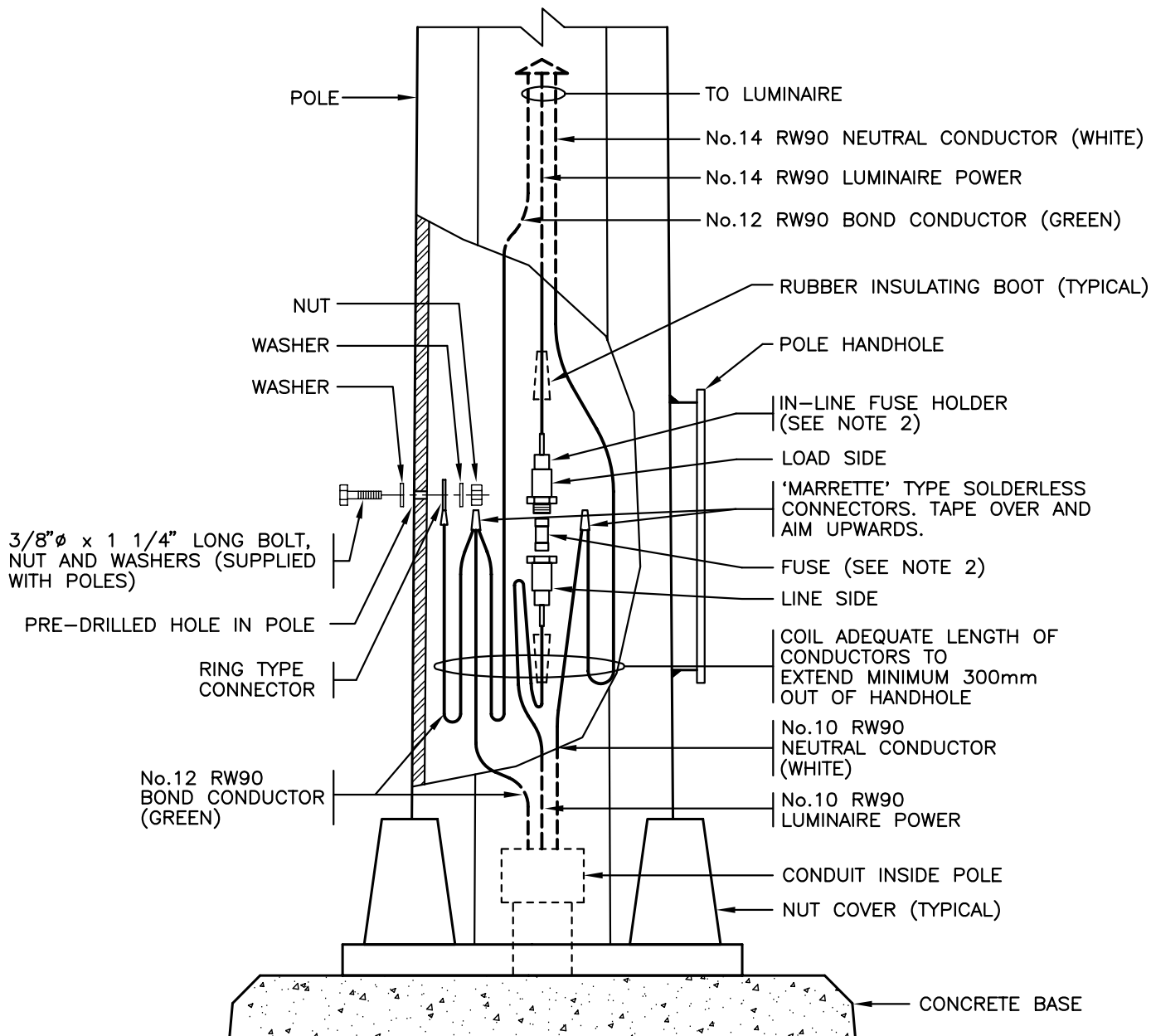
1. SEE DRAWING SP635-2.5.4 FOR ADDITIONAL NOTES & DETAILS.
2. ALL BOLTS & WASHERS SHALL BE GALVANIZED.

NOT TO SCALE



No.	Revision	Date	WIRING INSIDE CONCRETE VAULTS	
F			Date	Approved
E				
D			30/09/93	E.L. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-2.5.5
A	GENERAL REVISIONS	AUG 94		





### ELEVATION

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. IN-LINE FUSE HOLDER SHALL BE A TRON HEB-AA WEATHERPROOF FUSE HOLDER OR A GOULD SHAWMUT GEB-11-11 C/W 5A GOULD SHAWMUT ATM OR BUSS KTK FUSE (347V) OR A 10A GOULD SHAWMUT OTM OR BUSS BAN-10 FUSE (120V) AND 2 'L' TYPE INSULATING BOOTS.
3. FUSE INSTALLATION IN JUNCTION BOXES SIMILAR.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.

NOT TO SCALE



No.	Revision	Date	LUMINAIRE WIRING IN POLE HANDHOLE	
F			Date	Approved
E				
D				
C	FUSEHOLDER TYPE REVISED	AUG 99		SPECIFICATION DRAWING No.
B	NOTES REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>	SP635-2.5.6
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer	



I.D. TAG DESIGNATIONS		CONDUCTOR COLOUR CODING			
ADV. WARN. FLASH. No.?	ADVANCE WARNING FLASHERS	No. 1	No. 2	No. 3	No. 4
		YELLOW	YELLOW (RD TT)	YELLOW (OR TT)	YELLOW (BL TT)
		BROWN	BROWN	BROWN	BROWN
FLASH. BEACON	FLASHING BEACON	FLASHER CONTROL TO BASE OF POLE : BLACK		BASE OF POLE TO SIGNAL HEADS : RED	
ISLAND FLASH.	ISLAND FLASHER	ORANGE			
CONT. PWR.	CONTROLLER POWER	BLACK			
RAIL. PRE-EMPT.	RAILWAY PRE-EMPTION	2C No. 18 SHIELDED CABLE WHITE/BLACK * SEE NOTE 3			
FIRE PRE-EMPT. No.?	FIRE PRE-EMPTION	2C No. 18 SHIELDED CABLE WHITE/BLACK * SEE NOTE 3			
TEL	TELEPHONE	2C No. 18 SHIELDED CABLE WHITE/BLACK * SEE NOTE 3			
LOOP No.??	DETECTOR LOOPS	2C No. 18 SHIELDED CABLE WHITE/BLACK * SEE NOTE 3			
FIRE IND. LIGHTS	FIRE INDICATION LIGHTS	BLUE LIGHT	RED (WHITE TT)		
		WHITE LIGHT	RED		
LUM. CCTS. (A, B, ETC.)	LUMINAIRE CIRCUITS	1ø CIRCUITS	A and C	RED	
			B and D	BLACK	
		3ø CIRCUITS	A,D and G	RED	
			B,E and H	BLACK	
			C,F and I	BLUE	
P.E.C.	PHOTOELECTRIC CELL	SWITCH LEG	RED		
		POWER	BLACK		
—	NEUTRAL	WHITE			
—	GROUND	GREEN			

#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- TT DENOTES TAPE TRACER (WH – WHITE, BL – BLUE, OR – ORANGE, RD – RED, BR – BROWN)
- EACH SHIELDED CABLE SHALL BE IDENTIFIED AT BOTH ENDS. IDENTIFICATION SHALL BE MADE USING TY-RAP IDENTIFICATION TAGS (T&B TY5532 OR APPROVED ALTERNATE) WITH THE LOOP NUMBER OR PRE-EMPTION AND PHASE TYPE CLEARLY MARKED USING A BLACK INDELIBLE MARKING PEN.
- SEE DRAWING SP635-2.8.5 FOR DETECTOR LOOP CONDUCTOR COLOUR CODING.
- SEE DRAWING SP635-2.5.8 FOR TRAFFIC SIGNAL COLOUR CODING.
- CONDUCTORS SHALL BE IDENTIFIED IN ALL J.B'S, TRAFFIC CONTROLLERS AND ALL ACCESS POINTS. IDENTIFICATION SHALL BE MADE USING TY-RAP IDENTIFICATION TAGS (T&B TY5532 OR APPROVED ALTERNATE) INDICATING SIGNAL PHASES OR PEDESTRIAN PHASES AS NOTED ON DRAWING SP635-2.5.8. TAGS SHALL BE CLEARLY MARKED WITH A BLACK INDELIBLE PEN.



No.	Revision	Date	SINGLE CONDUCTOR COLOUR CODING		
F					
E					
D					
C					
B					
A	GENERAL REVISIONS	AUG 94	Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-2.5.7
			Chief Highway Engineer		



# CONDUCTOR COLOUR CODING

TRAFFIC SIGNAL HEAD	SIGNAL SECTION	1	2	3 or x	4 or y
A	RED	RED	RED	RED (BL TT)	RED (BL TT)
	YELLOW	YELLOW	YELLOW (RD TT)	YELLOW	YELLOW (RD TT)
	GREEN	BLUE	BLUE	BLUE	BLUE
	YELLOW ARROW	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)
	GREEN ARROW	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)
B	RED	RED	RED	RED (BL TT)	RED (BL TT)
	YELLOW	BROWN	BROWN (OR TT)	BROWN	BROWN (OR TT)
	GREEN	BLUE	BLUE	BLUE	BLUE
	YELLOW ARROW	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)
	GREEN ARROW	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)
C	RED	RED	RED	RED (BL TT)	RED (BL TT)
	YELLOW	ORANGE	ORANGE (BL TT)	ORANGE	ORANGE (BL TT)
	GREEN	BLUE	BLUE	BLUE	BLUE
	YELLOW ARROW	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)	ORANGE (WH TT)
	GREEN ARROW	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)	BLUE (WH TT)
D	RED	RED			
	YELLOW	ORANGE (RD TT)			
	GREEN	BLUE			
	YELLOW ARROW	ORANGE (WH TT)			
	GREEN ARROW	BLUE (WH TT)			
PA	DON'T WALK	YELLOW	YELLOW (RD TT)	YELLOW (OR TT)	YELLOW (BL TT)
	WALK	BLUE	BLUE	BLUE	BLUE
	PEDESTRIAN PUSHBUTTON	PURPLE (Y TT)	PURPLE (RD TT)	PURPLE (OR TT)	PURPLE (BL TT)
		PURPLE (Y TT)	PURPLE (RD TT)	PURPLE (OR TT)	PURPLE (BL TT)
PB	DON'T WALK	BROWN	BROWN (OR TT)	BROWN (RD TT)	BROWN (BL TT)
	WALK	BLUE	BLUE	BLUE	BLUE
	PEDESTRIAN PUSHBUTTON	PURPLE (BR TT)	PURPLE (OR TT)	PURPLE (RD TT)	PURPLE (BL TT)
		PURPLE (BR TT)	PURPLE (OR TT)	PURPLE (RD TT)	PURPLE (BL TT)
PC	DON'T WALK	ORANGE	ORANGE (BL TT)	TT – DENOTES TRACER TAPE WH – WHITE BL – BLUE OR – ORANGE RD – RED BR – BROWN	
	WALK	BLUE	BLUE		
	PEDESTRIAN PUSHBUTTON	PURPLE (OR TT)	PURPLE (BL TT)		
		PURPLE (OR TT)	PURPLE (BL TT)		
PD	DON'T WALK	RED (BL TT)			
	WALK	BLUE			
	PEDESTRIAN PUSHBUTTON	PURPLE			
		PURPLE			
FS	RED	RED			
	YELLOW	YELLOW			

NOTES:  
1. SEE DRAWING SP635–2.5.7 FOR NOTES AND  
ADDITIONAL COLOUR CODING.

'FS' INDICATES 'FIRE SIGNAL' HEAD

## NOTES:

- SEE DRAWING SP635-2.5.7 FOR NOTES AND ADDITIONAL COLOUR CODING.



No.	Revision	Date	SINGLE CONDUCTOR COLOUR CODING		
F					
E					
D					
C					
B					
A	GENERAL REVISIONS	AUG 94	Date <b>30/09/93</b> Chief Highway Engineer	Approved <b>E.L. (Signature on File)</b>	SPECIFICATION DRAWING No. <b>SP635-2.5.8</b>



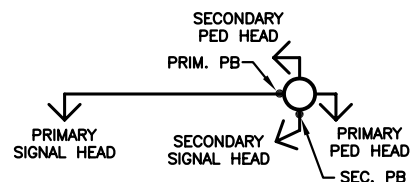
## COLOUR CODING (MULTICONDUCTOR SIGNAL CABLE)

**19 OR 25 CONDUCTOR No. 14 (41 STRAND)  
CSA SPEC. No.C21.1 OR C22.2 No. 210.2-M90 CABLE**

CONDUCTOR No.	SIGNAL ASSIGNMENT	LETTERING	CONDUCTOR COLOUR	SINGLE CONDUCTOR COLOUR IN POLE
1	NEUTRAL	WHITE ONE	WHITE	WHITE
2	PRIMARY PB RETURN	WHITE TWO	WHITE	PURPLE
3	PRIMARY PB	—	BLACK	PURPLE
4	SECONDARY PB	—	ORANGE	PURPLE
5	PRIMARY RED	RED ONE	RED	RED*
6	SECONDARY RED	RED TWO	RED	RED*
7	SECONDARY PB RETURN	RED THREE	RED	PURPLE
8	PRIMARY PED DW	RED FOUR	RED	YELLOW, BROWN, ORANGE OR RED(*)
9	SECONDARY PED DW	RED FIVE	RED	YELLOW, BROWN, ORANGE OR RED(*)
10	PRIMARY YELLOW	YELLOW ONE	YELLOW	YELLOW, BROWN OR ORANGE(*)
11	SECONDARY YELLOW	YELLOW TWO	YELLOW	YELLOW, BROWN OR ORANGE(*)
12	PRIMARY LT YELLOW	YELLOW THREE	YELLOW	ORANGE(*)
13	SECONDARY LT YELLOW	YELLOW FOUR	YELLOW	ORANGE(*)
14	SECONDARY PED WALK	YELLOW FIVE	YELLOW	BLUE(*)
15	PRIMARY GREEN	GREEN ONE	BLUE	BLUE(*)
16	SECONDARY GREEN	GREEN TWO	BLUE	BLUE(*)
17	PRIMARY LT GREEN	GREEN THREE	BLUE	BLUE(*)
18	SECONDARY LT GREEN	GREEN FOUR	BLUE	BLUE(*)
19	PRIMARY PED WALK	GREEN FIVE	BLUE	BLUE(*)
20	PRIMARY LT RED	RED SIX	RED	RED (BLUE T.T.)
21	SECONDARY LT RED	RED SEVEN	RED	RED (BLUE T.T.)
22	SPARE	AMBER SIX	YELLOW	—
23	SPARE	AMBER SEVEN	YELLOW	—
24	SPARE	GREEN SIX	BLUE	—
25	SPARE	GREEN SEVEN	BLUE	—

LT = LEFT TURN SIGNAL  
DW = DON'T WALK  
PB = PEDESTRIAN PUSHBUTTON  
TT = TRACER TAPE

\* YELLOW or BROWN DESIGNATIONS — YELLOW (N/B & S/B) BROWN — (E/B & W/B)



(\*) SEE NOTE 3

### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- 19 CONDUCTOR CABLE TO BE USED EXCEPT WHERE EXTRA CONDUCTORS ARE REQUIRED (IE; PROTECTED LEFT TURNS ON SIGNAL ARMS).
- COLOUR CODING AND TRACER TAPE INSIDE POLES SHALL BE IN ACCORDANCE WITH SP635-2.5.7 & 2.5.8.

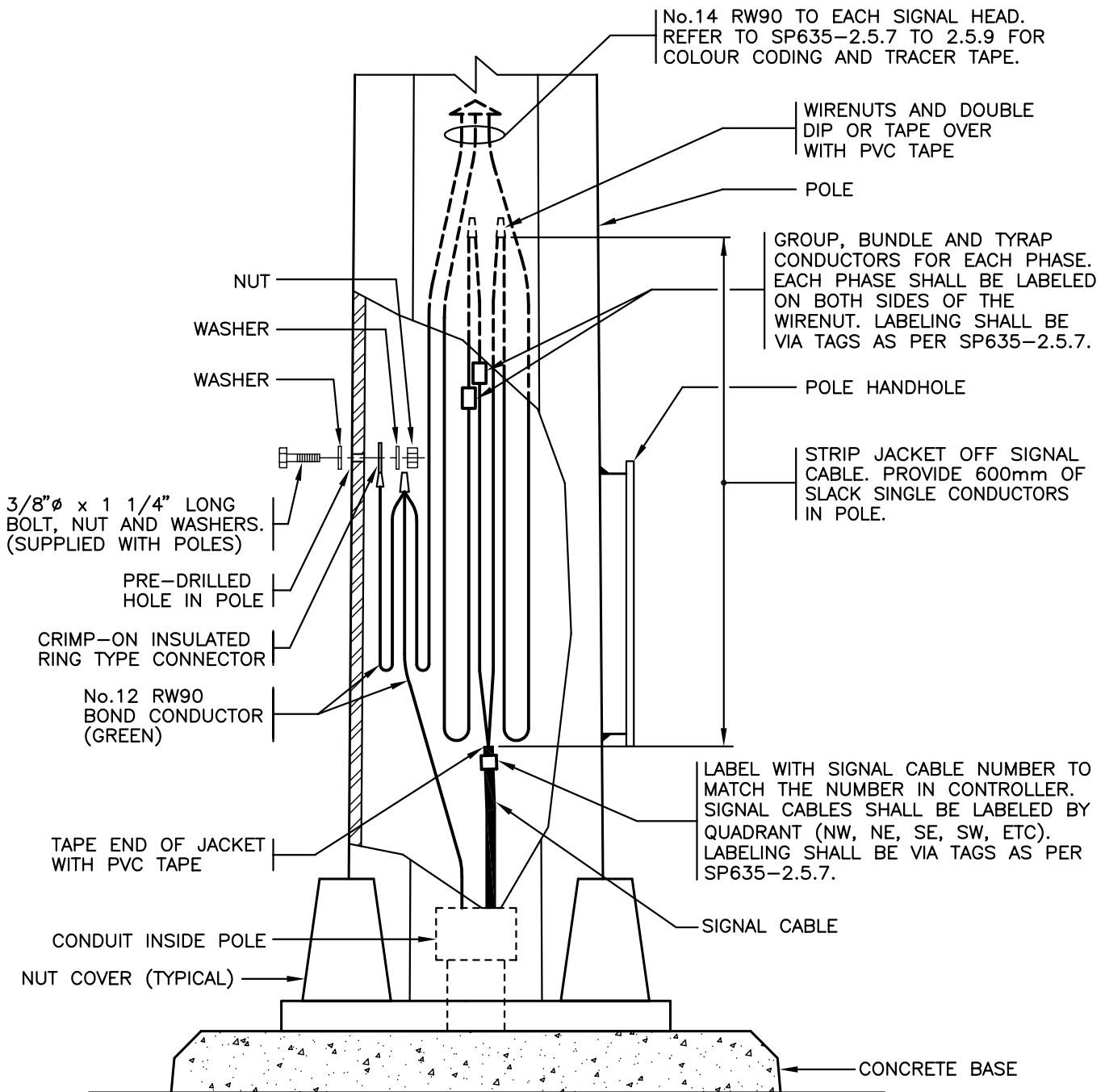


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	SIGNAL CABLE WIRING & COLOUR CODING	
F			<div style="display: flex; justify-content: space-between;"> <div> Date <b>14/11/03</b> Chief Engineer </div> <div> Approved <b>D.N. (Signature on File)</b> </div> </div>	SPECIFICATION DRAWING No. <b>SP635-2.5.9</b>
E				
D				
C				
B				
A				





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. REFER TO SP635-2.5.7 FOR CONDUCTOR LABELING.

NOT TO SCALE

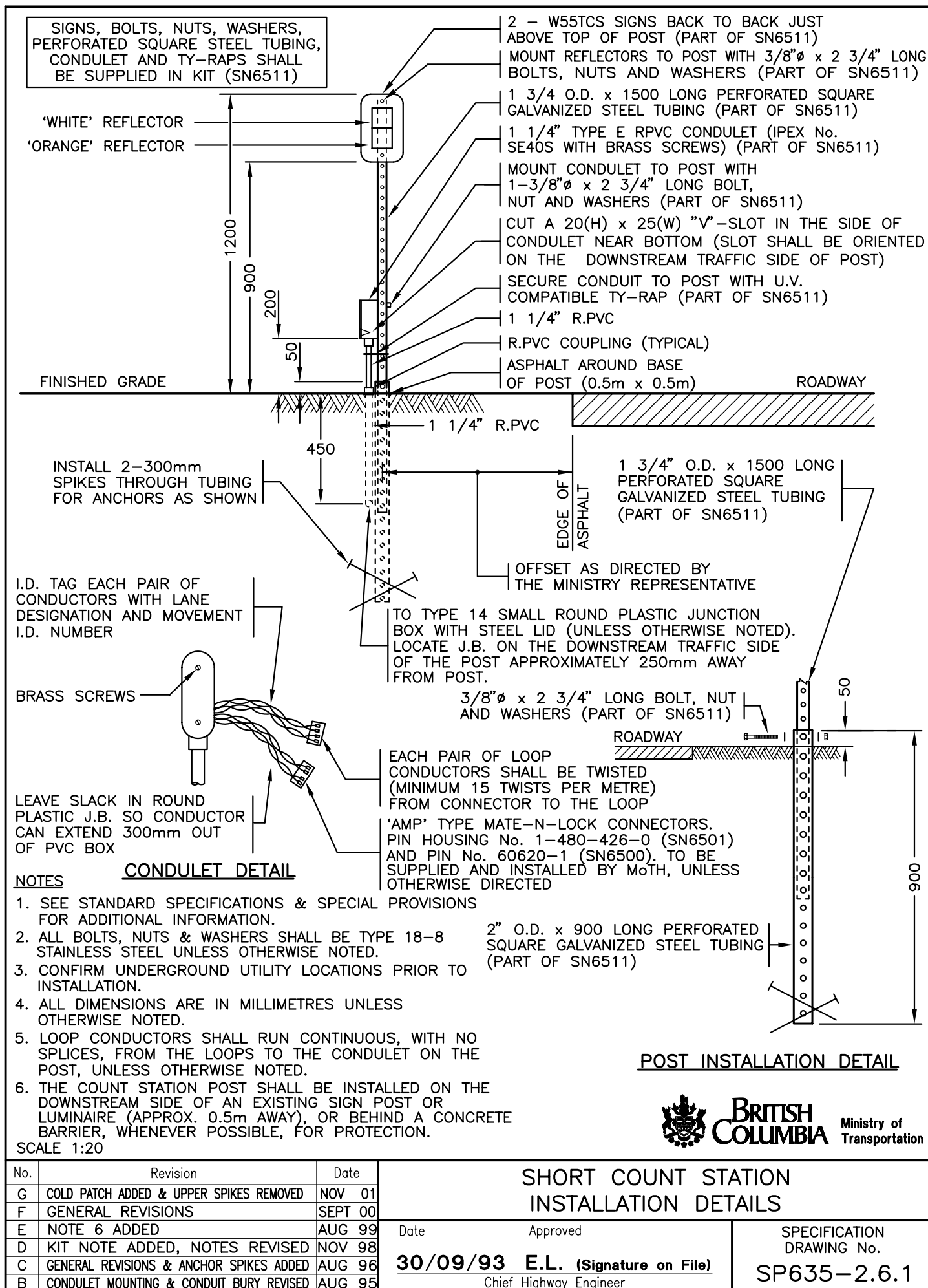


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	SIGNAL CABLE WIRING IN POLE HANDHOLE		
F					
E					
D					
C					
B					
A					
			Date	Approved	SPECIFICATION DRAWING No.
			14/11/03	D.N. (Signature on File) Chief Engineer	SP635-2.5.10

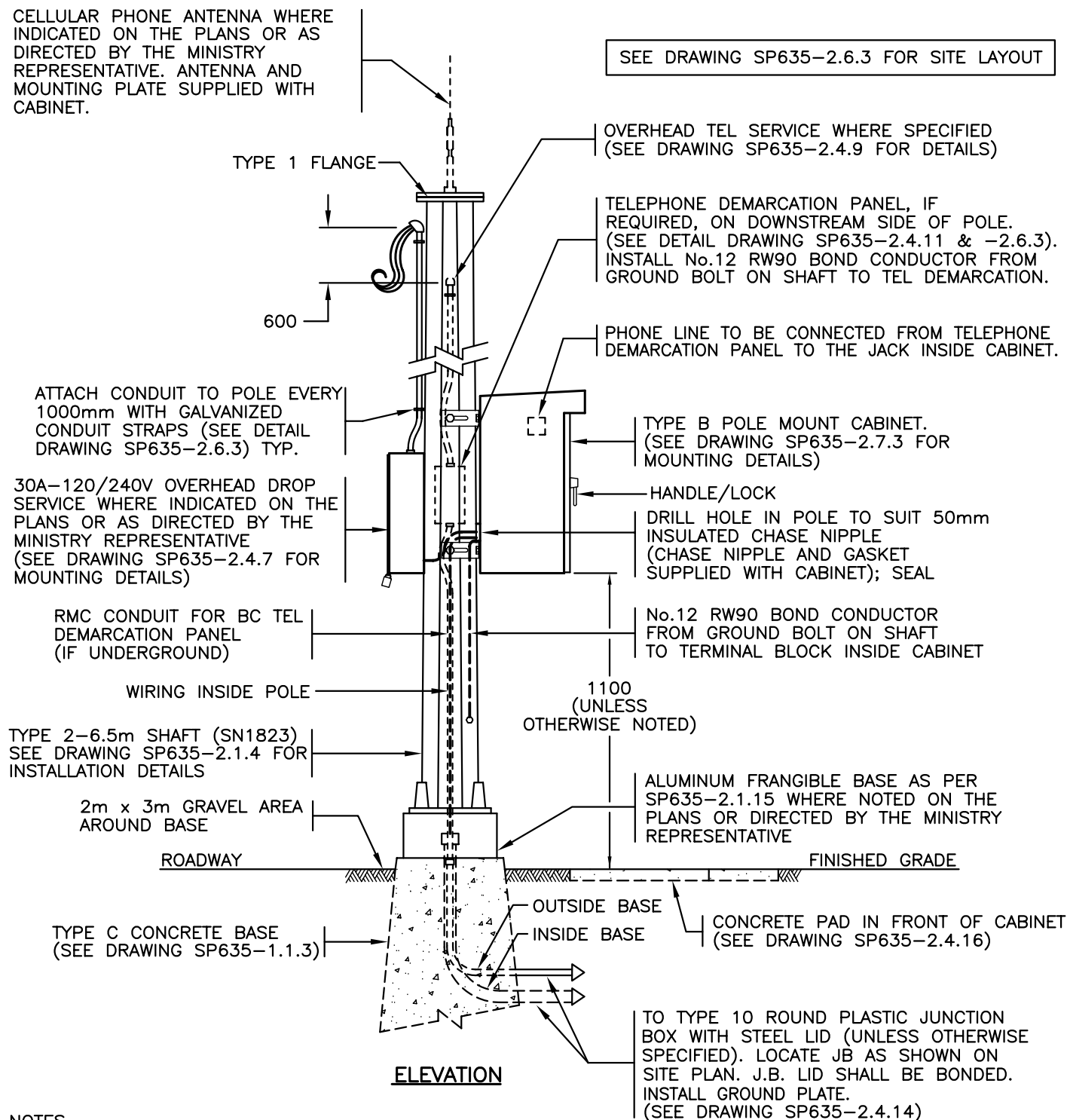






CELLULAR PHONE ANTENNA WHERE INDICATED ON THE PLANS OR AS DIRECTED BY THE MINISTRY REPRESENTATIVE. ANTENNA AND MOUNTING PLATE SUPPLIED WITH CABINET.

SEE DRAWING SP635-2.6.3 FOR SITE LAYOUT



#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. CONTRACTOR TO CONFIRM ORIENTATION OF CABINET WITH THE MINISTRY REPRESENTATIVE PRIOR TO INSTALLATION.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. CABINET SHALL BE SUPPLIED BY THE MINISTRY.

5. 2m OF LOOP WIRE AND/OR SHIELDED CABLE SHALL BE COILED IN THE CABINET FOR CONNECTIONS BY MINISTRY. TAG AND LABEL CABLES IN ACCORDANCE WITH DRAWING SP635-2.5.7. THE CABINET LOOP OPENING SHALL BE DUCT-SEALED ONCE WIRING IS PULLED THRU.

SCALE: 1:25



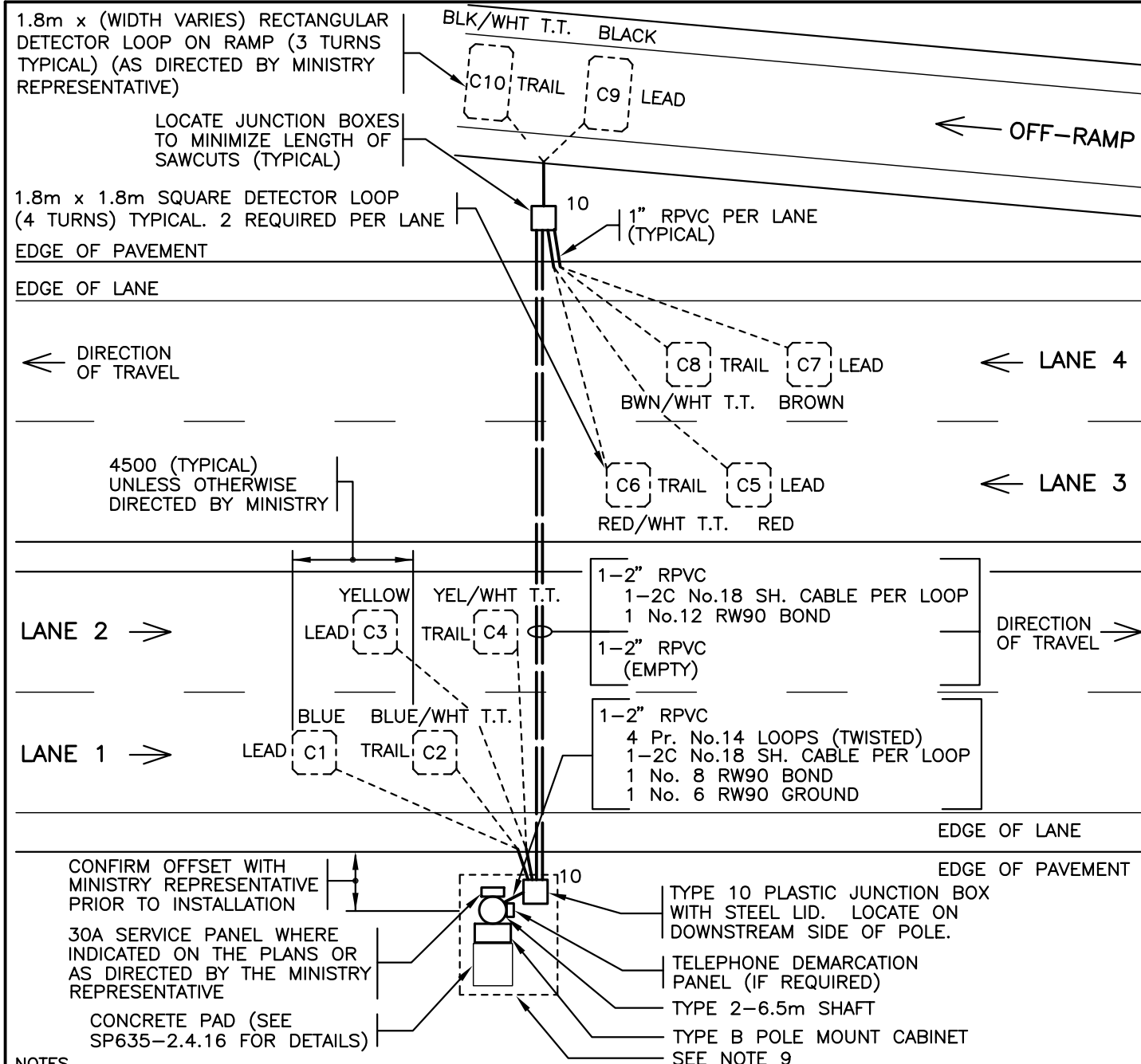
No.	Revision	Date
F		
E		
D	GENERAL REVISIONS	SEPT 00
C	TEL DEMARCATION PANEL RELOCATED	AUG 99
B	TEL DEMARCATION & CONCRETE PADS SHOWN	NOV 98
A	O/H TEL & POWER SERVICES ADDED	OCT 97

## PERMANENT COUNT STATION INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.6.2**





#### NOTES

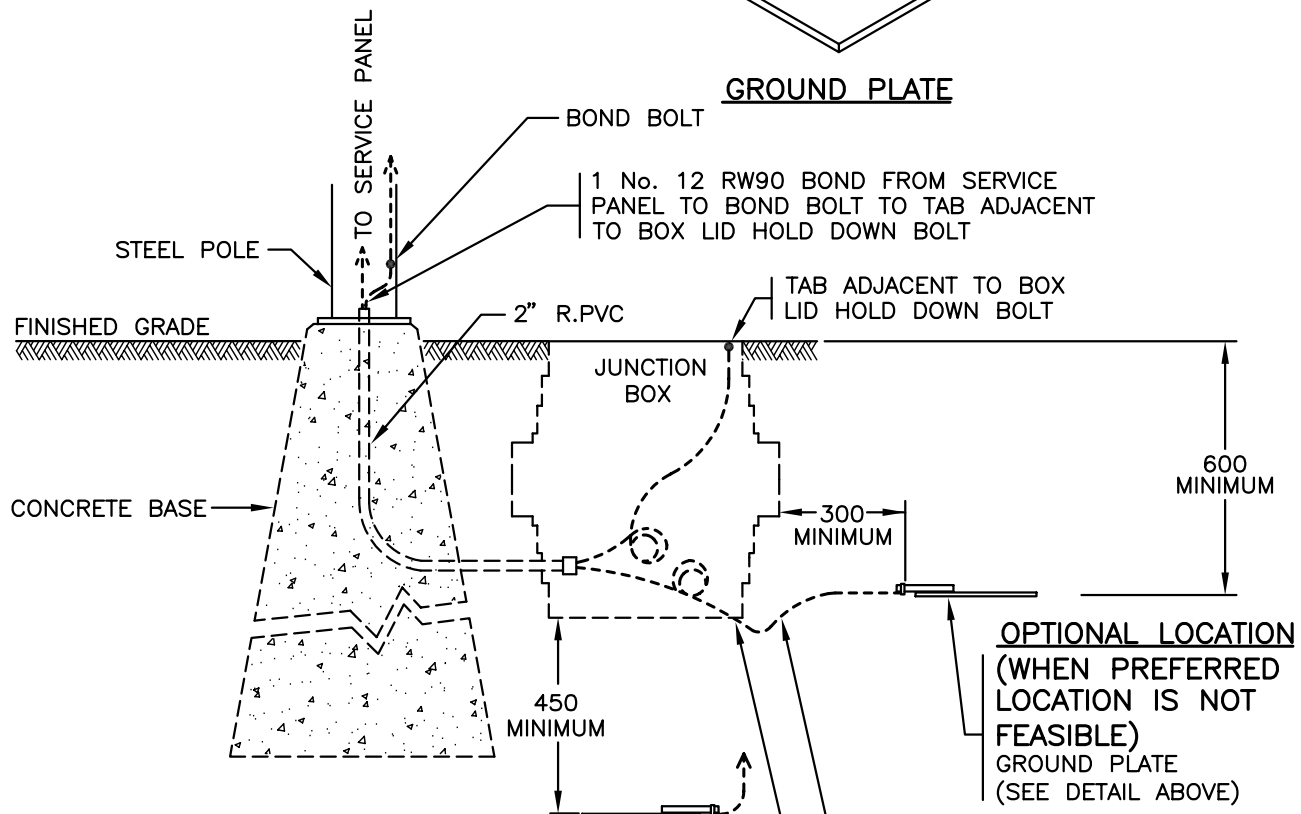
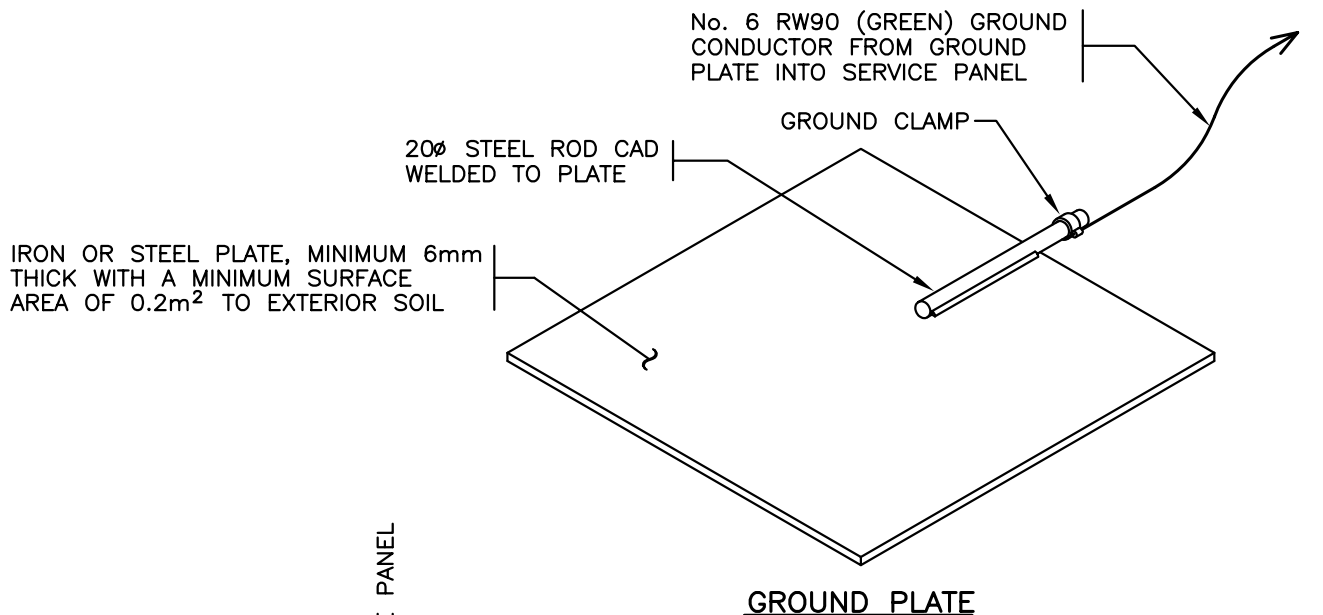
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- CONTRACTOR TO CONFIRM ORIENTATION OF CABINET AND SITE PLAN LAYOUT WITH THE MINISTRY REPRESENTATIVE PRIOR TO INSTALLATION.
- FOR LOCATIONS WITH 4 OR MORE LANES, 1-2C No.18 SHIELDED CABLE REQUIRED FOR EACH DETECTOR LOOP IN THE LANES FURTHEST FROM CABINET. SPLICING TO SHIELDED CABLE IS NOT REQUIRED IN 2 OR 3 LANE LOCATIONS UNLESS OTHERWISE DIRECTED BY THE MINISTRY REPRESENTATIVE.
- 1-25mm RPVC LOOP CONDUIT REQUIRED PER LANE.
- LOOPS SHALL BE NUMBERED SEQUENTIALLY FROM CABINET SIDE OUT.
- LOOPS SHALL BE CUT 4500mm FROM LEADING EDGE OF THE LEADING LOOP TO THE LEADING EDGE OF THE TRAILING LOOP PER LANE, UNLESS OTHERWISE DIRECTED BY THE MINISTRY.
- LOCATE LOOPS IN CENTRE OF LANES UNLESS OTHERWISE NOTED ON THE PLANS OR DIRECTED BY MINISTRY REPRESENTATIVE.
- AFTER INSTALLATION IS COMPLETE, THE CONTRACTOR SHALL PROVIDE A SKETCH SHOWING EXACT SIZE OF LOOPS AND SPACINGS. SKETCH AND LOOP CHECK SHEETS SHALL BE SUBMITTED TO THE MINISTRY REPRESENTATIVE.
- EXCAVATE 2m x 3m AREA AROUND POLE AND FILL WITH CRUSH TO 300mm ABOVE GRADE WITH TAPERED EDGES.



**BRITISH COLUMBIA** Ministry of Transportation

No.	Revision	Date	SITE PLAN AND LOOP LAYOUT FOR PERMANENT COUNT STATIONS		
F					
E					
D	GRAVEL CHANGED TO CRUSH IN NOTE 9	NOV 01			
C	CONDUIT CROSSING & NOTES REVISED	SEPT 00			
B	LOOP LAYOUT REVISED	AUG 99			
A	LOOP LAYOUT REVISED	NOV 98			
			Date	Approved	SPECIFICATION DRAWING No.
			18/02/98	D.M. (Signature on File)	SP635-2.6.3
			Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. GROUND PLATE SHALL BE INSTALLED IN UNDISTURBED MOIST SOILS. DEPTH AND LOCATION OF GROUND PLATE SHALL VARY TO PROVIDE OPTIMAL SOIL CONDITIONS FOR GROUNDING.
4. GROUND RESISTANCE READING SHALL BE 25 OHMS OR LESS.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E		
D		
C		
B		
A	DRAWING TITLE CHANGE	OCT 03

## GROUND PLATE INSTALLATION DETAIL FOR COUNT STATIONS

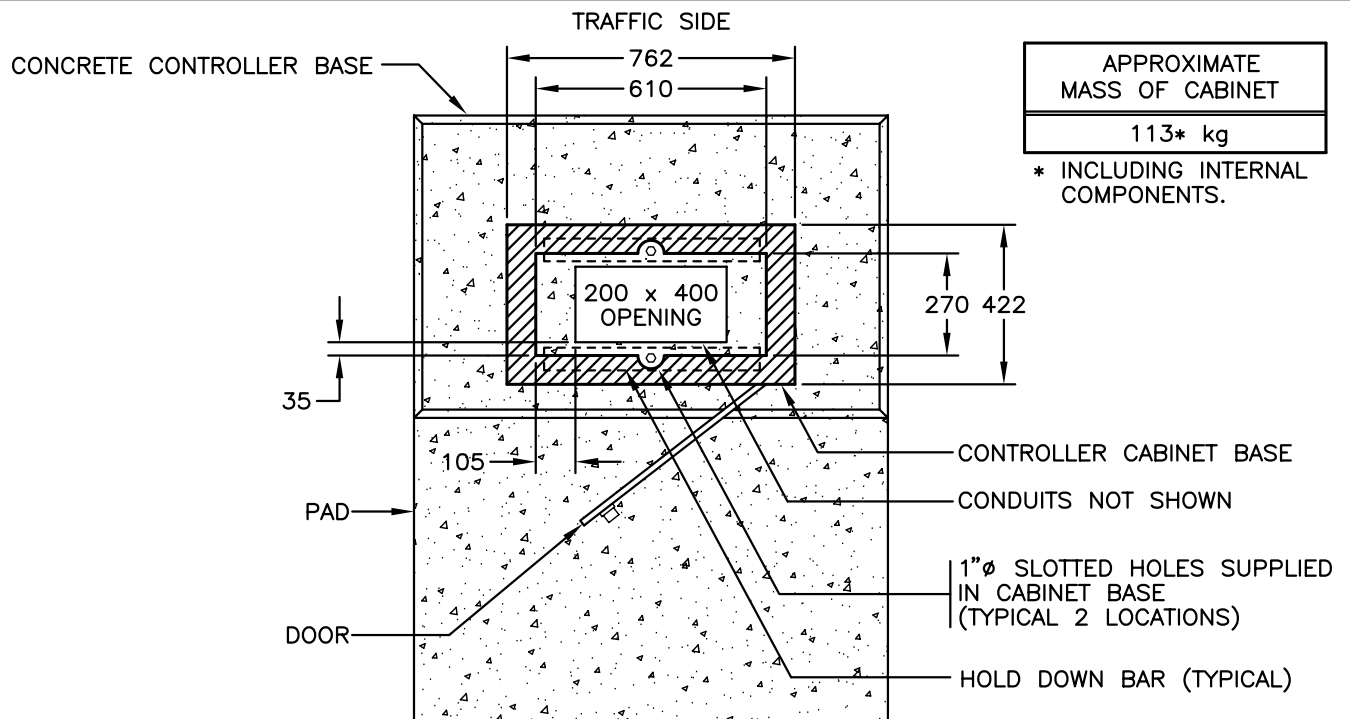
Date Approved

SPECIFICATION  
DRAWING No.

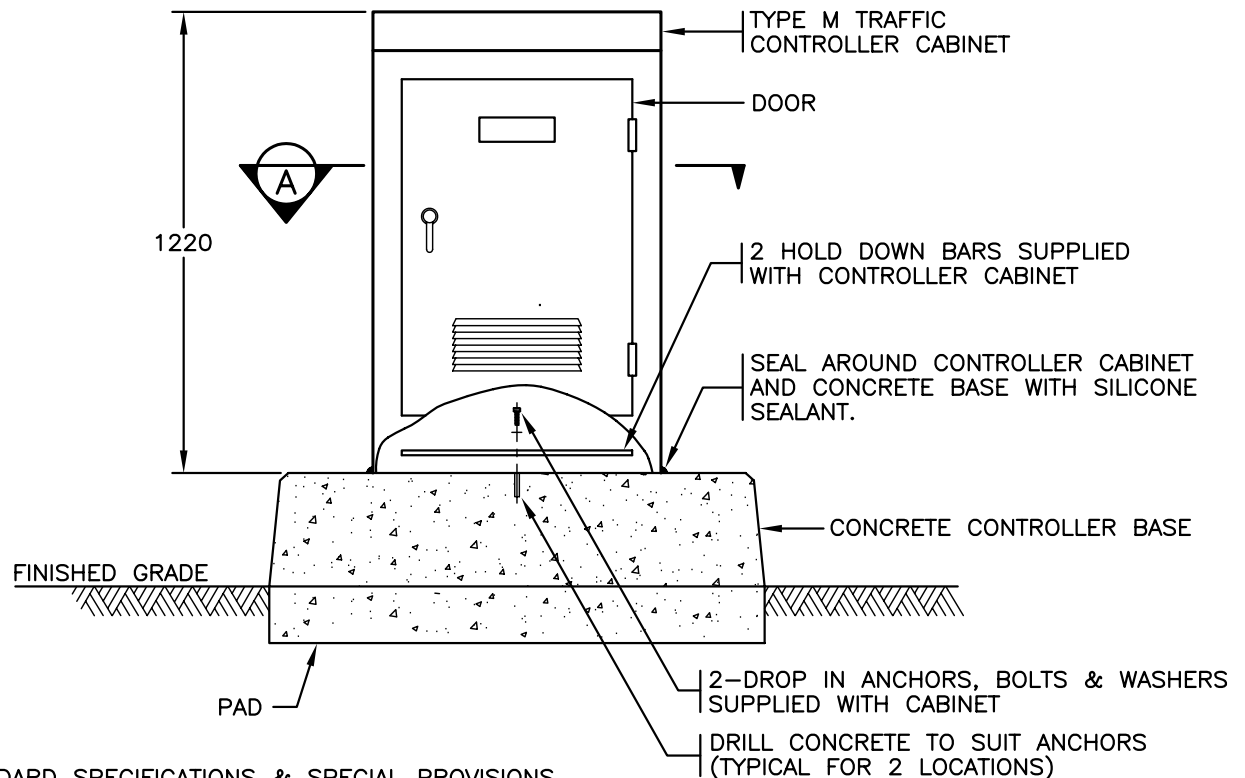
Chief Highway Engineer

SP635-2.6.4





### SECTION A



#### NOTES

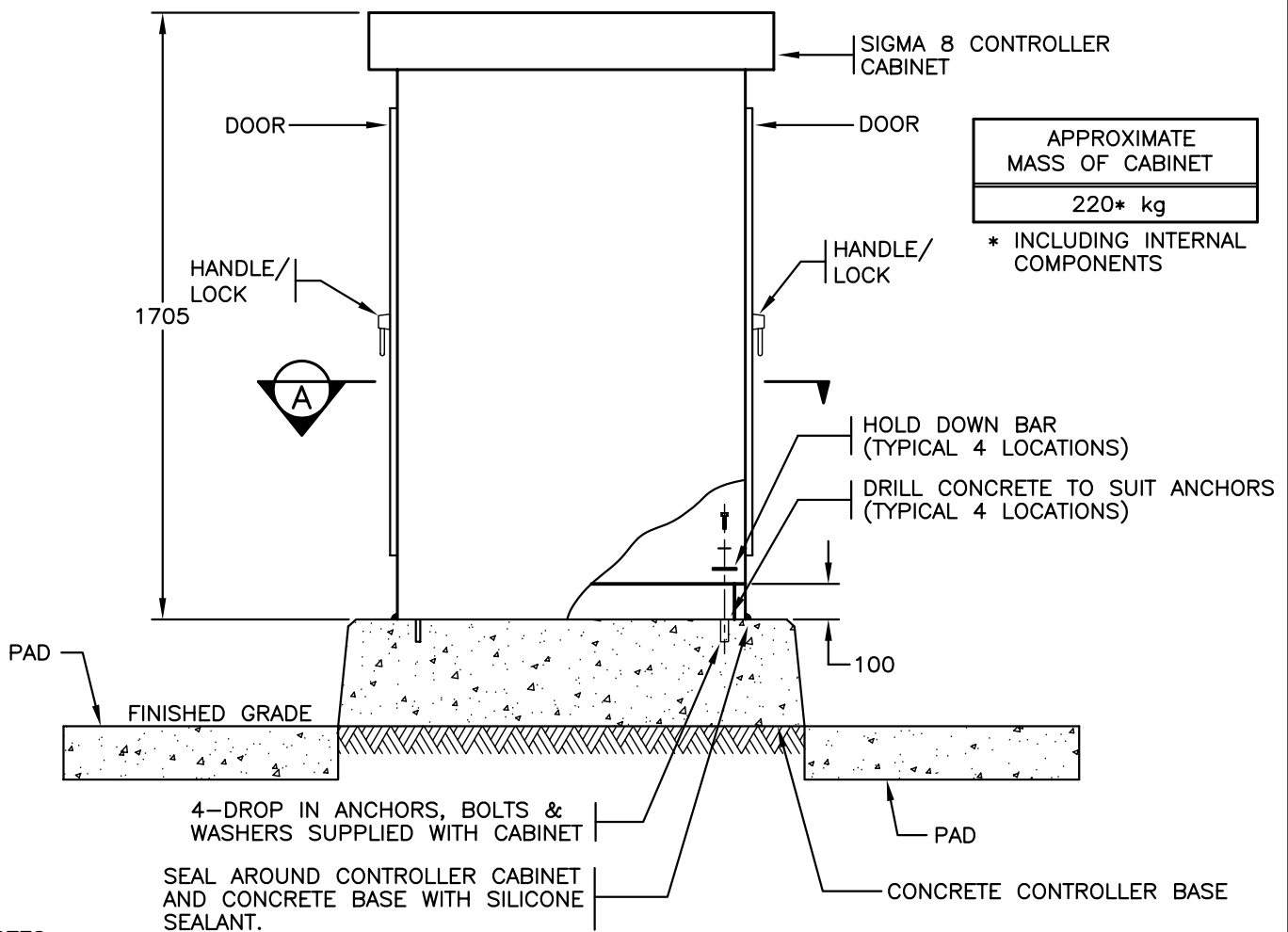
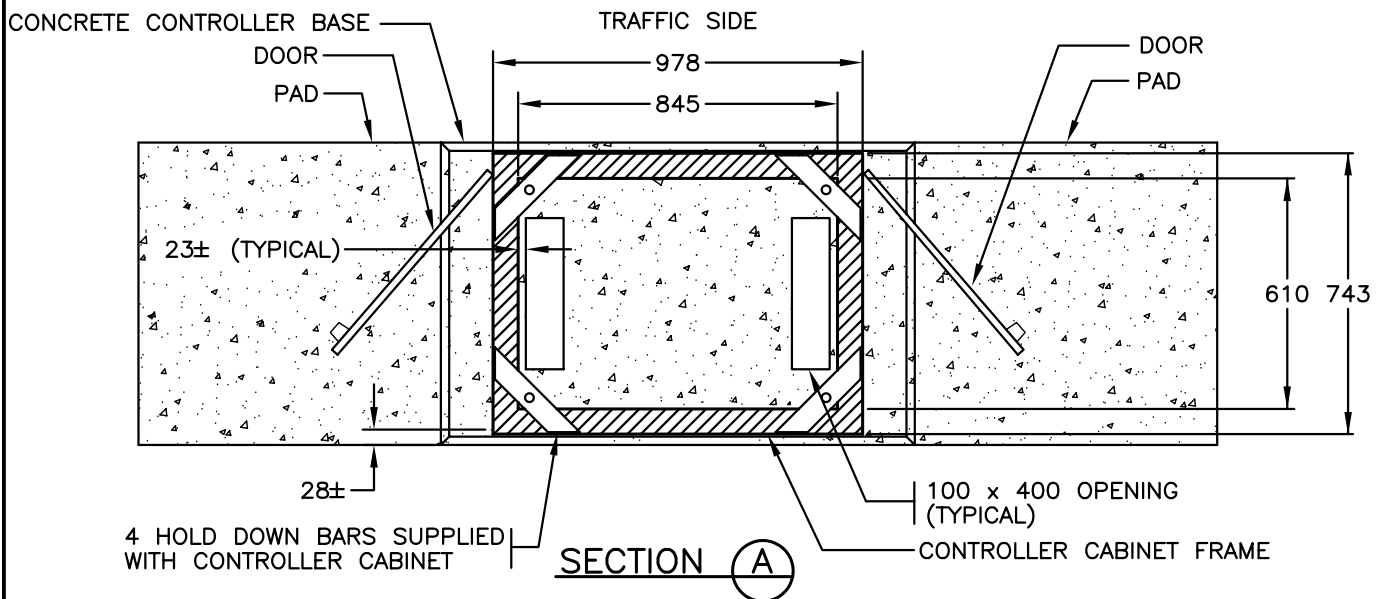
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	TYPE M CONTROLLER CABINET INSTALLATION DETAILS	
F			Date	Approved
E			30/09/93	E.L. (Signature on File)
D			SPECIFICATION DRAWING No.	
C			SP635-2.7.1	
B				
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer	





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

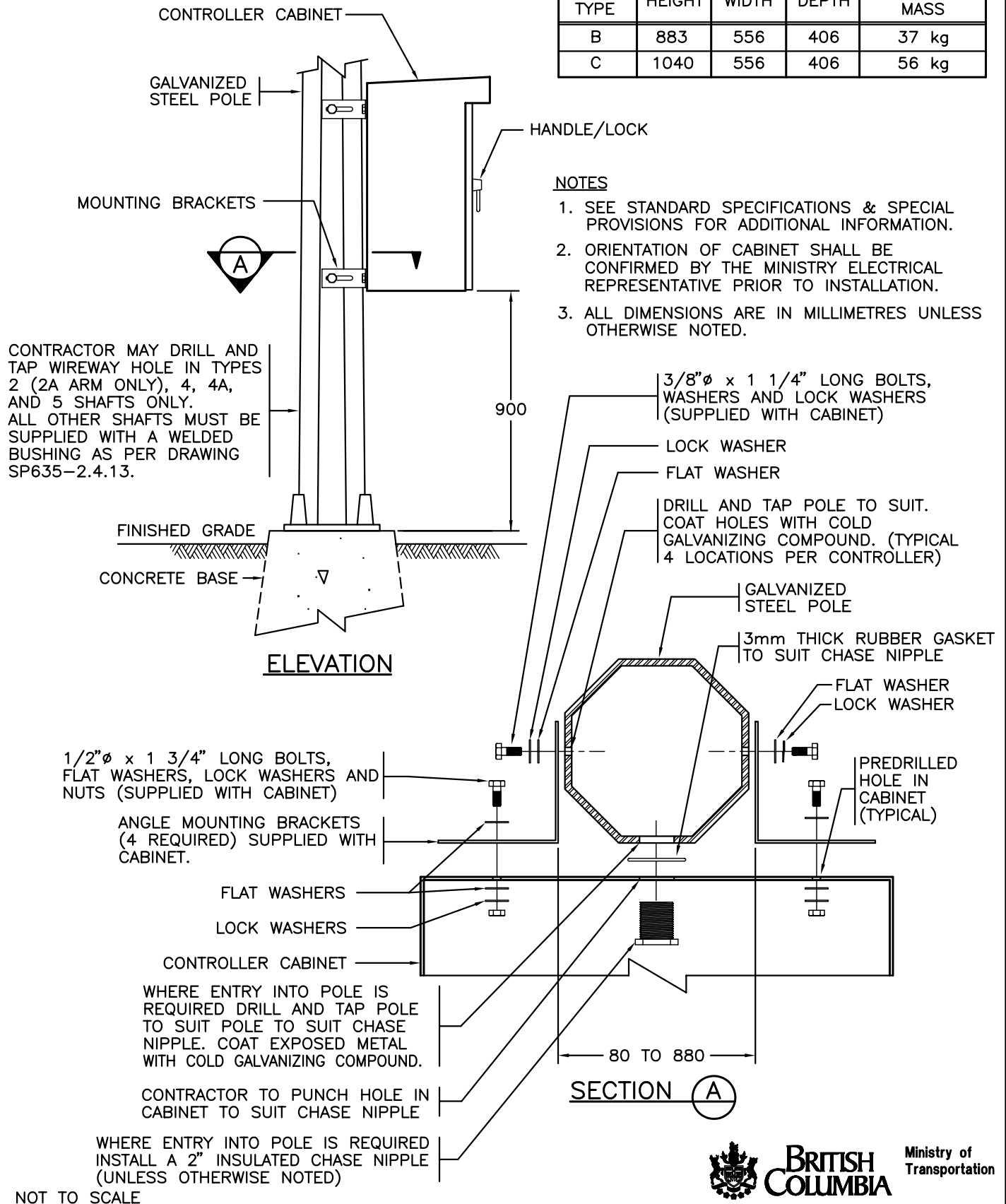
NOT TO SCALE



No.	Revision	Date	TYPE S CONTROLLER CABINET INSTALLATION DETAILS		
F			Date Approved  <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635-2.7.2
E					
D					
C					
B					
A	GENERAL REVISIONS	AUG 94			



CABINET TYPE	HEIGHT	WIDTH	DEPTH	APPROXIMATE MASS
B	883	556	406	37 kg
C	1040	556	406	56 kg

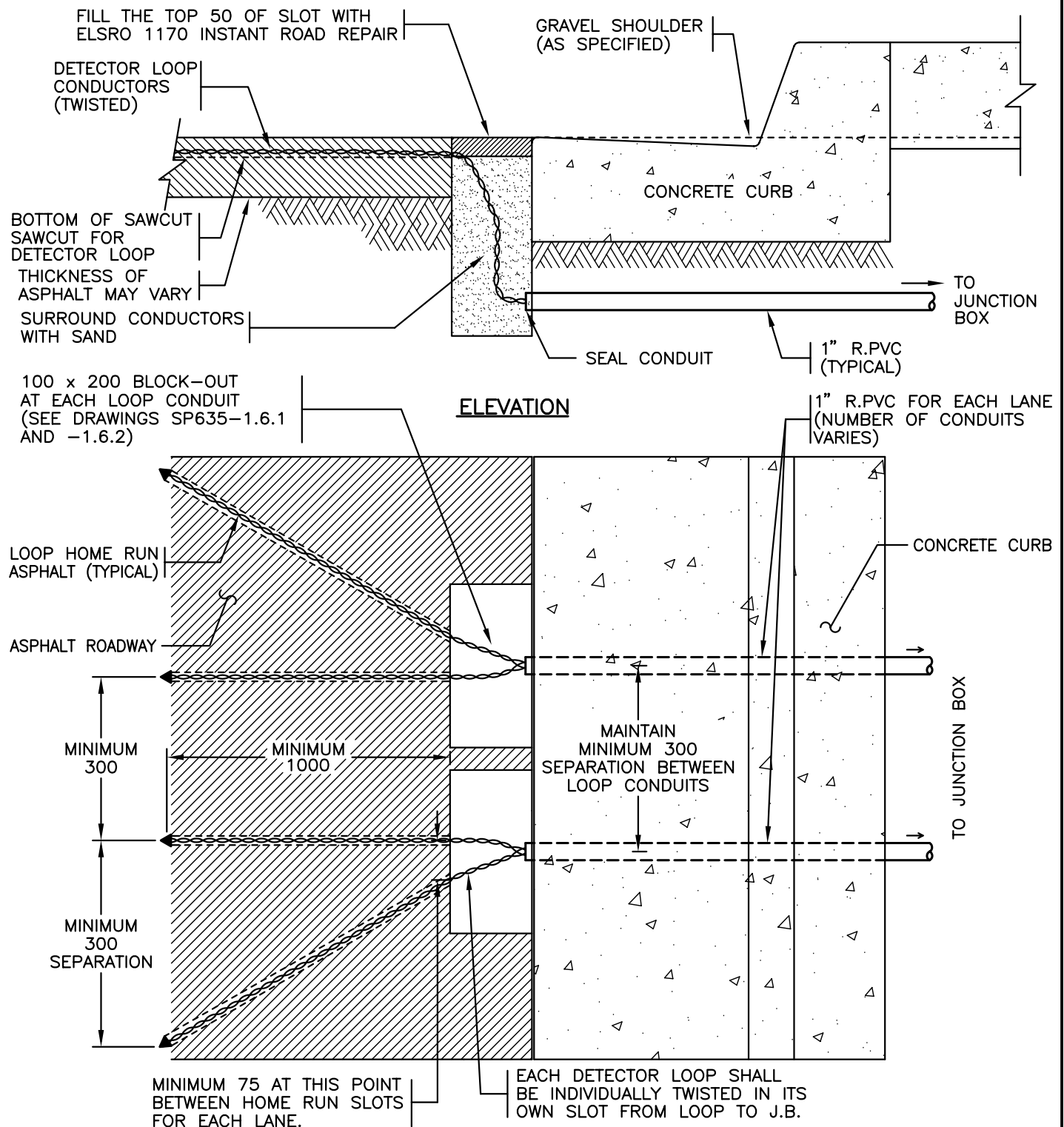


**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	TYPES B AND C CONTROLLER CABINET INSTALLATION DETAILS		
F					
E					
D					
C	TYPE G CABINET DELETED	OCT 03	Date	Approved	SPECIFICATION DRAWING No.
B	MOUNTING HEIGHT REVISED	OCT 97	30/09/93	E.L. (Signature on File)	SP635-2.7.3
A	GENERAL REVISIONS	AUG 94	Chief Highway Engineer		





**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-2.8.6 FOR LOOP COLOR CODING.
3. SEE DRAWING SP635-1.6.1 & 1.6.2 FOR LOOP CONDUIT INSTALLATION DETAILS.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

**TOP VIEW**

NOT TO SCALE



No.	Revision	Date	DETECTOR LOOP INSTALLATION DETAILS		
F					
E					
D					
C					
B	REFERENCED DWG. No. REV'D (NOTE 2)	DEC 98	Date	Approved	SPECIFICATION DRAWING No.
A	SPELLING REVISION	AUG 96	15/11/95	M.C. (Signature on File) Chief Highway Engineer	SP635-2.8.1



No.14 RW90 LOOP CONDUCTOR  
(SEE DRAWING SP635-2.8.6 FOR  
CONDUCTOR COLOUR CODING)

4 TURN LOOP SHOWN  
(NUMBER OF TURNS MAY VARY  
AS NOTED ON THE PLANS OR  
AS DIRECTED BY THE MINISTRY  
REPRESENTATIVE)

LAY CONDUCTOR IN  
DIRECTION OF ARROWS  
(TYPICAL)

TWIST OF LOOP CONDUCTORS  
IN HOME RUN SLOT FROM  
LOOP TO SHIELDED CABLE  
(15 TURNS PER METRE)

LEAVE ENOUGH SLACK IN LOOP  
CONDUCTORS AND SHIELDED  
CABLES TO EXTEND 500mm  
OUT OF THE JUNCTION BOX

SHIELDED CABLE TO LOOP  
CONDUCTOR SPLICES IN  
JUNCTION BOX (SEE DRAWING  
SP635-2.8.7 FOR DETAILS)

SHIELDED LEAD-IN CABLE

HOME RUN SLOT  
(SEE DRAWING SP635-2.8.5  
FOR DETAILS)

JUNCTION BOX

TO J.B.

LOOP SLOT  
(SEE DRAWING SP635-2.8.5  
FOR DETAILS)

1800  
(TYPICAL)

LOOP CONDUCTOR LAYOUT

LOOP SLOT PATTERN

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOOP CONDUCTORS SHALL BE INSTALLED IN THE SAWCUT SLOT.
4. LOOP INSTALLATION PROCEDURES & RULES SHALL BE FOLLOWED IN ACCORDANCE WITH DRAWINGS SP635-2.8.8 AND -2.8.9.
5. ALL DIAMOND DETECTOR LOOPS SHALL BE 4 TURN UNLESS OTHERWISE NOTED.
6. DIAMOND LOOPS SHALL NOT BE USED FOR SHORT DURATION OR PERMANENT TRAFFIC COUNTER STATION INSTALLATIONS.

NOT TO SCALE

LOOP INDUCTANCE TABLE ( $\mu\text{H}$ ) (LESS SHIELDED LEAD-IN CABLE INDUCTANCE)	
TURNS	INDUCTANCE
4	120 $\mu\text{H}$
5	180 $\mu\text{H}$
6	252 $\mu\text{H}$
7	336 $\mu\text{H}$

LOOP INDUCTANCE SHALL BE GREATER THAN THE SHIELDED CABLE INDUCTANCE. (A 2:1 RATIO IS PREFERABLE). SHIELDED CABLE INDUCTANCE IS 0.56  $\mu\text{H}$  PER METRE FOR 18 AWG WIRE.



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	DIAMOND DETECTOR LOOP INSTALLATION DETAILS		
F			Date Approved  <b>15/11/95    M.C. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  <b>SP635-2.8.2</b>
E					
D					
C					
B	SHIELDED CABLE WIRE SIZE NOTED, NOTE 6 ADDED	NOV 98			
A	SHIELDED CABLE INDUCTANCE REVISED	AUG 96			



No.14 RW90 LOOP CONDUCTOR  
(SEE DRAWING SP635-2.8.6 FOR  
CONDUCTOR COLOUR CODING)

4 TURN LOOP SHOWN  
(NUMBER OF TURNS MAY VARY  
AS NOTED ON THE PLANS OR  
AS DIRECTED BY THE MINISTRY  
REPRESENTATIVE)

LAY CONDUCTOR IN  
DIRECTION OF ARROWS  
(TYPICAL)

TWIST OF LOOP CONDUCTORS  
IN HOME RUN SLOT FROM  
LOOP TO SHIELDED CABLE  
(15 TURNS PER METRE)

LEAVE ENOUGH SLACK IN LOOP  
CONDUCTORS AND SHIELDED  
CABLES TO EXTEND 500mm  
OUT OF THE JUNCTION BOX

SHIELDED CABLE TO LOOP  
CONDUCTOR SPLICES IN  
JUNCTION BOX (SEE DRAWING  
SP635-2.8.7 FOR DETAILS)

SHIELDED LEAD-IN CABLE

HOME RUN SLOT  
(SEE DRAWING SP635-2.8.5  
FOR DETAILS)

JUNCTION BOX

LOOP SLOT  
(SEE DRAWING SP635-2.8.5  
FOR DETAILS)

1800  
(TYPICAL)

TO J.B.

LOOP CONDUCTOR LAYOUT

LOOP SLOT PATTERN

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOOP CONDUCTORS SHALL BE INSTALLED IN THE SAWCUT SLOT.
4. LOOP INSTALLATION PROCEDURES & RULES SHALL BE FOLLOWED IN ACCORDANCE WITH DRAWINGS SP635-2.8.8 AND -2.8.9.
5. ALL ROUND DETECTOR LOOPS SHALL BE 4 TURN UNLESS OTHERWISE NOTED.
6. ROUND LOOPS SHALL NOT BE USED FOR SHORT DURATION OR PERMANENT TRAFFIC COUNTER STATION INSTALLATIONS.

NOT TO SCALE

**LOOP INDUCTANCE TABLE ( $\mu\text{H}$ )**  
(LESS SHIELDED LEAD-IN CABLE INDUCTANCE)

TURNS	INDUCTANCE
4	95 $\mu\text{H}$
5	140 $\mu\text{H}$
6	195 $\mu\text{H}$
7	260 $\mu\text{H}$

LOOP INDUCTANCE SHALL BE GREATER THAN THE SHIELDED CABLE INDUCTANCE. (A 2:1 RATIO IS PREFERABLE). SHIELDED CABLE INDUCTANCE IS 0.56  $\mu\text{H}$  PER METRE FOR 18 AWG WIRE.



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

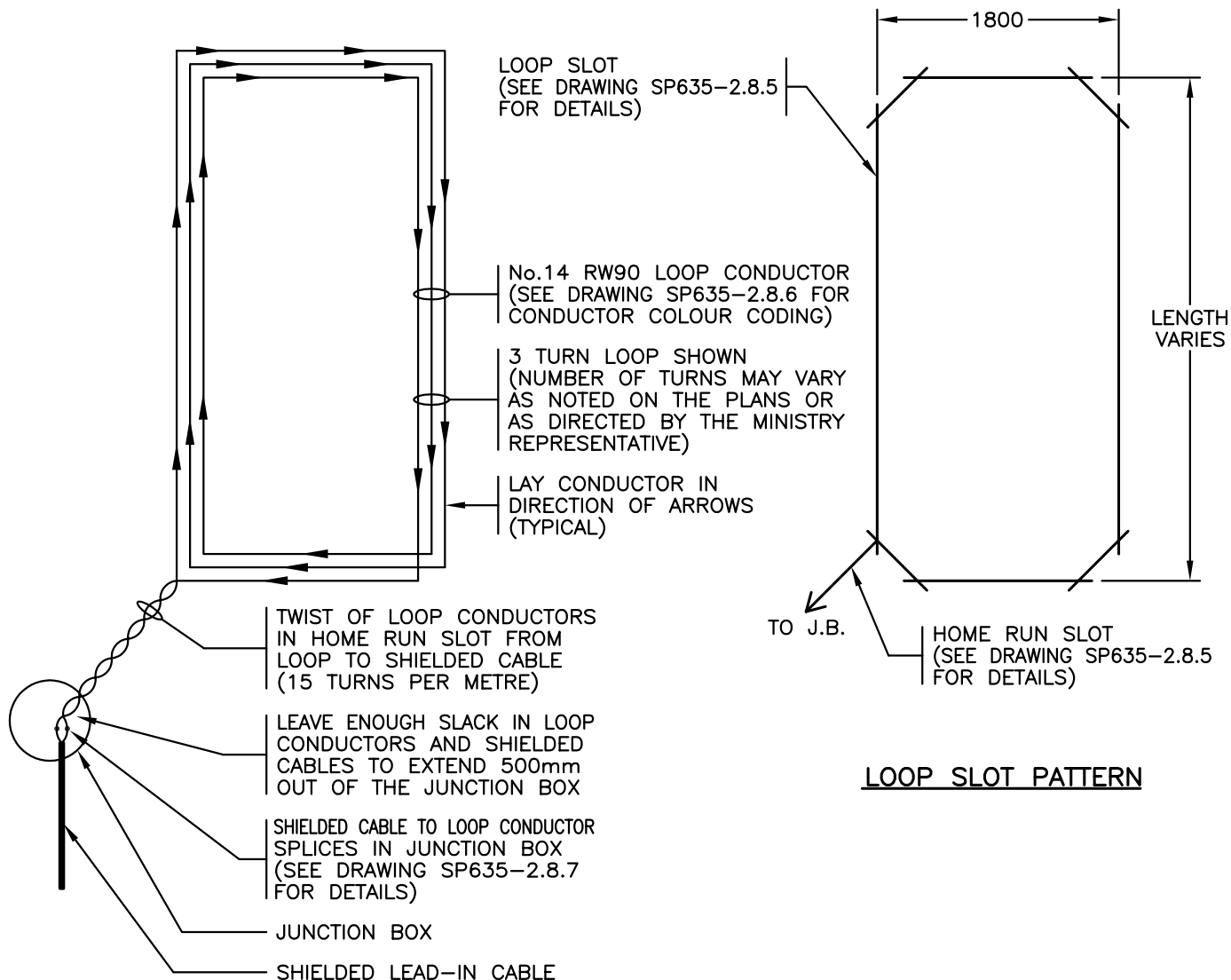
No.	Revision	Date
F		
E		
D		
C		
B		
A	ALTERNATE NOTE REMOVED	OCT 03

### ROUND DETECTOR LOOP INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.8.3**





**LOOP SLOT PATTERN**

**LOOP CONDUCTOR LAYOUT**

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOOP CONDUCTORS SHALL BE INSTALLED IN THE SLOTTED SAWCUT.
4. LOOP INSTALLATION PROCEDURES & RULES SHALL BE FOLLOWED IN ACCORDANCE WITH DRAWINGS SP635-2.8.8 AND -2.8.9.
5. ALL RECTANGULAR DETECTOR LOOPS SHALL BE 3 TURN UNLESS OTHERWISE NOTED.

**LOOP INDUCTANCE FORMULA ( $\mu\text{H}$ )  
(LESS SHIELDED LEAD-IN CABLE INDUCTANCE)**

$$L = P/4 (3.28)(N^2 + N)$$

$L$  = LOOP INDUCTANCE ( $\mu\text{H}$ )  
 $P$  = PERIMETER (METRES)  
 $N$  = NUMBER OF TURNS

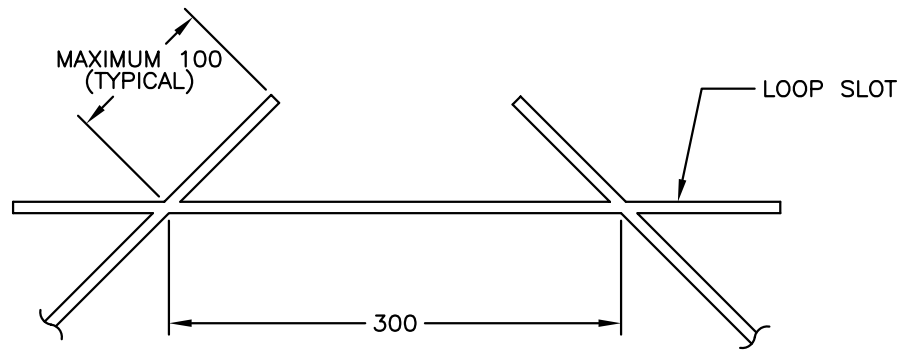
LOOP INDUCTANCE SHALL BE GREATER THAN THE SHIELDED CABLE INDUCTANCE. (A 2:1 RATIO IS PREFERABLE). SHIELDED CABLE INDUCTANCE IS 0.56  $\mu\text{H}$  PER METRE FOR 18 AWG WIRE.

NOT TO SCALE

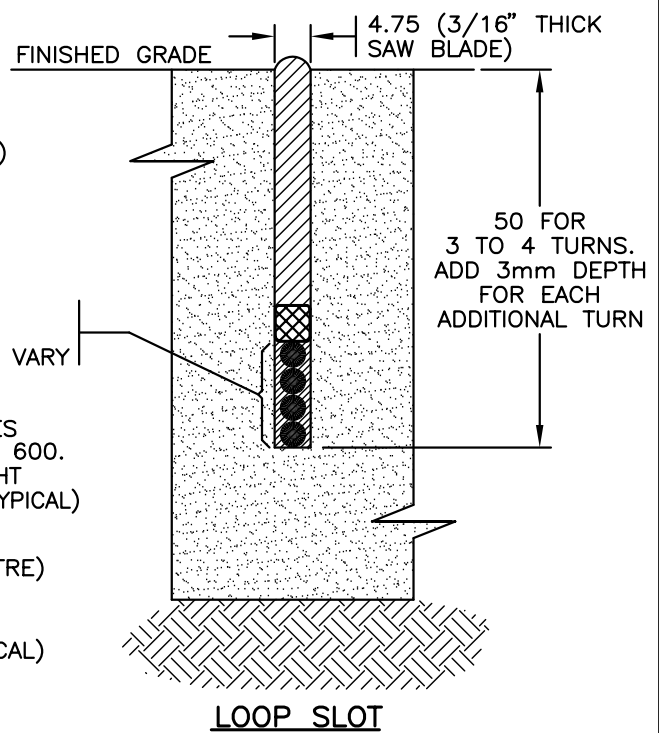
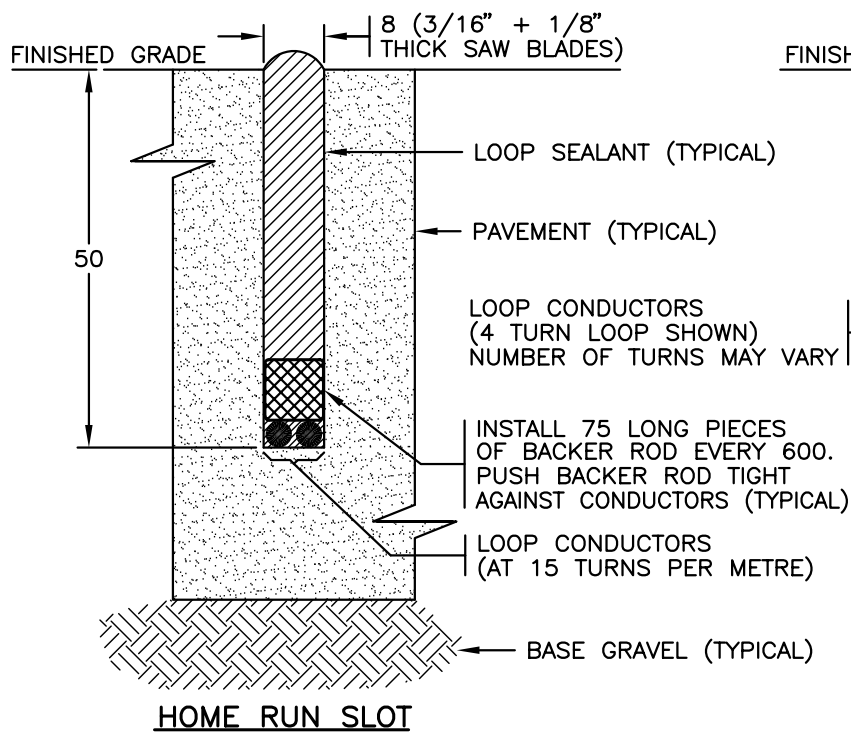


No.	Revision	Date	RECTANGULAR DETECTOR LOOP INSTALLATION DETAILS		
E			<div>DateApproved</div> <div><div>15/11/95M.C. (Signature on File)</div><div>Chief Highway Engineer</div></div> <div><div>SPECIFICATION DRAWING No.</div><div>SP635—2.8.4</div></div>		
D					
C					
B	DRAWING NUMBER CHANGED & SHIELDED CABLE WIRE SIZE NOTED	NOV 98			
A	SHIELDED CABLE INDUCTANCE REVISED	AUG 96			





**TYPICAL LOOP CORNER DETAIL**  
(FOR DIAMOND & RECTANGULAR LOOPS)



**NOTES**

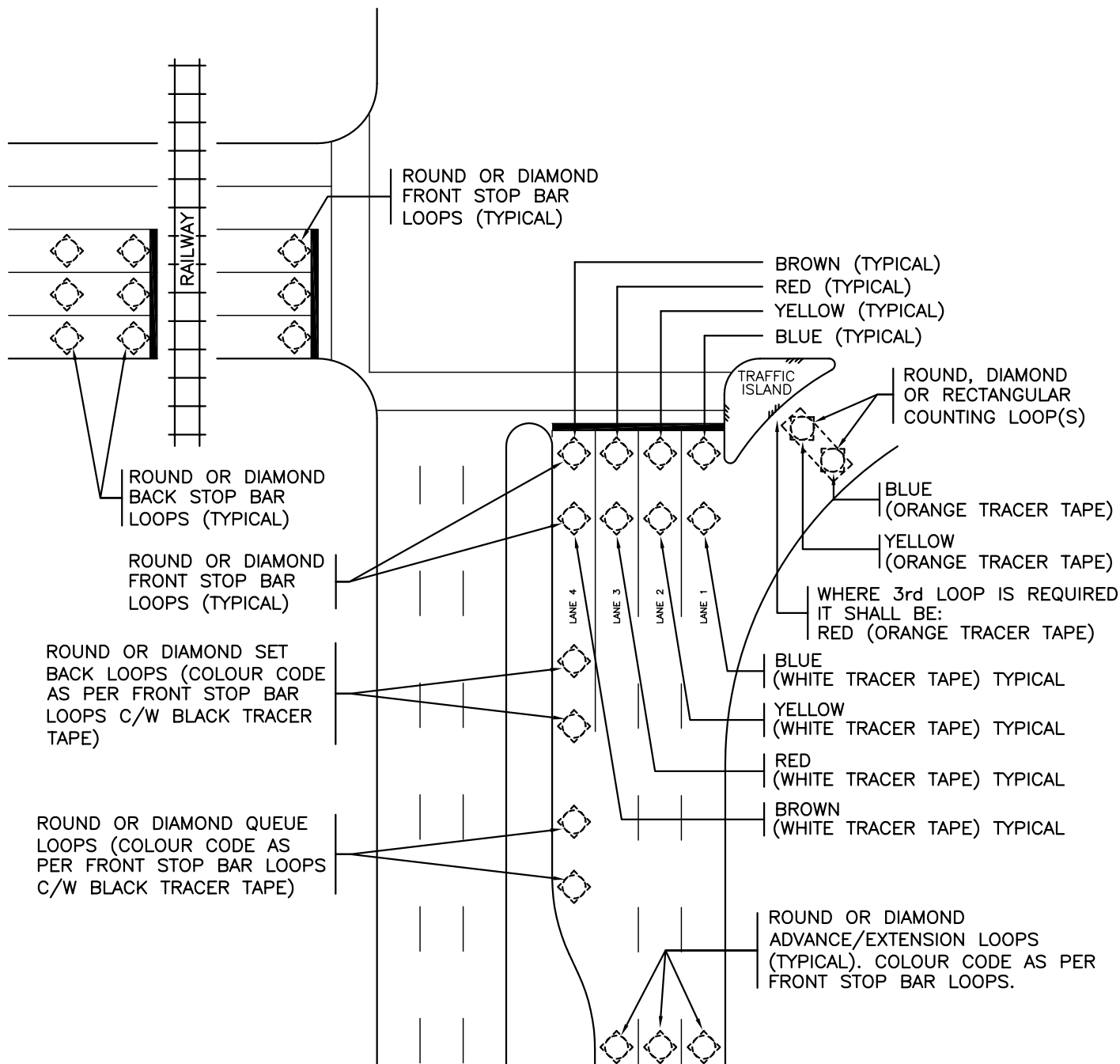
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. APPROVED LOOP SLOT SEALANTS ARE ELSRO HOT POUR CRACK FILLER No. 1190, BURFALT 16607 170, TYPE 2 OR LEFRENZ SYSTEM 400. ALTERNATE PRODUCTS MUST MEET MINISTRY APPROVAL.
4. APPROVED BACKER RODS ARE DETECTOR SYSTEMS BR-625. ALTERNATE PRODUCTS MUST MEET MINISTRY APPROVAL.
5. ONLY ONE LOOP SHALL BE INSTALLED IN EACH HOME RUN SLOT.

NOT TO SCALE



No.	Revision	Date	LOOP AND HOME RUN SLOT DETAILS	
F			Date	Approved
E				
D			15/11/95	M.C. (Signature on File)
C				
B	APPROVED SEALER ADDED	AUG 99	Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-2.8.5
A	DRAWING NUMBER CHANGED	NOV 98		





## DETECTOR LOOPS

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION
2. COLOUR CODE IS BASED ON USING RIGHT HAND CURB OF ROAD AS POINT OF REFERENCE & WORKING LOOP CONDUCTORS LEFT TOWARDS CENTRE OF ROADWAY. WHERE A 5th LANE, USE ORANGE CONDUCTOR COLOUR.
3. RECTANGULAR DETECTOR LOOP CONDUCTORS SHALL BE BLACK.

NOT TO SCALE



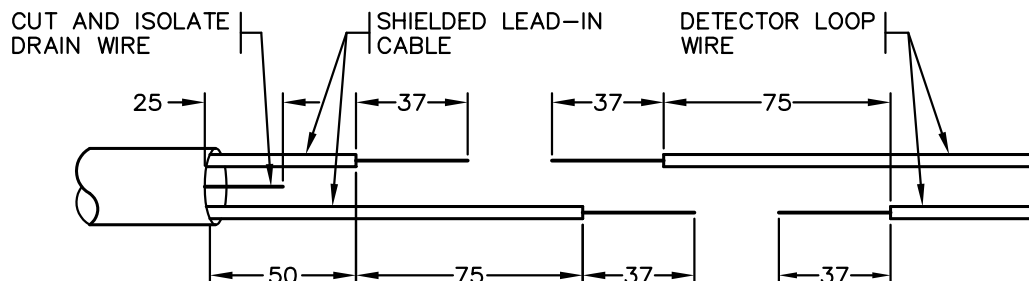
**BRITISH COLUMBIA**

Ministry of  
Transportation

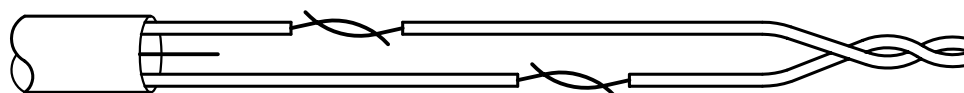
No.	Revision	Date	DETECTOR LOOP TYPES COLOUR CODING	
E				
D				
C				
B	SETBACK, QUEUE & ADVANCE LOOPS ADDED	SEPT 00	Date	Approved
A	DRAWING NUMBER CHANGED, ROUND LOOPS ADDED	NOV 98	<b>15/11/95 M.C. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-2.8.6</b>



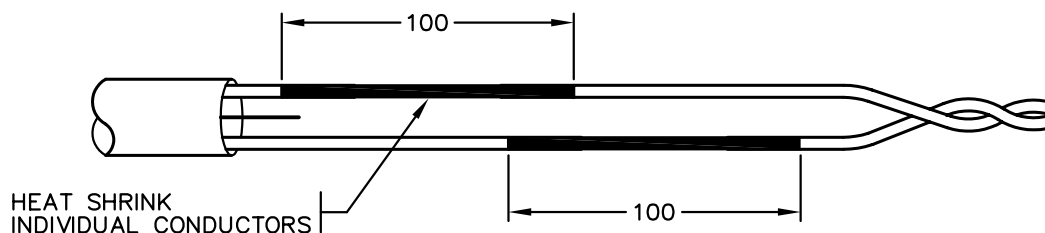
**STEP 1. STRIP LOOP WIRES AND LEAD-IN CABLE AND SLIDE ON HEAT SHRINKS**



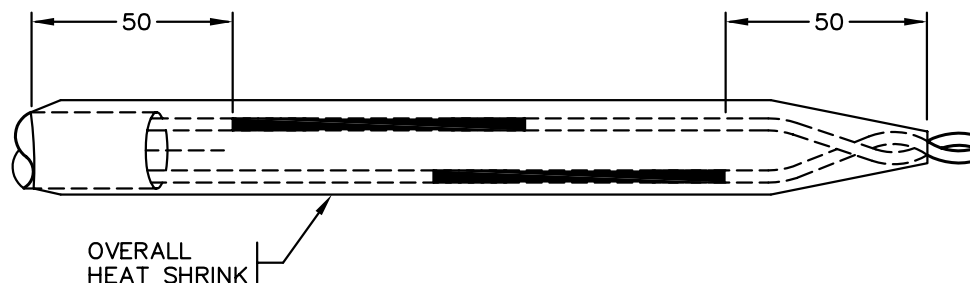
**STEP 2. CONNECT AND SOLDER. TWIST BARE CONDUCTORS TOGETHER AND SOLDER WITH 60/40 (TIN/LEAD) RESIN SOLDER.**



**STEP 3. INSULATE EACH SOLDER JOINT SEPARATELY**



**STEP 4. ENVIRONMENTALLY SEAL TOTAL SPLICE.**



**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. HEAT SHRINK SHALL BE PREMIER CLEAR-SEAL (1/4" I.D. INDIVIDUAL CONDUCTORS & 3/8" I.D. FOR OVERALL) OR APPROVED ALTERNATE.

NOT TO SCALE



No.	Revision	Date	DETECTOR LOOP TO SHIELDED CABLE SPLICING DETAILS	
F			Date	Approved
E			15/11/95	M.C. (Signature on File)
D			Chief Highway Engineer	SPECIFICATION DRAWING No.
C				SP635-2.8.7
B				
A	DRAWING NUMBER CHANGED	NOV 98		



## STEP BY STEP LOOP INSTALLATION PROCEDURES AND RULES ARE AS FOLLOWS:

**STEP 1** CONFIRM THE TYPE OF LOOP TO BE INSTALLED (ie. DIAMOND ROUND OR RECTANGULAR).  
LOOP TYPES ARE DETAILED ON DRAWINGS SP635-2.8.2 to -2.8.4.

**STEP 2** LAYOUT DETECTOR LOOPS AND REVIEW LOCATIONS WITH THE MINISTRY ELECTRICAL REPRESENTATIVE PRIOR TO SAWCUTTING THE ROADWAY. THE GENERAL LAYOUT OF THE DETECTOR LOOPS IS INDICATED ON DRAWINGS SP635-2.8.11 to -2.8.14. STOP BARS AND LANE LINES MUST BE LAID OUT PRIOR TO LOCATING DETECTOR LOOPS.

**RULE 1** *DETECTOR LOOPS SHALL NOT BE INSTALLED WHEN THE ROAD IS WET OR WHEN THE AMBIENT (AIR) TEMPERATURE IS LOWER THAN 5°C, UNLESS APPROVED IN WRITING BY THE MINISTRY ELECTRICAL REPRESENTATIVE. SEALANTS DO NOT ADHERE PROPERLY IN WET CONDITIONS. SHOULD THE CONTRACTOR BE ASKED IN WRITING BY THE MINISTRY ELECTRICAL REPRESENTATIVE TO INSTALL LOOPS IN THE WET AND/OR WHEN THE AIR TEMPERATURE IS BELOW 5°C, THE INSTALLATION WARRANTY WILL NOT BE ENFORCED.*

**RULE 2** *DETECTOR LOOPS SHALL NOT BE INSTALLED WHEN THE PAVEMENT IS CRACKED OR BADLY RUTTED UNLESS THE INSTALLATION IS APPROVED IN WRITING BY THE MINISTRY ELECTRICAL REPRESENTATIVE. SAW CUTS CAN OFTEN CAUSE PAVEMENT CONDITIONS TO DETERIORATE FURTHER. IF RE-SURFACING OF THE INTERSECTION IS NOT PLANNED THEN PHOTOGRAPHS SHOULD BE TAKEN TO DOCUMENT THE PAVEMENT CONDITIONS BEFORE AND AFTER THE LOOP INSTALLATION. PHOTOGRAPHS SHALL BE LABELED WITH THE LOOP NUMBERS AND THEN SUBMITTED TO THE THE MINISTRY ELECTRICAL REPRESENTATIVE AFTER THE INSTALLATION IS COMPLETED.*

**STEP 3** CUT LOOP AND HOME RUN SLOTS IN ASPHALT.  
ALL LOOP AND HOME RUN SLOTS SHALL BE CUT TO THE SAME DEPTH, WITH A PAVEMENT SAW. SLOTS SHALL NOT PASS THROUGH PAVEMENT INTO THE BASE GRAVEL.

**RULE 3** *LOOP AND HOME RUN SLOT MUST BE INSTALLED AT LEAST 300mm FROM ANY OTHER LOOP AND EACH LEAD-IN SLOTS, EXCEPT WHERE THE LEAD-IN CONDUCTORS ENTER THE 1" RPVC CONDUIT. THIS WILL REDUCE THE PROBABILITY OF INTERFERENCE BETWEEN LOOPS.*

**RULE 4** *WHEN REPLACING LOOPS, CUT THROUGH TWICE ON EACH SIDE OF EXISTING LOOP. THIS MAY REQUIRE ADDITIONAL SAW CUTS, IF THE EXISTING LOOP IS NOT LOCATED IN THE SAW CUT PATH OF THE NEW LOOP. THIS WILL ELIMINATE THE POSSIBILITY OF INTERFERENCE BETWEEN THE OLD AND THE NEW LOOP.*

**STEP 4** CLEAN THE SLOT WITH A PROFESSIONAL GRADE PRESSURIZED WATER SYSTEM. REMOVE ALL WATER AND DIRT OUT OF THE SLOT CUT AND THE SURROUNDING 100mm OF ROAD SURFACE USING COMPRESSED AIR. SLOT MUST REMAIN COMPLETELY CLEAN AND DRY UNTIL THE SLOT IS SEALED.

**STEP 5** INSTALL THE LOOP CONDUCTOR INTO THE LOOP SLOT. ENSURE CONDUCTORS ARE TIGHTLY WOUND AND PUSHED INTO THE BOTTOM OF THE SLOT. TWIST CONDUCTOR HOME RUN AT 15 TURNS PER METRE. INSTALL 75mm STRIPS OF BACKER ROD EVERY 600mm TO HOLD CONDUCTORS INTO SLOT.

**RULE 5** *ONLY ONE CONTINUOUS CONDUCTOR SHALL BE INSTALLED IN EACH LOOP AND HOME RUN SLOT TO THE JUNCTION BOX.*

**RULE 6** *LOOP CONDUCTORS MUST BE INSTALLED IMMEDIATELY AFTER THE LOOP AND HOMERUN SLOTS ARE CUT.*

**STEP 6** INSTALL LOOP SEALANT AFTER CONDUCTORS HAVE BEEN INSTALLED. LOOP SEALANTS SHALL BE HEATED AS PER MANUFACTURER'S INSTRUCTIONS AND NEATLY APPLIED USING A FUNNEL WITH A NARROW SPOUT. ANY EXCESS SEALANT ON ROAD SURFACE SHALL BE REMOVED. AN ADDITIONAL APPLICATION OF LOOP SEALANT MAY BE REQUIRED WHERE THE SEALANT IS NOT UP TO THE PAVEMENT GRADE.

**STEP 7** ONCE THE SEALING OF THE SLOT HAS BEEN PROPERLY COMPLETED, A DUST SUCH AS PORTLAND CEMENT SHALL BE SPRINKLED ONTO THE SEALANT TO PREVENT TRACKING BY ROADWAY TRAFFIC. ANY EXCESS DUST SHALL BE SWEEPED OFF THE ROADWAY PRIOR TO ALLOWING TRAFFIC TO PASS OVER THE SEALED SLOT.

**RULE 7** *SPLICES WILL NOT BE ALLOWED IN LOOP CONDUCTORS OR SHIELDED CABLES.*

### NOTES

1. SEE DRAWING SP635-2.8.9 FOR CONTINUATION OF PROCEDURES AND RULES.



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	DETECTOR LOOP INSTALLATION PROCEDURES AND RULES		
D					
C					
B	MINISTRY REPRESENTATIVE CHANGED TO MINISTRY ELECTRICAL REPRESENTATIVE	OCT 03	Date	Approved	SPECIFICATION DRAWING No.
A	DRAWING NUMBER CHANGED, ROUND LOOPS ADDED	NOV 98	15/11/95	M.C. (Signature on File) Chief Highway Engineer	SP635-2.8.8



**CONTINUED FROM DRAWING SP635-2.8.8**

**STEP 8** A LOOP CHECK SHEET AS SHOWN ON DRAWING SP635-2.8.10 SHALL BE COMPLETED EACH TIME A NEW LOOP IS INSTALLED. PAVEMENT CONDITIONS ARE TO BE RECORDED BEFORE ANY SAW CUTS HAVE BEEN MADE. WEATHER CONDITIONS ARE TO BE RECORDED AT THE TIME THAT THE LOOPS ARE SEALED. MEASUREMENTS SHALL BE TAKEN AT THE JUNCTION BOX CLOSEST TO THE LOOP. (SEE RULE 8)

**STEP 9** THE SPLICES BETWEEN DETECTOR LOOP CONDUCTORS AND THE SHIELDED CABLE ARE TO BE SOLDERED AND SEALED WITH HEAT SHRINK IN ACCORDANCE WITH DRAWING SP635-2.8.7.

**STEP 10** REPEAT STEP 8 AT THE JUNCTION BOX OR VAULT NEAREST CONTROLLER.

**RULE 8** *LOOP DETECTOR RESISTANCE TO GROUND SHALL BE GREATER THAN 1 MEGAOHM, LOOP RESISTANCE SHALL BE FROM 0 TO 5 OHMS & LOOP INDUCTANCE SHALL BE WITHIN 20% OF THE VALUES SHOWN ON DRAWINGS SP635-2.8.2 TO -2.8.4 OR AS NOTED ON THE PLANS.*

**STEP 11** SUBMIT THE COMPLETED LOOP CHECK SHEET AND ANY RELEVANT PHOTOGRAPHS TO THE MINISTRY ELECTRICAL REPRESENTATIVE AND THE MINISTRY REGIONAL ELECTRICAL MANAGER. THE TOTAL CIRCUIT INDUCTANCE VALUES AND THE MEGGER TEST VALUES WILL BE USED AS A BASELINE TO VERIFY DEGRADATION IN LOOP PERFORMANCE.

**STEP 12** TAG EACH LOOP CABLE AS NOTED ON DRAWINGS SP635-2.5.7 AND -2.5.8.

**RULE 9** *MAINTAIN THE MAXIMUM SEPARATION POSSIBLE IN THE JUNCTION BETWEEN THE LOOP CONDUCTORS AND POWER CONDUCTORS.*



No.	Revision	Date	DETECTOR LOOP INSTALLATION PROCEDURES AND RULES		
F					
E					
D					
C	STEP 11 CLARIFIED	OCT 03	Date	Approved	SPECIFICATION DRAWING No.
B	DRAWING NUMBER CHANGED	NOV 98	15/11/95	M.C. (Signature on File)	SP635-2.8.9
A	RULE 8 REVISED	AUG 96	Chief Highway Engineer		





Weather Conditions: Air Temp: \_\_\_\_\_ Precipitation: \_\_\_\_\_

[illegible][illegible]

\* example of possible pavement conditions: good, cracked, sealed cracked, ruts at stop bar, pavement patches

\*\* megger test — max 250V DC

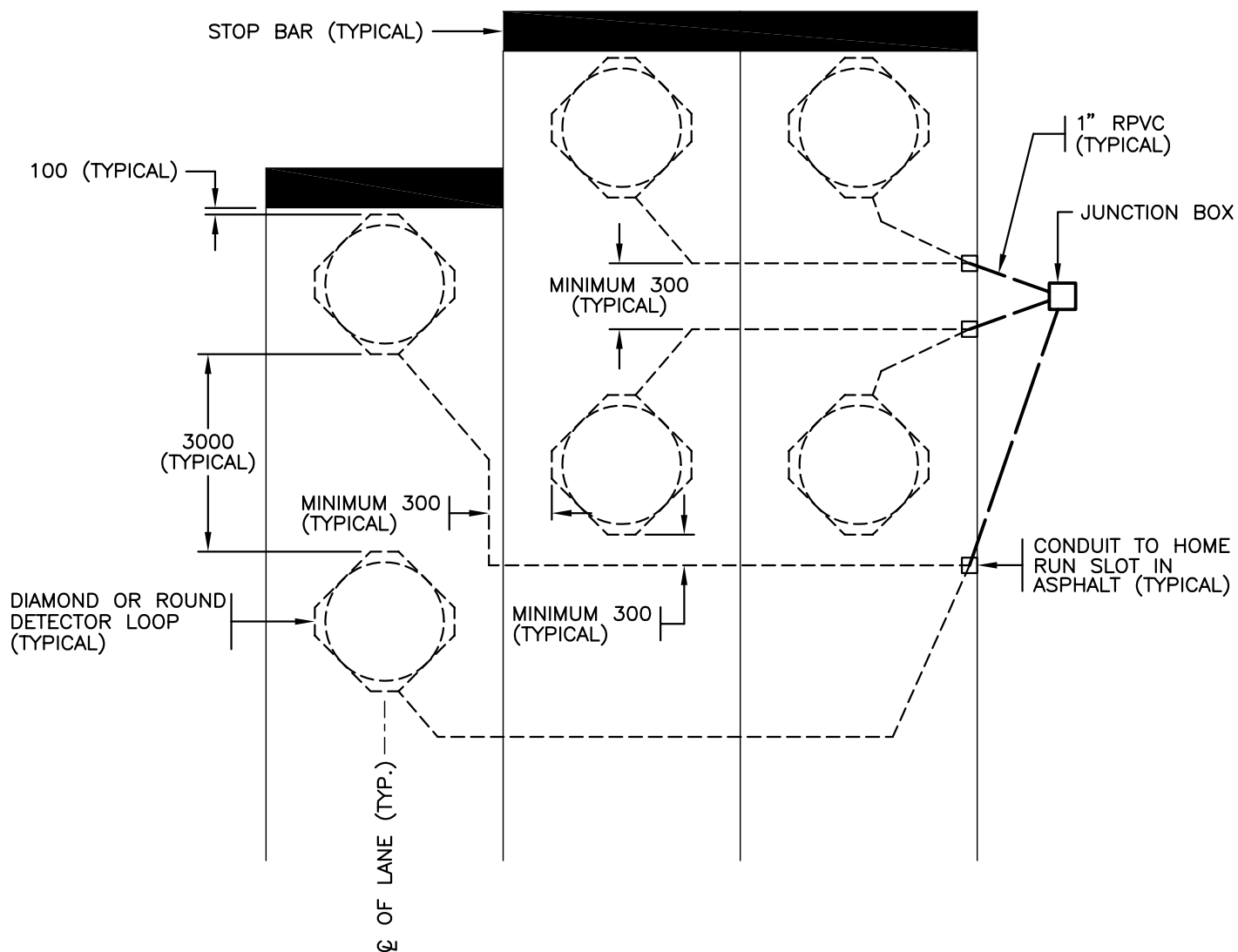
No.	Revision	Date
F		
E		
D		
C		
B		
A	DRAWING NUMBERS CHANGED	NOV 98

# LOOP CHECK SHEET

Date Approved  
**15/11/95 M.C. (Signature on File)**  
 Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
SP635-2.8.10





**TYPICAL LOOP LAYOUT**

**NOTES**

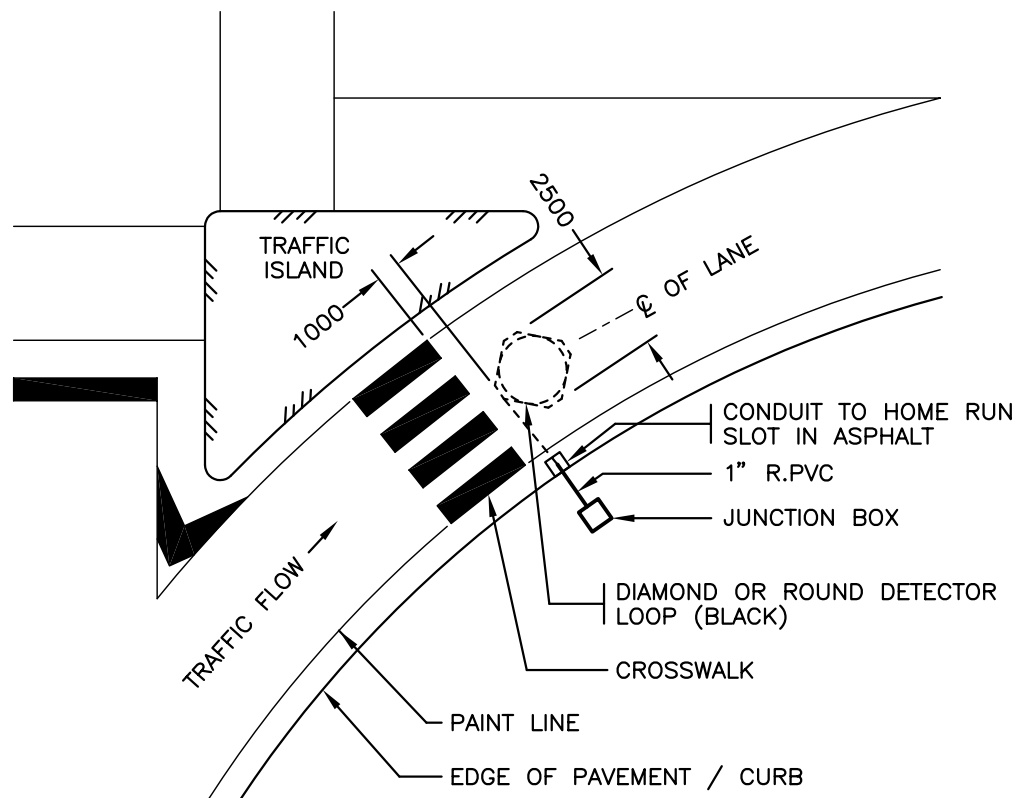
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. LOCATE LOOP CONDUITS IN ASPHALT TO SUIT LOOP LOCATIONS & MINIMIZE THE LENGTHS OF HOME RUN SLOTS IN THE ASPHALT.

NOT TO SCALE



No.	Revision	Date	LAYOUT FOR DIAMOND OR ROUND TRAFFIC SIGNAL DETECTOR LOOPS		
E			<div>DateApproved</div> <div>15/11/95M.C. (Signature on File) Chief Highway Engineer</div> <div>SPECIFICATION DRAWING No. SP635—2.8.11</div>		
D					
C					
B					
A	DRAWING NUMBER CHANGED, ROUND LOOPS ADDED	NOV 98			





**RIGHT TURN LANE WITH  
TRAFFIC ISLAND SCENARIO SHOWN**  
PAVEMENT WIDTH UP TO 5900

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. FOR DIAMOND LOOP DETECTOR DETAILS SEE DRAWING SP635-2.8.2 FOR ROUND LOOP DETECTOR DETAILS SEE DRAWING SP635-2.8.3
4. LOCATE LOOP CONDUITS IN ASPHALT TO SUIT LOOP LOCATIONS & MINIMIZE THE LENGTHS OF HOME RUN SLOTS IN THE ASPHALT.

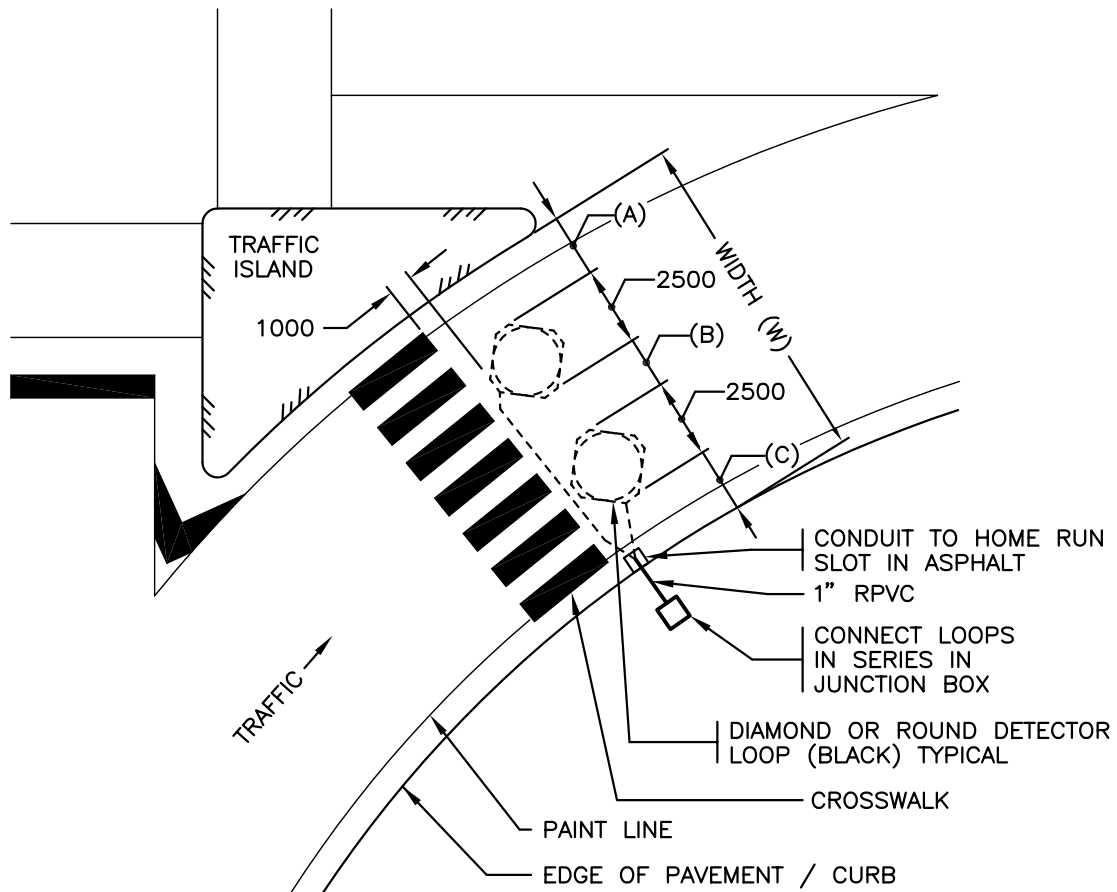
NOT TO SCALE



No.	Revision	Date	LAYOUT FOR DIAMOND OR ROUND COUNTING DETECTOR LOOP	
E				
D			Date 15/11/95	Approved M.C. (Signature on File) Chief Highway Engineer
C				
B			SPECIFICATION DRAWING No. SP635-2.8.12	
A	DRAWING NUMBER CHANGED, ROUND LOOPS ADDED	NOV 98		



LOOP SPACING TABLE			
WIDTH (W)	(A)	(B)	(C)
6000	400	200	400
7000	750	500	750
8000	1100	800	1100
9000	1500	1000	1500



## RIGHT TURN LANE WITH TRAFFIC ISLAND SCENARIO SHOWN

PAVEMENT WIDTH  
BETWEEN 6000 AND 9000

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. FOR DIAMOND DETECTOR LOOP DETAILS SEE DRAWING SP635-2.8.2.  
FOR ROUND DETECTOR LOOP DETAILS SEE DRAWING SP635-2.8.3.
4. LOCATE LOOP CONDUITS IN ASPHALT TO SUIT LOOP LOCATIONS & MINIMIZE THE LENGTHS OF HOME RUN SLOTS IN THE ASPHALT.

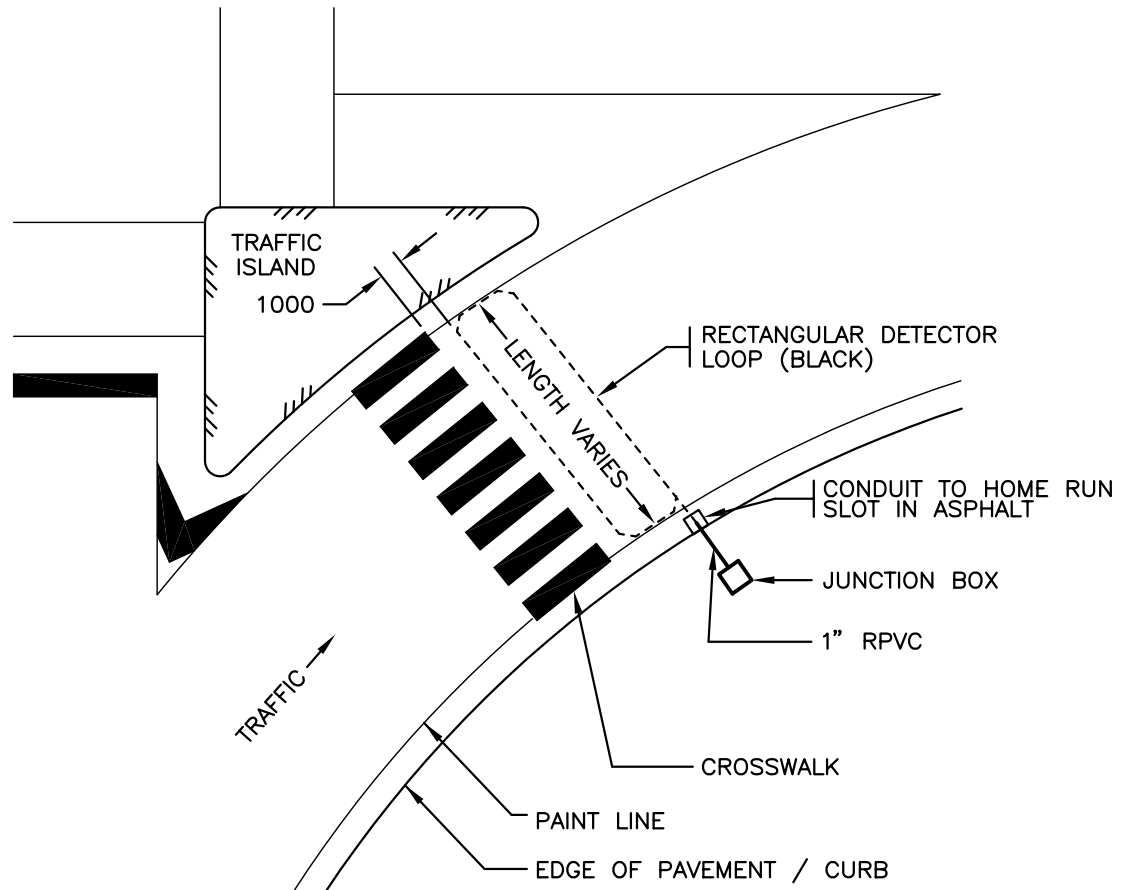
NOT TO SCALE



No.	Revision	Date	LAYOUT FOR DIAMOND OR ROUND COUNTING DETECTOR LOOPS	
E			Date Approved  <b>15/11/95 M.C. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No.  <b>SP635-2.8.13</b>
D				
C				
B				
A	DRAWING NUMBER CHANGED, ROUND LOOPS ADDED	NOV 98		



ON STRAIGHT SECTIONS OF ROADS, THE LOOP  
WILL BE CENTERED IN THE LANE.  
ON CURVED ROADS (AS SHOWN BELOW) THE  
LOOP WILL BE LOCATED, SHAPED AND SIZED TO  
BEST REFLECT THE TRAVEL PATHS OF VEHICLES.



### RIGHT TURN LANE WITH TRAFFIC ISLAND SCENARIO SHOWN

#### NOTES

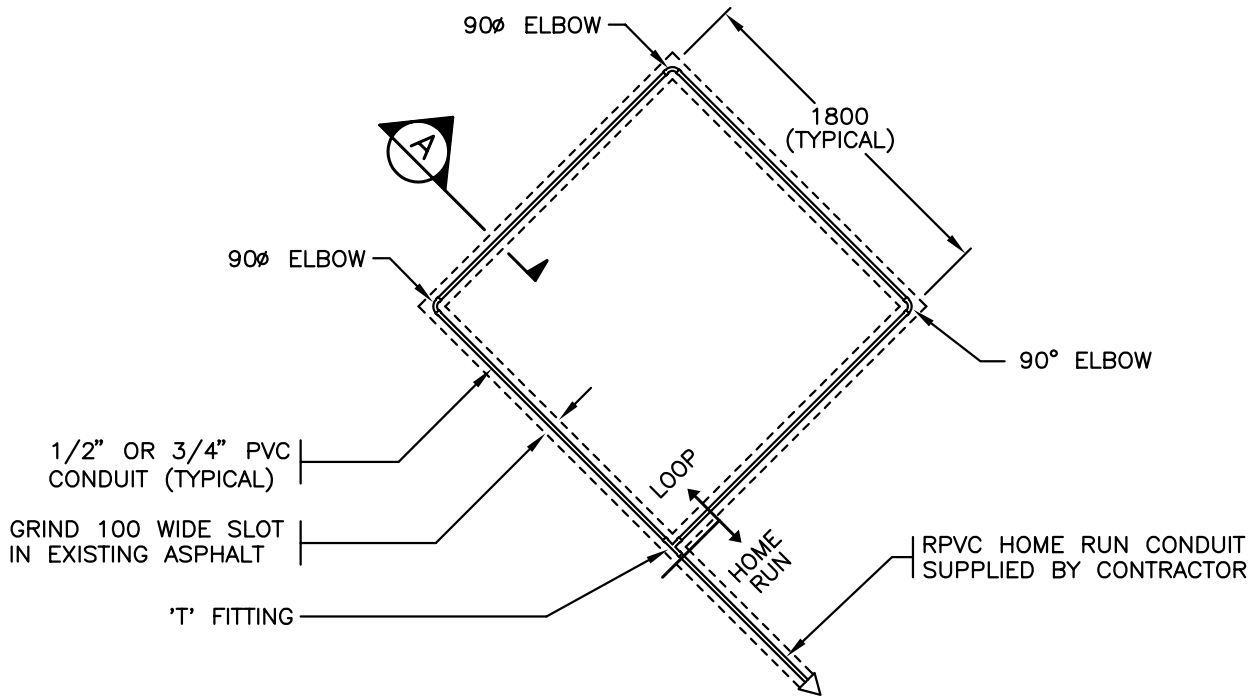
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. FOR RECTANGULAR DETECTOR LOOP DETAILS SEE DRAWING SP635-2.8.4
4. LOCATE LOOP CONDUITS IN ASPHALT TO SUIT LOOP LOCATIONS & MINIMIZE THE LENGTHS OF HOME RUN SLOTS IN THE ASPHALT.

NOT TO SCALE



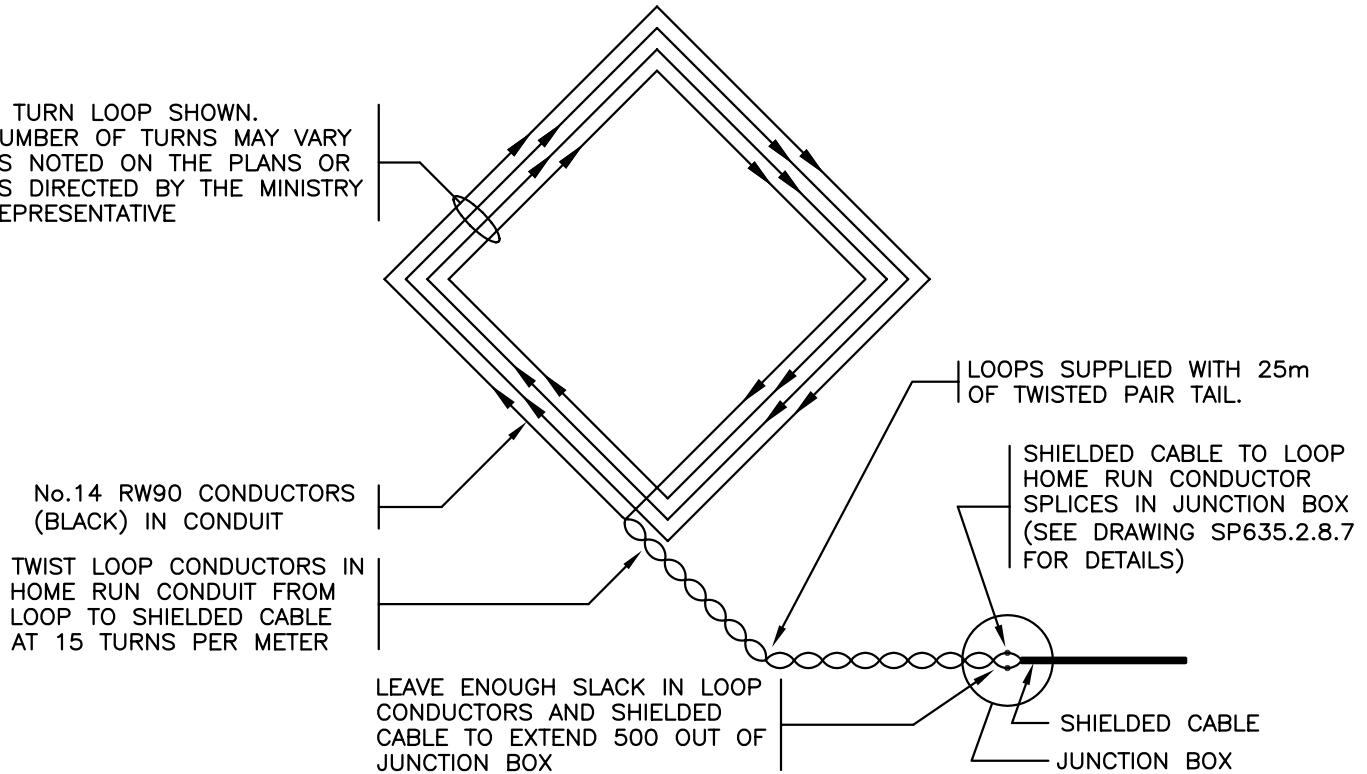
No.	Revision	Date	LAYOUT FOR RECTANGULAR COUNTING DETECTOR LOOPS	
F			Date	Approved
E				
D			15/11/95	M.C. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-2.8.14
A	DRAWING NUMBER CHANGED,	NOV 98		





### PREFORMED LOOP LAYOUT

4 TURN LOOP SHOWN.  
NUMBER OF TURNS MAY VARY  
AS NOTED ON THE PLANS OR  
AS DIRECTED BY THE MINISTRY  
REPRESENTATIVE



### CONDUIT LAYOUT IN PREFORMED LOOP

SEE DRAWING SP635-2.8.16 FOR NOTES

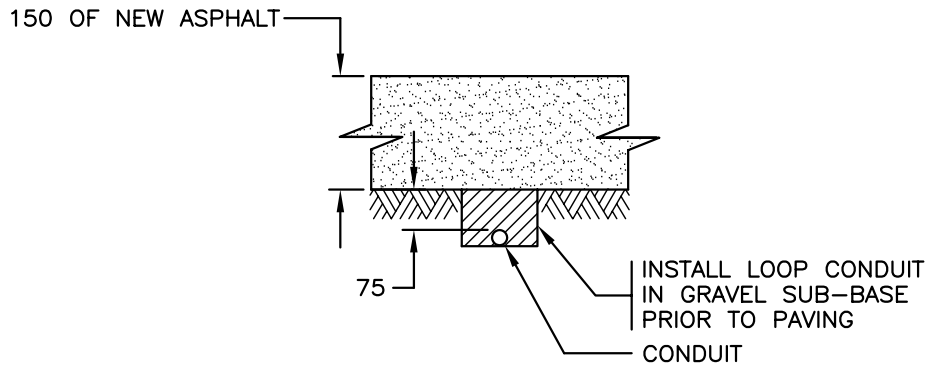
SEE DRAWING SP635-2.8.2 FOR LOOP INDUCTANCE TABLE

NOT TO SCALE

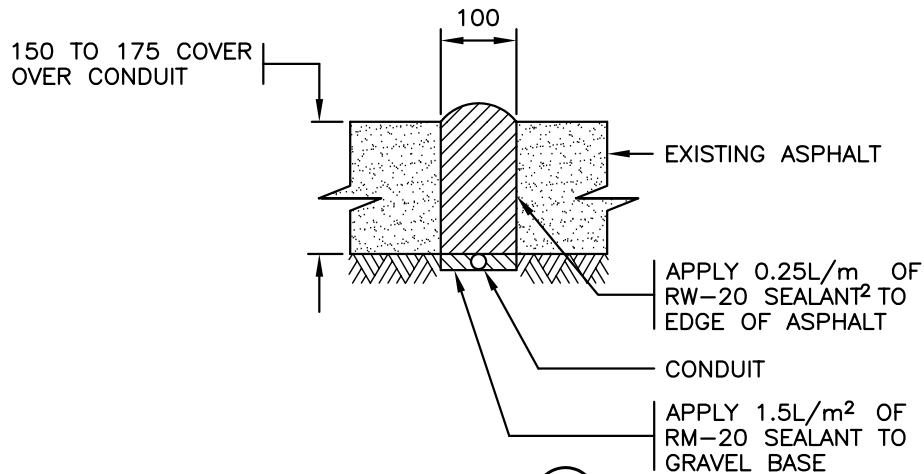


No.	Revision	Date	PRE—FORMED DIAMOND DETECTOR LOOP INSTALLATION DETAILS	
F			Date Approved  <b>16/10/00 M.C. (Signature on File)</b> Chief Engineer	SPECIFICATION DRAWING No.  SP635—2.8.15
E				
D				
C				
B				
A				





**SECTION (A)**  
NEW ROAD CONSTRUCTION



**SECTION (A)**  
EXISTING ROAD SURFACE

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. WHERE INSTALLING PREFORMED LOOPS IN EXISTING ASPHALT GRIND OUT SLOT AND INSTALL PREFORMED LOOP. BACKFILL SLOT WITH HOT MIXED ASPHALT PAVEMENT. COMPACT ASPHALT WITH VIBRATING MECHANICAL COMPACTOR WITH 75mm SQUARE PLATE. WHERE INSTALLING PREFORMED LOOPS IN NEW ROAD CONSTRUCTION, PLACE CONDUIT IN GRAVEL SUB-BASE JUST BELOW ASPHALT. LAYOUT STOP BARS, CURB RETURNS, ISLANDS, MEDIANS, LANE LINES AND LOOPS AND VERIFY WITH MINISTRY REPRESENTATIVE PRIOR TO CONSTRUCTION. FAILURE TO CORRECTLY LOCATE THE LOOPS IN THEIR REQUIRED LOCATIONS WILL RESULT IN REINSTALLATION OF THE LOOPS AT THE CONTRACTORS EXPENSE.
4. PREFORMED LOOPS SHALL MEET THE APPROVAL OF THE MINISTRY REPRESENTATIVE PRIOR TO INSTALLATION.
5. CONTRACTOR SHALL VERIFY LOOPS LOCATIONS (CUT INTO OVERLAYED OR NEW PAVED ROADWAYS) WITH THE MINISTRY REPRESENTATIVE AFTER INSTALLATION.
6. PRE-APPROVED LOOPS ARE NOTED ON THE MINISTRY "PRE-APPROVED PRODUCT LIST". PRE-FORMED LOOPS OR EITHER RIGID OR FLEXIBLE PVC TYPE AND COME COMPLETE WITH 25m HOME RUN OF CONDUCTOR. AS THE HOME RUN LENGTHS WILL VARY, THE CONTRACTOR SHALL SUPPLY PVC CONDUIT FOR HOME RUNS. TYPE OF LOOPS (FLEXIBLE OR RIGID) SHALL BE APPROVED BY THE MINISTRY REGIONAL ELECTRICAL MANAGER.

NOT TO SCALE

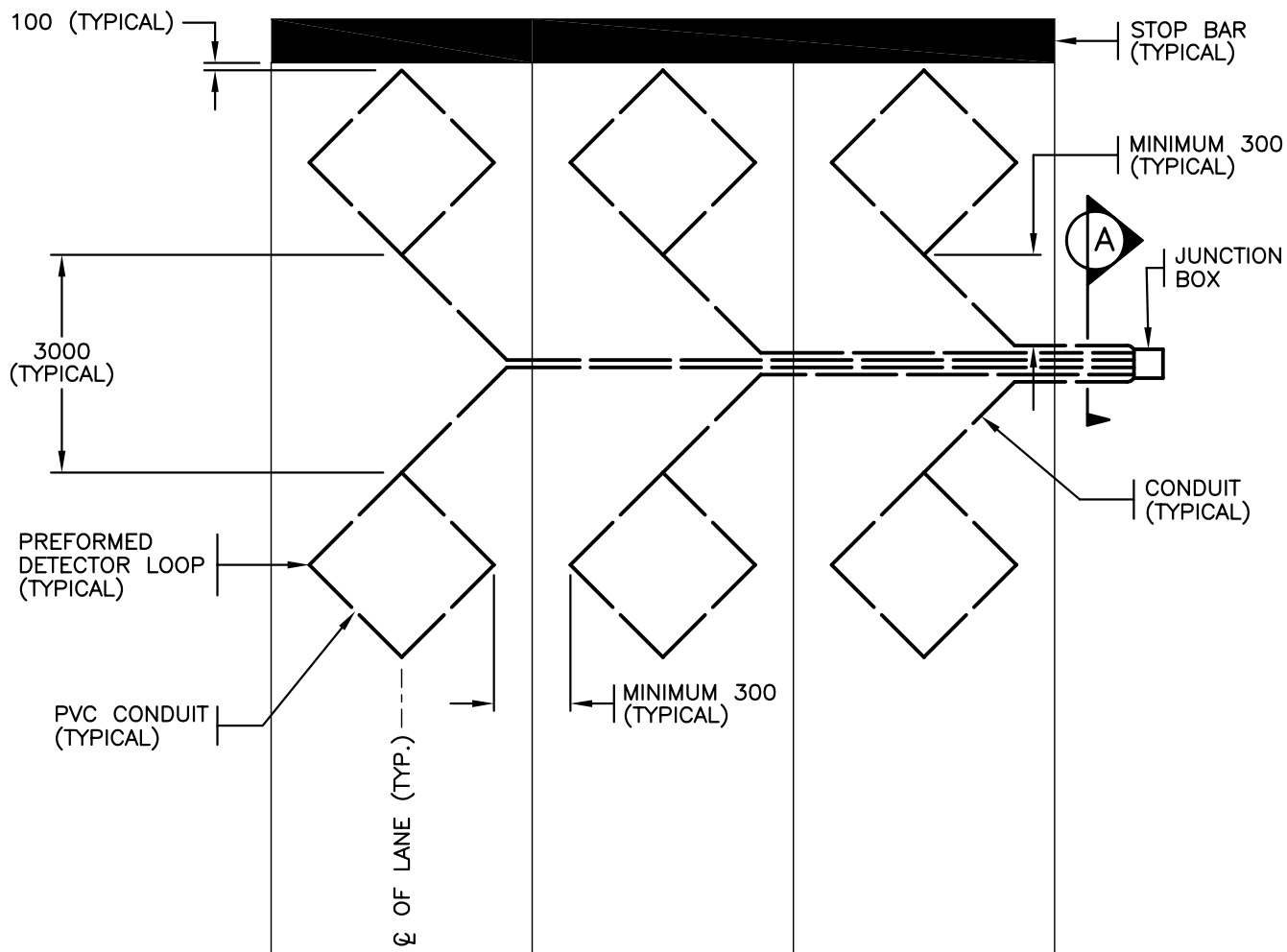


**BRITISH COLUMBIA**

Ministry of  
Transportation

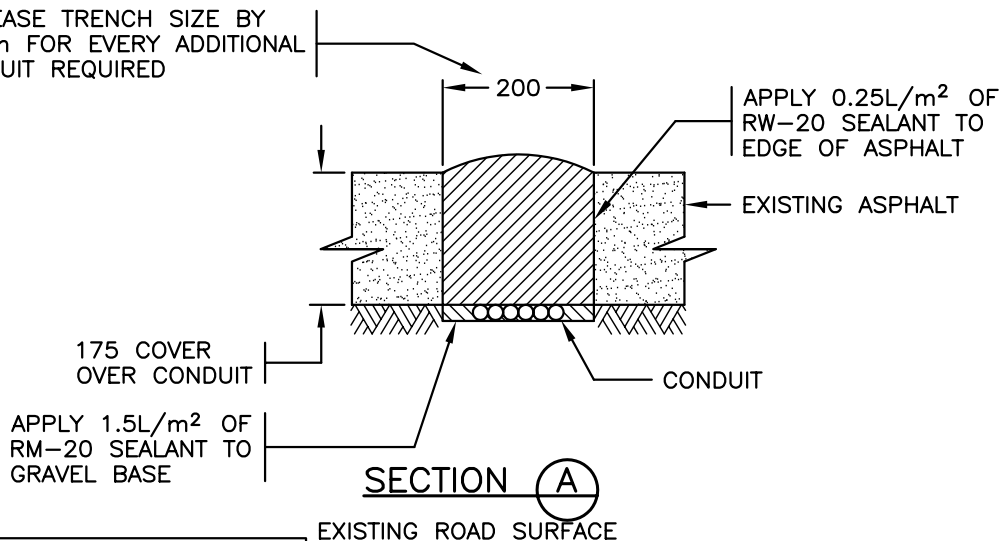
No.	Revision	Date	PRE-FORMED DIAMOND DETECTOR LOOP INSTALLATION DETAILS	
F				
E			Date	Approved
D				
C				
B				
A	NOTE 6 REVISED	OCT 03	Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-2.8.16</b>





**TYPICAL PREFORMED LOOP LAYOUT**

INCREASE TRENCH SIZE BY 20mm FOR EVERY ADDITIONAL CONDUIT REQUIRED



**SECTION A**

EXISTING ROAD SURFACE

SEE DRAWING SP635-2.8.16 FOR NOTES

SEE DRAWING SP635-2.8.2 FOR LOOP INDUCTANCE TABLE

NOT TO SCALE



No.	Revision	Date
F		
E		
D		
C		
B		
A		

**LAYOUT FOR PRE-FORMED  
TRAFFIC SIGNAL DETECTOR LOOPS**

Date Approved  
**16/10/00 M.C. (Signature on File)**  
Chief Engineer

SPECIFICATION  
DRAWING No.  
**SP635-2.8.17**



NOT TO SCALE

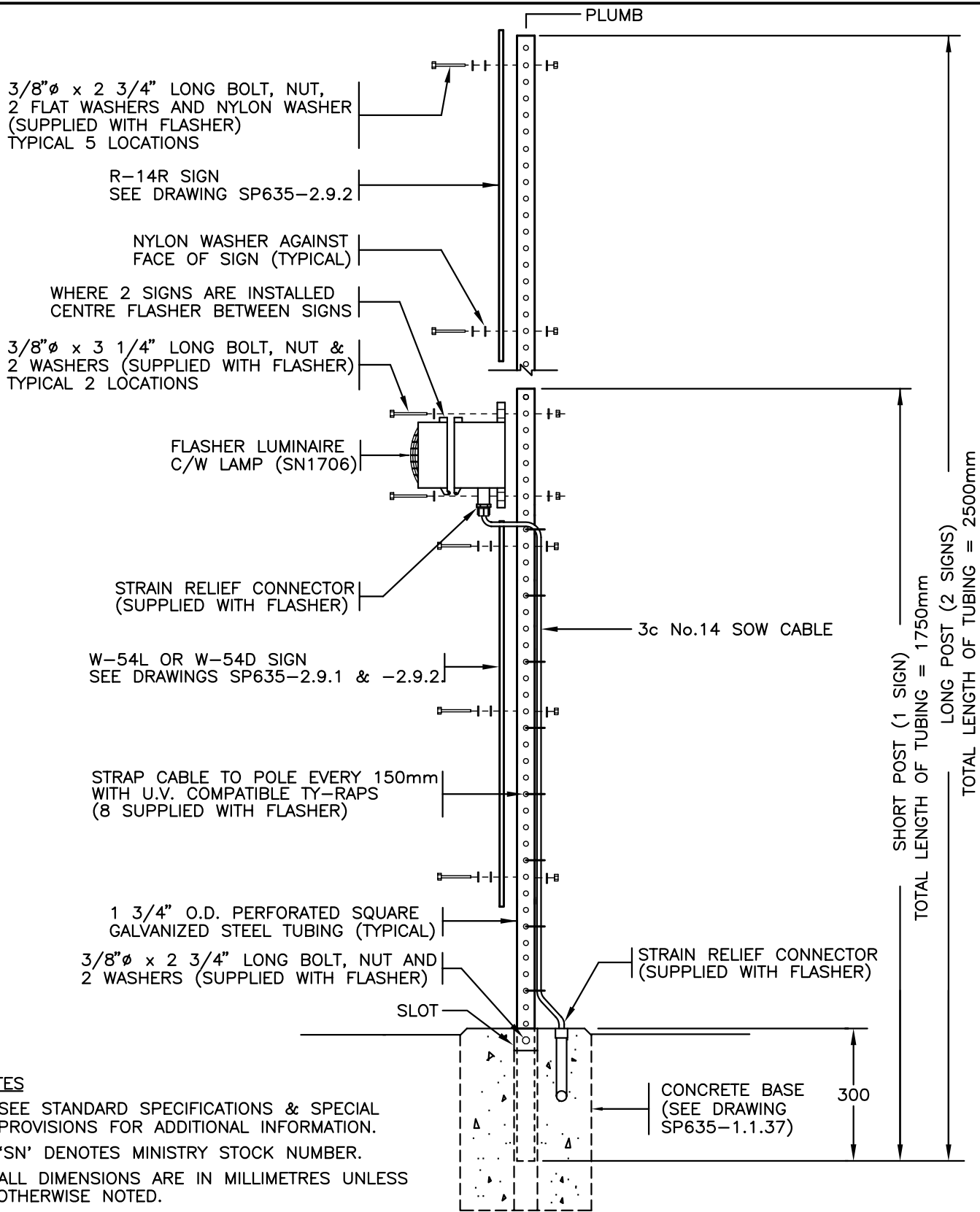


No.	Revision	Date	FLASHER LUMINAIRE INSTALLATION DETAILS ON PERFORATED SQUARE STEEL TUBING (1 SIGN)		
F			<div>Date<div>Approved</div></div> <div><div>MAR 94 E.L. (Signature on File)</div><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. SP635-2.9.1</div>		
E					
D					
C	CONCRETE BASE DRAWING REFERENCE REVISED	AUG 96			
B	REVISION NOTE 'A' ADDED	AUG 95			
A	GENERAL REVISIONS	AUG 94			









#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

SIDE VIEW

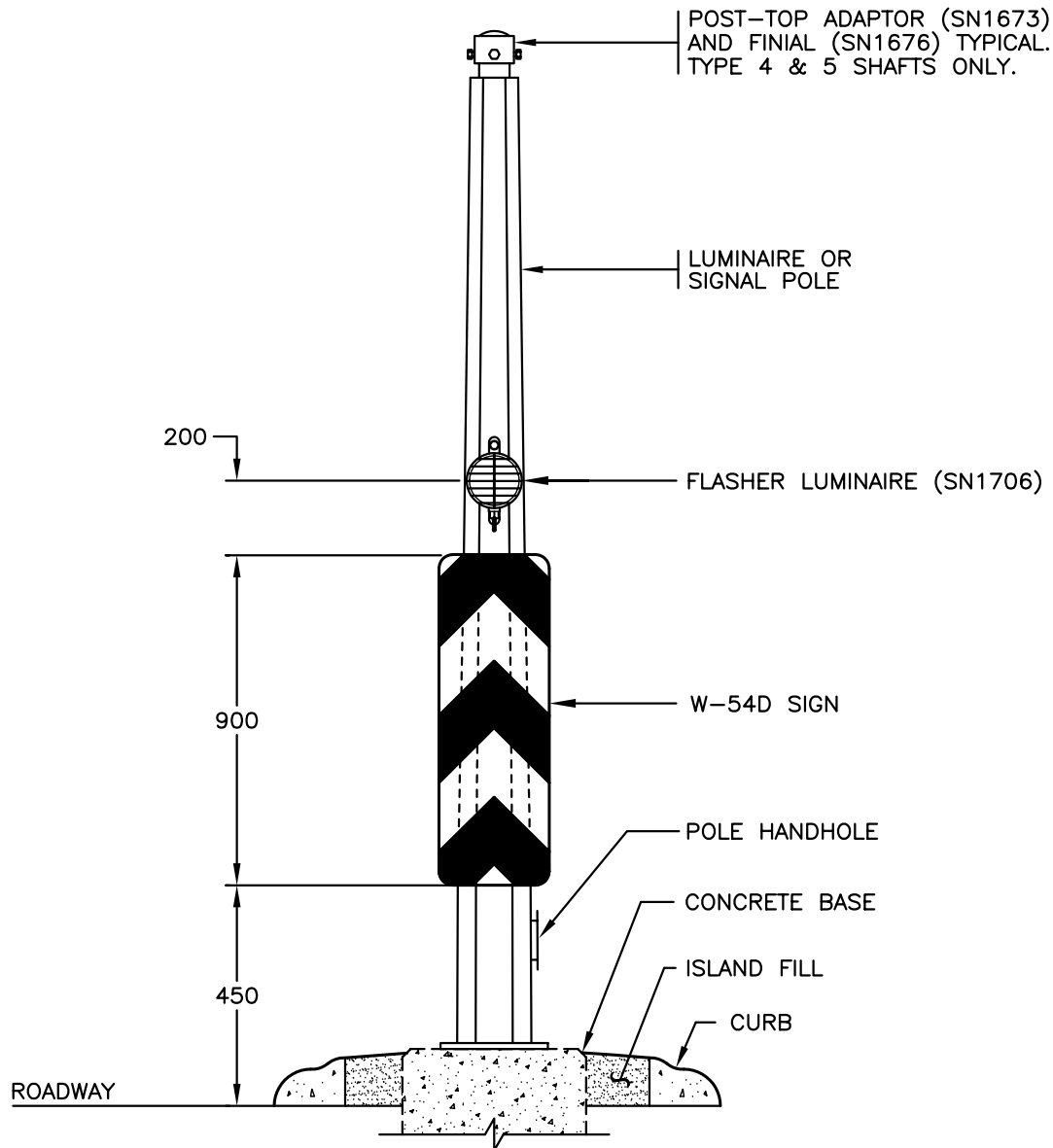


NOT TO SCALE

No.	Revision	Date	FLASHER LUMINAIRE INSTALLATION DETAILS ON PERFORATED SQUARE STEEL TUBING	
F			Date	Approved
E				
D			Date	Approved
C				
B	3c No.14 CABLE NOT SUPPLIED WITH FLASHER	AUG 96	MAR 94 E.L. (Signature on File)	SPECIFICATION DRAWING No. SP635-2.9.3
A	GENERAL REVISIONS	AUG 94		

Chief Highway Engineer





**ELEVATION**

REFER TO THE MINISTRY'S  
MANUAL OF STANDARD SIGNS  
FOR SPECIFIC APPLICATIONS  
WHICH APPLY TO THESE SIGNS

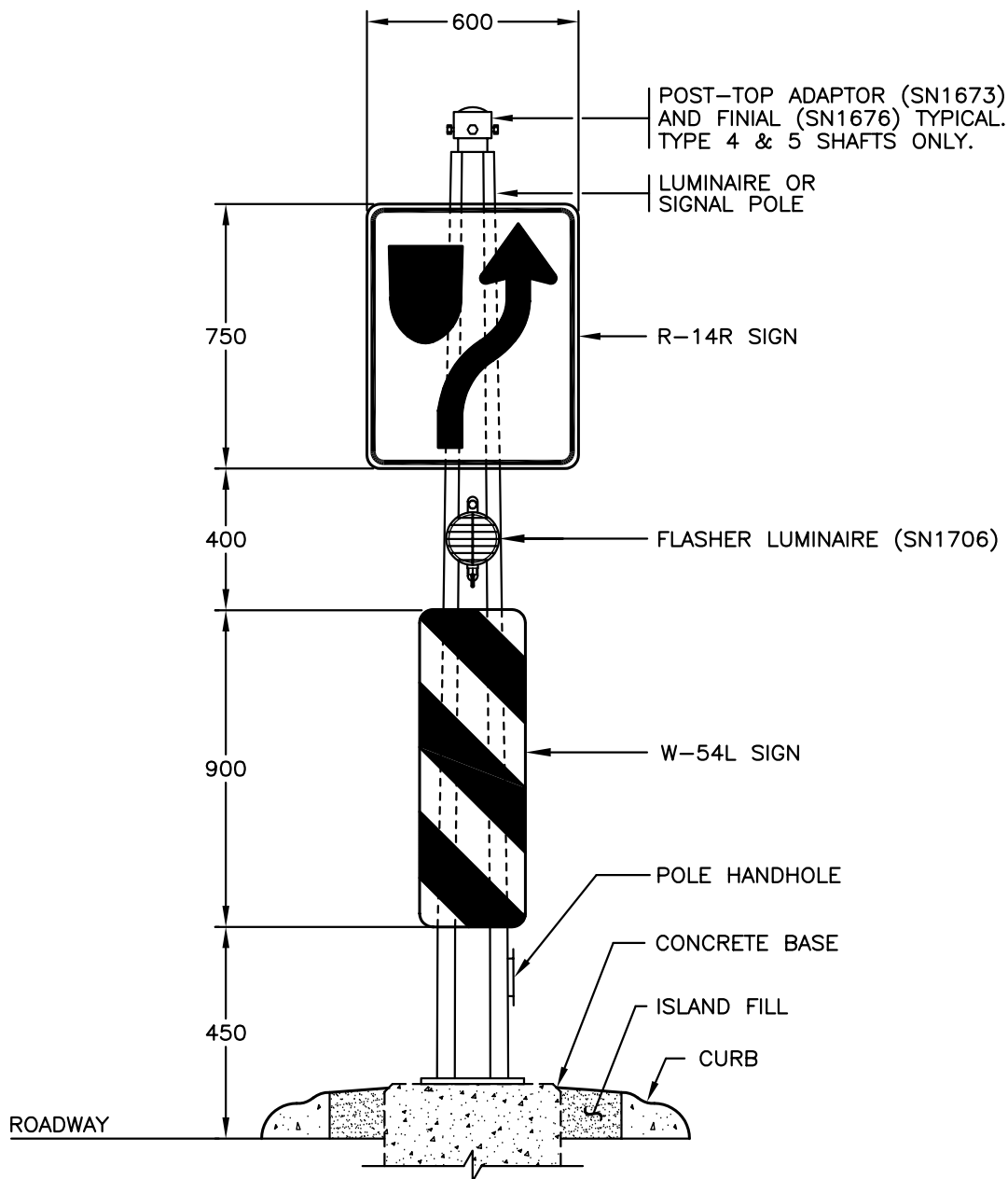
SEE DRAWING SP635-2.9.6 FOR  
NOTES AND ADDITIONAL DETAILS



NOT TO SCALE

No.	Revision	Date	FLASHER LUMINAIRE INSTALLATION DETAILS ON STEEL POLE (1 SIGN)	
F				
E			Date	Approved
D			18/11/94	E.L. (Signature on File)
C			Chief Highway Engineer	
B			SPECIFICATION DRAWING No.	
A			SP635-2.9.4	





REFER TO THE MINISTRY'S  
MANUAL OF STANDARD SIGNS  
FOR SPECIFIC APPLICATIONS  
WHICH APPLY TO THESE SIGNS

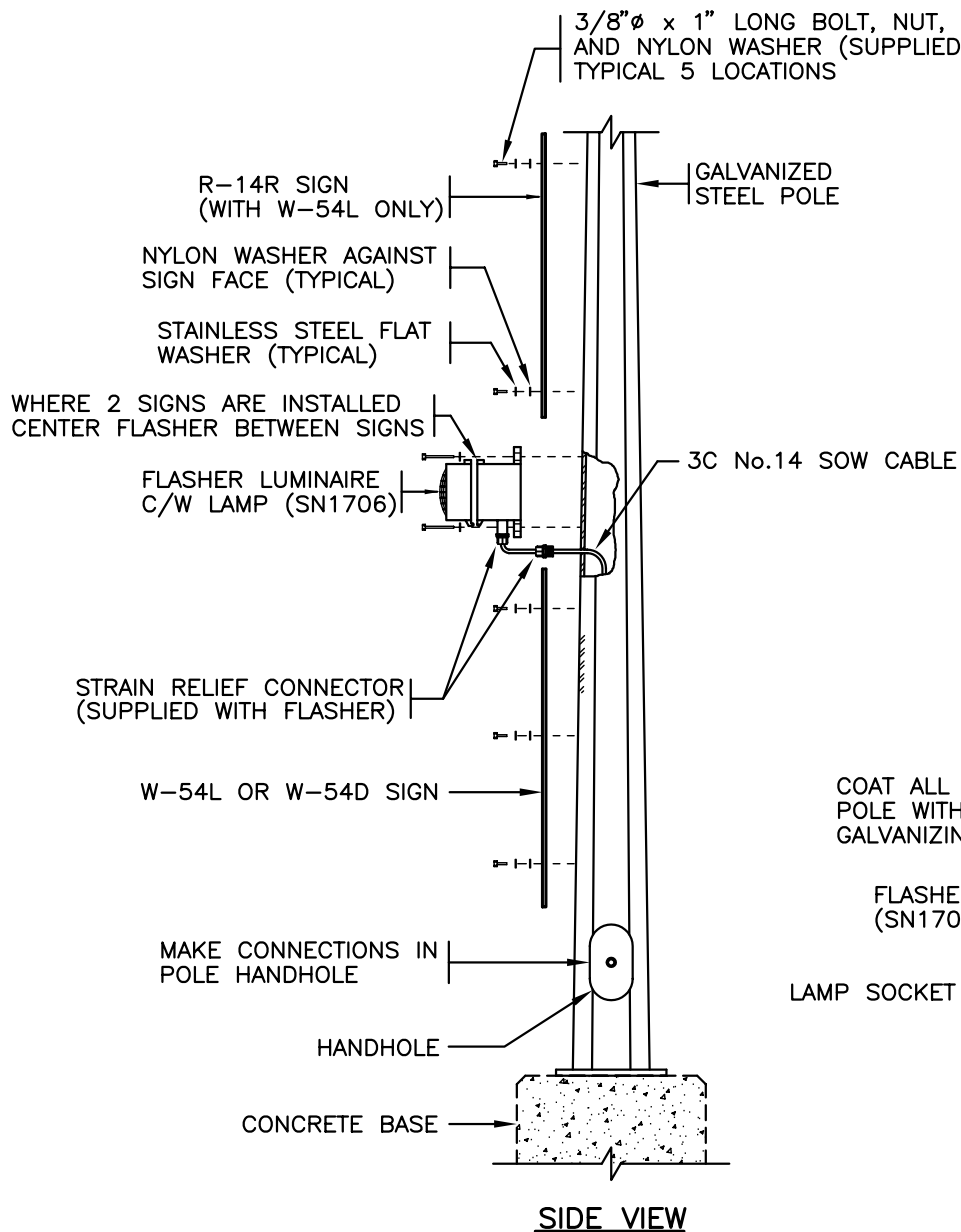
SEE DRAWING SP635-2.9.6 FOR  
NOTES AND ADDITIONAL DETAILS



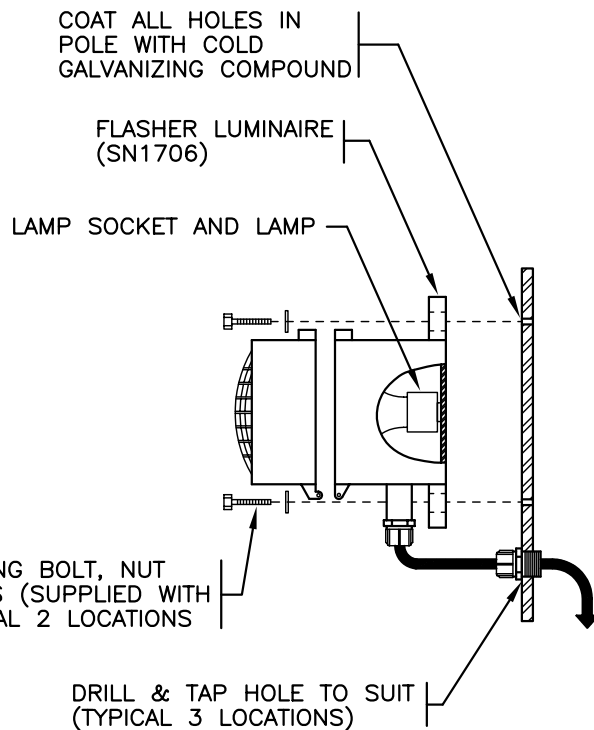
NOT TO SCALE

No.	Revision	Date	FLASHER LUMINAIRE INSTALLATION DETAILS ON STEEL POLE (2 SIGNS)	
F			<div><div>DateApproved</div><div><b>18/11/94</b><b>E.L. (Signature on File)</b></div><div>Chief Highway Engineer</div></div> <div><div>SPECIFICATION DRAWING No.</div><div>SP635-2.9.5</div></div>	
E				
D				
C				
B				
A				





**SIDE VIEW**



**FLASHER LUMINAIRE MOUNTING DETAIL**  
N.T.S.

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	FLASHER LUMINAIRE INSTALLATION DETAILS ON STEEL POLE	
F				
E				
D				
C				
B				
A	3C No.14 NOT SUPPLIED WITH FLASHER	AUG 96	Date <b>18/11/94</b> Chief Highway Engineer	Approved <b>M.C. (Signature on File)</b> SPECIFICATION DRAWING No. <b>SP635-2.9.6</b>



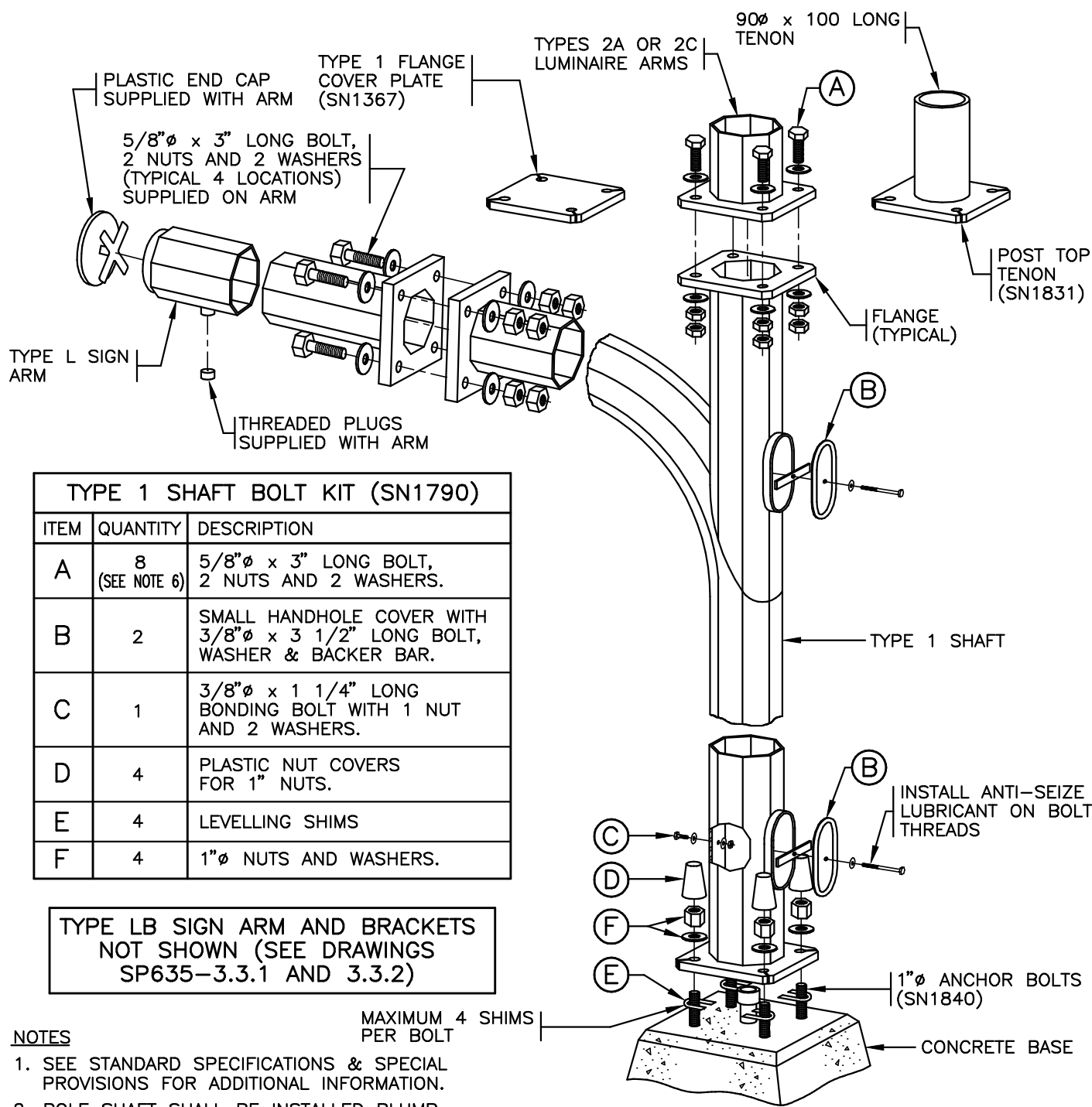
**PART D**

**SIGNING  
DRAWINGS**









### TYPE 1 SHAFT BOLT KIT (SN1790)

ITEM	QUANTITY	DESCRIPTION
A	8 (SEE NOTE 6)	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	2	SMALL HANDHOLE COVER WITH 3/8" $\phi$ x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS
F	4	1" $\phi$ NUTS AND WASHERS.

TYPE LB SIGN ARM AND BRACKETS NOT SHOWN (SEE DRAWINGS SP635-3.3.1 AND 3.3.2)

### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- POLE SHAFT SHALL BE INSTALLED PLUMB.
- ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
- APPLY GREASE TO ANCHOR BOLT THREADS.
- TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.
- 4 EXTRA BOLTS, AS BOLTS ARE SUPPLIED WITH SIGN ARM.
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

NOT TO SCALE

### POLE ASSEMBLY DETAIL

No.	Revision	Date	TYPE 1 SHAFT INSTALLATION DETAILS (SIGN POLE)	
E				
D				
C				
B				
A	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date 24/02/97 M.C. (Signature on File) Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.1.2



TYPE L SIGN ARM  
INCLUDING 4-5/8"  $\phi$  x 3"  
LONG BOLTS, 8 NUTS  
AND 8 FLAT WASHERS

SEE DRAWINGS SP635-3.3.3 TO 3.3.6 FOR  
PLYWOOD SIGN MOUNTING DETAILS & DRAWINGS  
SP635-3.3.11 TO 3.3.17 FOR EXTRUDED  
ALUMINUM SIGN MOUNTING DETAILS.

SIGN OUTLINE  
(MAX 2400 WIDE)

120 A/F

TYPE 1 FLANGE

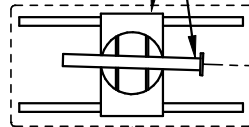
120 A/F  
PLASTIC  
END CAP

3° TO 5°  
RISE

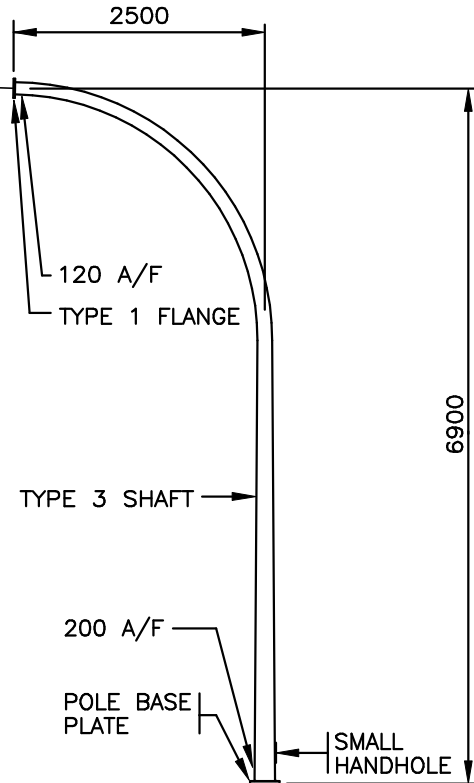
100 (TYPICAL)

LENGTH VARIES  
(MAX 1200)

TYPE LB SIGN ARM AND  
BRACKET FOR PLYWOOD  
SIGNS (SEE DRAWINGS  
SP635-3.3.1 & 3.3.2)

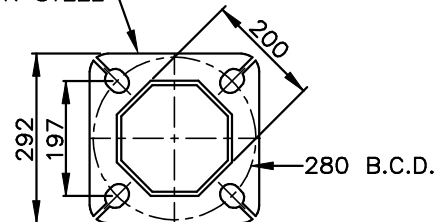


PLYWOOD  
SIGN OUTLINE



**ELEVATION**

25mm THICK STEEL



**POLE BASE PLATE**

## PARTS LIST

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [3] SHAFT	SN1826	186
TYPE L SIGN ARM [LSA] LENGTH VARIES	SN2093	20 PER METRE
TYPE L SIGN ARM [1.2LSA] 1.2m LONG	SN2095	24
TYPE [LB] SIGN ARM AND BRACKET	SN2096	100

\* [ ] I.D. LABEL ON POLE

## NOTES

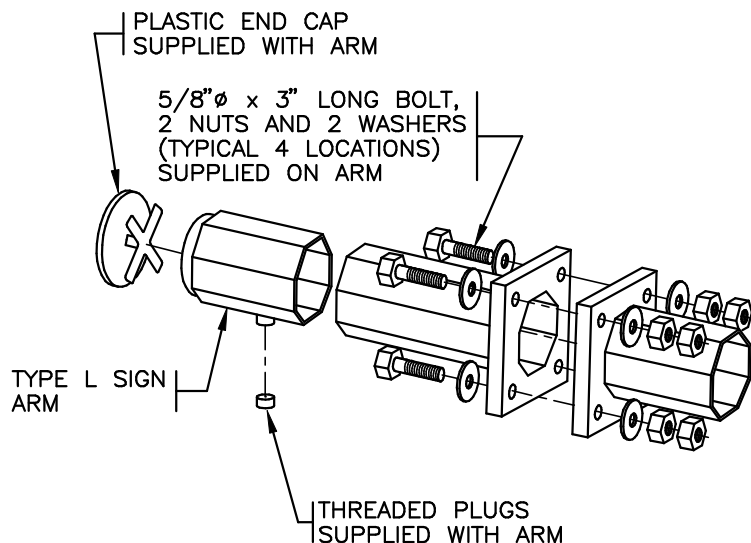
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-3.1.4 FOR TYPE 3 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



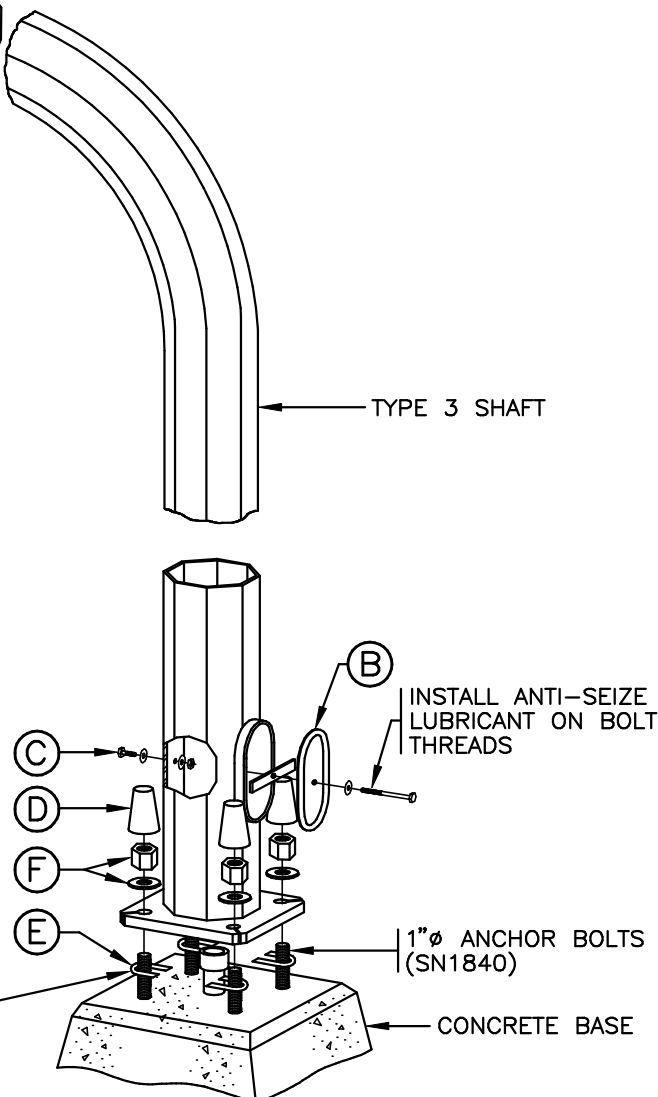
No.	Revision	Date	TYPE 3 SHAFT INSTALLATION DETAILS (SIGN POLE)	
F			Date 24/02/97 M.C. (Signature on File) Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.1.3
E				
D				
C				
B				
A	COUPLING DELETED ON SIGN ARM	NOV 01		





TYPE LB SIGN ARM AND BRACKETS  
NOT SHOWN (SEE DRAWINGS  
SP635-3.3.1 AND 3.3.2)

TYPE 3 SHAFT BOLT KIT (SN1791)		
ITEM	QUANTITY	DESCRIPTION
A	8 (SEE NOTE 6)	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	1	SMALL HANDHOLE COVER WITH 3/8" $\phi$ x 3 1/2" LONG BOLT, WASHER & BACKER BAR.
C	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
D	4	PLASTIC NUT COVERS FOR 1" NUTS.
E	4	LEVELLING SHIMS.
F	4	1" $\phi$ NUTS AND WASHERS.



### POLE ASSEMBLY DETAIL

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.
6. 4 EXTRA BOLTS, AS BOLTS ARE SUPPLIED WITH SIGN ARM.

NOT TO SCALE



No.	Revision	Date	TYPE 3 SHAFT INSTALLATION DETAILS (SIGN POLE)		
E			<div>DateApproved</div> <div><b>24/02/97 M.C. (Signature on File)</b></div> <div>Chief Highway Engineer</div>		
D					
C					
B					
A	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	SPECIFICATION DRAWING No.		SP635-3.1.4



4-HEX HEAD BOLTS  
(PART OF SN1799)  
4-UPPER WASHERS  
(PART OF SN1799)  
POLE BASE PLATE

4-NUT COVERS  
(PART OF POLE BOLT KIT)  
4-HEX HEAD NUTS  
(PART OF SN1799)  
4-UPPER WASHERS  
(PART OF SN1799)  
TRANSITION PLATE  
(PART OF SN1799)

4-LOWER WASHERS  
(PART OF SN1799)  
4-HEX HEAD NUTS  
(PART OF SN1799)

4-LOWER WASHERS  
(PART OF SN1799)  
4-COUPLER ASSEMBLIES  
(PART OF SN1799)

4-HEX HEAD NUTS  
AND WASHERS  
(SUPPLIED WITH POLE)

REACTION PLATE  
(PART OF SN1799)  
4-HEX HEAD BOLTS  
TO SECURE COUPLERS  
(PART OF SN1799)

BOLTS TO BE HELD  
CAPTIVE IN REACTION  
PLATE

1" ANCHOR BOLT  
SN1840 (TYPICAL)

CONCRETE BASE

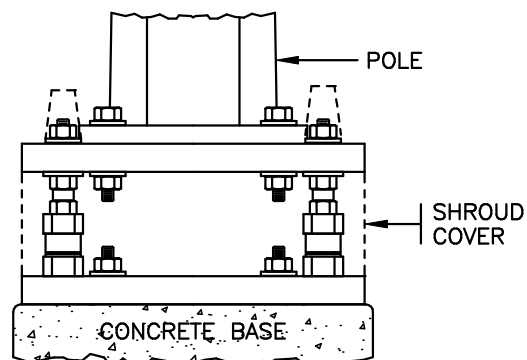
#### NOTES:

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. INSTALL BASE AND TIGHTEN BOLTS AS PER MANUFACTURERS INSTRUCTIONS.

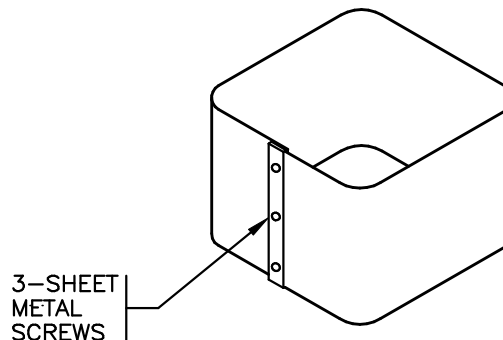
#### BREAKAWAY BASE ASSEMBLY

SN1799

NOT TO SCALE

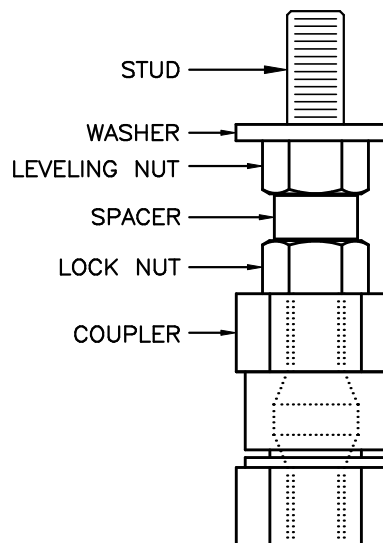


#### ASSEMBLED BREAKAWAY BASE



#### SHROUD COVER

(PART OF SN1799)



#### COUPLER ASSEMBLY

(PART OF SN1799)



**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	BREAKAWAY BASE FOR ADVANCED WARNING AND DIRECTIONAL SIGNS ON TYPE 1 AND 3 POLES	
F			Date Approved  <b>24/02/97 M.C. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No.  SP635—3.1.5
E				
D				
C				
B				
A				

Chief Highway Engineer



TYPE L SIGN ARM  
INCLUDING 4-5/8"  $\phi$  x 3"  
LONG BOLTS, 8 NUTS  
AND 8 FLAT WASHERS

SEE DRAWINGS SP635-3.3.3 TO 3.3.6 FOR  
PLYWOOD SIGN MOUNTING DETAILS & DRAWINGS  
SP635-3.3.11 TO 3.3.17 FOR EXTRUDED  
ALUMINUM SIGN MOUNTING DETAILS.

SIGN OUTLINE  
(MAX 2400 WIDE)

120 A/F

TYPE 1 FLANGE

120 A/F

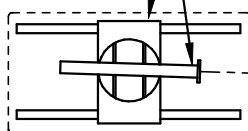
PLASTIC  
END CAP

3° TO 5°  
RISE

100 (TYPICAL)

LENGTH VARIES  
(MAX 1200)

TYPE LB SIGN ARM AND  
BRACKET FOR PLYWOOD  
SIGNS (SEE DRAWINGS  
SP635-3.3.1 & 3.3.2)



PLYWOOD  
SIGN OUTLINE

240 TYPE [7A]  
1800 TYPE [7B]  
2500 TYPE [7C]

2500

120 A/F

170 A/F

170 A/F

TYPE 8 FLANGE

TYPE 1 FLANGE

TYPE 6 SHAFT

254 A/F

POLE BASE  
PLATE

LARGE  
HANDHOLE

6900

ELEVATION

## PARTS LIST

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [6] SHAFT	SN1829	412
TYPE L SIGN ARM [LSA] LENGTH VARIES	SN2093	20 PER METRE
TYPE L SIGN ARM [1.2LSA] 1.2m LONG	SN2095	24
TYPE [LB] SIGN ARM AND BRACKET	SN2096	100
TYPE [7A] EXTENSION - 0.24m	SN1890A	20
TYPE [7B] EXTENSION - 1.8m	SN1890B	69
TYPE [7C] EXTENSION - 2.5m	SN1890C	86
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 8 FLANGE COVER PLATE [8FCP]	SN2089	2.5

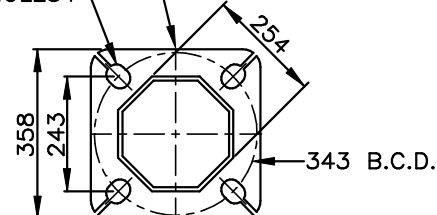
\* [ ] I.D. LABEL ON POLE

## NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-3.1.7 FOR TYPE 6 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

38mm THICK PLATE  
38 x 48  
SLOTTED HOLES



POLE BASE PLATE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
F		
E		
D	COUPLING DELETED ON SIGN ARM	NOV 01
C	L SIGN ARM & DRAWING No. REVISED	AUG 96
B	L SIGN ARM MAX LENGTH & PLATE HOLE SIZE ADDED	AUG 95
A	GENERAL REVISION	AUG 94

## TYPE 6 SHAFT INSTALLATION DETAILS (SIGN POLE)

Date Approved

**30/09/93 E.L. (Signature on File)**

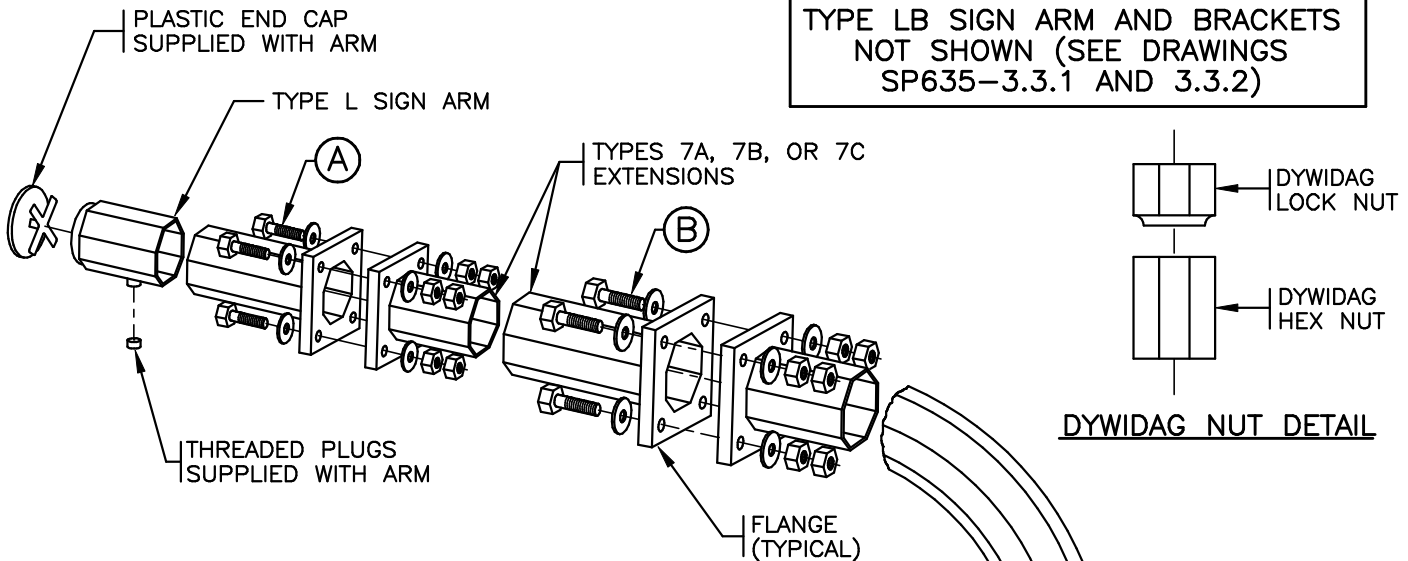
Chief Highway Engineer

SPECIFICATION  
DRAWING No.

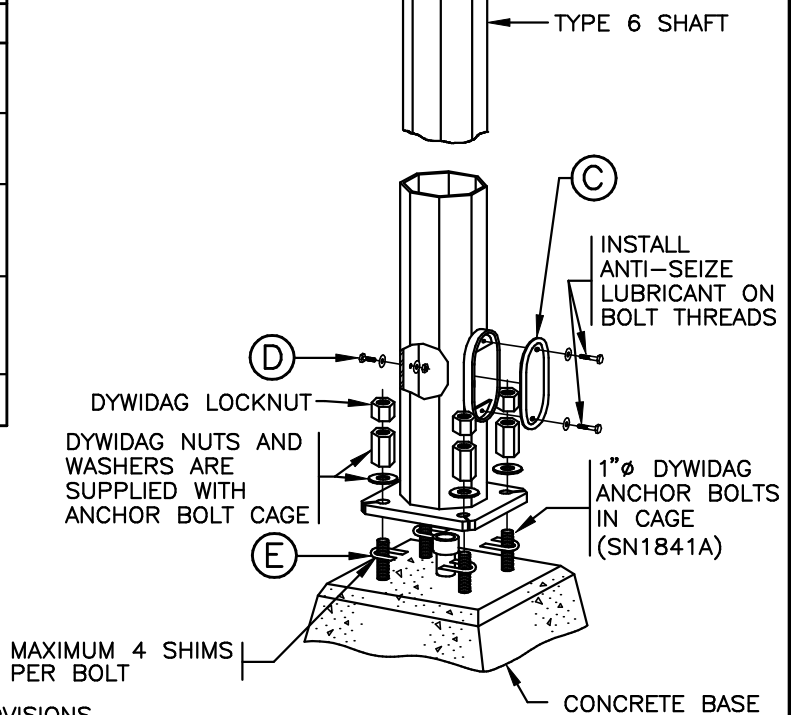
**SP635-3.1.6**



**TYPE LB SIGN ARM AND BRACKETS  
NOT SHOWN (SEE DRAWINGS  
SP635-3.3.1 AND 3.3.2)**



TYPE 6 SHAFT BOLT KIT (SN1792)		
ITEM	QUANTITY	DESCRIPTION
A	4	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	4	1" $\phi$ x 5" LONG BOLT, 2 NUTS AND 2 WASHERS.
C	1	LARGE HANDHOLE COVER WITH 2-3/8" $\phi$ x 1" LONG BOLTS AND 2 WASHERS.
D	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
E	4	LEVELLING SHIMS.



**NOTES**

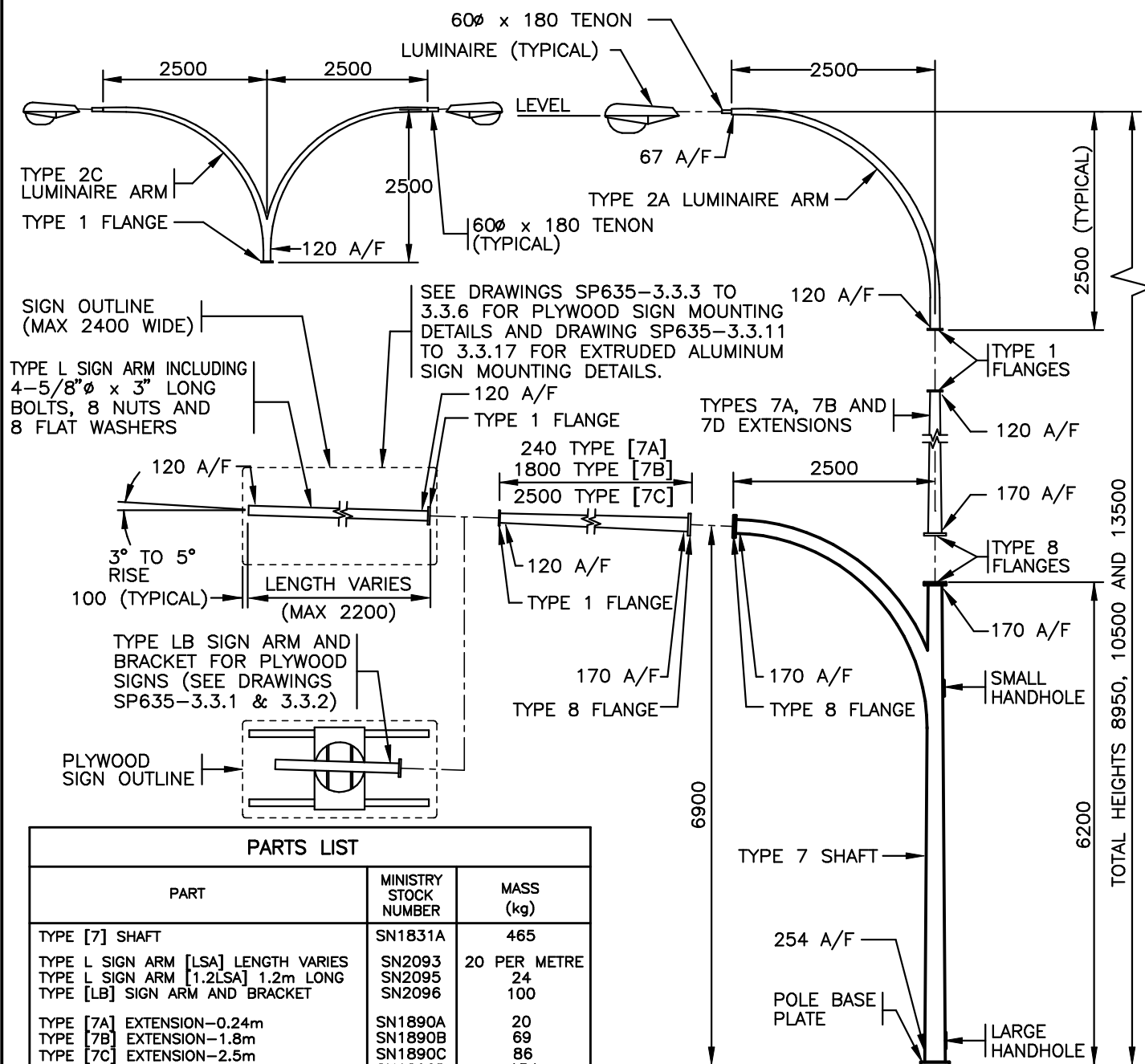
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS. TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE



No.	Revision	Date	TYPE 6 SHAFT INSTALLATION DETAILS (SIGN POLE)	
E				
D	ANTI-SEIZE LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98	Date	Approved
C	DRAWING NUMBER REVISED	AUG 96		
B	END CAP SUPPLIED ON L SIGN ARM	AUG 95		
A	GENERAL REVISION	AUG 94		
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-3.1.7</b>





### PARTS LIST

PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [7] SHAFT	SN1831A	465
TYPE L SIGN ARM [LSA] LENGTH VARIES	SN2093	20 PER METRE
TYPE L SIGN ARM [1.2LSA] 1.2m LONG	SN2095	24
TYPE [LB] SIGN ARM AND BRACKET	SN2096	100
TYPE [7A] EXTENSION-0.24m	SN1890A	20
TYPE [7B] EXTENSION-1.8m	SN1890B	69
TYPE [7C] EXTENSION-2.5m	SN1890C	86
TYPE [7D] EXTENSION-4.8m	SN1890D	154
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
POST TOP TENON [PTT]	SN1831	5
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 8 FLANGE COVER PLATE [8FCP]	SN2089	2.5

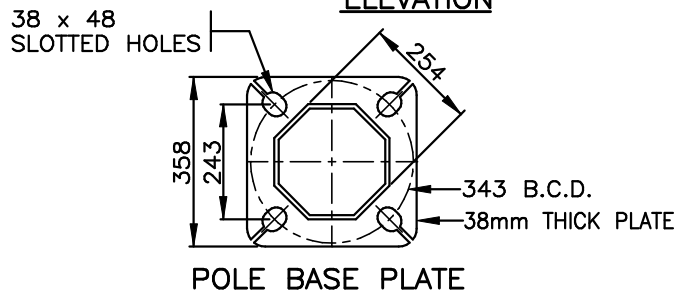
\* [ ] I.D. LABEL ON POLE

### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- SEE DRAWING SP635-3.1.9 FOR TYPE 7 SHAFT, BOLT KITS AND POLE ASSEMBLY DETAILS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

### ELEVATION



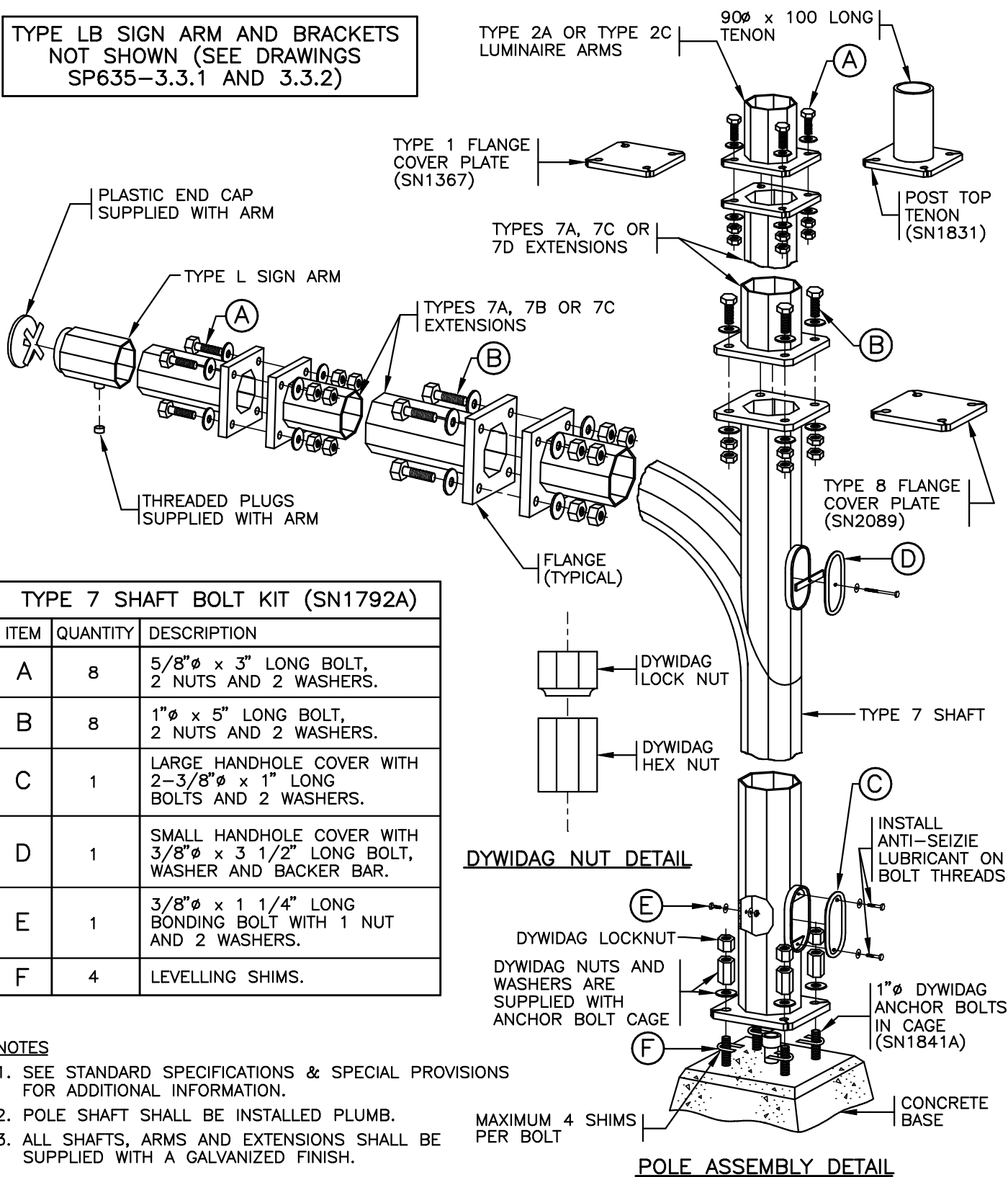
**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE 7 SHAFT INSTALLATION DETAILS (SIGN POLE)		
F			<div>Date<div>Approved</div></div> <div><b>30/09/93 E.L. (Signature on File)</b><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. <b>SP635—3.1.8</b></div>		
E					
D	COUPLING DELETED ON SIGN ARM	NOV 01			
C	L SIGN ARM & DRAWING No. REVISED	AUG 96			
B	L SIGN ARM MAX LENGTH & 7C EXT. ADDED	AUG 95			
A	GENERAL REVISION	AUG 94			



**TYPE LB SIGN ARM AND BRACKETS  
NOT SHOWN (SEE DRAWINGS  
SP635-3.3.1 AND 3.3.2)**



**TYPE 7 SHAFT BOLT KIT (SN1792A)**

ITEM	QUANTITY	DESCRIPTION
A	8	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	8	1" $\phi$ x 5" LONG BOLT, 2 NUTS AND 2 WASHERS.
C	1	LARGE HANDHOLE COVER WITH 2-3/8" $\phi$ x 1" LONG BOLTS AND 2 WASHERS.
D	1	SMALL HANDHOLE COVER WITH 3/8" $\phi$ x 3 1/2" LONG BOLT, WASHER AND BACKER BAR.
E	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
F	4	LEVELLING SHIMS.

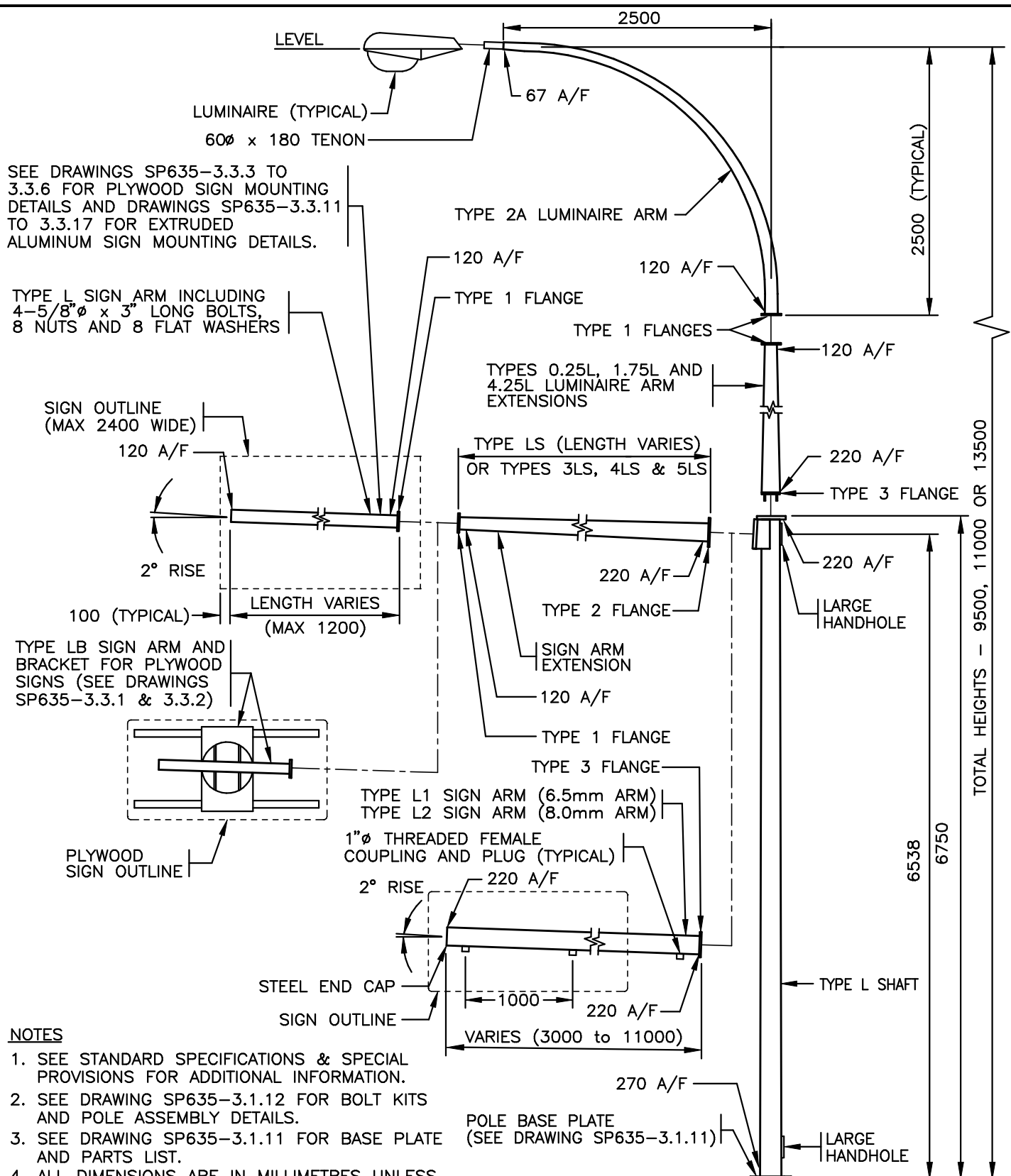
**NOTES**

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- POLE SHAFT SHALL BE INSTALLED PLUMB.
- ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
- APPLY GREASE TO ANCHOR BOLT THREADS.
- TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE

No.	Revision	Date	TYPE 7 SHAFT INSTALLATION DETAILS (SIGN POLE)	
E				
D	ANTI-SEIZE LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98		
C	SMALL HANDHOLE BOLT LENGTH & DRAWING No. REV'D	AUG 96	Date	Approved
B	END CAP SUPPLIED ON L SIGN ARM	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>	SPECIFICATION DRAWING No.
A	GENERAL REVISION	AUG 94	Chief Highway Engineer	<b>SP635-3.1.9</b>





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-3.1.12 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING SP635-3.1.11 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. SEE DRAWING SP635-3.1.11 FOR TYPE 2C LUMINAIRE ARM DETAILS.

NOT TO SCALE

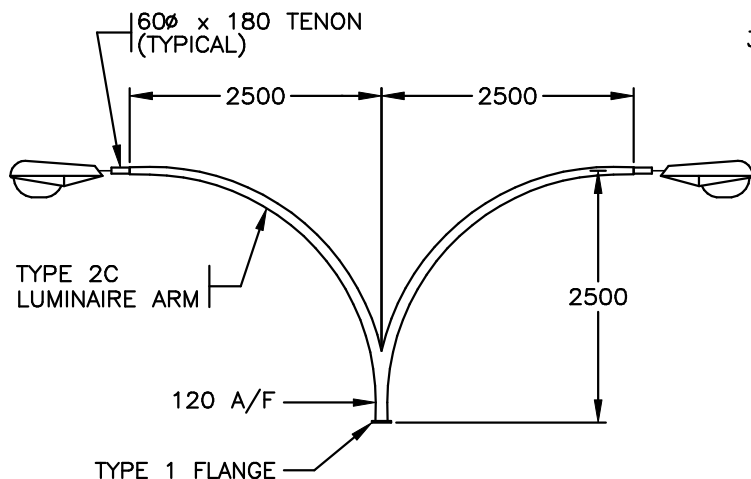


**BRITISH COLUMBIA**

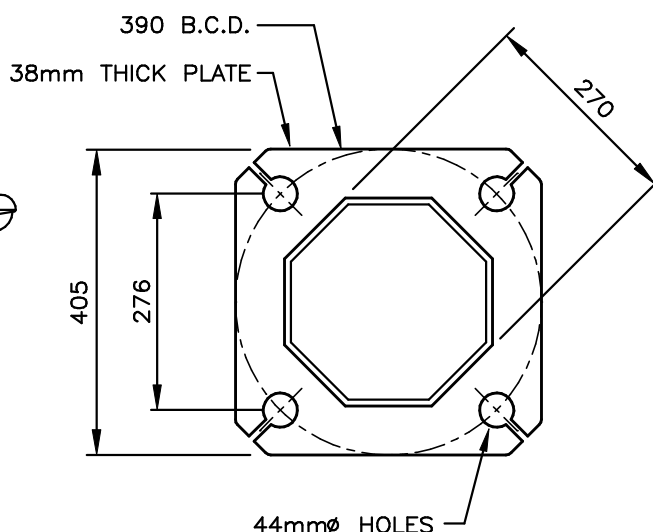
Ministry of Transportation

No.	Revision	Date	TYPE L SIGN POLE INSTALLATION DETAILS		
F					
E					
D	COUPLING DELETED ON SIGN ARM	NOV 01	Date	Approved	SPECIFICATION
C	L SIGN ARM & DWG. No. REV'D & 4LS EXT ADDED	AUG 96	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		DRAWING No.
B	L1/L2 SIGN ARMS & NOTE 5 ADDED	AUG 95			SP635—3.1.10
A	GENERAL REVISION	AUG 94			





TYPE 2C LUMINAIRE ARM DETAILS



TYPE L POLE BASE PLATE

PARTS LIST FOR TYPE L SIGN POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [L] POLE SHAFT	SN2052	442
TYPE L SIGN ARM [LSA] LENGTH VARIES	SN2093	20 PER METRE
TYPE L SIGN ARM [1.2LSA] 1.2m LONG	SN2095	24
TYPE L1 SIGN ARM [L1SA] LENGTH VARIES	SN2095A	39 PER METRE
TYPE L2 SIGN ARM [L2SA] LENGTH VARIES	SN2095B	46 PER METRE
TYPE [LB] SIGN ARM AND BRACKETS	SN2096	100
TYPE [LS] SIGN ARM EXTENSION - LENGTH VARIES	SN2094	45 PER METRE
TYPE [3LS] SIGN ARM EXTENSION - 3.0m	SN2094A	135
TYPE [4LS] SIGN ARM EXTENSION - 4.0m	SN2094B	180
TYPE [5LS] SIGN ARM EXTENSION - 5.0m	SN2094C	225
TYPE [4.25L] LUMINAIRE ARM EXTENSION - 4.25m	SN2062	82
TYPE [1.75L] LUMINAIRE ARM EXTENSION - 1.75m	SN2063	29
TYPE [0.25L] LUMINAIRE ARM EXTENSION - 0.25m	SN2064	10
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 2 FLANGE COVER PLATE [2FCP]	SN2083	4
TYPE 3 FLANGE COVER PLATE [3FCP]	SN2084	4
POST TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABEL ON POLE

NOT TO SCALE

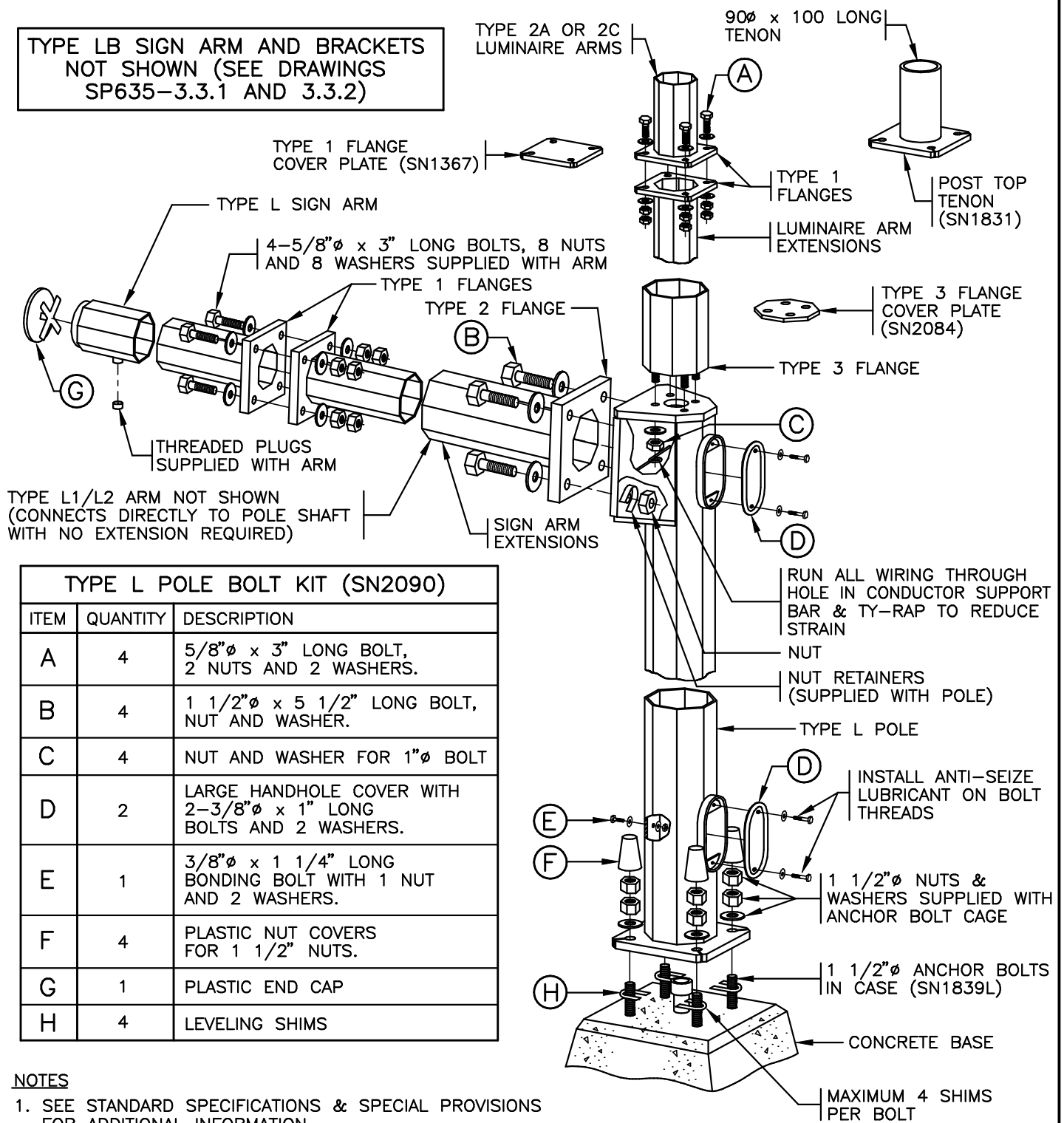


No.	Revision	Date	TYPE L SIGN POLE INSTALLATION DETAILS		
F			Date Approved		SPECIFICATION DRAWING No. SP635—3.1.11
E					
D					
C	TYPE L SIGN ARM & DWG. No. REV'D & 4LS EXT ADDED	AUG 96			
B	L1/L2 SIGN ARMS & 2C ARM ADDED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		
A	GENERAL REVISION	AUG 94			

Chief Highway Engineer



**TYPE LB SIGN ARM AND BRACKETS  
NOT SHOWN (SEE DRAWINGS  
SP635-3.3.1 AND 3.3.2)**



**TYPE L POLE BOLT KIT (SN2090)**

ITEM	QUANTITY	DESCRIPTION
A	4	5/8" $\phi$ x 3" LONG BOLT, 2 NUTS AND 2 WASHERS.
B	4	1 1/2" $\phi$ x 5 1/2" LONG BOLT, NUT AND WASHER.
C	4	NUT AND WASHER FOR 1" $\phi$ BOLT
D	2	LARGE HANDHOLE COVER WITH 2-3/8" $\phi$ x 1" LONG BOLTS AND 2 WASHERS.
E	1	3/8" $\phi$ x 1 1/4" LONG BONDING BOLT WITH 1 NUT AND 2 WASHERS.
F	4	PLASTIC NUT COVERS FOR 1 1/2" NUTS.
G	1	PLASTIC END CAP
H	4	LEVELING SHIMS

**NOTES**

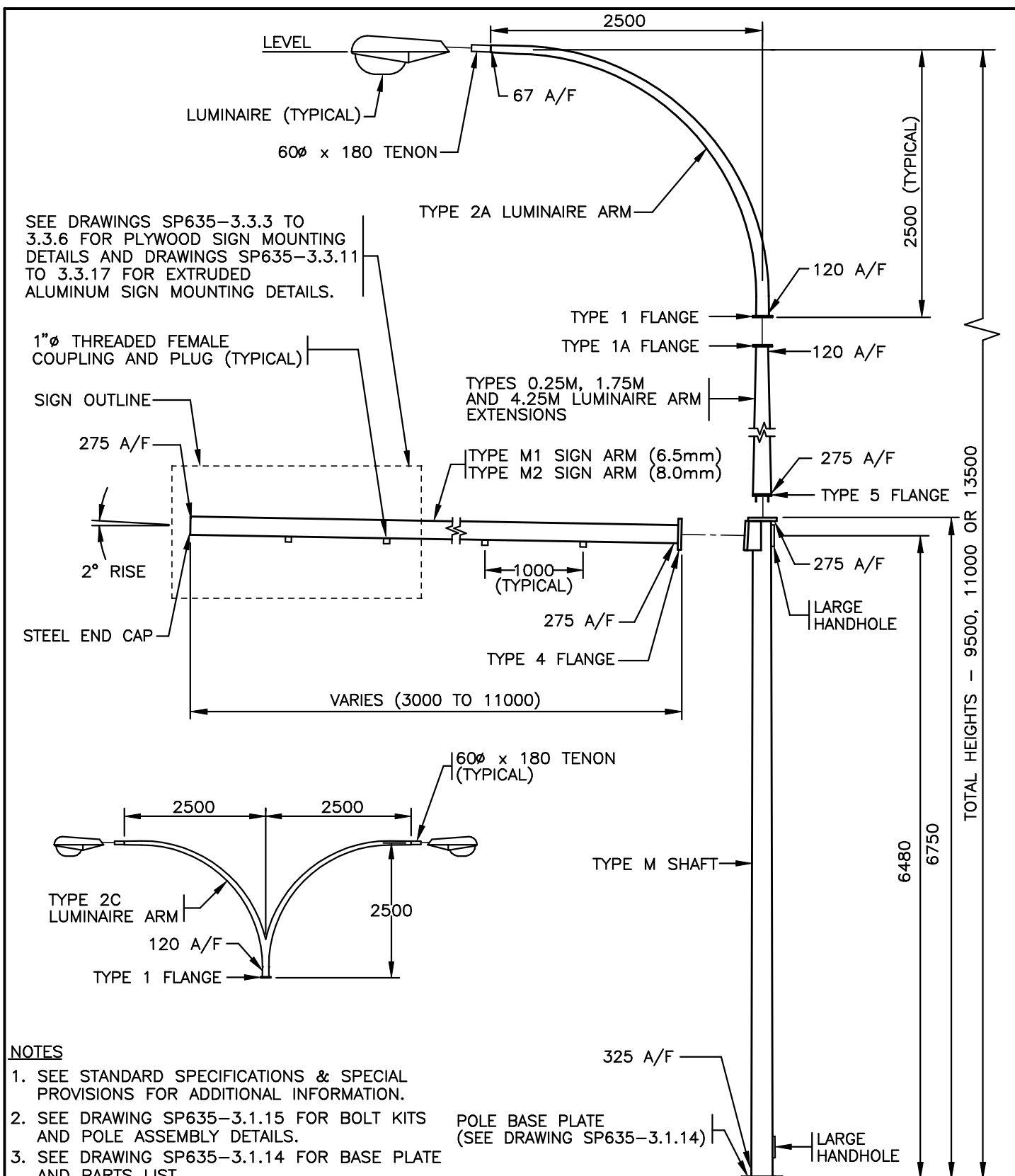
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. POLE SHAFT SHALL BE INSTALLED PLUMB.
3. ALL SHAFTS, ARMS AND EXTENSIONS SHALL BE SUPPLIED WITH A GALVANIZED FINISH.
4. APPLY GREASE TO ANCHOR BOLT THREADS.
5. TOUCH UP ANY SCRATCHES IN GALVANIZED SURFACES WITH COLD GALVANIZING COMPOUND.

NOT TO SCALE

**POLE ASSEMBLY DETAIL**

No.	Revision	Date	TYPE L SIGN POLE INSTALLATION DETAILS	
E				
D	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98		
C	SIGN ARM & DRAWING NUMBERS REVISED	AUG 96		
B	L ARM BOLT SIZES REVISED.	AUG 95		
A	GENERAL REVISION	AUG 94		
			Date	Approved
			30/09/93 E.L. (Signature on File)	Chief Highway Engineer
			SPECIFICATION DRAWING No. SP635-3.1.12	





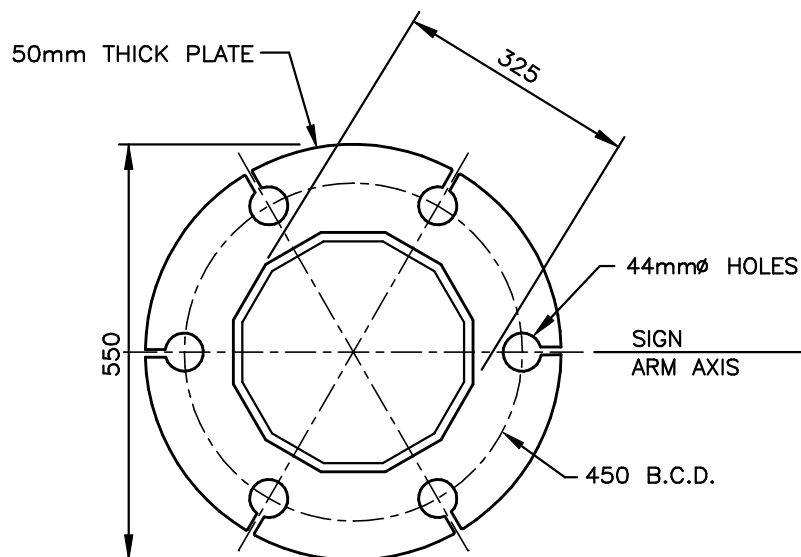
#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-3.1.15 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING SP635-3.1.14 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

No.	Revision	Date	TYPE M SIGN POLE INSTALLATION DETAILS	
F			Date Approved	SPECIFICATION DRAWING No. SP635—3.1.13
E				
D				
C				
B	DRAWING REFERENCES & DRAWING NUMBER REVISED	DEC 96		
A	GENERAL REVISION	AUG 94	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	





**TYPE M POLE BASE PLATE**

PARTS LIST FOR TYPE M SIGNAL POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [M] POLE SHAFT	SN2070	565
TYPE [M1] SIGN ARM (LENGTH VARIES)	SN2097	55 PER METRE
TYPE [M2] SIGN ARM (LENGTH VARIES)	SN2098	65 PER METRE
TYPE [4.25M] LUMINAIRE ARM EXTENSION - 4.25m	SN2072	115
TYPE [1.75M] LUMINAIRE ARM EXTENSION - 1.75m	SN2073	38
TYPE [0.25M] LUMINAIRE ARM EXTENSION - 0.25m	SN2074	14
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 3 FLANGE COVER PLATE [3FCP]	SN2084	4
TYPE 4 FLANGE COVER PLATE [4FCP]	SN2085	8
TYPE 5 FLANGE COVER PLATE [5FCP]	SN2086	4
TYPE 4 TO 2 FLANGE ADAPTOR [FA]	SN2080	75
POST TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABELS ON POLE

NOT TO SCALE



No.	Revision	Date	TYPE M SIGN POLE INSTALLATION DETAILS		
F			<div>Date<div>Approved</div></div> <div><div>30/09/93</div><div>E.L. (Signature on File)</div><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. SP635—3.1.14</div>		
E					
D					
C	DRAWING NUMBER REVISED	AUG 96			
B	HOLE SIZES REVISED	AUG 95			
A	GENERAL REVISION	AUG 94			

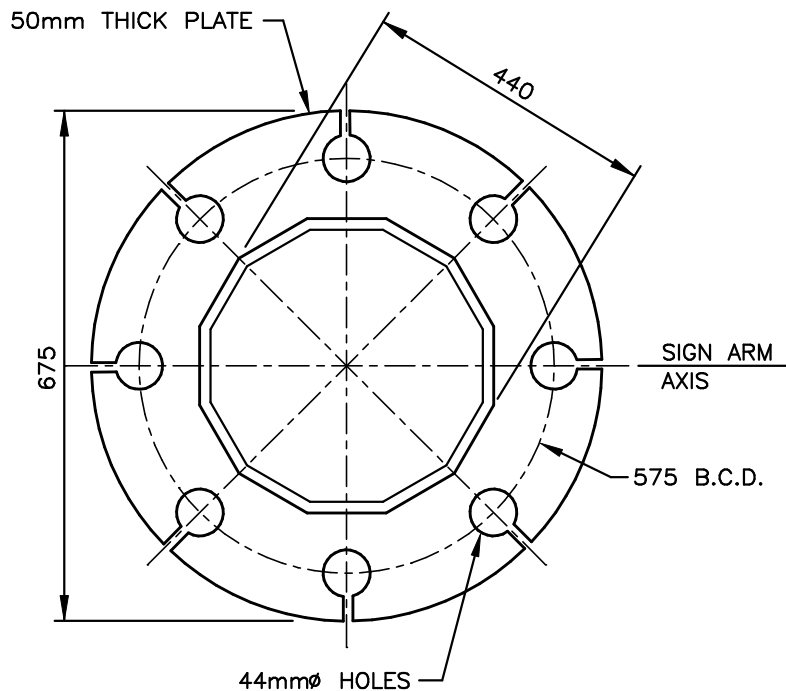






No.	Revision	Date	TYPE H SIGN POLE INSTALLATION DETAILS		
F			<div>DateApproved</div> <div><div>30/09/93E.L. (Signature on File)</div><div>Chief Highway Engineer</div></div> <div><div>SPECIFICATION DRAWING No.</div><div>SP635—3.1.16</div></div>		
E					
D					
C					
B	DRAWING NUMBER & DRAWING REFERENCES REVISED	DEC 96			
A	GENERAL REVISION	AUG 94			





TYPE H POLE BASE PLATE

PARTS LIST FOR TYPE H SIGNAL POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [H] POLE SHAFT	SN2077	870
TYPE [H1] SIGN ARM (LENGTH VARIES)	SN2099	73 PER METRE
TYPE [H2] SIGN ARM (LENGTH VARIES)	SN2100	86 PER METRE
TYPE [3.63H] LUMINAIRE ARM EXTENSION – 3.63m	SN2078	118
TYPE [1.13H] LUMINAIRE ARM EXTENSION – 1.13m	SN2079	36
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE [2C] LUMINAIRE ARM	SN1833	65
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE 6 FLANGE COVER PLATE [6FCP]	SN2087	12
TYPE 7 FLANGE COVER PLATE [7FCP]	SN2088	6
POST TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABEL ON POLE

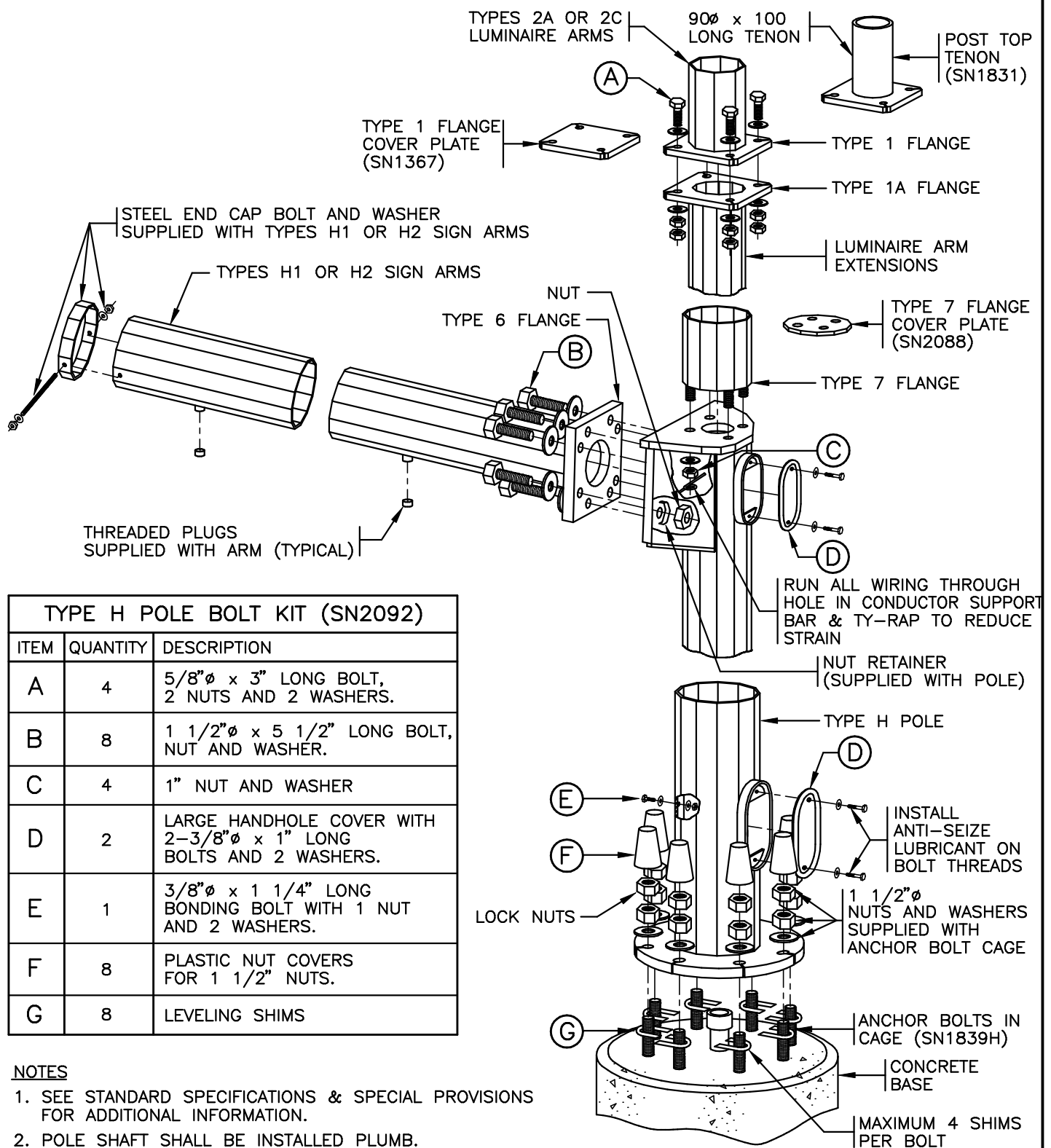
NOT TO SCALE



No.	Revision	Date	TYPE H SIGN POLE INSTALLATION DETAILS	
F			Date	Approved
E				
D			Date	Approved
C	DRAWING NUMBER REVISED	AUG 96		
B	HOLE SIZE REVISED	AUG 95		
A	GENERAL REVISION	AUG 94		
			SPECIFICATION DRAWING No. SP635—3.1.17	

**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

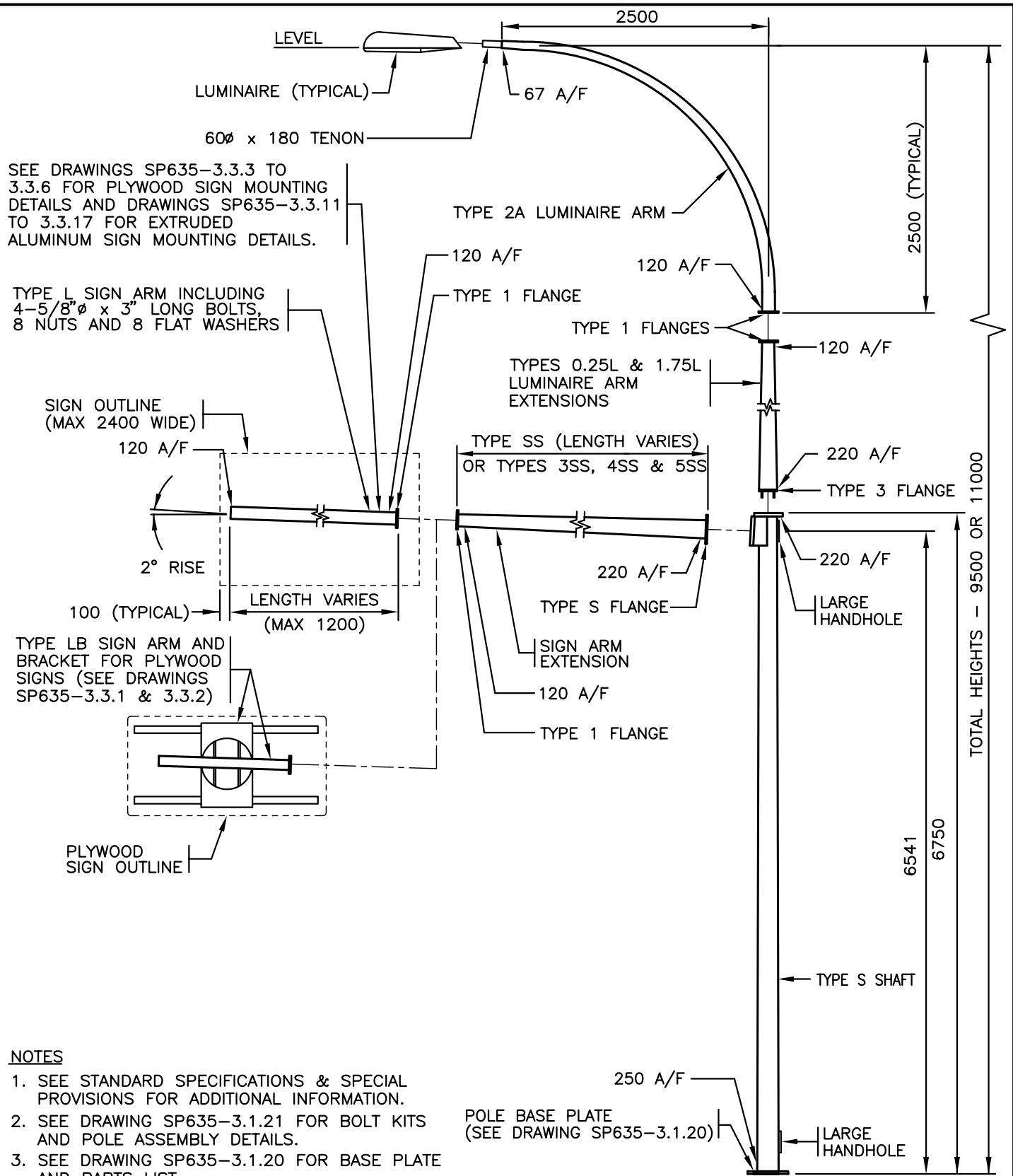




**POLE ASSEMBLY DETAIL**

No.	Revision	Date	TYPE H SIGN POLE INSTALLATION DETAILS	
E				
D	ANTI-SEIZE LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98		
C	DRAWING NUMBER REVISED & CONDUCTOR SUPPORT ADDED	AUG 96	Date	Approved
B	HANDHOLE BOLT SIZE REVISED	AUG 95		
A	GENERAL REVISION	AUG 94		
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-3.1.18</b>





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWING SP635-3.1.21 FOR BOLT KITS AND POLE ASSEMBLY DETAILS.
3. SEE DRAWING SP635-3.1.20 FOR BASE PLATE AND PARTS LIST.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

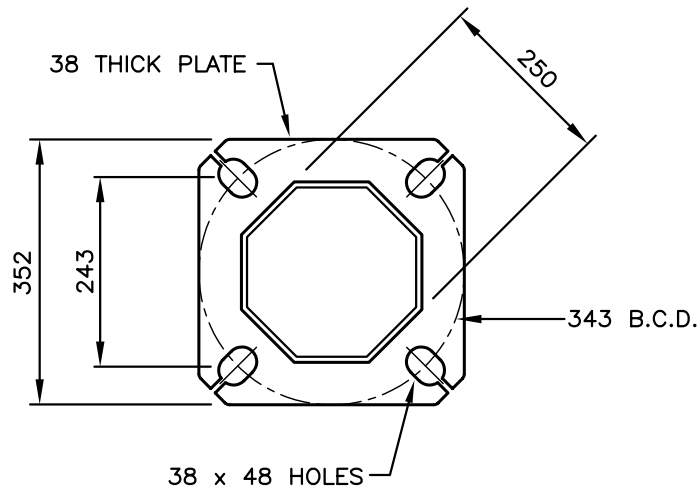


**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE S SIGN POLE INSTALLATION DETAILS	
F			<div><div>Date</div><div>Approved</div><div><div>14/11/03</div><div>D.N. (Signature on File)</div><div>Chief Engineer</div></div></div> <div><div>SPECIFICATION DRAWING No.</div><div>SP635—3.1.19</div></div>	
E				
D				
C				
B				
A				





**TYPE S POLE BASE PLATE**

1:10

PARTS LIST FOR TYPE S SIGN POLE		
PART	MINISTRY STOCK NUMBER	MASS (kg)
TYPE [S] POLE SHAFT	SN3152	385
TYPE L SIGN ARM [LSA] LENGTH VARIES	SN2095	20 PER METRE
TYPE L SIGN ARM [1.2LSA] 1.2m LONG	SN2093	24
TYPE [LB] SIGN ARM AND BRACKETS	SN2096	100
TYPE [SS] SIGN ARM EXTENSION – LENGTH VARIES	SN3090	45 PER METRE
TYPE [3SS] SIGN ARM EXTENSION – 3.0m	SN3093	135
TYPE [4SS] SIGN ARM EXTENSION – 4.0m	SN3094	180
TYPE [5SS] SIGN ARM EXTENSION – 5.0m	SN3095	225
TYPE [1.75L] LUMINAIRE ARM EXTENSION – 1.75m	SN2063	29
TYPE [0.25L] LUMINAIRE ARM EXTENSION – 0.25m	SN2064	10
TYPE [2A] LUMINAIRE ARM	SN1832	35
TYPE 1 FLANGE COVER PLATE [1FCP]	SN1367	1.5
TYPE S FLANGE COVER PLATE [SFCP]	SN1368	3
TYPE 3 FLANGE COVER PLATE [3FCP]	SN2084	4
POST TOP TENON [PTT]	SN1831	5

\* [ ] I.D. LABEL ON POLE

NOT TO SCALE



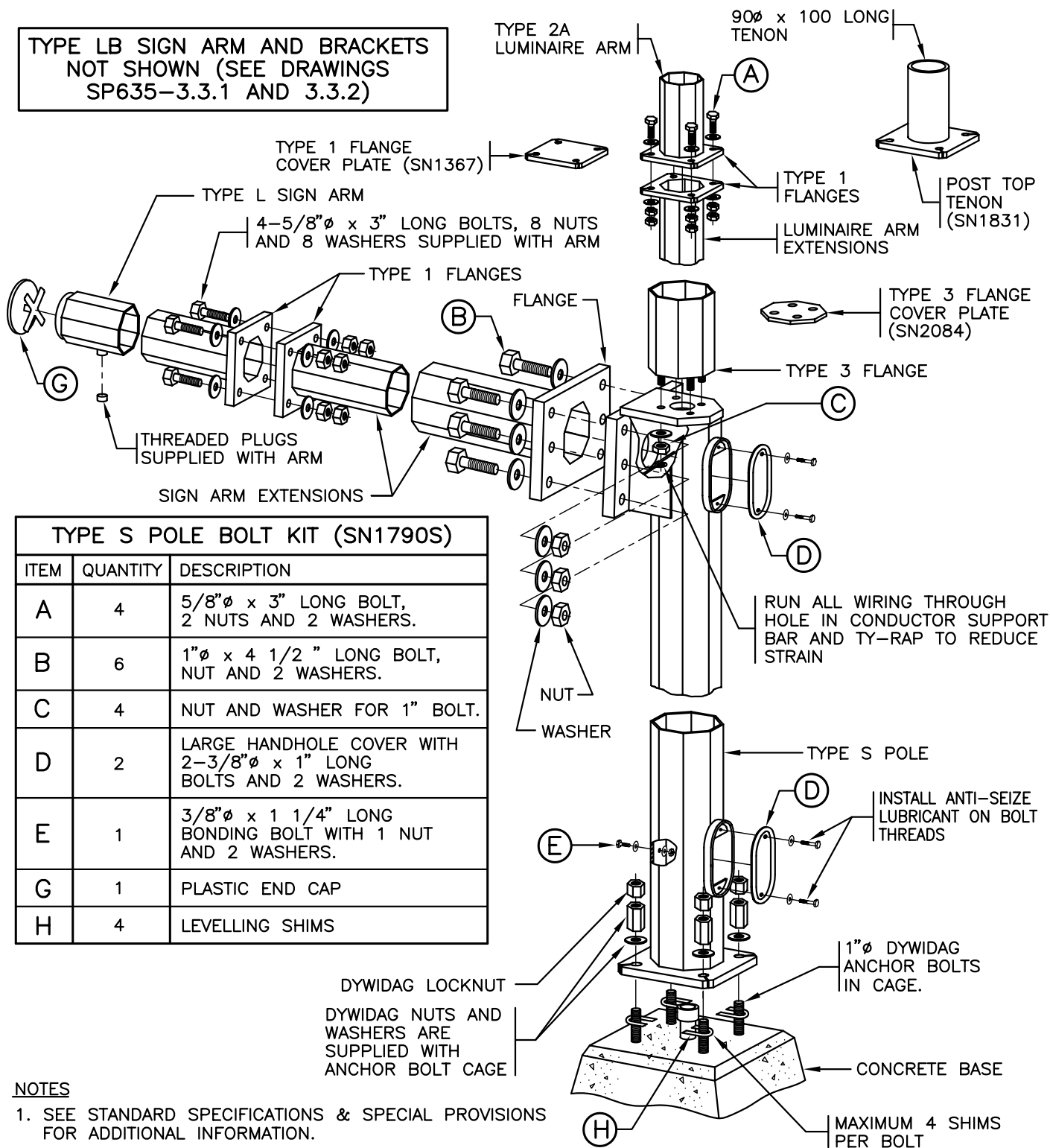
**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date	TYPE S SIGN POLE INSTALLATION DETAILS	
F			Date <b>14/11/03</b> <b>D.N. (Signature on File)</b> Chief Engineer	SPECIFICATION DRAWING No. <b>SP635–3.1.20</b>
E				
D				
C				
B				
A				



**TYPE LB SIGN ARM AND BRACKETS  
NOT SHOWN (SEE DRAWINGS  
SP635-3.3.1 AND 3.3.2)**



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

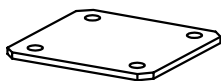
No.	Revision	Date
F		
E		
D		
C		
B		
A		

**TYPE S SIGN POLE  
INSTALLATION DETAILS**

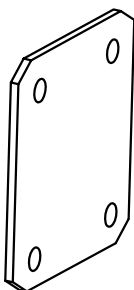
Date Approved  
**14/11/03 D.N. (Signature on File)**  
Chief Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.1.21**

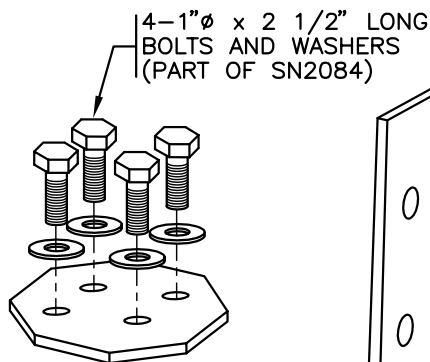




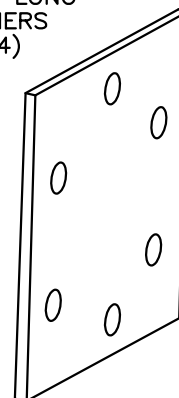
TYPE 1 & 1A FLANGE  
COVER PLATE  
SN1367



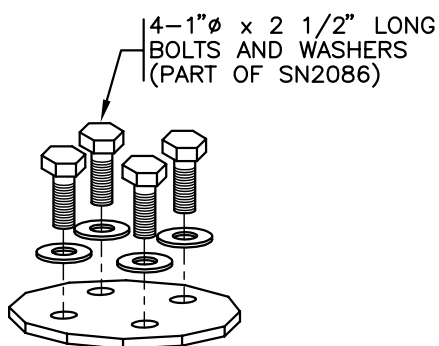
TYPE 2 FLANGE  
COVER PLATE  
SN2083



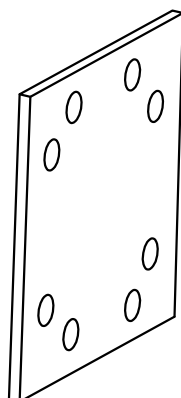
TYPE 3 FLANGE  
COVER PLATE  
SN2084



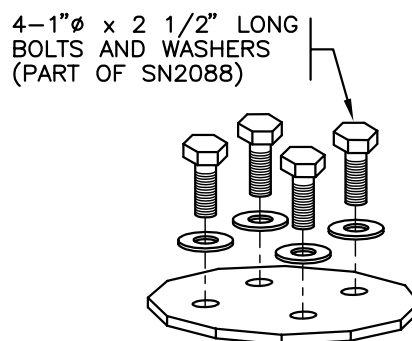
TYPE 4 FLANGE  
COVER PLATE  
SN2085



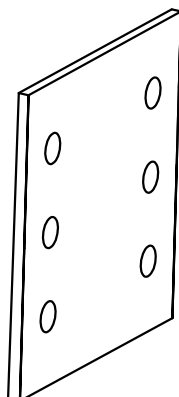
TYPE 5 FLANGE  
COVER PLATE  
SN2086



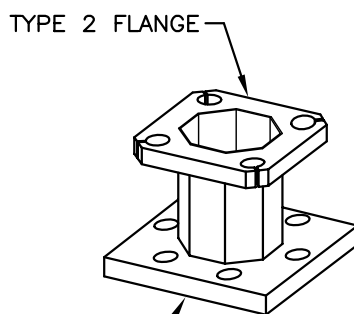
TYPE 6 FLANGE  
COVER PLATE  
SN2087



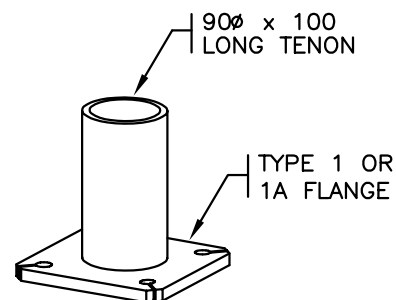
TYPE 7 FLANGE  
COVER PLATE  
SN2088



TYPE S FLANGE  
COVER PLATE  
SN1368



TYPE 4 TO TYPE 2  
FLANGE ADAPTOR  
SN2080



POST TOP  
TENON  
SN1831

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

NOT TO SCALE

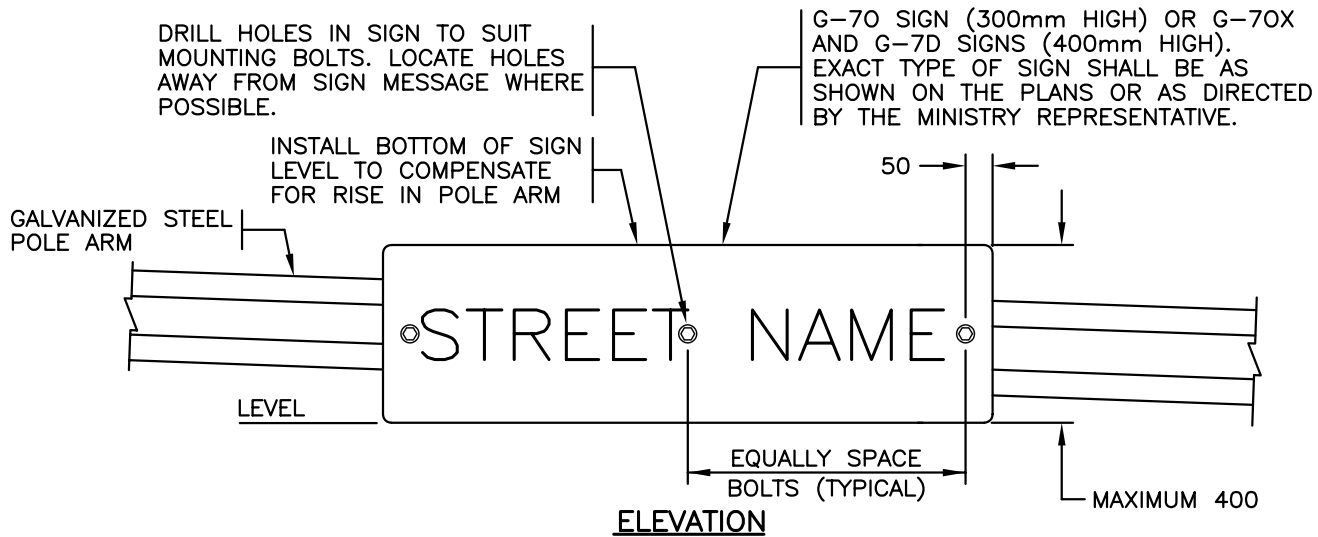


**BRITISH  
COLUMBIA**

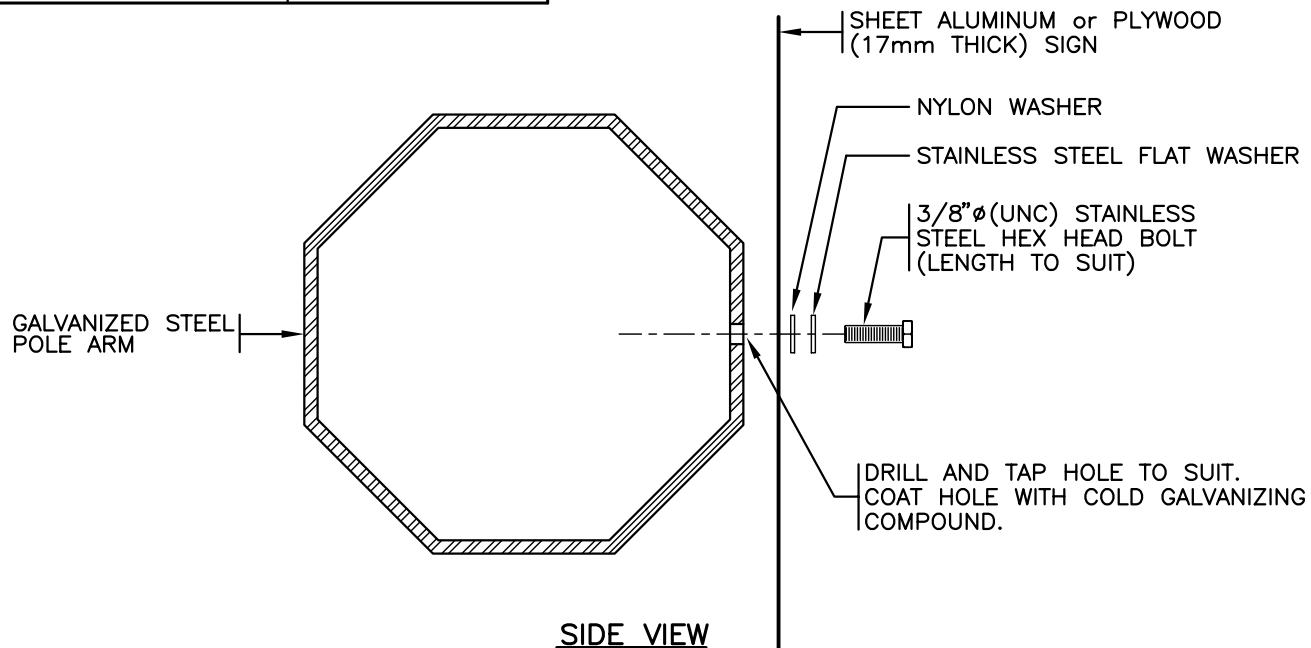
Ministry of  
Transportation

No.	Revision	Date	SIGN POLE ACCESSORIES	
F			Date	Approved
E				
D				SPECIFICATION DRAWING No.
C				
B			Chief Highway Engineer	SP635-3.1.22
A	TYPE S FLANGE COVER PLATE ADDED	OCT 03		





SIGN WIDTH	NUMBER OF BOLTS
900 WIDE	3
1200 WIDE	4
1500 WIDE	5
1800 WIDE	6
2100 WIDE	7



#### NOTES

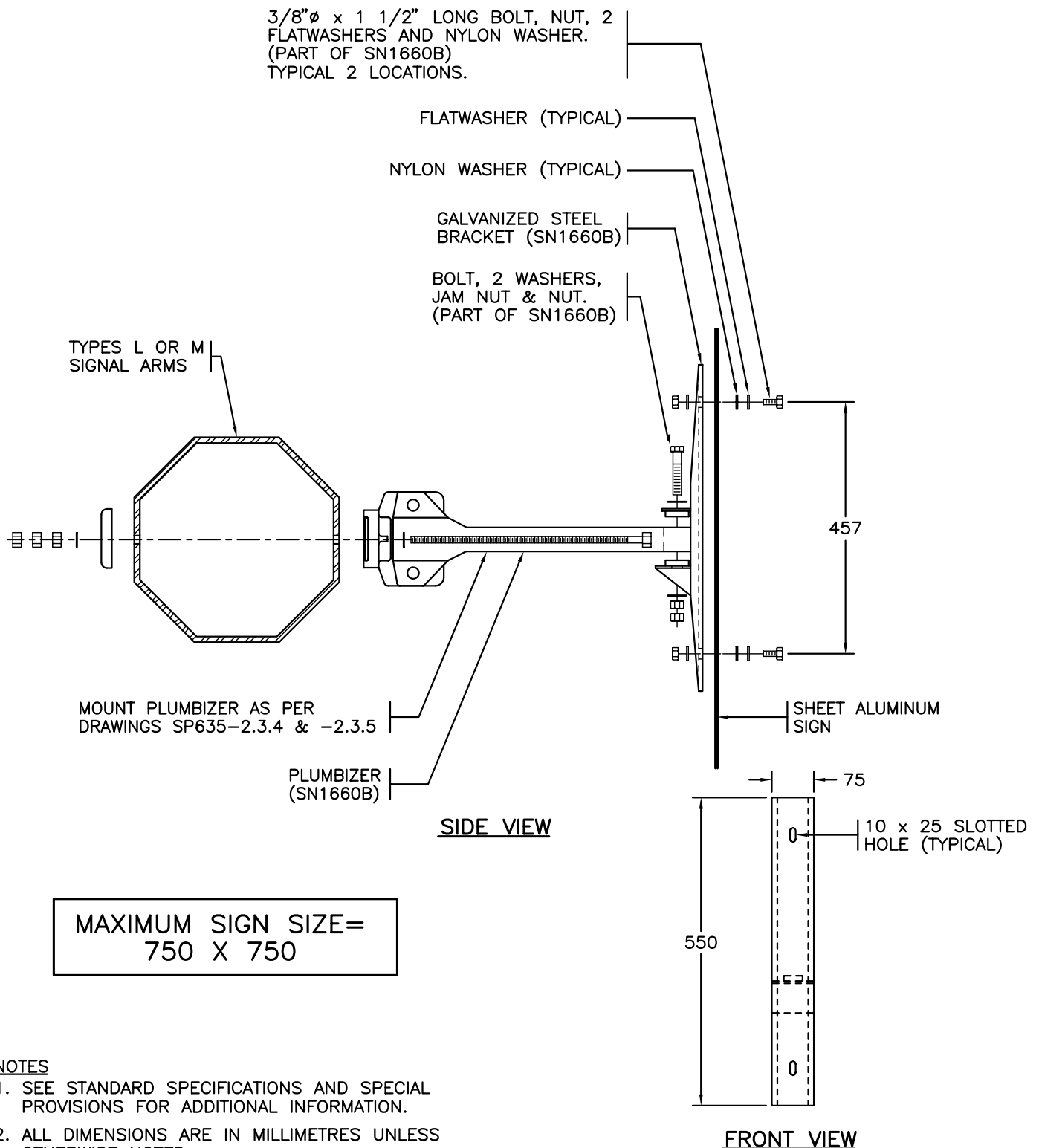
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- POSITION SIGN ON POLE ARM AS INDICATED ON THE PLANS OR AS DIRECTED BY THE MINISTRY REPRESENTATIVE.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	OVERHEAD STREETNAME SIGN INSTALLATION DETAILS (ON SIGNAL POLE ARMS)		
F			Date Approved		SPECIFICATION DRAWING No.  SP635—3.2.1
E					
D					
C	GENERAL REVISIONS	AUG 96			
B	SIGN NUMBER AND SIZES REVISED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		
A	GENERAL REVISION	AUG 94			





#### NOTES

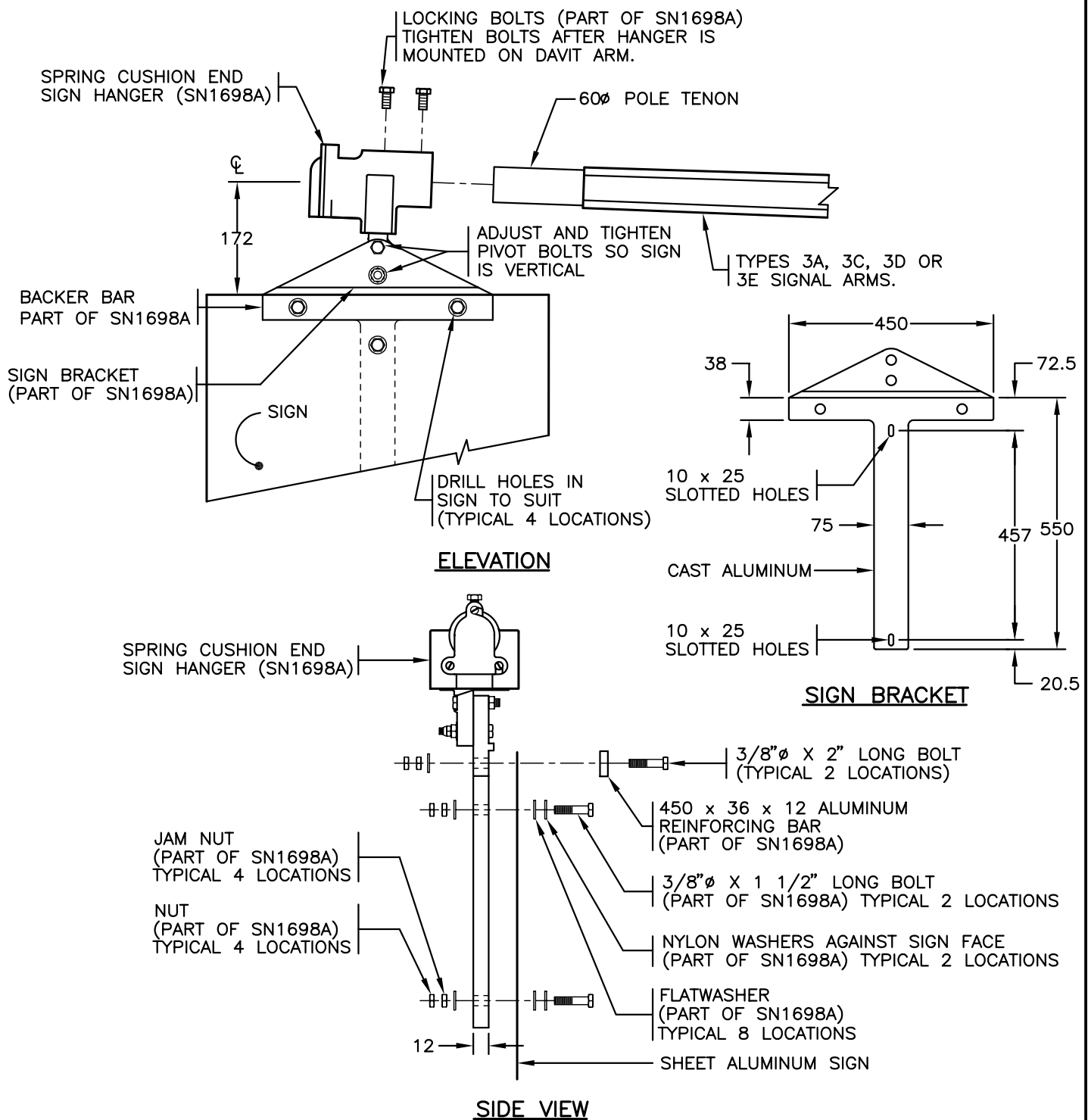
1. SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. AIM AS DIRECTED BY THE MINISTRY REPRESENTATIVE.

NOT TO SCALE



No.	Revision	Date	SMALL OVERHEAD SIGN INSTALLATION DETAILS (ON TYPE L & M SIGNAL POLES)		
F					
E					
D					
C	NYLOCK NUT REMOVED. NUT ADDED	AUG 99	Date	Approved	SPECIFICATION DRAWING No. SP635—3.2.2
B	REFERENCED DWG Nos. REVISED	DEC 98	18/11/94	E.L. (Signature on File)	
A	PLUMBIZER BOLTING REVISED	AUG 95		Chief Highway Engineer	





**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

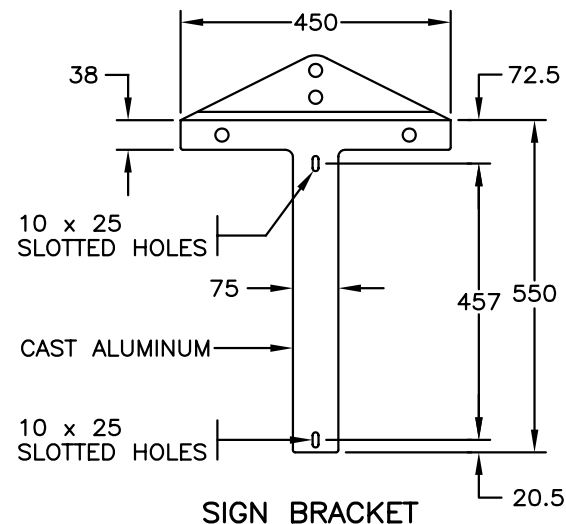
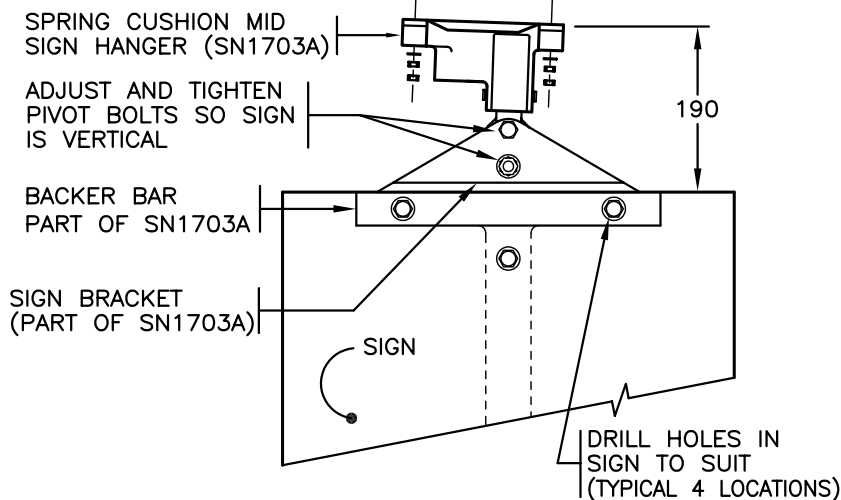
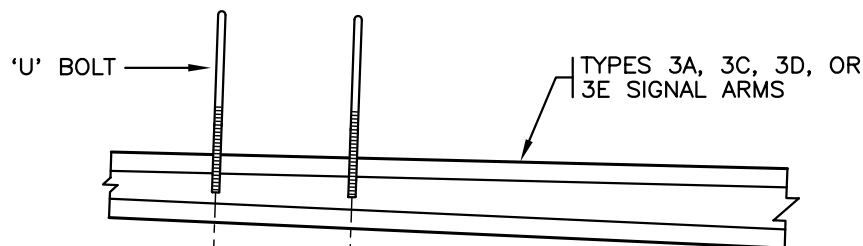
MAXIMUM SIGN SIZE =  
750 X 750

NOT TO SCALE



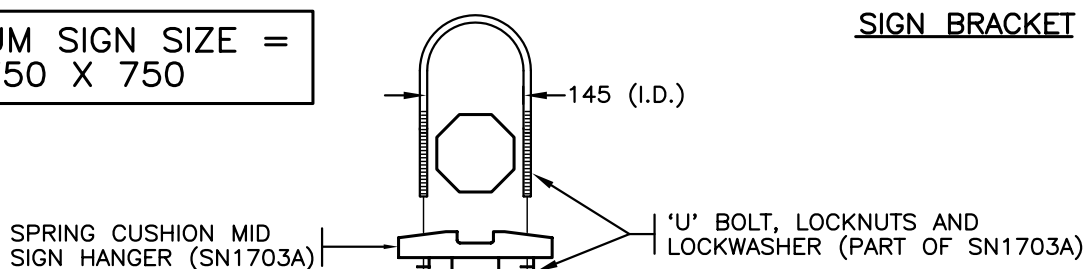
No.	Revision	Date	SMALL OVERHEAD SIGN INSTALLATION DETAILS (ON TYPE 3 SIGNAL ARMS)		
F			Date	Approved	SPECIFICATION DRAWING No.  SP635—3.2.3
E					
D					
C	NYLOCK NUT REMOVED. NUT ADDED	AUG 99			
B	SIGN BOLTING TO BRACKET MODIFIED	AUG 95			
A	GENERAL REVISION	AUG 94			
			<b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		





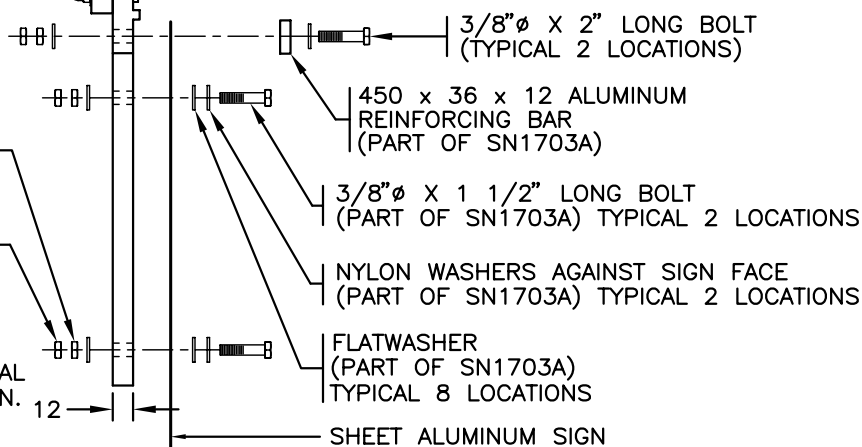
MAXIMUM SIGN SIZE =  
750 X 750

**ELEVATION**



JAM NUT (PART OF SN1703A) TYPICAL 4 LOCATIONS

NUT (PART OF SN1703A) TYPICAL 4 LOCATIONS



**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGNS AS DIRECTED BY THE MINISTRY REPRESENTATIVE.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

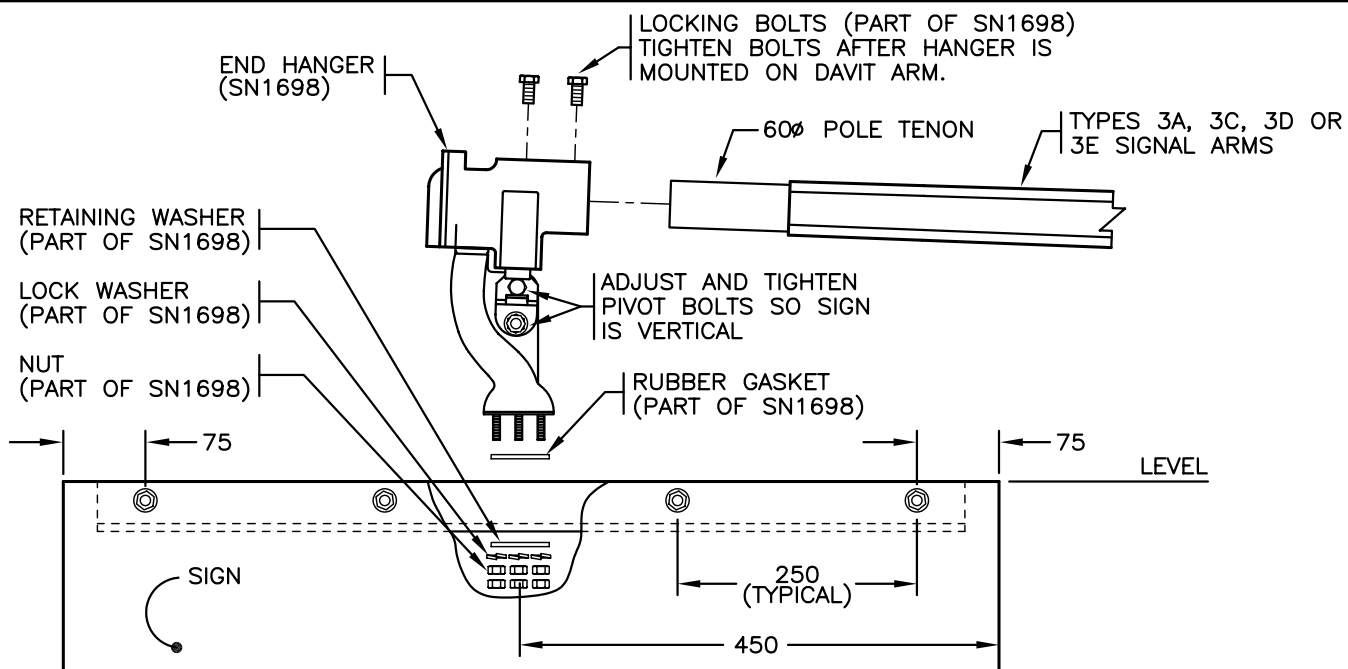
**SIDE VIEW**



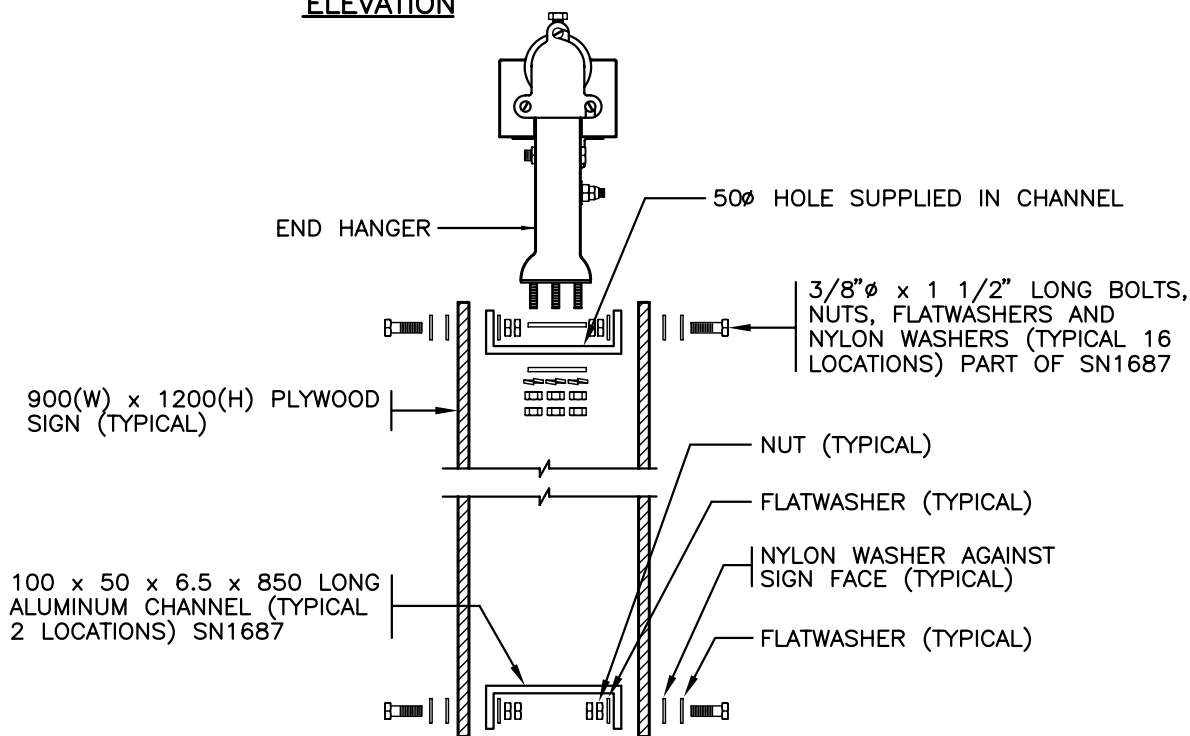
**BRITISH COLUMBIA** Ministry of Transportation

No.	Revision	Date	SMALL OVERHEAD SIGN INSTALLATION DETAILS (ON TYPE 3 SIGNAL ARMS)		
F					
E					
D					
C	NYLOCK NUT REMOVED. NUT ADDED	AUG 99	Date	Approved	SPECIFICATION DRAWING No.
B	SIGN BOLTING TO BRACKET MODIFIED	AUG 95	<b>30/09/93 E.L. (Signature on File)</b>		SP635—3.2.4
A	GENERAL REVISION	AUG 94	Chief Highway Engineer		





**ELEVATION**



**SIDE VIEW**

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. AIM SIGN AS DIRECTED BY THE MINISTRY REPRESENTATIVE.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

**MAXIMUM SIGN SIZE =  
1200 X 900**

NOT TO SCALE

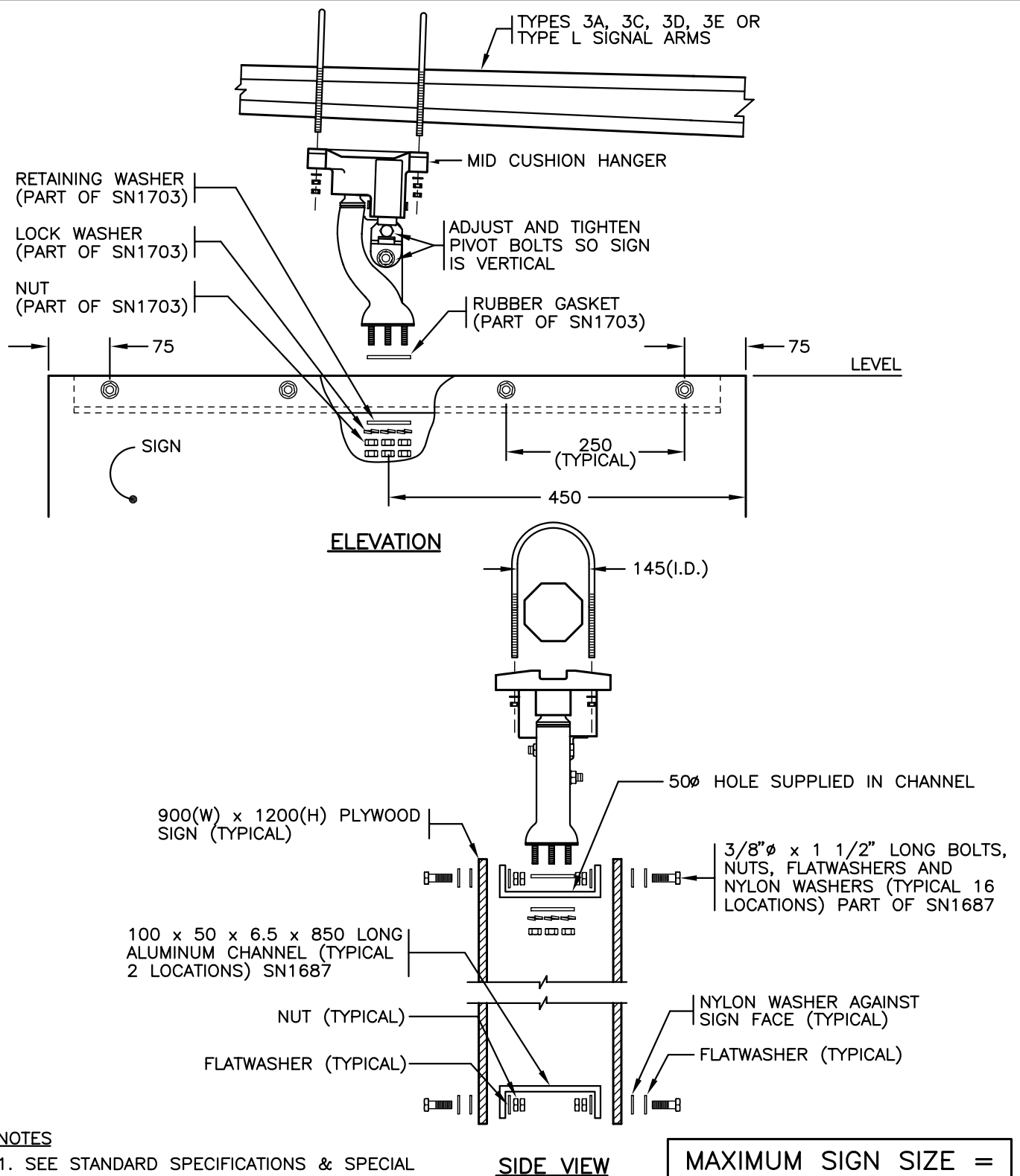


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	2-WAY SMALL OVERHEAD SIGN INSTALLATION DETAILS (ON TYPE 3 SIGNAL ARMS)	
F			Date	Approved
E			30/09/93	E.L. (Signature on File)
D			SPECIFICATION DRAWING No.	
C			SP635-3.2.5	
B	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99	Chief Highway Engineer	
A	GENERAL REVISION	AUG 94		

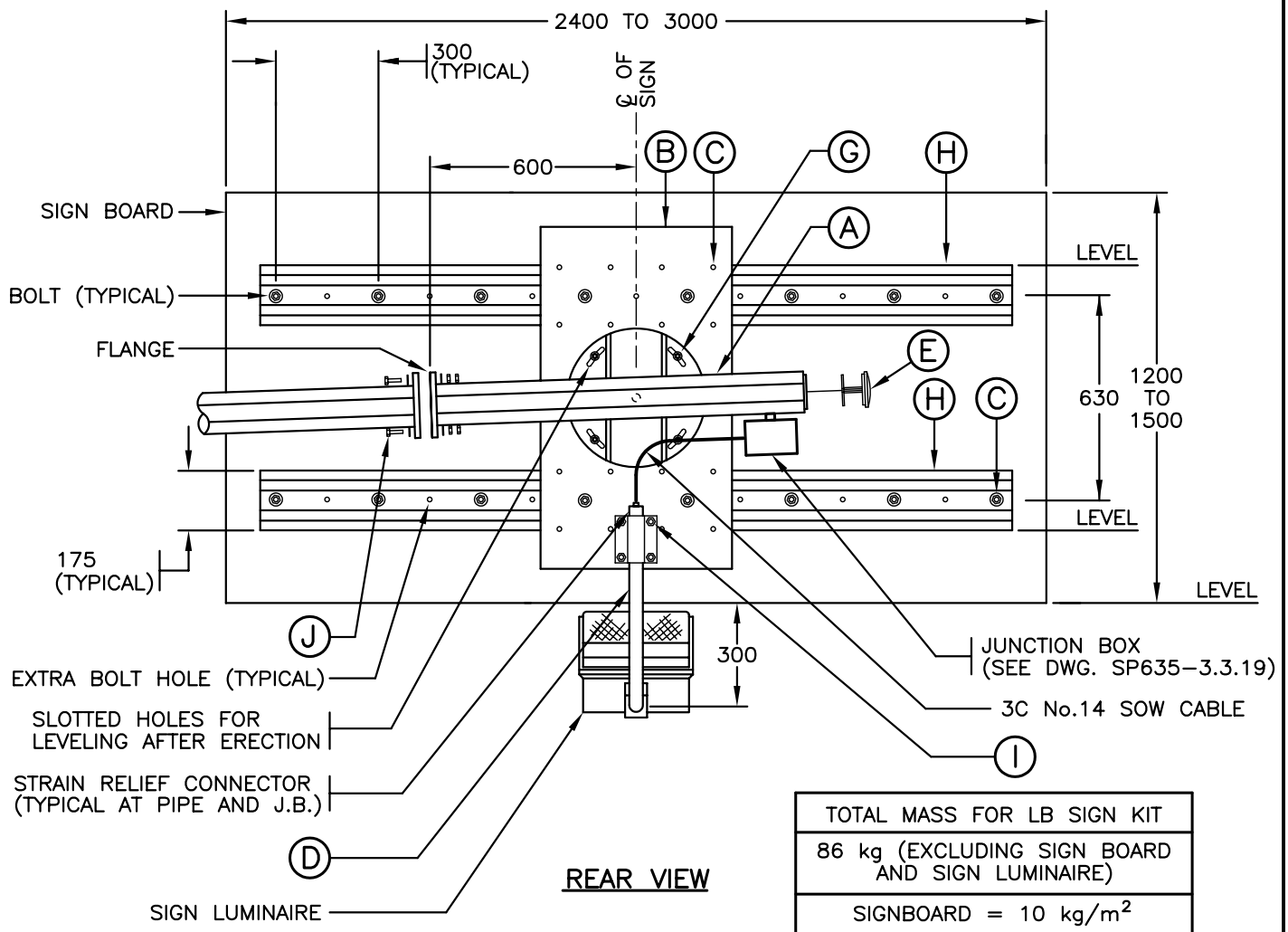




NOT TO SCALE

No.	Revision	Date	2-WAY SMALL OVERHEAD SIGN INSTALLATION DETAILS (FOR TYPE 3 AND L SIGNAL ARMS)	
F			Date	Approved
E				
D			30/09/93	E.L. (Signature on File)
C				
B	NYLOCK NUTS REMOVED. DOUBLE NUTS ADDED	AUG 99	Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.2.6
A	GENERAL REVISION	AUG 94		





TYPE LB SIGN MOUNTING KIT (SN2096)		
ITEM	QUANTITY	DESCRIPTION
A	1	TYPE LB GALVANIZED SIGN ARM
B	1	550 x 1000 GALVANIZED SIGN SUPPORT MOUNTING PLATE
C	16	3/8"Ø x 1 1/2" LONG BOLT, NUT, 2 FLATWASHERS, LOCKWASHER AND NYLON WASHER.
D	1	SIGN LUMINAIRE PIPE BRACKET
E	1	PLASTIC END CAP
F	1	PIPE MOUNTING CLAMP
G	4	1/2"Ø x 1 1/4" LONG BOLT, FLATWASHER AND LOCKWASHER
H	2	2350 LONG GALVANIZED HORIZONTAL SIGN SUPPORTS
I	4	1/2"Ø x 1 1/2" LONG BOLT, NUT, 2 FLATWASHERS AND LOCKWASHER
J	4	5/8"Ø x 3" LONG BOLT, 2 NUTS AND 2 FLATWASHERS

SEE DRAWING SP635-3.3.2 FOR NOTES

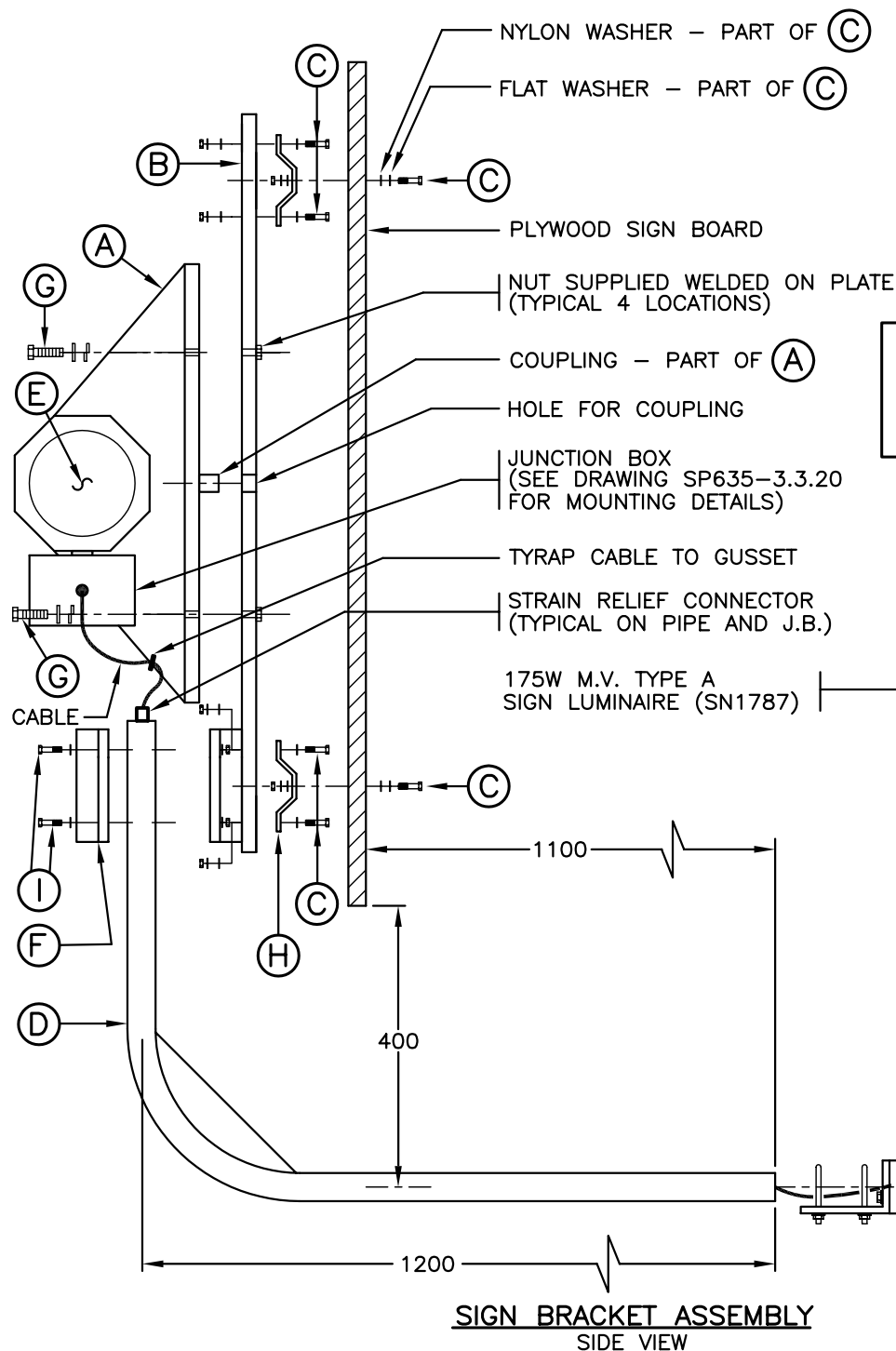
NOT TO SCALE

**SIGN LUMINAIRES SHALL BE USED ONLY WHEN SPECIFICALLY NOTED ON THE DESIGN DRAWINGS**



No.	Revision	Date	LARGE OVERHEAD PLYWOOD GUIDE SIGN INSTALLATION DETAILS (FOR SIGNS UP TO 1500 X 3000)		
F					
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00	<div>Date<div>Approved</div></div> <div><b>30/09/93 E.L. (Signature on File)</b></div> <div>Chief Highway Engineer</div> <div>SPECIFICATION DRAWING No. <b>SP635—3.3.1</b></div>		
D	J.B. DRAWING REFERENCE REVISED	DEC 98			
C	J.B. DRAWING REFERENCE REVISED	DEC 96			
B	LUMINAIRE CHANGED & J.B. ADDED	AUG 95			
A	GENERAL REVISION	AUG 94			





WHERE SPECIFIED SIGN LUMINAIRE SHALL BE MOUNTED ON THE TOP OF THE SIGN

SIGN LUMINAIRES SHALL BE USED ONLY WHEN SPECIFICALLY NOTED ON THE DESIGN DRAWINGS

**SIGN BRACKET ASSEMBLY**  
SIDE VIEW

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

ANGLE TO SUIT LUMINAIRE OPTICS.  
ANGLE TO BE SPECIFIED ON THE PLANS OR TO BE OBTAINED FROM THE MINISTRY REPRESENTATIVE

SEE DRAWING SP635-3.3.1 FOR ADDITIONAL DETAILS

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD PLYWOOD GUIDE SIGN INSTALLATION DETAILS (FOR SIGNS UP TO 1500 X 3000)	
F				
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00		
D	SIGN LUMINAIRE TYPE C CHANGED TO TYPE A	NOV 98		
C	SIGN LUMINAIRE & MOUNTING REVISED	DEC 96		
B	LUMINAIRE CHANGED & J.B. ADDED	AUG 95		
A	GENERAL REVISION	AUG 94		
			Date	Approved
			30/09/93	E.L. (Signature on File)
			Chief Highway Engineer	
			SPECIFICATION DRAWING No.	SP635-3.3.2



GALVANIZED VERTICAL ANGLE IRON (LENGTH TO SUIT)  
TYPICAL (SN2112 FOR 100 x 75 ANGLE IRON AND  
SN2113 FOR 150 x 100 ANGLE IRON. USE 100 x 75  
FOR SIGNS UP TO 1800 HIGH AND 150 x 100 FOR  
SIGNS OVER 1800 HIGH)

GALVANIZED SIGN MOUNTING CLAMP (TYPICAL)  
SN2103 FOR L ARMS, SN2103A FOR L1/L2 ARMS,  
SN2104 FOR M1/M2 ARMS, SN2105 FOR H1/H2 ARMS.



1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. A SKETCH DETAILING THE EXACT SPACING OF VERTICAL ANGLE IRONS AND HORIZONTAL SIGN SUPPORTS WILL BE SUPPLIED WITH SIGN BRACKET ASSEMBLY.
3. NUMBER OF SIGN LUMINAIRES MAY VARY.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.
5. SIGN LUMINAIRE, PIPE CLAMP AND CABLE ARE NOT REQUIRED FOR NON-ILLUMINATED SIGN.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

TOTAL MASS
SIGNBOARD = 10 kg/m <sup>2</sup>

 **BRITISH COLUMBIA** Ministry of Transportation

No.	Revision	Date
F	JUNCTION BOX ON SIGNAL ARM RELOCATED	NOV 01
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00
D	J.B. DRAWING REFERENCE REVISED	DEC 98
C	SIGN LUMINAIRE CLAMP REVISED	DEC 96
B	L1/L2 ARMS & JUNCTION BOX ADDED	AUG 95
A	GENERAL REVISION	AUG 94

Date 30/09/93 Approved E.L. (Signature on File)  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
SP635-3.3.3



SIGN LUMINAIRES SHALL BE USED ONLY WHEN SPECIFICALLY NOTED ON THE DESIGN DRAWINGS

GALVANIZED VERTICAL ANGLE IRON (LENGTH TO SUIT) TYPICAL (SN2112 FOR 100 x 75 ANGLE IRON AND SN2113 FOR 150 x 100 ANGLE IRON. USE 100 x 75 FOR SIGNS UP TO 1800 HIGH AND 150 x 100 FOR SIGNS OVER 1800 HIGH)

SIGN LIGHTING WIRING (TYPICAL)

TYPE L, L1/L2, M1/M2 OR H1/H2 GALVANIZED SIGN ARMS

MAXIMUM 3600 WIDE

MAXIMUM 600

100 (TYPICAL)  
LEVEL (TYPICAL)

MAXIMUM 1200

END CAP

2° RISE IN ARM

MAXIMUM 600 (TYPICAL)

MAXIMUM 300 (TYPICAL)

MAXIMUM 2400 HIGH

VARIES

175

LEVEL

50

WHERE SPECIFIED SIGN LUMINAIRE SHALL BE MOUNTED ON THE TOP OF SIGN

GALVANIZED SIGN LUMINAIRE MOUNTING CLAMP (TYPICAL)

TYRAP CABLE TO ARM EVERY 600

GALVANIZED SIGN MOUNTING CLAMP (TYPICAL) SN2103 FOR L ARMS, SN2103A FOR L1/L2 ARMS, SN2104 FOR M1/M2 ARMS, SN2105 FOR H1/H2 ARMS.

Q OF SIGN

PLUMB

JUNCTION BOX (SEE DRAWING SP635-3.3.19)

GALVANIZED SIGN LUMINAIRE PIPE BRACKET (TYPICAL)

SIGN LUMINAIRE (TYPICAL)

GALVANIZED HORIZONTAL SIGN SUPPORT (LENGTH TO SUIT) TYPICAL (SN2114)

REAR ELEVATION

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. A SKETCH DETAILING THE EXACT SPACING OF VERTICAL ANGLE IRONS AND HORIZONTAL SIGN SUPPORTS WILL BE SUPPLIED WITH SIGN BRACKET ASSEMBLY.
3. NUMBER OF SIGN LUMINAIRES MAY VARY.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.
5. SIGN LUMINAIRE, PIPE CLAMP AND CABLE ARE NOT REQUIRED FOR NON-ILLUMINATED SIGN.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

TOTAL MASS

SIGNBOARD = 10 kg/m<sup>2</sup>

SEE DRAWING SP635-3.3.18 FOR SIGN LIGHTING DETAILS.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	LARGE OVERHEAD PLYWOOD GUIDE SIGN INSTALLATION DETAILS (2500 TO 3600 WIDE SIGNS)		
F					
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00			
D	J.B. DRAWING REFERENCE REVISED	DEC 98			
C	SIGN LUMINAIRE CLAMPS REVISED	DEC 96			
B	L1/L2 ARMS & JUNCTION BOX ADDED	AUG 95			
A	GENERAL REVISION	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-3.3.4
			Chief Highway Engineer		



SIGN LUMINAIRES SHALL BE USED ONLY WHEN SPECIFICALLY NOTED ON THE DESIGN DRAWINGS

GALVANIZED VERTICAL ANGLE IRON (LENGTH TO SUIT) TYPICAL (SN2112 FOR 100 x 75 ANGLE IRON AND SN2113 FOR 150 x 100 ANGLE IRON. USE 100 x 75 FOR SIGNS UP TO 1800 HIGH AND 150 x 100 FOR SIGNS OVER 1800 HIGH)

SIGN LIGHTING WIRING (TYPICAL)

TYPE M1/M2 OR H1/H2 GALVANIZED SIGN ARMS

MAXIMUM 4800 WIDE

MAXIMUM 600

100 (TYPICAL)  
LEVEL (TYPICAL)

MAXIMUM 1200

END CAP

MAXIMUM 600  
(TYPICAL)

MAXIMUM 300  
(TYPICAL)

MAXIMUM 2400 HIGH

2° RISE IN ARM

VARIES

175

LEVEL

50

WHERE SPECIFIED SIGN LUMINAIRE SHALL BE MOUNTED ON THE TOP OF SIGN

GALVANIZED SIGN LUMINAIRE MOUNTING CLAMP (TYPICAL)

TYRAP CABLE TO ARM EVERY 600

GALVANIZED SIGN MOUNTING CLAMP (TYPICAL) SN2104 FOR M1/M2 ARMS AND SN2105 FOR H1/H2 ARMS.

PLUMB

JUNCTION BOX (SEE DRAWING SP635-3.3.19)

GALVANIZED SIGN LUMINAIRE PIPE BRACKET (TYPICAL)

SIGN LUMINAIRE (TYPICAL)

GALVANIZED HORIZONTAL SIGN SUPPORT (LENGTH TO SUIT) TYPICAL (SN2114)

REAR ELEVATION

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. A SKETCH DETAILING THE EXACT SPACING OF VERTICAL ANGLE IRONS AND HORIZONTAL SIGN SUPPORTS WILL BE SUPPLIED WITH SIGN BRACKET ASSEMBLY.
3. NUMBER OF SIGN LUMINAIRES MAY VARY.
4. 'SN' DENOTES MINISTRY STOCK NUMBER.
5. SIGN LUMINAIRE, PIPE CLAMP AND CABLE ARE NOT REQUIRED FOR NON-ILLUMINATED SIGN.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

TOTAL MASS

SIGNBOARD = 10 kg/m<sup>2</sup>

SEE DRAWING SP635-3.3.18 FOR SIGN LIGHTING DETAILS.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00
D	J.B. DRAWING REFERENCE REVISED	DEC 98
C	SIGN LUMINAIRE CLAMPS REVISED	DEC 96
B	JUNCTION BOX ADDED	AUG 95
A	GENERAL REVISION	AUG 94

## LARGE OVERHEAD PLYWOOD GUIDE SIGN INSTALLATION DETAILS (3700 TO 4800 WIDE SIGNS)

Date

Approved

30/09/93 E.L. (Signature on File)

Chief Highway Engineer

SPECIFICATION  
DRAWING No.

SP635-3.3.5



GALVANIZED VERTICAL ANGLE IRONS.  
 SN2112 FOR 100 x 75 ANGLE IRON  
 SN2113 FOR 150 x 100 ANGLE IRON  
 (USE 100 x 75 FOR SIGNS UP TO  
 1800 HIGH AND 150 x 100 FOR SIGNS  
 OVER 1800 HIGH).

GALVANIZED SIGN  
 MOUNTING CLAMP  
 SN2103 FOR L ARMS  
 SN2103A FOR L1/L2 ARMS  
 SN2104 FOR M1/M2 ARMS  
 SN2105 FOR H1/H2 ARMS

8 SIDED FOR L, L1/L2  
 AND M1/M2 ARMS  
 12 SIDED FOR H1/H2 ARM

5/8"Ø (LENGTH VARIES)  
 BOLT, NUT, 2 FLATWASHERS  
 AND LOCKWASHER.  
 (SUPPLIED WITH CLAMP)

SLOTTED HOLES

GALVANIZED HORIZONTAL SIGN  
 SUPPORT (SN2114)

3/8"Ø x 1 1/2" LONG BOLT, NUT AND  
 WASHERS (PART OF SN2114) TYPICAL

NYLON WASHER AGAINST PLYWOOD  
 SIGN FACE (PART OF SN2114) TYPICAL

5/8"Ø x 2 1/2" LONG BOLT, NUT,  
 2 FLATWASHERS AND LOCKWASHER  
 (SUPPLIED WITH CLAMP)

SLOTTED HOLES FOR MAXIMUM  
 ADJUSTMENT

PLYWOOD SIGN

PLUMB

## SIGN BRACKET ASSEMBLY

SIDE VIEW

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

SIGN LIGHTING NOT SHOWN  
 SEE DRAWING SP635-3.3.18 FOR  
 SIGN LIGHTING DETAILS.

NOT TO SCALE

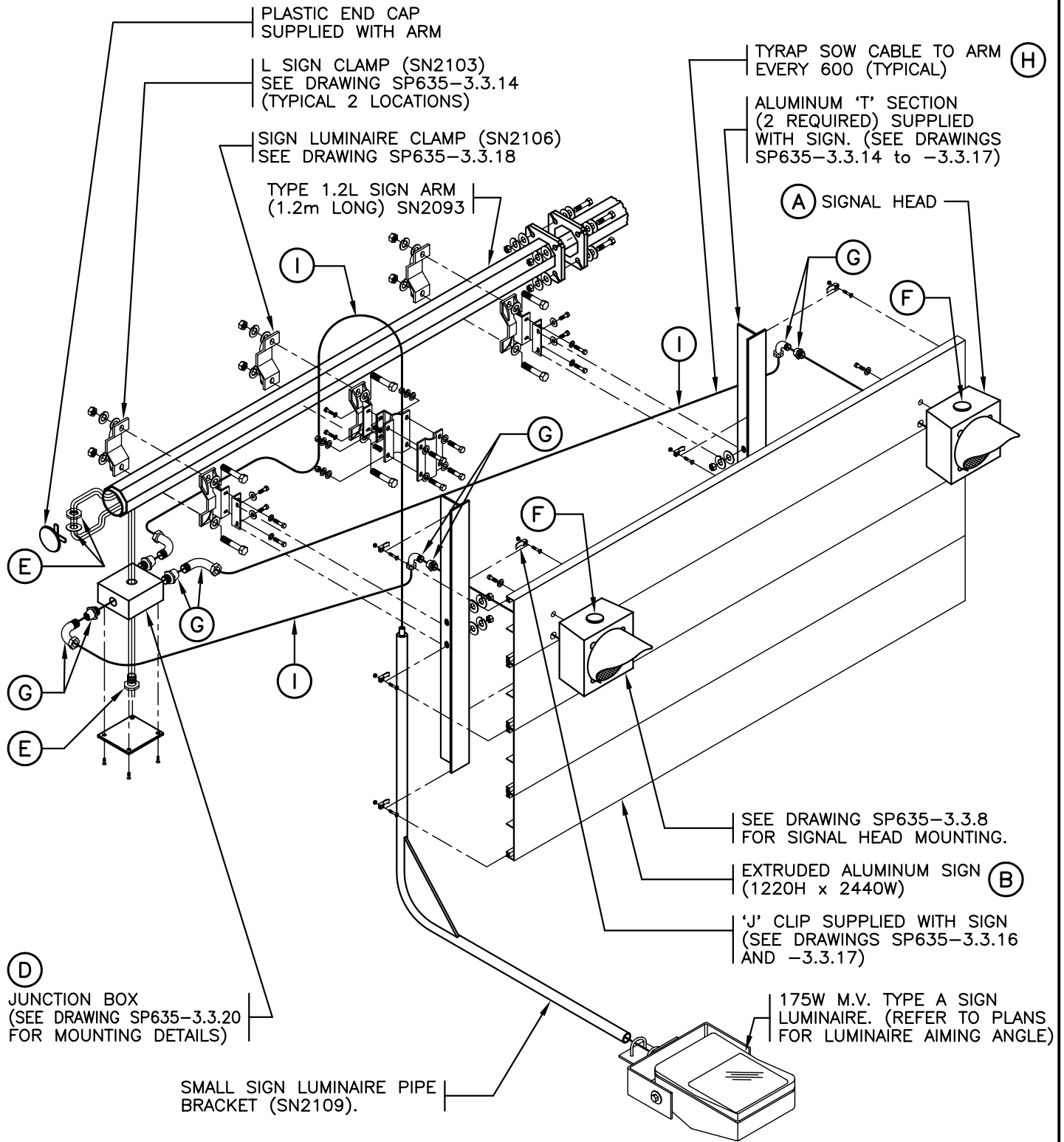


**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	LARGE OVERHEAD PLYWOOD GUIDE SIGN ASSEMBLY DETAILS		
F			<div>Date<div>Approved</div></div> <div><div>30/09/93</div><div>E.L. (Signature on File)</div><div>Chief Highway Engineer</div></div> <div>SPECIFICATION DRAWING No. SP635—3.3.6</div>		
E					
D					
C	SIGN MOUNTING CLAMPS REVISED	DEC 96			
B	L1/L2 ARMS ADDED & CLAMP REVISED	AUG 95			
A	GENERAL REVISION	AUG 94			





SEE DRAWING SP635-3.3.8 FOR  
NOTES AND ADDITIONAL DETAILS

NOT TO SCALE

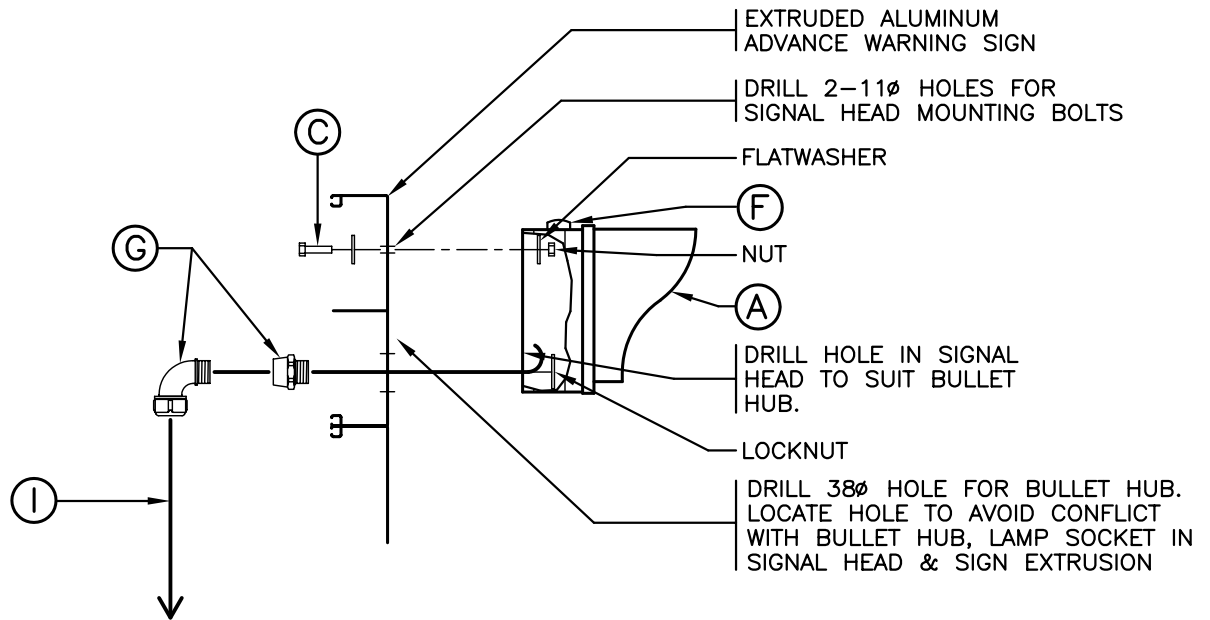
No.	Revision	Date
F		
E		
D	JUNCTION BOX MOUNTING REVISED	NOV 01
C	SIGN LUMINAIRE TYPE C CHANGED TO TYPE A	NOV 98
B	SIGN ARM REDRAWN	OCT 97
A	MOUNTING CLAMPS REVISED	AUG 96

## LARGE OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN ASSEMBLY DETAILS

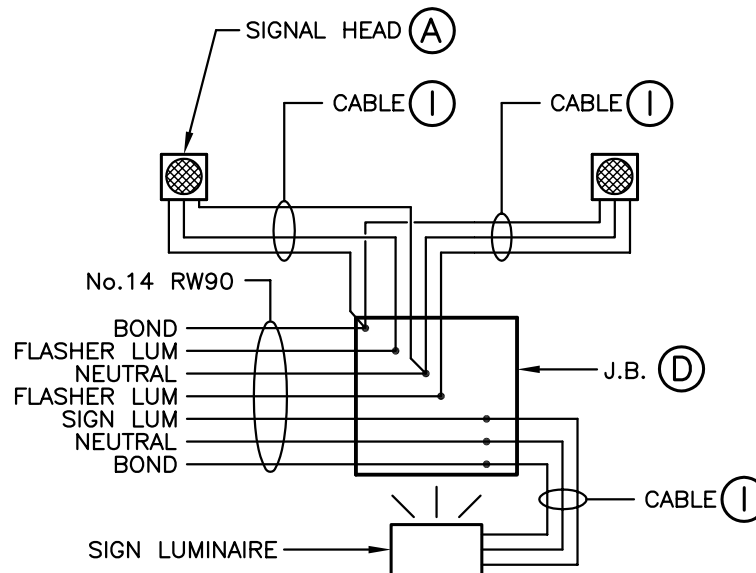
Date 15/11/95 Approved **M.C.** (Signature on File)  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.3.7**





SIGNAL HEAD MOUNTING DETAIL



WIRING DIAGRAM

NOTES

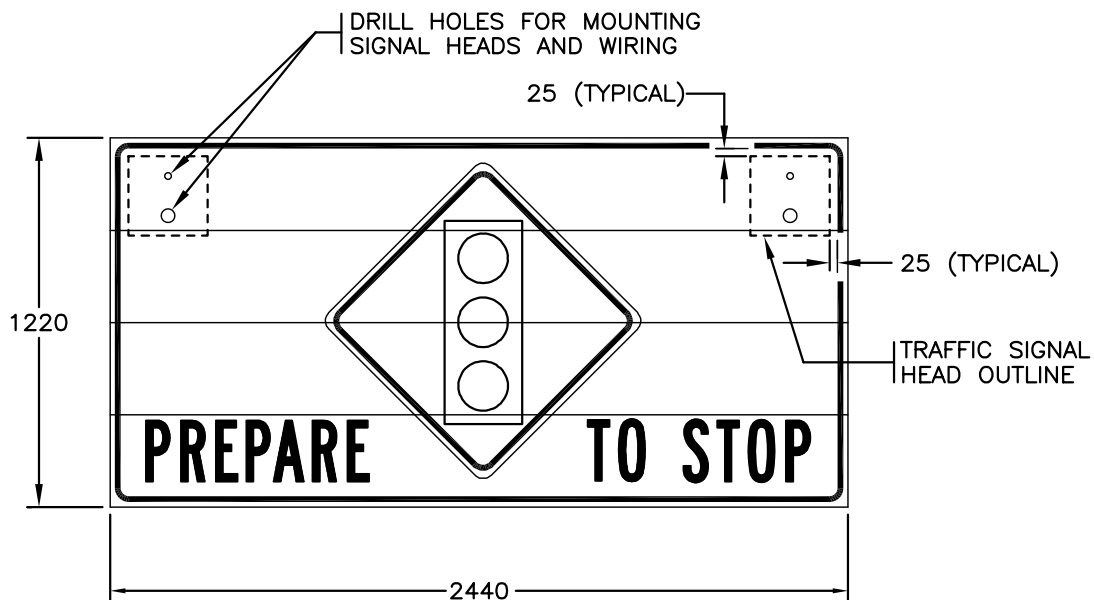
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. SEE DRAWINGS SP635-3.3.9 & -3.3.10 FOR PARTS LISTS.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM ADVANCE WARNING SIGN INSTALLATION DETAILS		
F			Date Approved		
E					
D			SPECIFICATION DRAWING No.		
C					
B	SIGN CHANGED TO ALUMINUM EXTRUDED	AUG 95	30/09/93 E.L. (Signature on File) Chief Highway Engineer		
A	GENERAL REVISION	AUG 94			
			SP635-3.3.8		





TRAFFIC SIGNAL ADVANCE WARNING SIGN

TRAFFIC SIGNAL ADVANCE WARNING SIGN KIT (SN1783D)		
ITEM	QUANTITY	DESCRIPTION
A	2	8" SIGNAL HEAD SECTION C/W YELLOW LENS, LAMP AND COWL VISOR
B	1	TRAFFIC SIGNAL EXTRUDED ALUMINUM ADVANCE WARNING SIGN BOARD
C	2	3/8" $\phi$ x 1 1/2" LONG STAINLESS STEEL HEX HEAD BOLT, NUT, 2 FLAT WASHERS AND 1 LOCKWASHER
D	1	150 x 150 x 100 PVC J.B.
E	1	3/4" INSULATED CHASE NIPPLE, LOCKNUT AND FLAT WASHER
F	2	FINIAL
G	4	1/2" BULLET HUB AND 90° STRAIN RELIEF CONNECTOR AND LOCKNUT
H	5	LARGE TY-RAP
I	7m	3c No. 14 S.O.W. CABLE

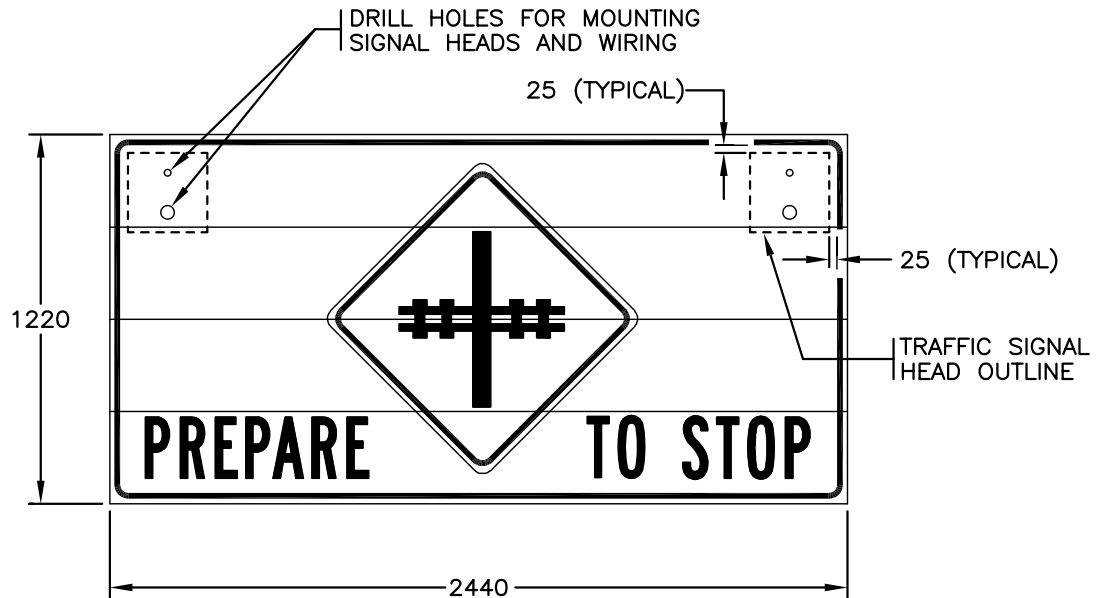
SEE DRAWING SP635-3.3.8 FOR NOTES

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM TRAFFIC SIGNAL ADVANCE WARNING SIGN INSTALLATION DETAILS	
F				
E			Date _____ Approved _____ <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	
D				
C	ITEM E REVISED	NOV 01	SPECIFICATION DRAWING No. <b>SP635-3.3.9</b>	
B	SIGN CHANGED TO ALUMINUM EXTRUDED	AUG 95		
A	GENERAL REVISIONS	AUG 94		





**RAILWAY ADVANCE WARNING SIGN**

TRAFFIC SIGNAL ADVANCE WARNING SIGN KIT (SN1783E)		
ITEM	QUANTITY	DESCRIPTION
A	2	8" SIGNAL HEAD SECTION C/W YELLOW LENS, LAMP AND COWL VISOR
B	1	EXTRUDED ALUMINUM RAILWAY ADVANCE WARNING SIGN BOARD
C	2	3/8"Ø x 1 1/2" LONG STAINLESS STEEL HEX HEAD BOLT, NUT, 2 FLAT WASHERS AND 1 LOCKWASHER
D	1	150 x 150 x 100 PVC J.B.
E	1	3/4" INSULATED CHASE NIPPLE, 2 LOCKNUTS AND 2 FLAT WASHERS
F	2	FINIAL
G	4	1/2" BULLET HUB AND 90° STRAIN RELIEF CONNECTOR AND LOCKNUT
H	5	LARGE TY-RAP
I	7m	3c No. 14 S.O.W. CABLE

SEE DRAWING SP635-3.3.8 FOR NOTES

NOT TO SCALE

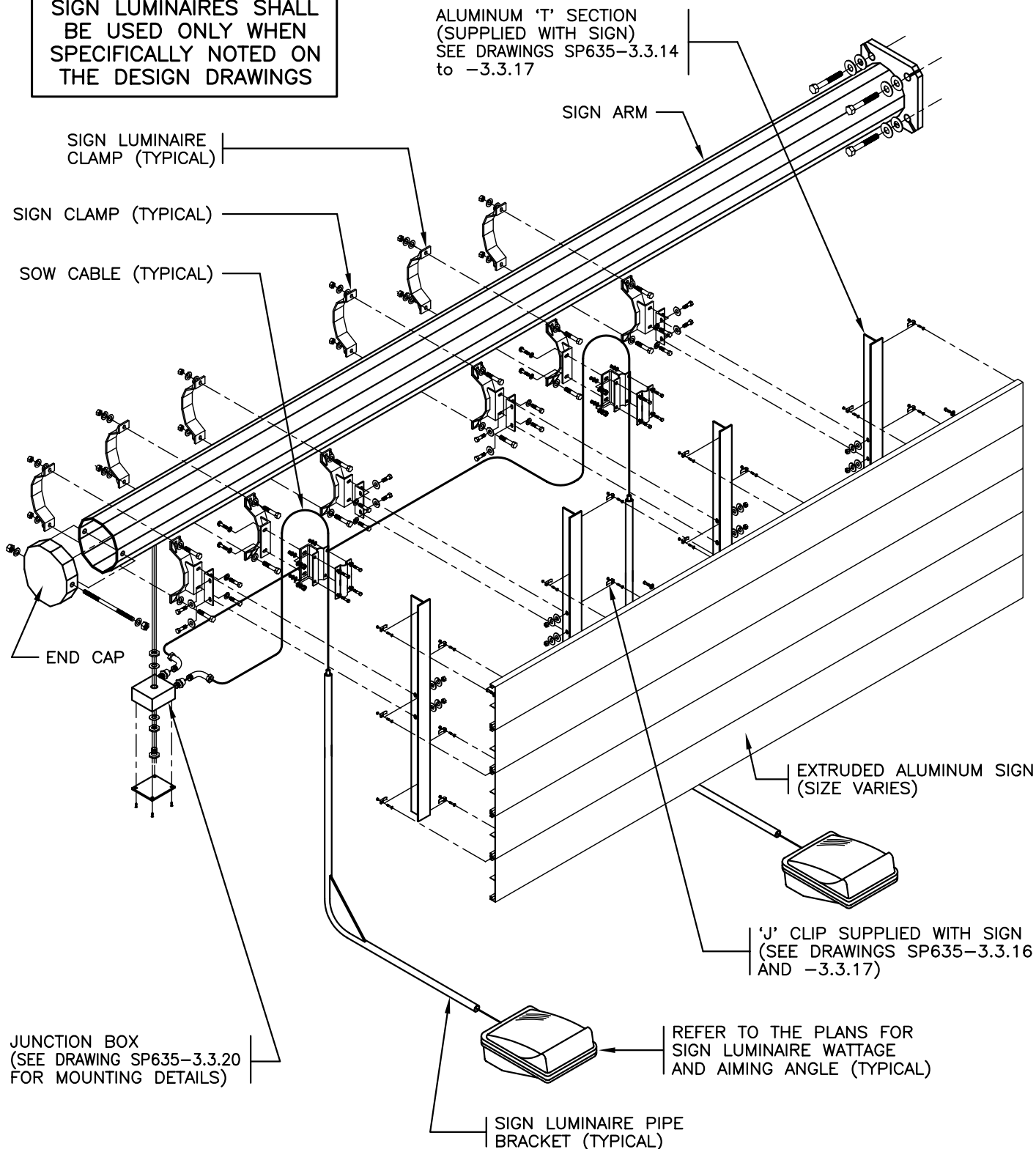


No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM RAILWAY ADVANCE WARNING SIGN INSTALLATION DETAILS	
F			Date	Approved
E				
D			18/11/94	E.L. (Signature on File)
C				
B	SIGN CHANGED TO ALUMINUM EXTRUDED	AUG 95	Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.3.10
A	GENERAL REVISIONS	AUG 94		



SIGN LUMINAIRE SHALL  
BE USED ONLY WHEN  
SPECIFICALLY NOTED ON  
THE DESIGN DRAWINGS

ALUMINUM 'T' SECTION  
(SUPPLIED WITH SIGN)  
SEE DRAWINGS SP635-3.3.14  
to -3.3.17



SEE DRAWING SP635-3.3.12 FOR  
NOTES AND ADDITIONAL DETAILS

NOT TO SCALE



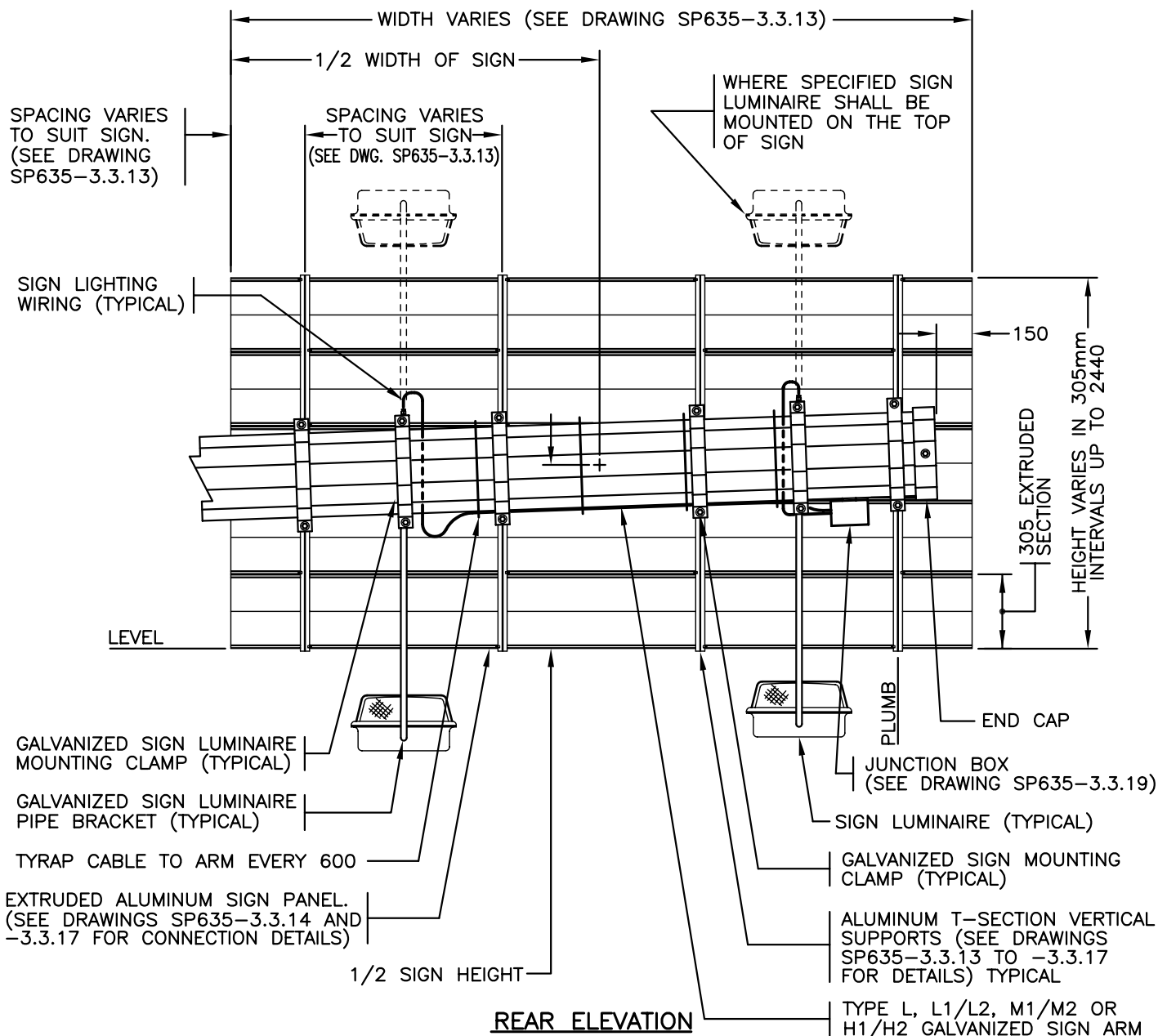
No.	Revision	Date
F		
E		
D		
C	SIGN LUMINAIRE NOTE ADDED	SEPT 00
B	SIGN LUMINAIRE TYPE B NOTE DELETED	NOV 98
A	MOUNTING CLAMPS REVISED	AUG 96

## LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN ASSEMBLY DETAILS

Date Approved  
**15/11/95 M.C. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.3.11**





TOTAL MASS
EACH EXTRUDED ALUMINUM SIGN SECTION = 4 kg/m

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. NUMBER OF SIGN LUMINAIRES MAY VARY.
3. 'SN' DENOTES MINISTRY STOCK NUMBER.
4. FUSE SIGN LUMINAIRES IN POLE HANDHOLE.
5. SIGN LUMINAIRE, MOUNTING PIPE, CLAMP AND CABLE IS NOT REQUIRED FOR NON-ILLUMINATED SIGN.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

SIGN LUMINAIRES SHALL BE USED ONLY WHEN SPECIFICALLY NOTED ON THE DESIGN DRAWINGS

SEE DRAWING SP635-3.3.18 FOR SIGN LIGHTING DETAILS.

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN INSTALLATION DETAILS		
F					
E					
D	SIGN LUMINAIRE NOTE ADDED	SEPT 00	Date	Approved	SPECIFICATION DRAWING No.
C	J.B. DRAWING REFERENCE REVISED	DEC 98	21/11/94	E.L. (Signature on File)	SP635-3.3.12
B	SIGN LUMINAIRE CLAMPS REVISED	DEC 96	Chief Highway Engineer		
A	L1/L2 ARMS & JUNCTION BOX ADDED	AUG 95			



TYPICAL SIGN WIDTH	SPACING OF VERTICAL T-SECTIONS	NUMBER OF VERTICALS
7320mm		6
6710mm		5
6100mm		5
5490mm		4
4880mm		4
4270mm		4
3660mm		3
3050mm		3
2440mm		2

SEE DRAWING SP635-3.3.12 FOR  
NOTES AND ADDITIONAL DETAILS



NOT TO SCALE

No.	Revision	Date	<b>LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN INSTALLATION DETAILS</b>	
F				
E				
D				
C				
B	T-SECTION SPACING FOR 2440 WIDE SIGN REVISED	AUG 96	<b>18/11/94 E.L. (Signature on File)</b> Chief Highway Engineer	
A	SIGN WIDTHS & T-SECTION SPACING REVISED	AUG 95		
			Date _____ Approved _____	<b>SPECIFICATION DRAWING No. SP635-3.3.13</b>



VERTICAL T-SECTIONS (102 x 102 x 9.5 ALUMINUM 6061-T6) SUPPLIED WITH SIGN

DRILL & TAP T-SECTION TO SUIT  
3/8"Ø STAINLESS STEEL HEX HEAD BOLT

SIGN

GALVANIZED SIGN MOUNTING CLAMP  
SN2103 FOR L ARMS  
SN2103A FOR L1/L2 ARMS  
SN2104 FOR M1/M2 ARMS  
SN2105 FOR H1/H2 ARMS

T-SECTION

10 (TYPICAL TOP AND BOTTOM)

CONNECTION BOLTS (SUPPLIED WITH SIGN)  
SEE DRAWINGS SP635-3.3.15 AND 3.3.16 FOR DETAILS (TYPICAL)

EXTRUDED ALUMINUM SIGN

5/8"Ø X 2" 1/2 LONG BOLT, NUT, 2 FLATWASHERS AND LOCKWASHER (SUPPLIED WITH CLAMP)

5/8"Ø (LENGTH VARIES) BOLT, NUT 2 FLATWASHERS AND LOCKWASHER (SUPPLIED WITH CLAMP)

8 SIDED FOR L, L1/L2 AND M1/M2 ARMS  
12 SIDED FOR H1/H2 ARM

EXTRUDED ALUMINUM SIGN SECTION (305 HIGH)

PLUMB

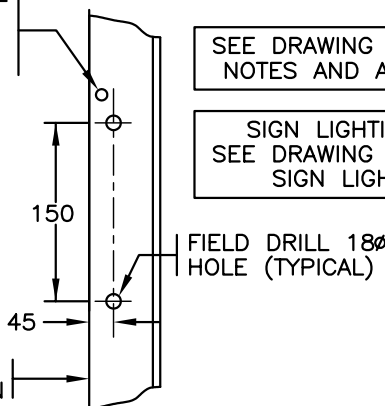
### SIGN BRACKET ASSEMBLY

SIDE VIEW

FIELD DRILL 14Ø HOLE FOR LOCKING BOLT AFTER T-SECTION IS INSTALLED ON CLAMP

SEE DRAWING SP635-3.3.12 FOR NOTES AND ADDITIONAL DETAILS.

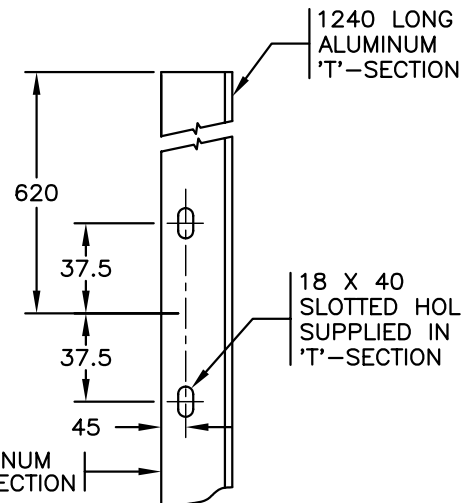
SIGN LIGHTING NOT SHOWN. SEE DRAWING SP635-3.3.18 FOR SIGN LIGHTING DETAILS.



ALUMINUM T-SECTION

### T-SECTION HOLE DETAIL

(FOR L1/L2, M1/M2 & H1/H2 SIGN ARMS)



### T-SECTION SLOT DETAIL

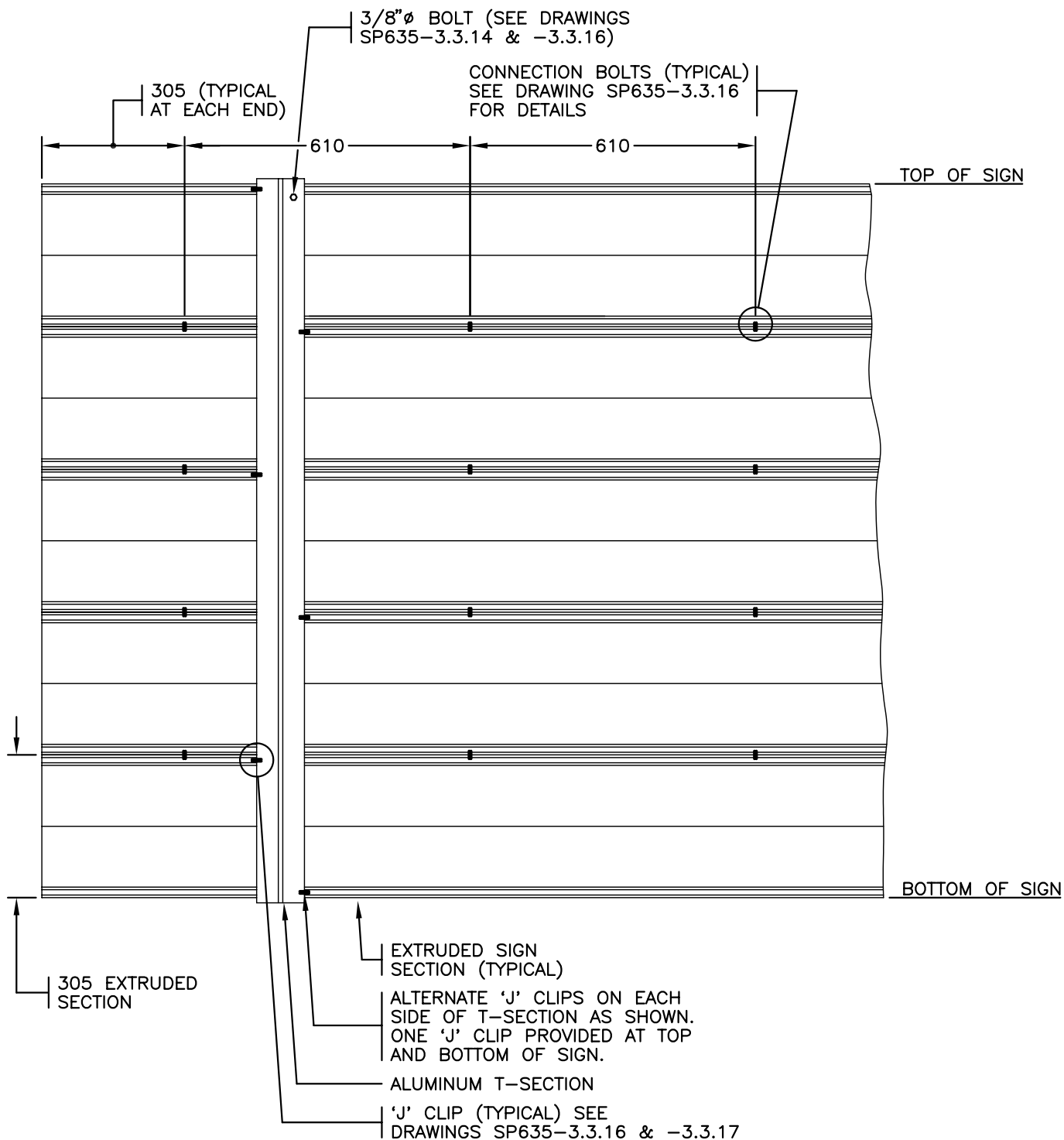
(FOR 1.2m(H) X 2.4m(W) SIGN ON L SIGN ARM)

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN ASSEMBLY DETAILS		
F					
E					
D					
C	T-SECTION SLOT DETAIL ADDED	NOV 01	Date	Approved	SPECIFICATION DRAWING No.
B	MOUNTING CLAMPS REV'D & SAFETY BOLT ADDED	AUG 96	18/11/94	E.L. (Signature on File)	SP635-3.3.14
A	L1/L2 ARMS ADDED & T-SECTION DETAILS REVISED	AUG 95	Chief Highway Engineer		





**REAR VIEW OF SIGN**

SEE DRAWING SP635-3.3.12 FOR NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of Transportation

No.	Revision	Date
F		
E		
D		
C		
B	SAFETY BOLT ADDED	AUG 96
A	END HOLE SPACING REVISED	AUG 95

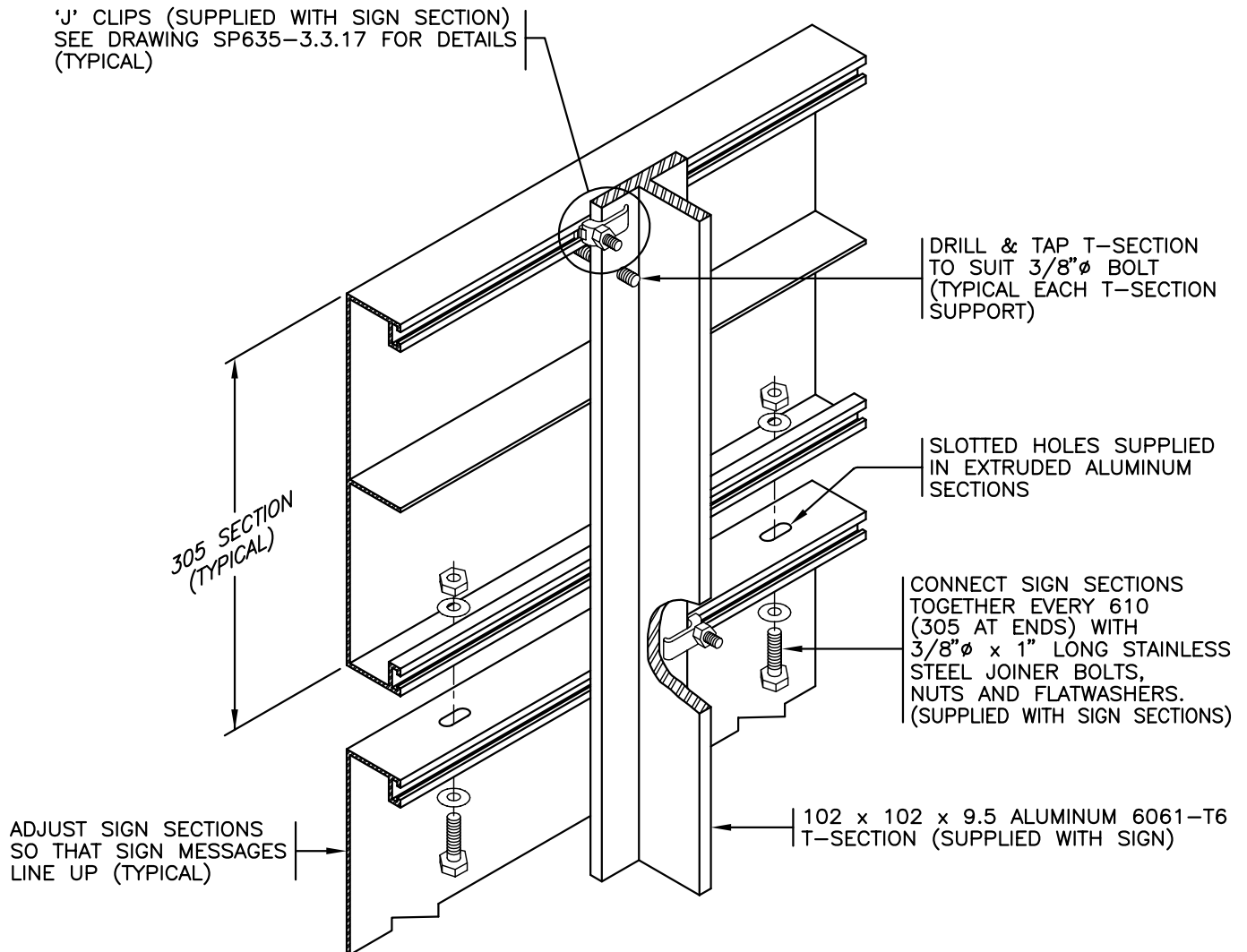
# LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN ASSEMBLY DETAILS

Date Approved  
**18/11/94** **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.3.15**



'J' CLIPS (SUPPLIED WITH SIGN SECTION)  
SEE DRAWING SP635-3.3.17 FOR DETAILS  
(TYPICAL)



ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

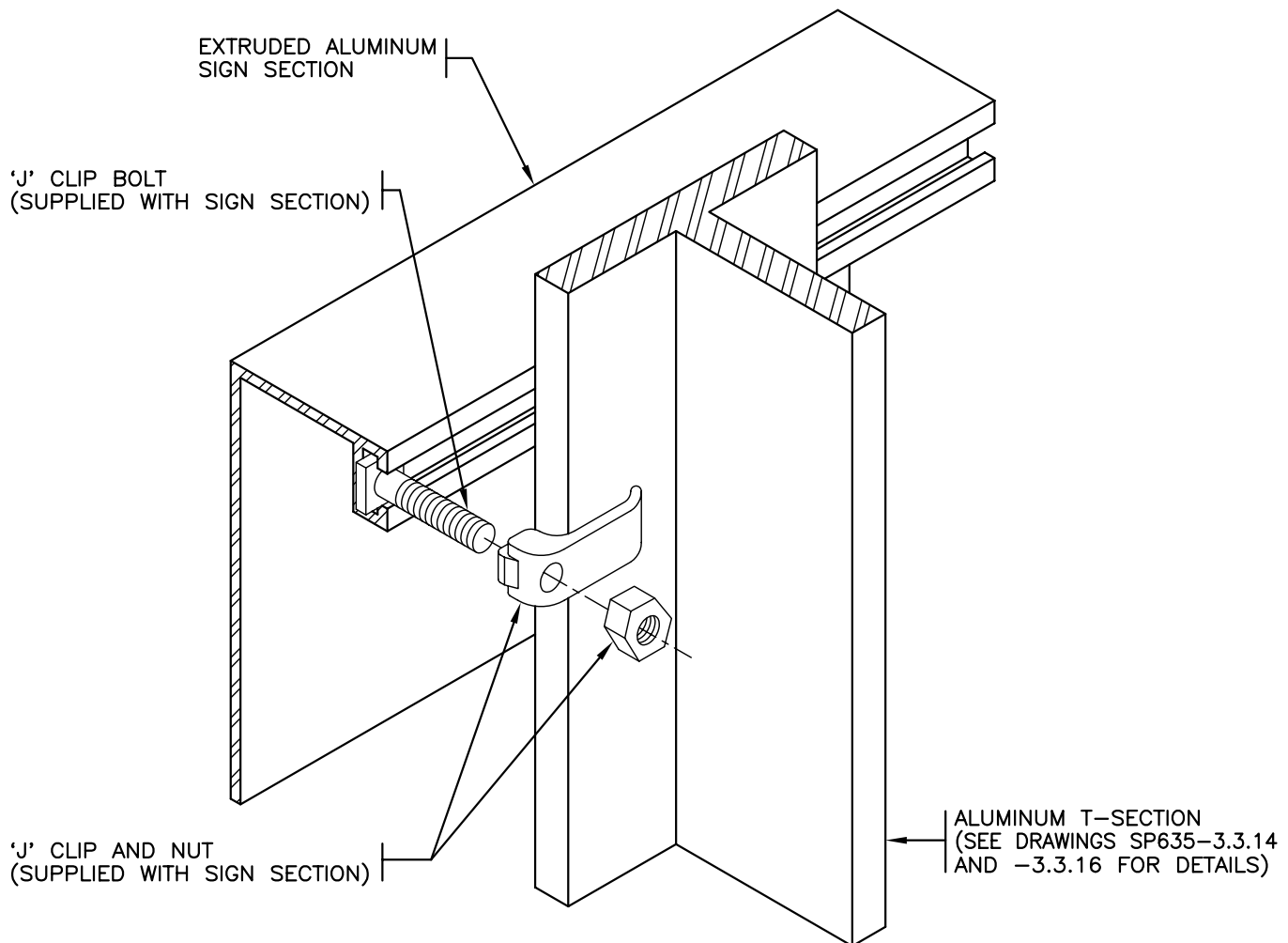
SEE DRAWING SP635-3.3.12 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN ASSEMBLY DETAILS		
F			Date	Approved	SPECIFICATION DRAWING No.
E			18/11/94	E.L. (Signature on File)	SP635-3.3.16
D			Chief Highway Engineer		
C					
B	SAFETY BOLT ADDED	AUG 96			
A	END HOLE SPACING REVISED	AUG 95			





ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

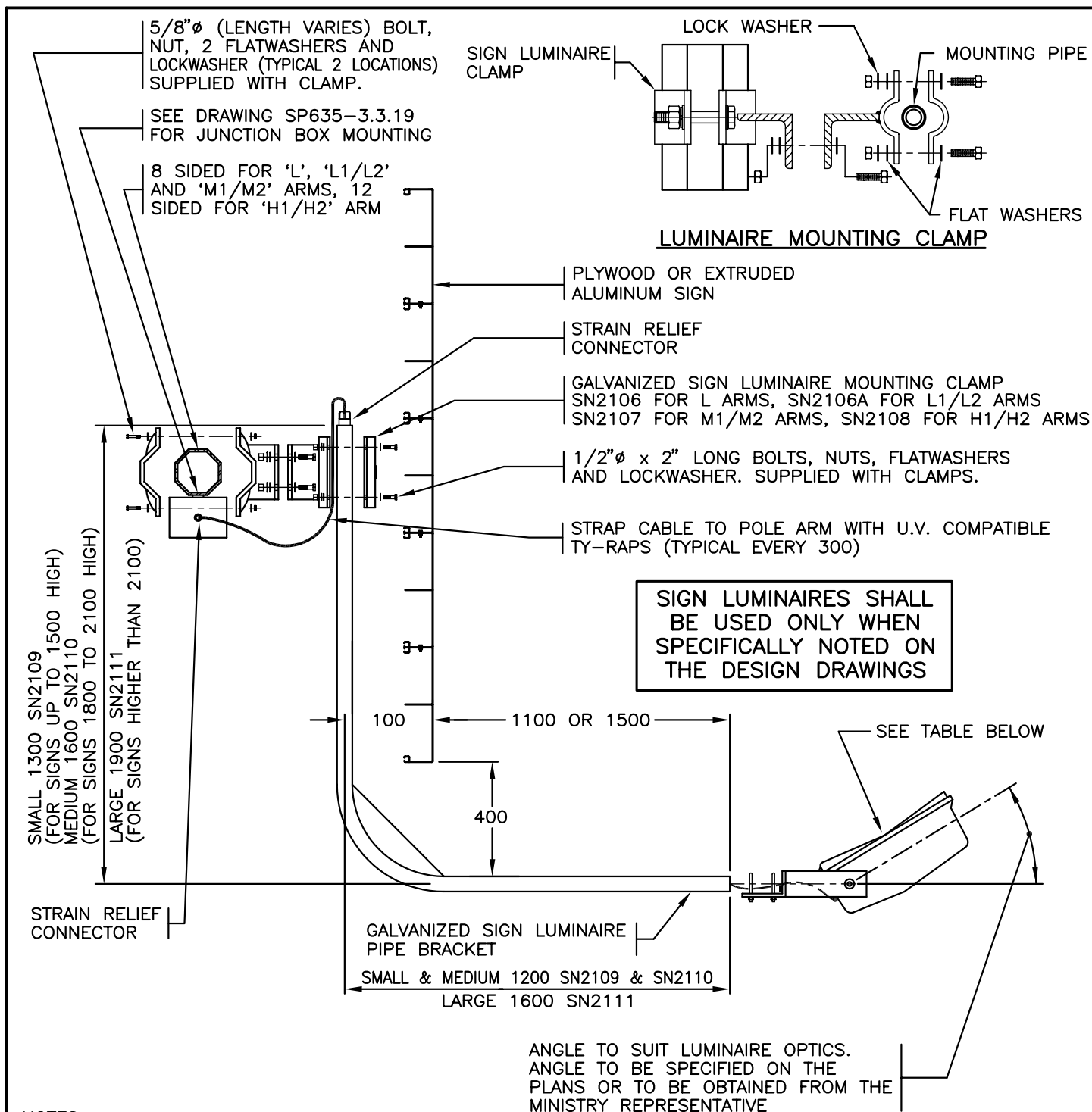
SEE DRAWING SP635-3.3.12 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN ASSEMBLY DETAILS		
F			Date	Approved	SPECIFICATION DRAWING No.
E			18/11/94	E.L. (Signature on File)	SP635-3.3.17
D			Chief Highway Engineer		
C					
B					
A	DRAWING NUMBER REVISED	AUG 95			





#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- USE TYPE A 175W MV SIGN LUMINAIRES FOR ALL SIGNS UP TO 1.8m HIGH BY 3.0m WIDE. REFER TO THE PLANS FOR SIGN LUMINAIRE TYPE AND AIMING ANGLES FOR SIGNS LARGER THAN 1.8m HIGH BY 3.0m WIDE.

LUMINAIRE TYPE AND WATTAGE	STOCK NUMBER	LAMP	SIGN LUMINAIRE ARM LENGTH
TYPE A 175W MV	SN1787	175W MV COATED LAMP	1200
TYPE A 250W MV	SN1783A	250W MV COATED LAMP	1600
TYPE B 250W MV	SN1783	250W MV COATED LAMP	1600

#### SIGN LIGHTING SIDE VIEW



**BRITISH COLUMBIA**

Ministry of  
Transportation

NOT TO SCALE

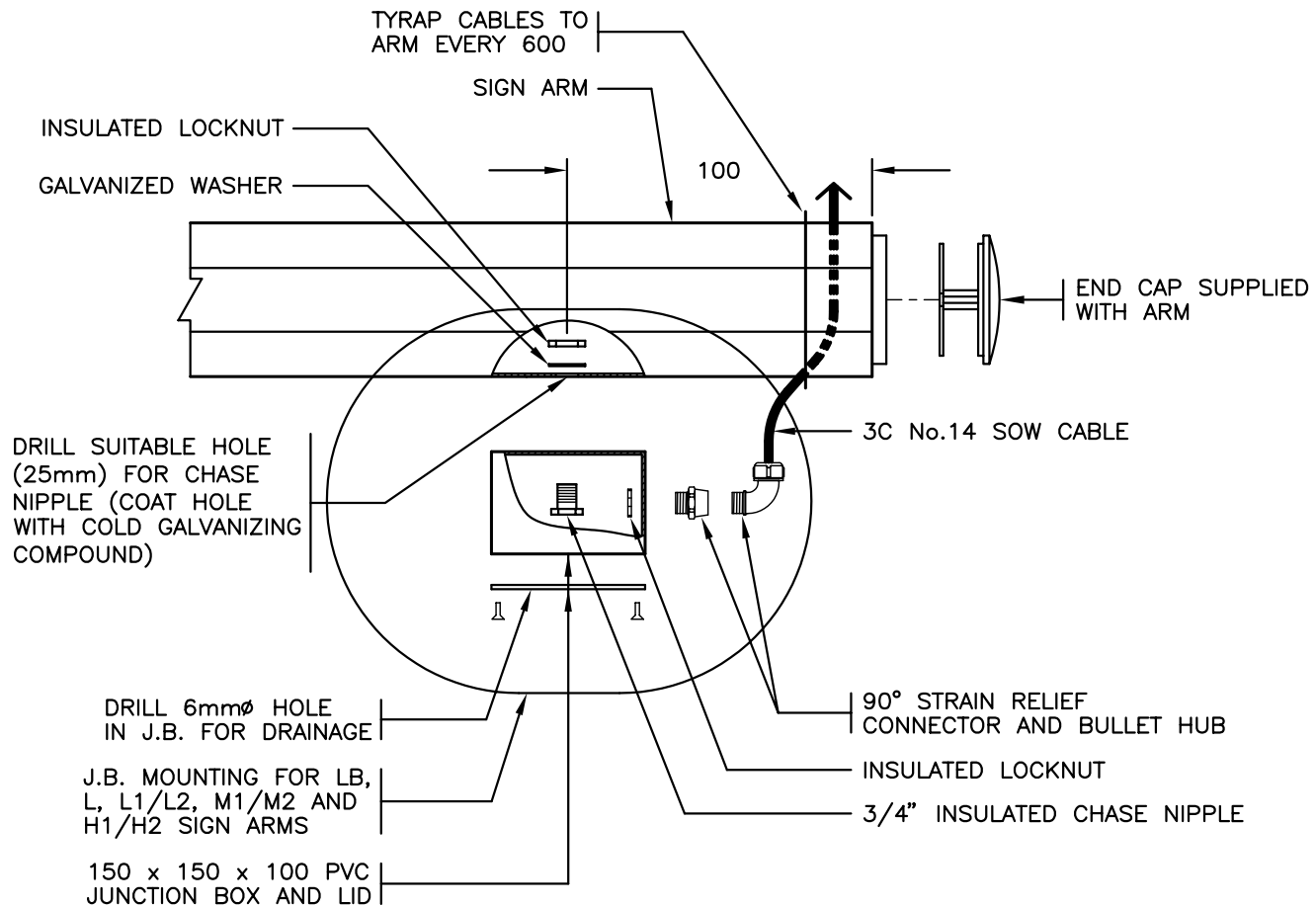
No.	Revision	Date
F	JUNCTION BOX MOUNTING REVISED	NOV 01
E	SIGN LUMINAIRE NOTE ADDED	SEPT 00
D	SIGN LUMINAIRE MOUNTING DIMENSIONS CHANGED	NOV 98
C	SIGN LUMINAIRE & MOUNTING REVISED	DEC 96
B	TYPE C LUMINAIRE & J.B. ADDED	AUG 95
A	GENERAL REVISION	AUG 94

#### LARGE OVERHEAD GUIDE SIGN LUMINAIRE INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.3.18**





**J.B. MOUNTING DETAIL**

**NOTES**

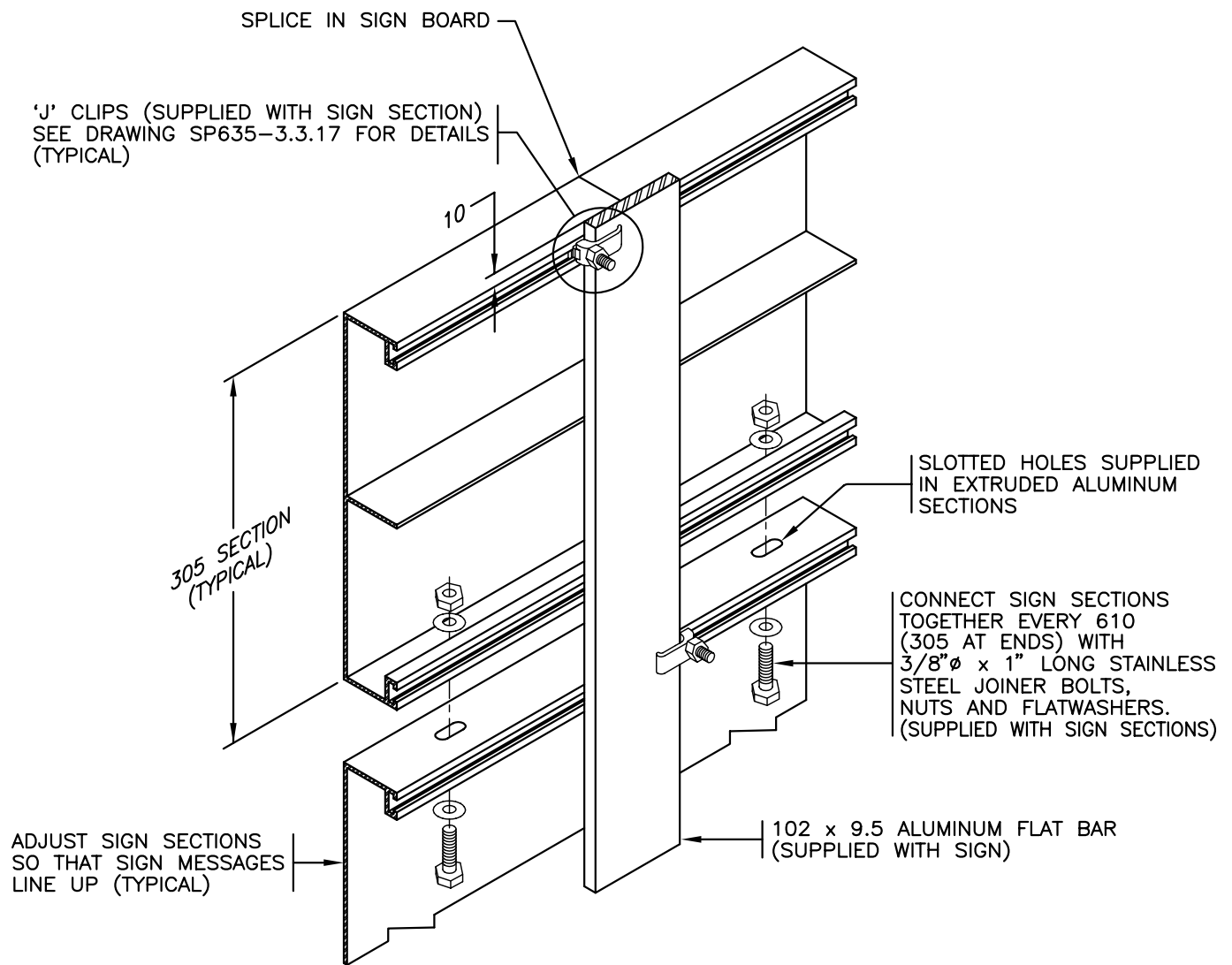
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. 'SN' DENOTES MINISTRY STOCK NUMBER.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	JUNCTION BOX INSTALLATION DETAILS ON SIGN ARMS	
F			Date	Approved
E				
D			15/11/95	M.C. (Signature on File)
C				
B	MOUNTING REVISED	NOV 01	Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.3.19
A	DRAWING NUMBER REVISED	DEC 98		





ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

SEE DRAWING SP635-3.3.12 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



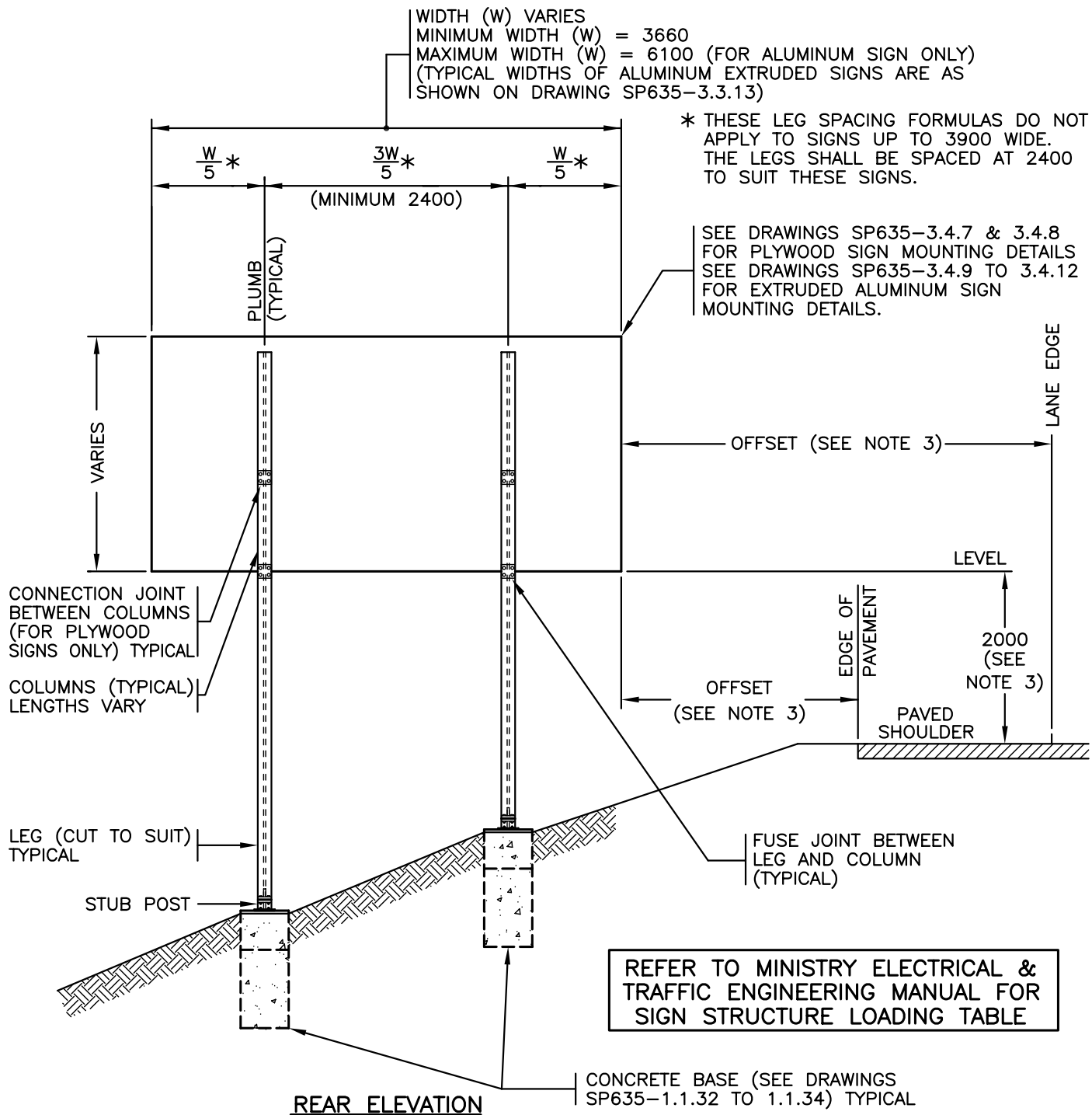
No.	Revision	Date	LARGE OVERHEAD EXTRUDED ALUMINUM GUIDE SIGN FLAT BAR AT SPLICE DETAILS	
F				
E			Date	Approved
D				
C				
B				
A	DRAWING NUMBER REVISED	DEC 98	Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.3.20



WIDTH (W) VARIES  
 MINIMUM WIDTH (W) = 3660  
 MAXIMUM WIDTH (W) = 6100 (FOR ALUMINUM SIGN ONLY)  
 (TYPICAL WIDTHS OF ALUMINUM EXTRUDED SIGNS ARE AS  
 SHOWN ON DRAWING SP635-3.3.13)

\* THESE LEG SPACING FORMULAS DO NOT  
 APPLY TO SIGNS UP TO 3900 WIDE.  
 THE LEGS SHALL BE SPACED AT 2400  
 TO SUIT THESE SIGNS.

SEE DRAWINGS SP635-3.4.7 & 3.4.8  
 FOR PLYWOOD SIGN MOUNTING DETAILS  
 SEE DRAWINGS SP635-3.4.9 TO 3.4.12  
 FOR EXTRUDED ALUMINUM SIGN  
 MOUNTING DETAILS.



REFER TO MINISTRY ELECTRICAL &  
 TRAFFIC ENGINEERING MANUAL FOR  
 SIGN STRUCTURE LOADING TABLE

#### NOTES

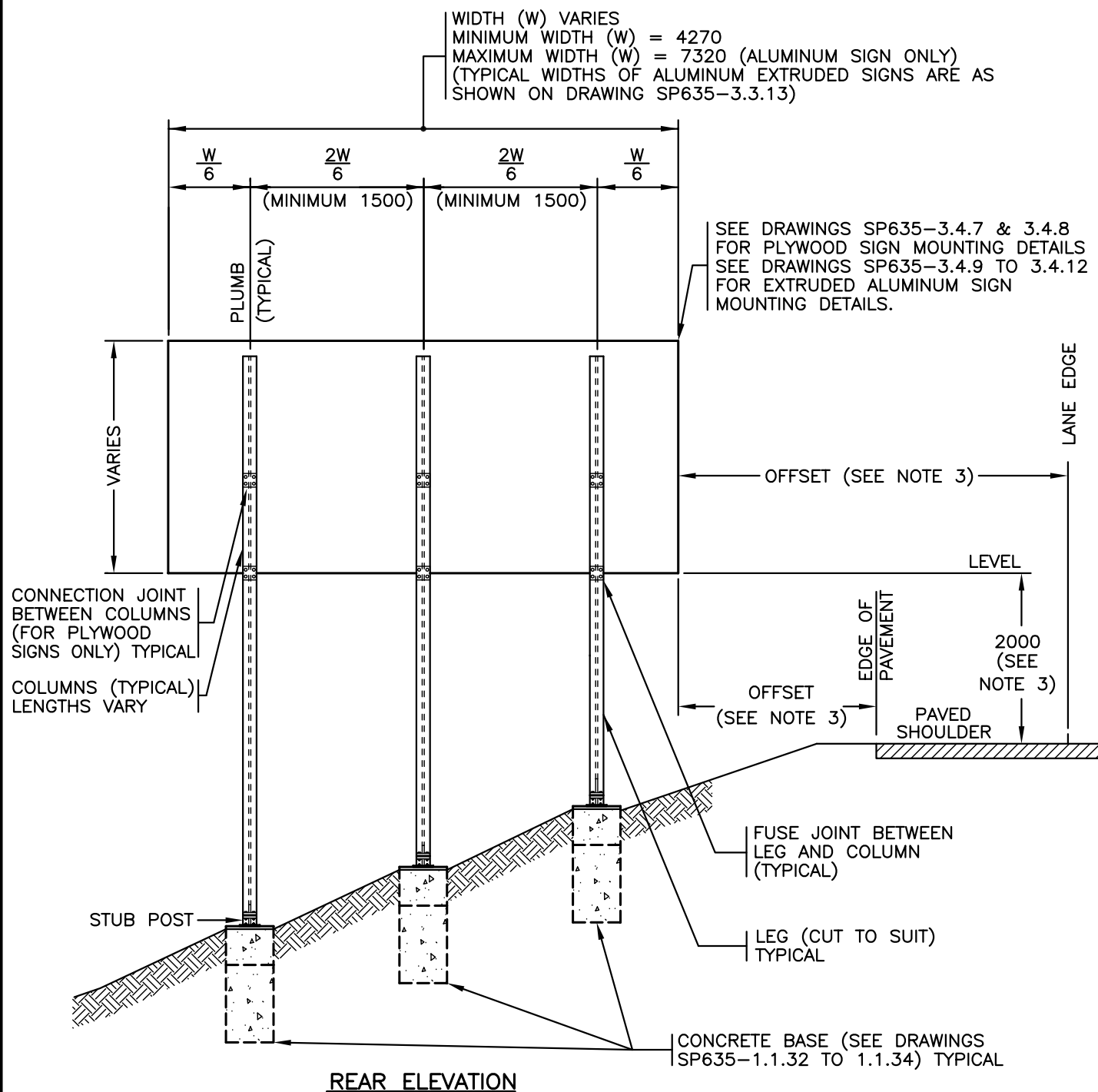
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

NOT TO SCALE



No.	Revision	Date	TWO LEG BREAKAWAY SIGN STRUCTURE INSTALLATION DETAIL		
E					
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98			
C	SLOPE & BASE DWG. REFERENCES REV'D	AUG 96			
B	SLOPE SHOWN & TYPICAL SIGN WIDTHS SHOWN	AUG 95			
A	GENERAL REVISION	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-3.4.1
			Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE

NOT TO SCALE



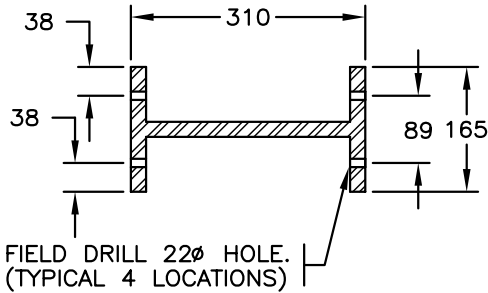
No.	Revision	Date	THREE LEG BREAKAWAY SIGN STRUCTURE INSTALLATION DETAILS		
E					
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98			
C	SLOPE & BASE DWG. REFERENCES REV'D	AUG 96			
B	SLOPE SHOWN & TYPICAL SIGN WIDTHS SHOWN	AUG 95			
A	GENERAL REVISION	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-3.4.2
			Chief Highway Engineer		



TOP OF EACH LEG TO BE  
EQUAL ELEVATION

FIELD CUT AND DRILL LEG IF REQUIRED.  
(SEE SECTION (A) BELOW). COAT CUTS AND  
HOLES WITH COLD GALVANIZING COMPOUND

TORQUE  $3/4"$   $\phi$  x  $3\ 1/2"$   
LONG BOLTS TO 75ft. lbs.



SECTION (A)

STUB POST MASS
40 kg

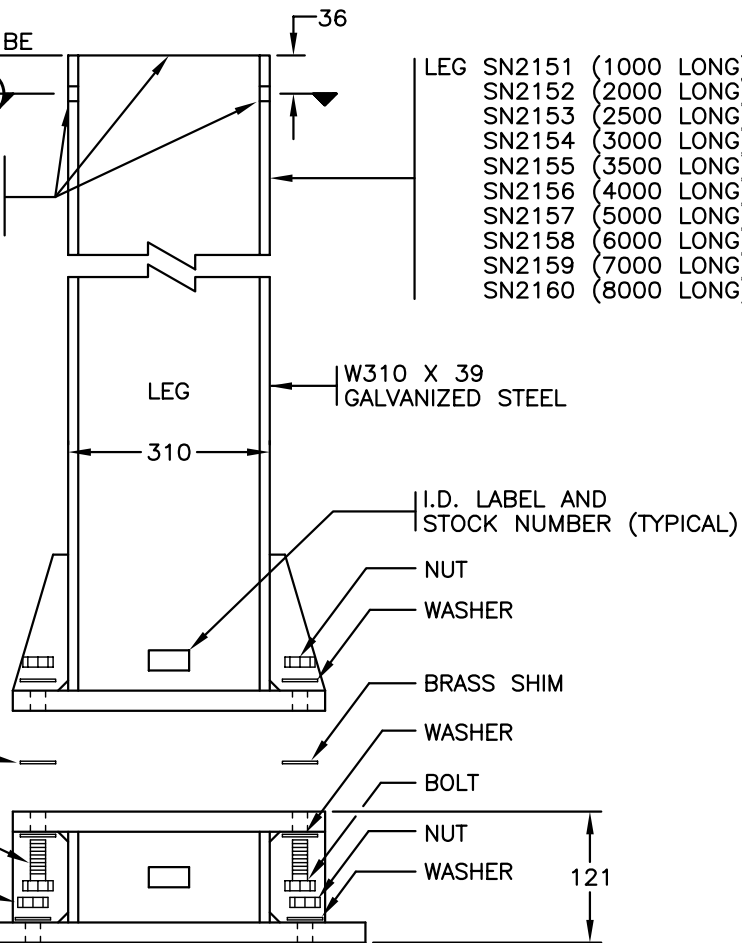
(D)

(C)

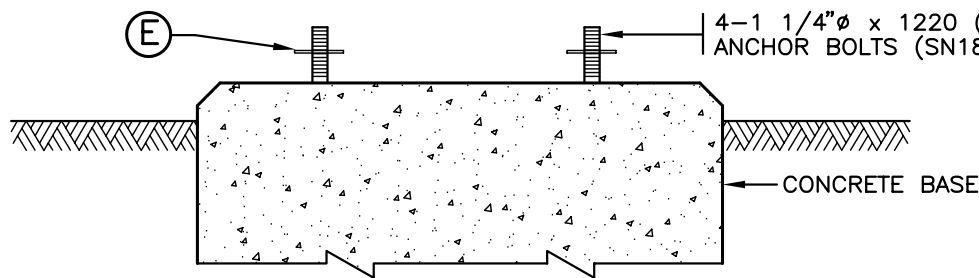
(B)

(A)

(E)



LEG	SN2151	(1000 LONG)	54 kg
	SN2152	(2000 LONG)	93 kg
	SN2153	(2500 LONG)	113 kg
	SN2154	(3000 LONG)	132 kg
	SN2155	(3500 LONG)	152 kg
	SN2156	(4000 LONG)	171 kg
	SN2157	(5000 LONG)	210 kg
	SN2158	(6000 LONG)	240 kg
	SN2159	(7000 LONG)	288 kg
	SN2160	(8000 LONG)	327 kg



ASSEMBLY DETAIL  
SIDE VIEW

STUB POST KIT (SN2165)		
ITEM	QUANTITY	DESCRIPTION
A	1	GALVANIZED STEEL STUB POST
B	4	GALVANIZED NUT AND WASHER FOR $1\ 1/4"$ $\phi$ ANCHOR BOLT
C	4	$3/4"$ $\phi$ x $3\ 1/2"$ LONG GALVANIZED BOLT, 2 WASHERS AND NUT
D	4	BRASS SHIMS (1 PER BOLT)
E	4	LEVELING SHIMS (MAX 4 PER BOLT)

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.



NOT TO SCALE

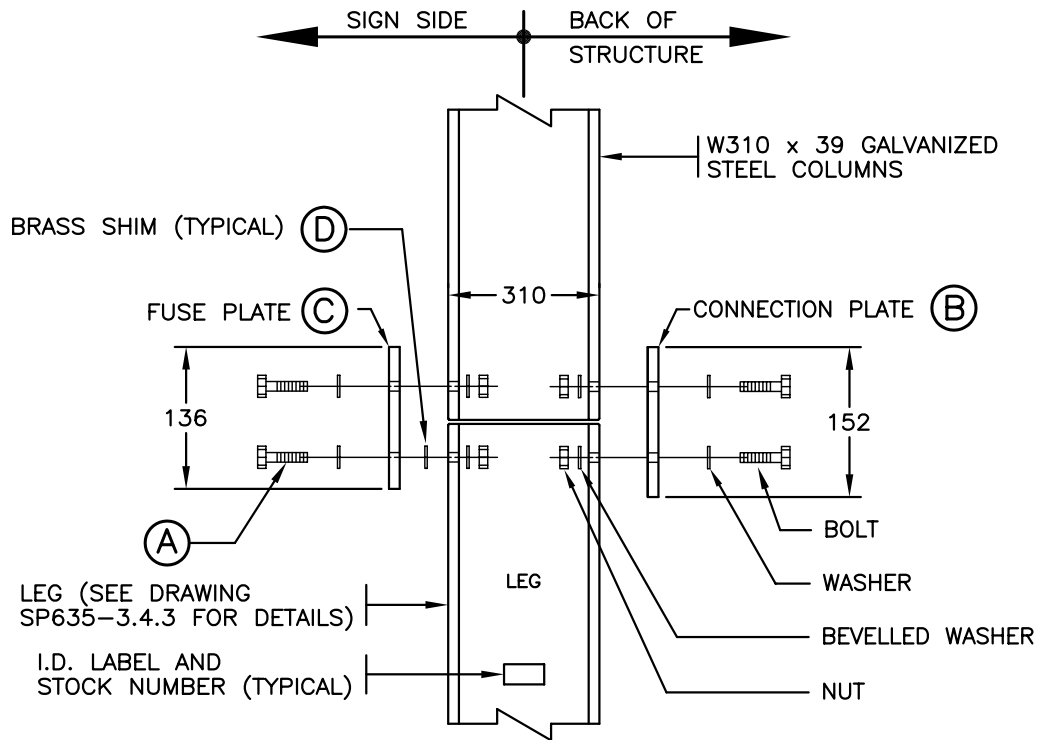
No.	Revision	Date
F		
E		
D		
C		
B		
A	GENERAL REVISION	AUG 94

## BREAKAWAY LEG AND STUB POST INSTALLATION DETAILS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

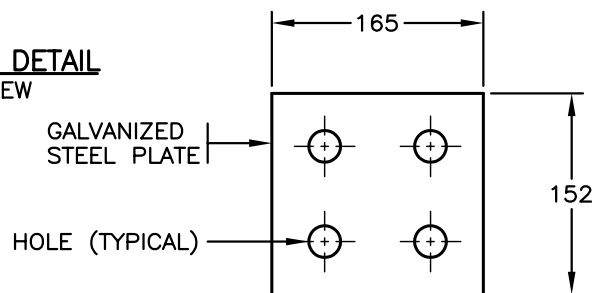
SPECIFICATION  
DRAWING No.  
**SP635-3.4.3**



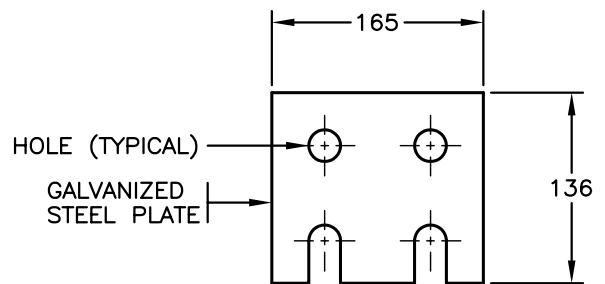


**ASSEMBLY DETAIL**  
SIDE VIEW

TORQUE  $3/4"$   $\phi$  x 2" LONG  
BOLTS TO 262ft. lbs.



**CONNECTION PLATE**  
(ITEM B)



**FUSE PLATE**  
(ITEM C)

FUSE JOINT KIT (SN2166)		
ITEM	QUANTITY	DESCRIPTION
A	8	$3/4"$ $\phi$ x 2" LONG GALVANIZED BOLT, NUT, WASHER AND BEVELLED WASHER.
B	1	CONNECTION PLATE
C	1	FUSE PLATE
D	2	BRASS SHIMS

**NOTES**

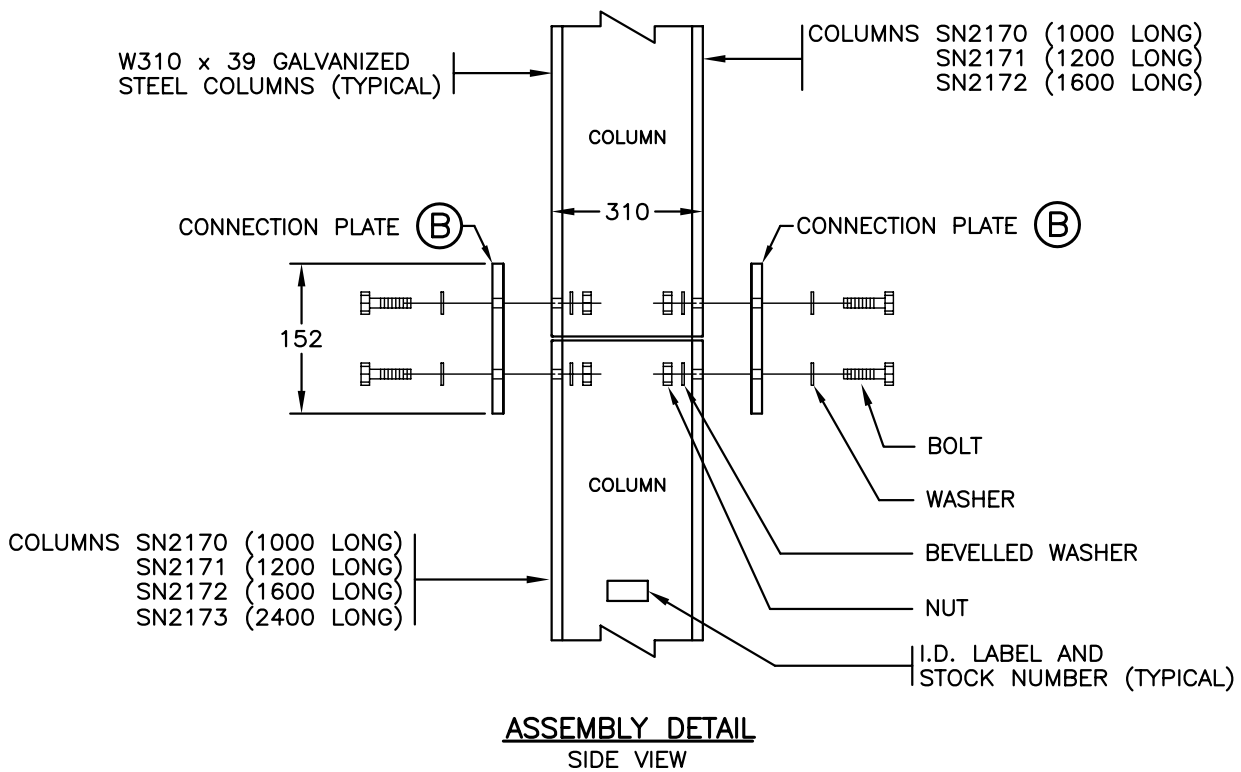
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



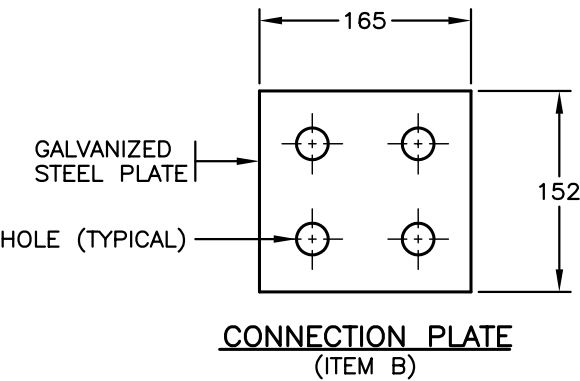
No.	Revision	Date	BREAKAWAY FUSE JOINT INSTALLATION DETAILS			
F			Date Approved  <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635—3.4.4	
E						
D						
C						
B						
A	GENERAL REVISION	AUG 94				





TORQUE 3/4"φ x 2" LONG BOLTS TO 262ft. lbs.

CONNECTION JOINT KIT (SN2167)		
ITEM	QUANTITY	DESCRIPTION
A	8	3/4"φ x 2" LONG GALVANIZED BOLT, NUT, WASHER AND BEVELLED WASHER.
B	2	CONNECTION PLATE



**NOTES**

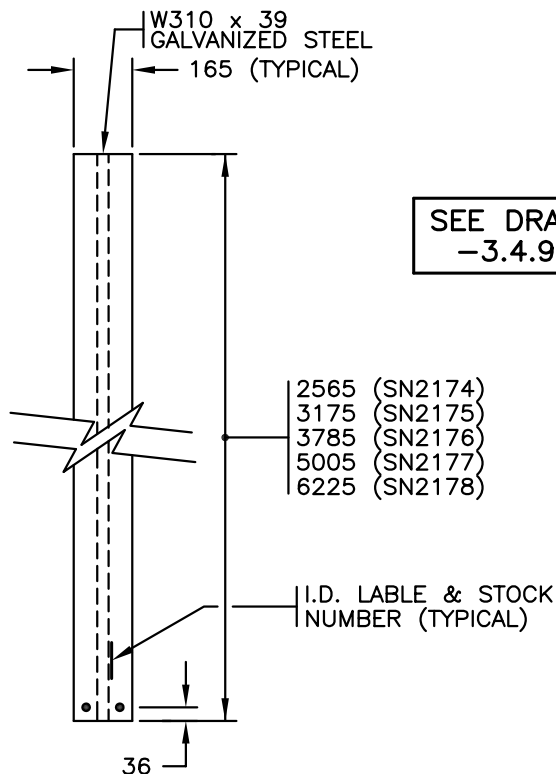
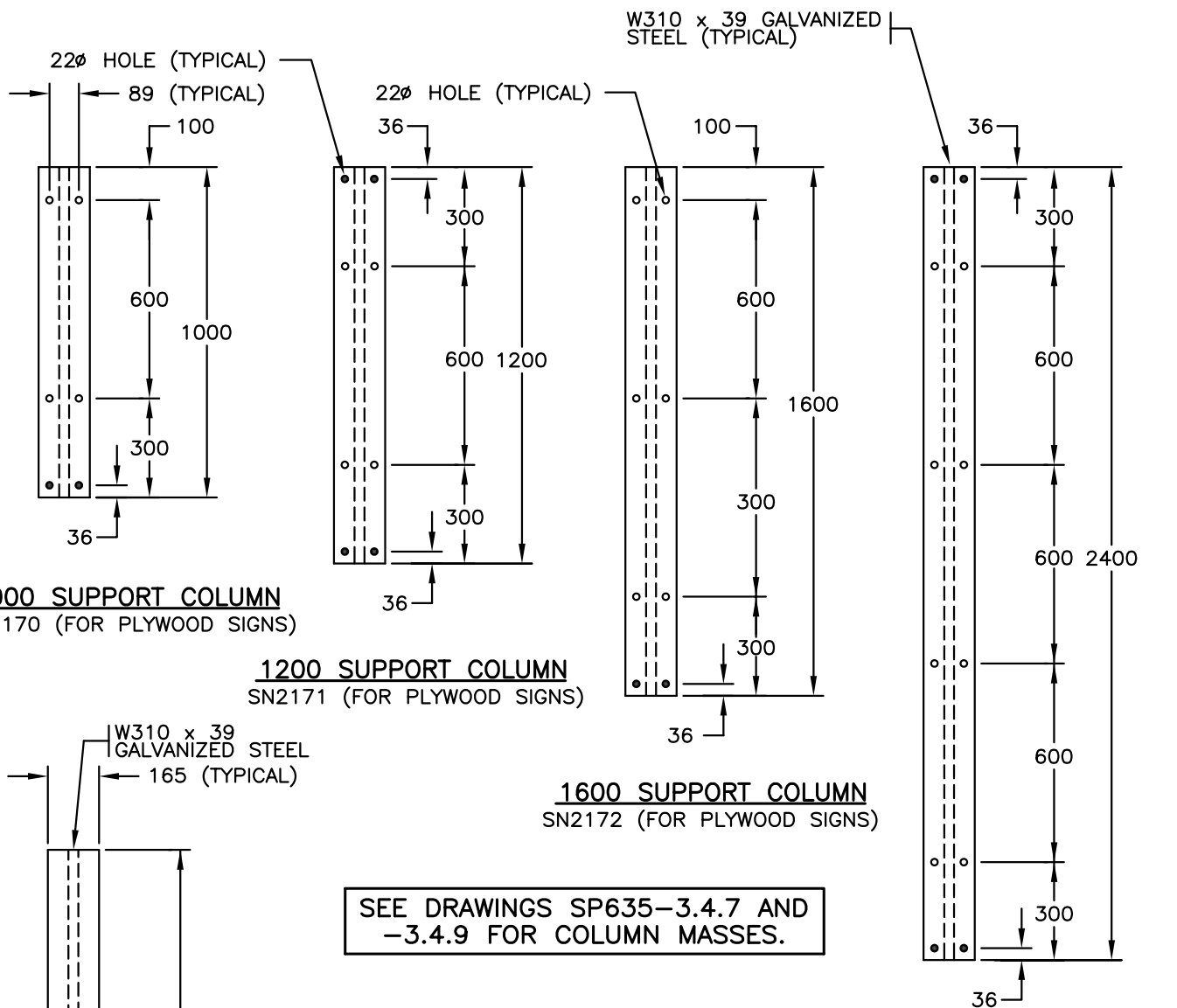
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	BREAKAWAY CONNECTION JOINT INSTALLATION DETAILS (FOR PLYWOOD SIGN ONLY)	
F			Date 30/09/93 E.L. (Signature on File) Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.4.5
E				
D				
C				
B				
A	GENERAL REVISION	AUG 94		





**SUPPORT COLUMN FOR EXTRUDED ALUMINUM SIGNS**

SCALE 1:20



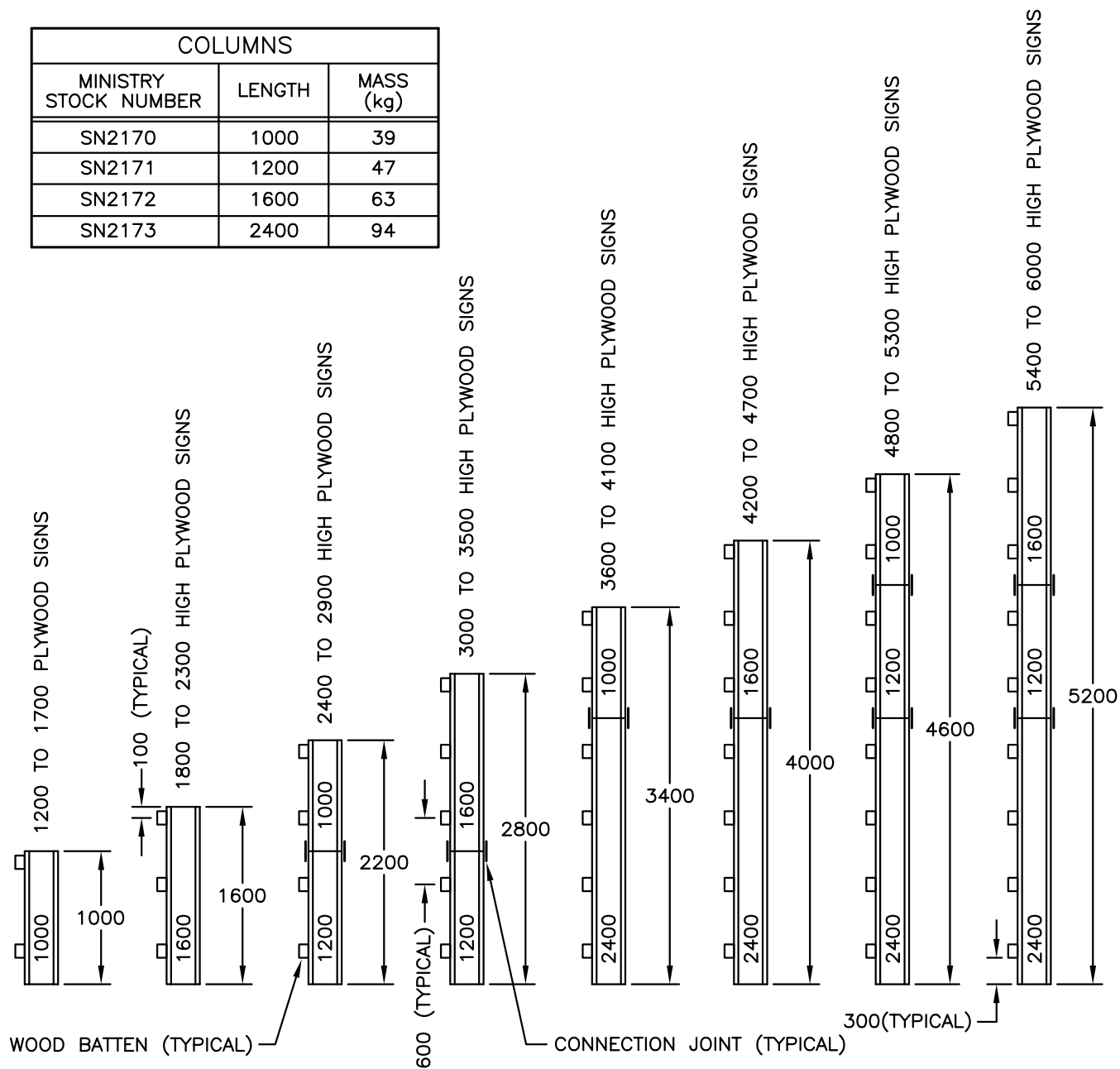
**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. HOLES SHOWN ● ARE FOR FUSE OR CONNECTION PLATES ONLY
3. HOLES SHOWN ○ ARE FOR WOOD BATTENS ONLY
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

No.	Revision	Date	BREAKAWAY SIGN SUPPORT COLUMN DETAILS	
F			Date	Approved
E				
D			30/09/93	E.L. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.4.6
A	GENERAL REVISION	AUG 94		



COLUMNS		
MINISTRY STOCK NUMBER	LENGTH	MASS (kg)
SN2170	1000	39
SN2171	1200	47
SN2172	1600	63
SN2173	2400	94



SIDE VIEW

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

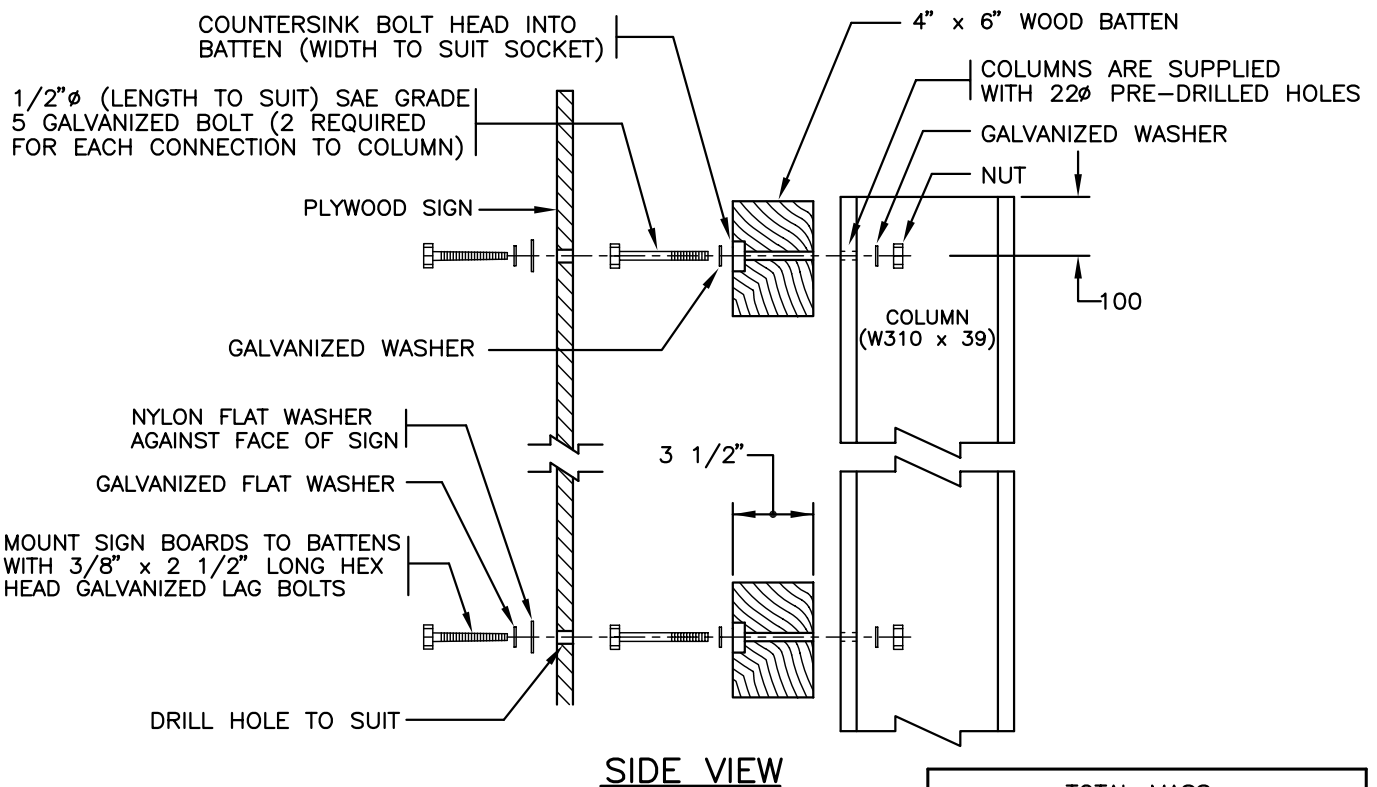
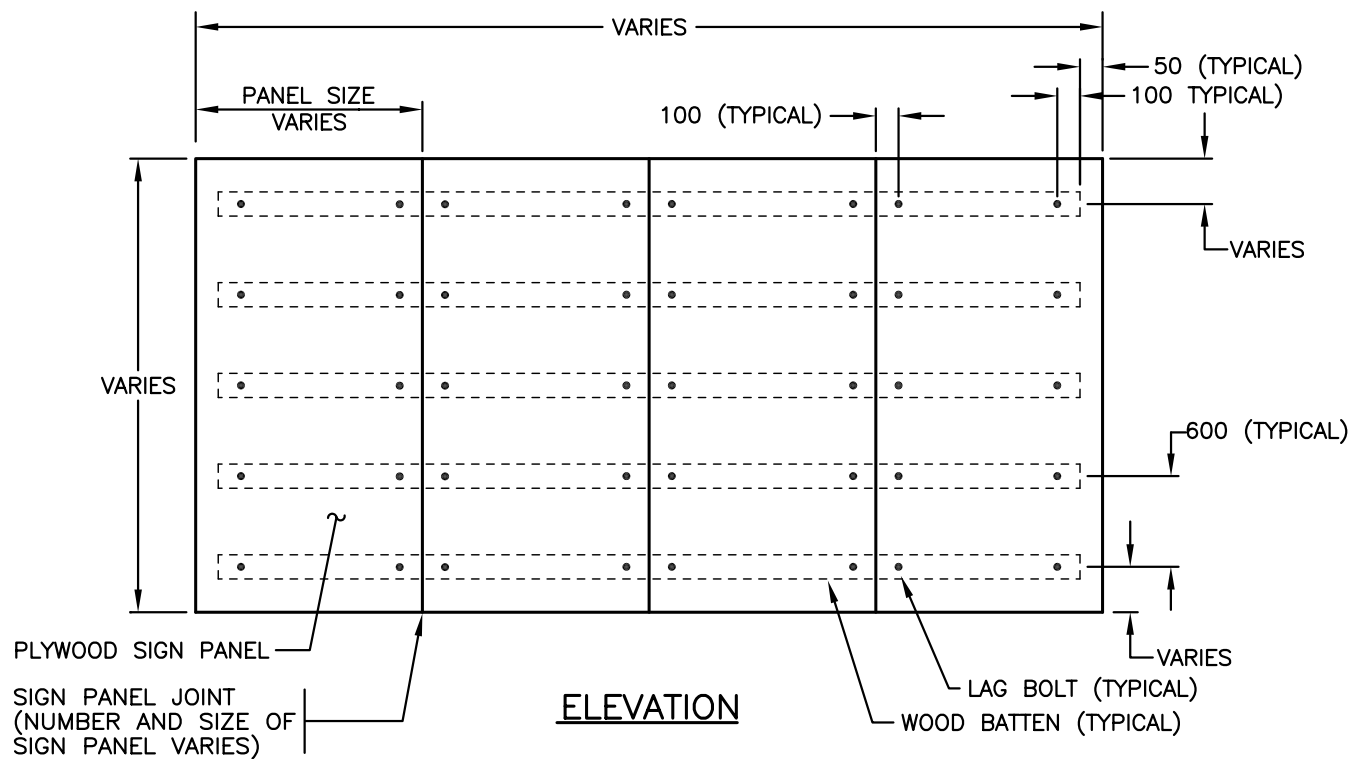
No.	Revision	Date
F		
E		
D		
C		
B		
A	GENERAL REVISION	AUG 94

### PLYWOOD SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.4.7**





#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

TOTAL MASS
SIGNBOARD = 10 kg/m <sup>2</sup>

NOT TO SCALE



No.	Revision	Date	PLYWOOD SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE		
F			Date Approved  <b>30/09/93 E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No.  SP635—3.4.8	
E					
D					
C					
B					
A	GENERAL REVISION	AUG 94			



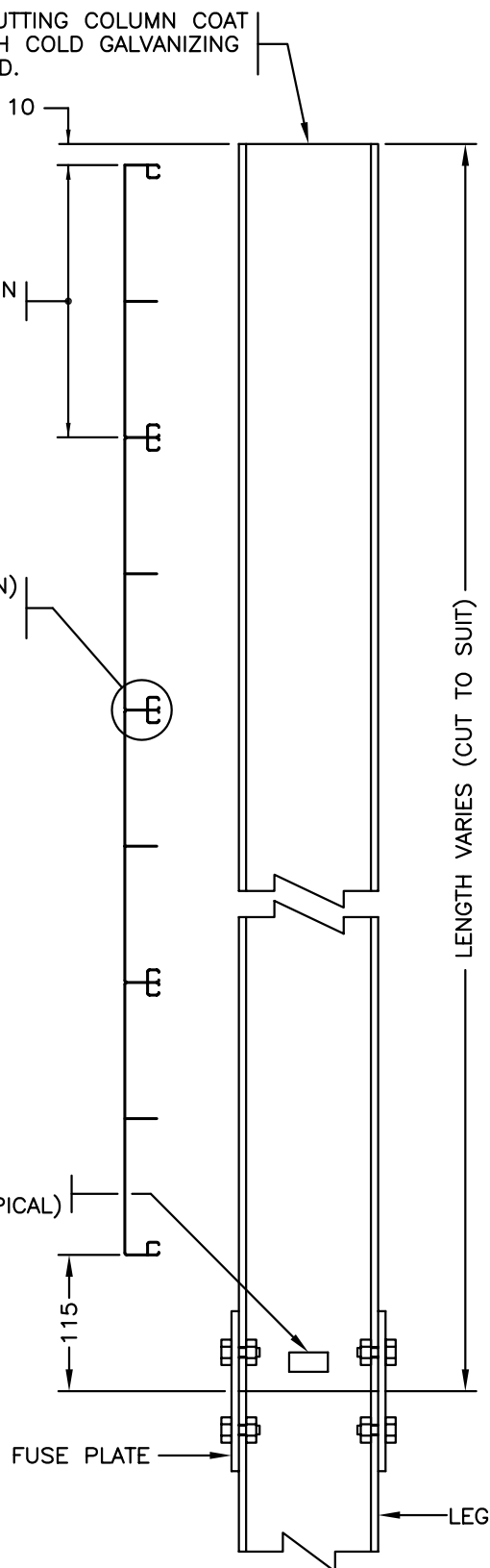
COLUMNS		
MINISTRY STOCK NUMBER	LENGTH	MASS (kg)
SN2174	2565	100
SN2175	3175	124
SN2176	3785	148
SN2177	5005	195
SN2178	6225	243

EXTRUDED ALUMINUM SIGN SECTION (305 HIGH)

CONNECTION BOLTS (SUPPLIED WITH SIGN)  
SEE DRAWINGS SP635-3.4.10 TO 3.4.12  
FOR DETAILS (TYPICAL)

TOTAL MASS
EACH EXTRUDED ALUMINUM SIGN SECTION = 4 kg/m

I.D. LABEL AND STOCK NUMBER (TYPICAL)



#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



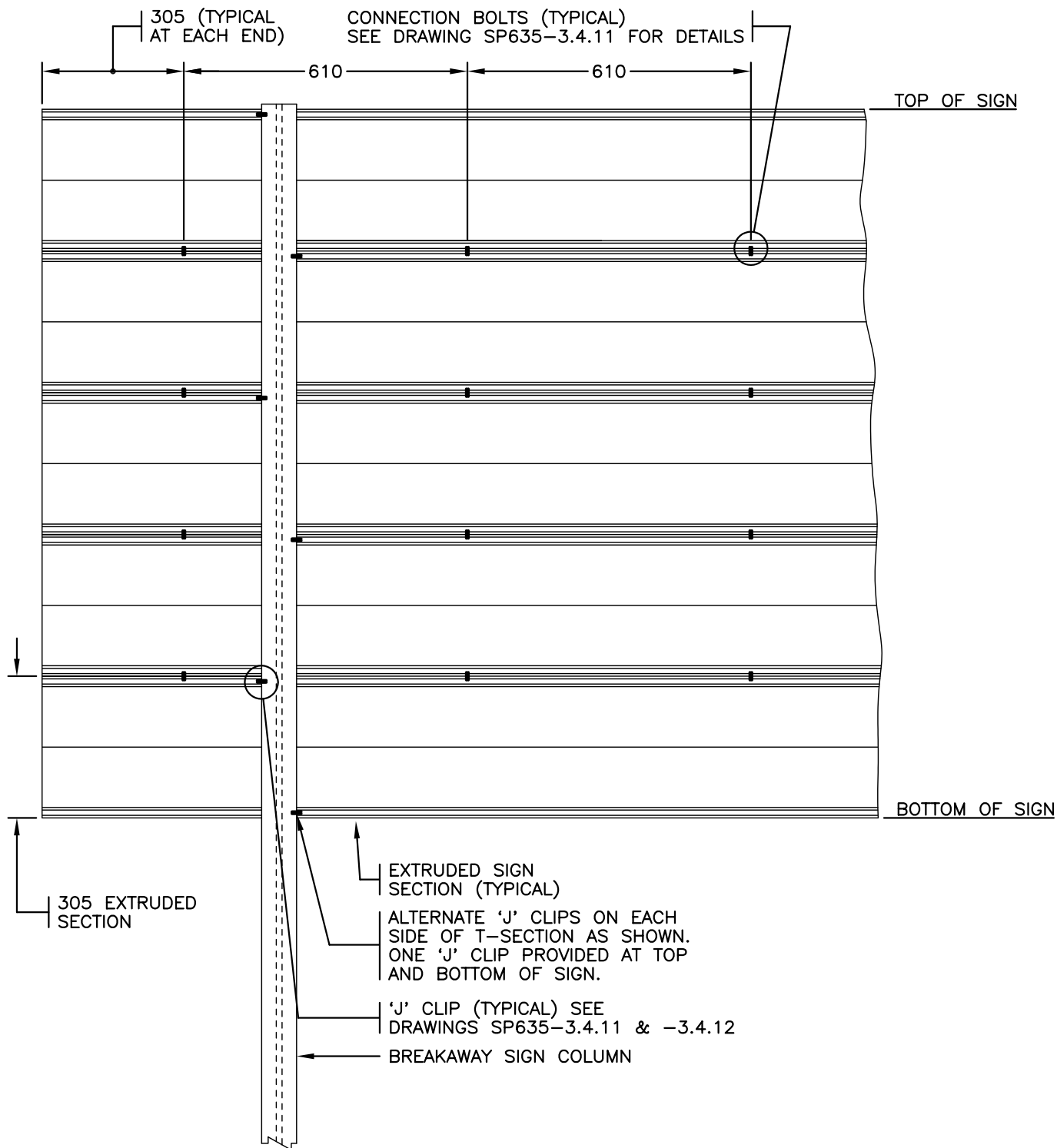
No.	Revision	Date
F		
E		
D		
C		
B		
A	NEW DRAWING NUMBER	OCT 97

### EXTRUDED ALUMINUM SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE

Date Approved  
**18/11/94 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.4.9**





REAR VIEW OF SIGN

SEE DRAWING SP635-3.4.9 FOR NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



No.	Revision	Date	EXTRUDED ALUMINUM SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE		
F			Date Approved  <b>18/11/94     E.L. (Signature on File)</b> Chief Highway Engineer		SPECIFICATION DRAWING No.  SP635—3.4.10
E					
D					
C					
B	NEW DRAWING NUMBER	OCT 97			
A	END HOLE SPACING REVISED	AUG 95			



'J' CLIPS (SUPPLIED WITH SIGN SECTION)  
SEE DRAWING SP635-3.4.12 FOR DETAILS  
(TYPICAL)

ADJUST SIGN SECTIONS  
SO THAT SIGN MESSAGES  
LINE UP (TYPICAL)

305 SECTION  
(TYPICAL)

SLOTTED HOLES SUPPLIED  
IN EXTRUDED ALUMINUM  
SECTIONS

CONNECT SIGN SECTIONS  
TOGETHER EVERY 610  
(305 AT ENDS) WITH  
3/8"  $\phi$  x 1" LONG  
STAINLESS STEEL JOINER  
BOLTS, NUTS AND  
FLATWASHERS (SUPPLIED  
WITH SIGN SECTIONS)

BREAKAWAY SIGN  
COLUMN

### ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

SEE DRAWING SP635-3.4.9 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



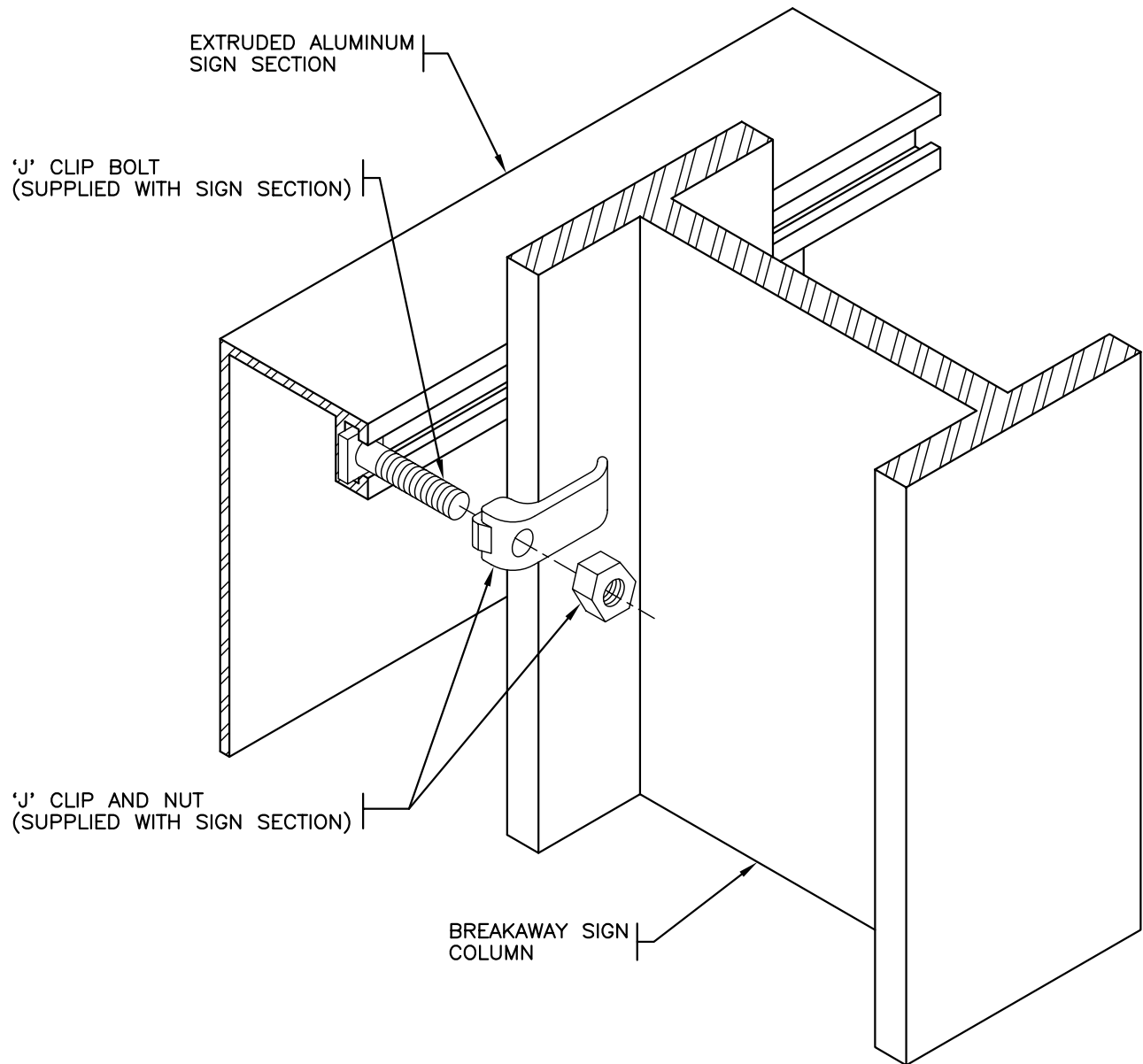
No.	Revision	Date
F		
E		
D		
C		
B	NEW DRAWING NUMBER	OCT 97
A	END HOLE SPACING REVISED	AUG 95

### EXTRUDED ALUMINUM SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE

Date Approved  
**18/11/94 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.4.11**





ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

SEE DRAWING SP635-3.4.9 FOR  
NOTES AND ADDITIONAL DETAILS.

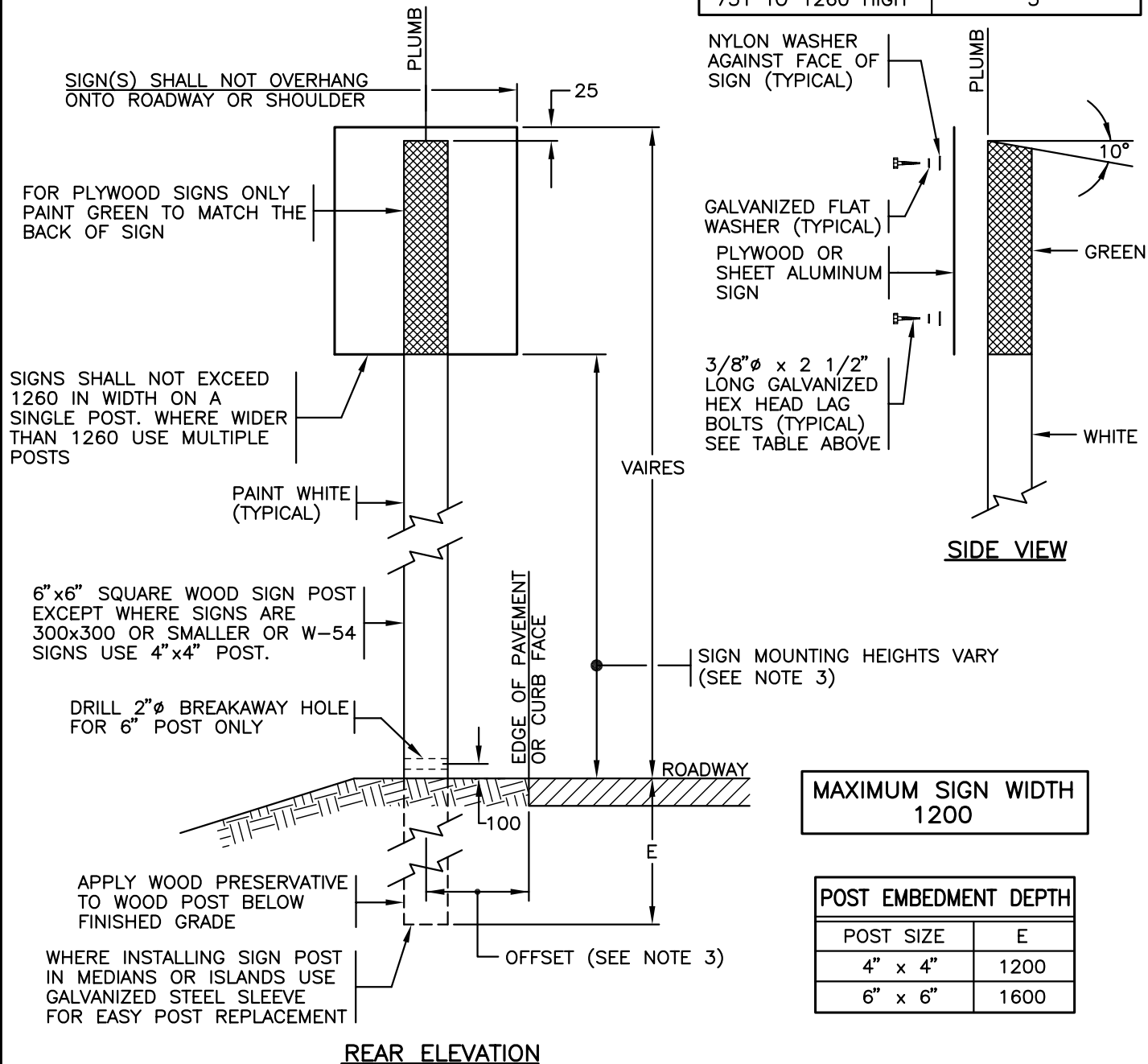
NOT TO SCALE



No.	Revision	Date	EXTRUDED ALUMINUM SIGN MOUNTING DETAILS ON BREAKAWAY SIGN STRUCTURE	
F			Date	Approved
E			18/11/94	E.L. (Signature on File)
D			SPECIFICATION DRAWING No.	
C			SP635-3.4.12	
B				
A	NEW DRAWING NUMBER	OCT 97	Chief Highway Engineer	



SIGN HEIGHT	NUMBER OF BOLTS
UP TO 750 HIGH	2
751 TO 1260 HIGH	3



#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

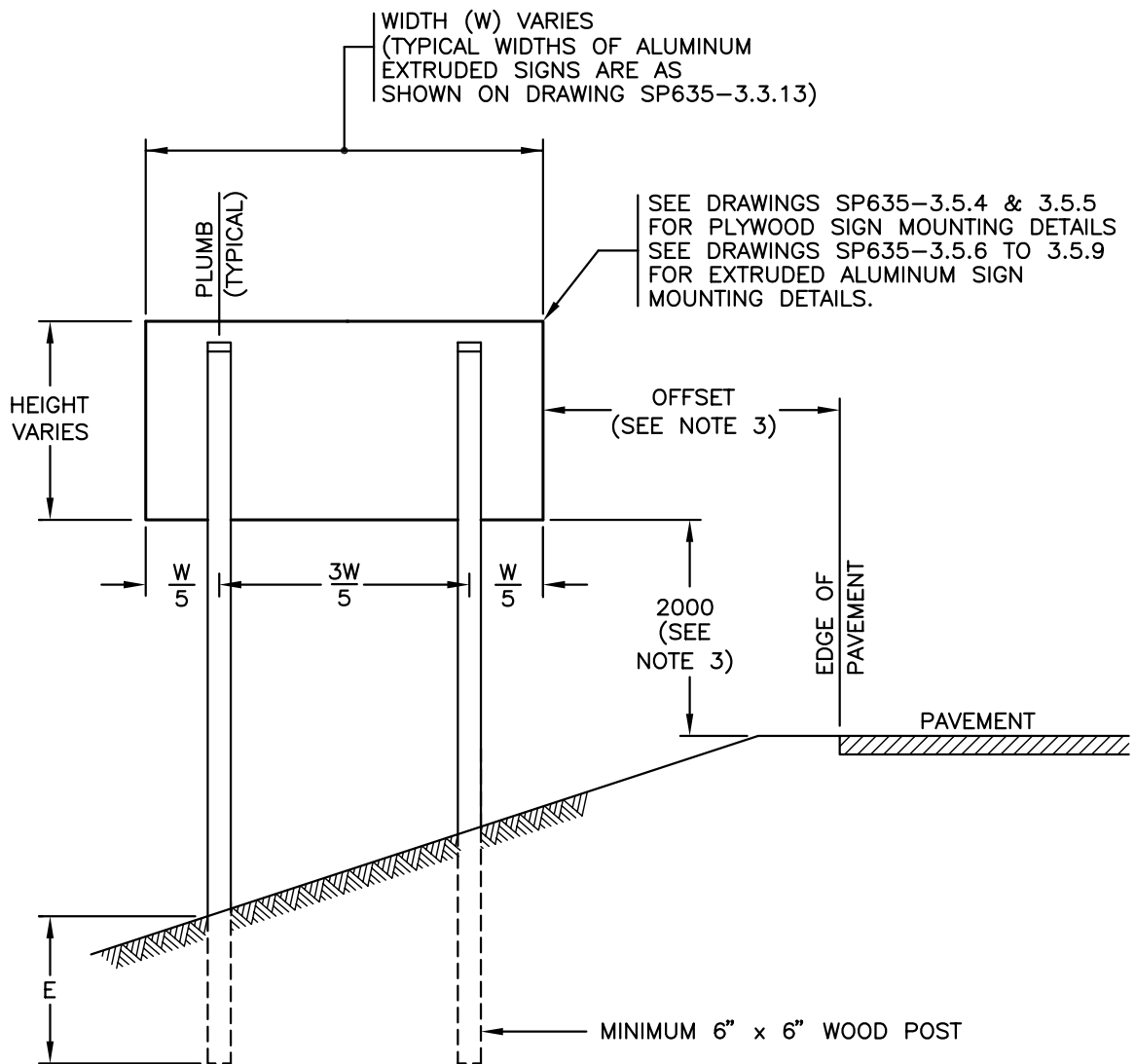
NOT TO SCALE

REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE



No.	Revision	Date	SINGLE WOOD POST SIGN STRUCTURE INSTALLATION DETAILS	
E	MOUNTING HEIGHTS & OFFSETS REFERRED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98		
D	PAINTING NOTE REVISED	NOV 98	Date	Approved
C	REDRAWN & SIGN MOUNTING HEIGHTS REVISED	DEC 96	30/09/93	E.L. (Signature on File)
B	MOUNTING HEIGHT & MAX. SIGN WIDTH REVISED	AUG 95		
A	GENERAL REVISION	AUG 94	Chief Highway Engineer	
			SPECIFICATION DRAWING No. SP635-3.5.1	





**REAR ELEVATION**

EMBEDMENT DEPTH	
POST SIZE	E
6" x 6"	1600
8" x 8"	2000
10" x 10"	2200

**NOTES**

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

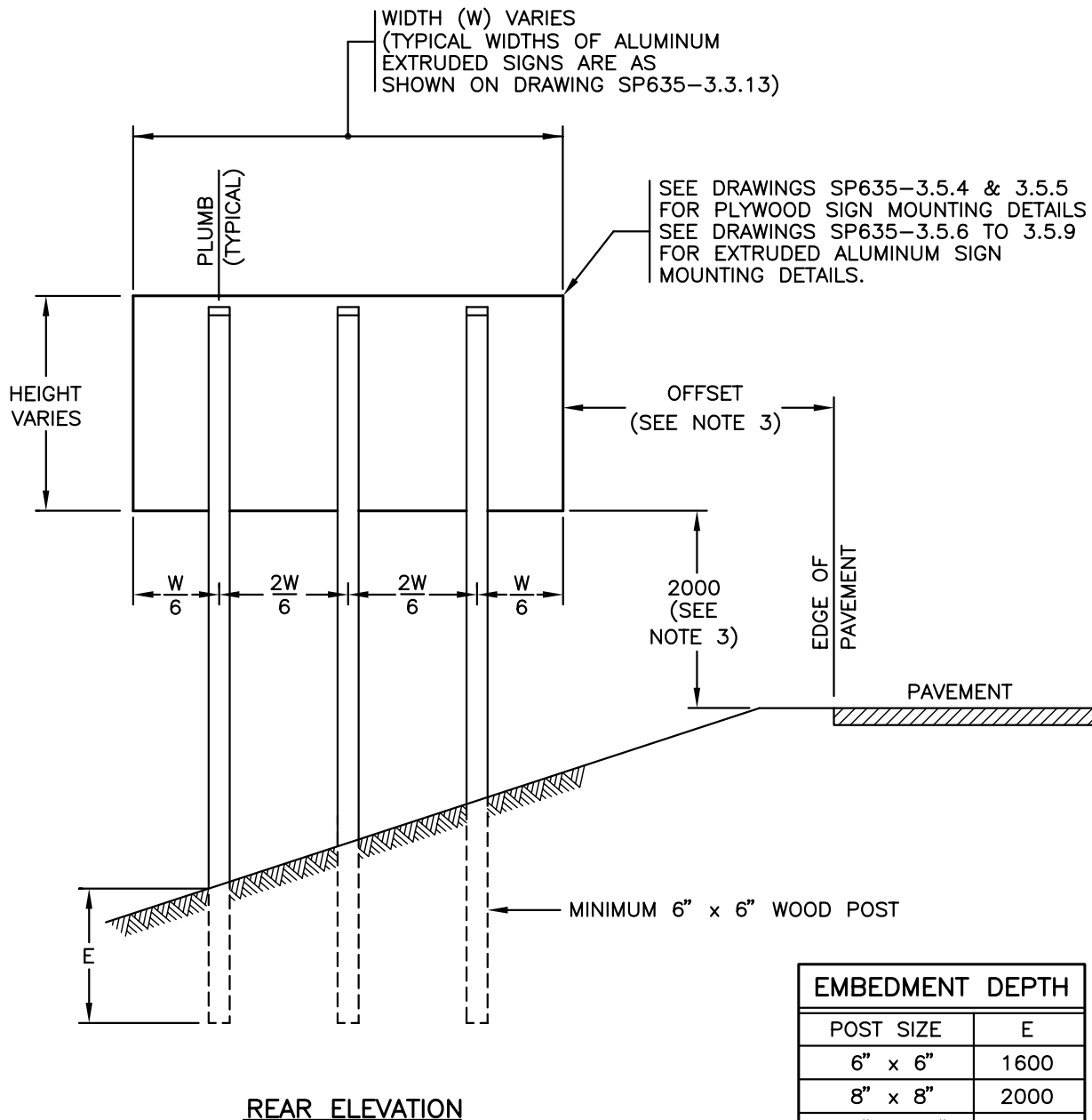
REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE

NOT TO SCALE



No.	Revision	Date	WOOD POST SIGN STRUCTURE INSTALLATION DETAIL (TWO POST)	
E				
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98	Date <u>30/09/93</u> Approved <u>E.L. (Signature on File)</u> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-3.5.2</b>
C	LOADING TABLE REFERENCE NOTE REVISED	AUG 96		
B	SIGN OFFSET REVISED & TYP. SIGN WIDTH SHOWN	AUG 95		
A	GENERAL REVISION	AUG 94		





REFER TO MINISTRY ELECTRICAL &  
TRAFFIC ENGINEERING MANUAL FOR  
SIGN STRUCTURE LOADING TABLE

#### NOTES

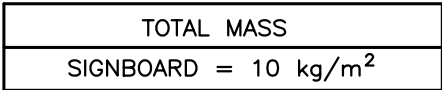
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

NOT TO SCALE



No.	Revision	Date	WOOD POST SIGN STRUCTURE INSTALLATION DETAILS (THREE POST)		
E					
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98			
C	LOADING TABLE REFERENCE NOTE REVISED	AUG 96			
B	SIGN OFFSET REVISED & TYP. SIGN WIDTH SHOWN	AUG 95			
A	GENERAL REVISION	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-3.5.3
			Chief Highway Engineer		





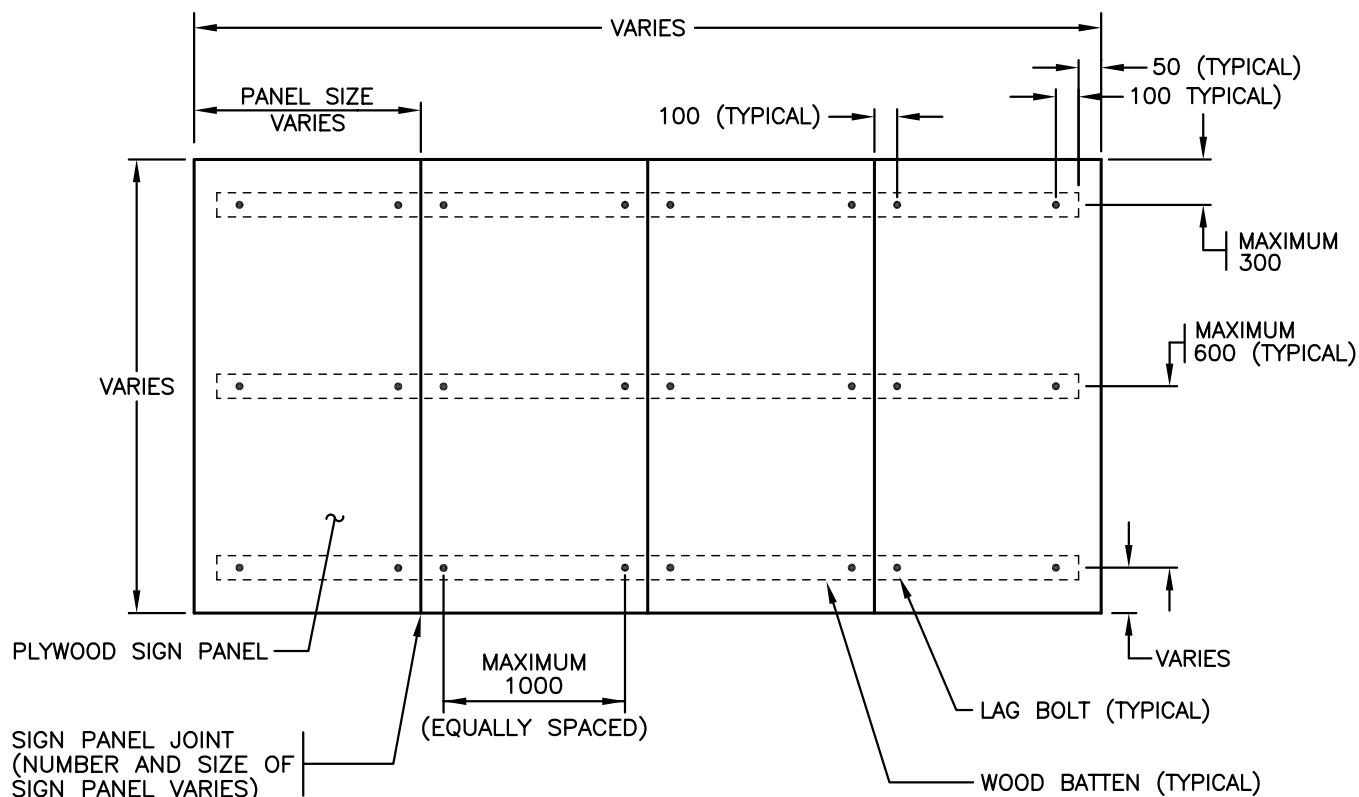
SPECIFICATION  
DRAWING No.  
SP635-3.5.4



**BRITISH  
COLUMBIA**

Ministry of  
Transportation





## ELEVATION

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

TOTAL MASS

SIGNBOARD = 10 kg/m<sup>2</sup>

NOT TO SCALE



**BRITISH COLUMBIA**

Ministry of  
Transportation

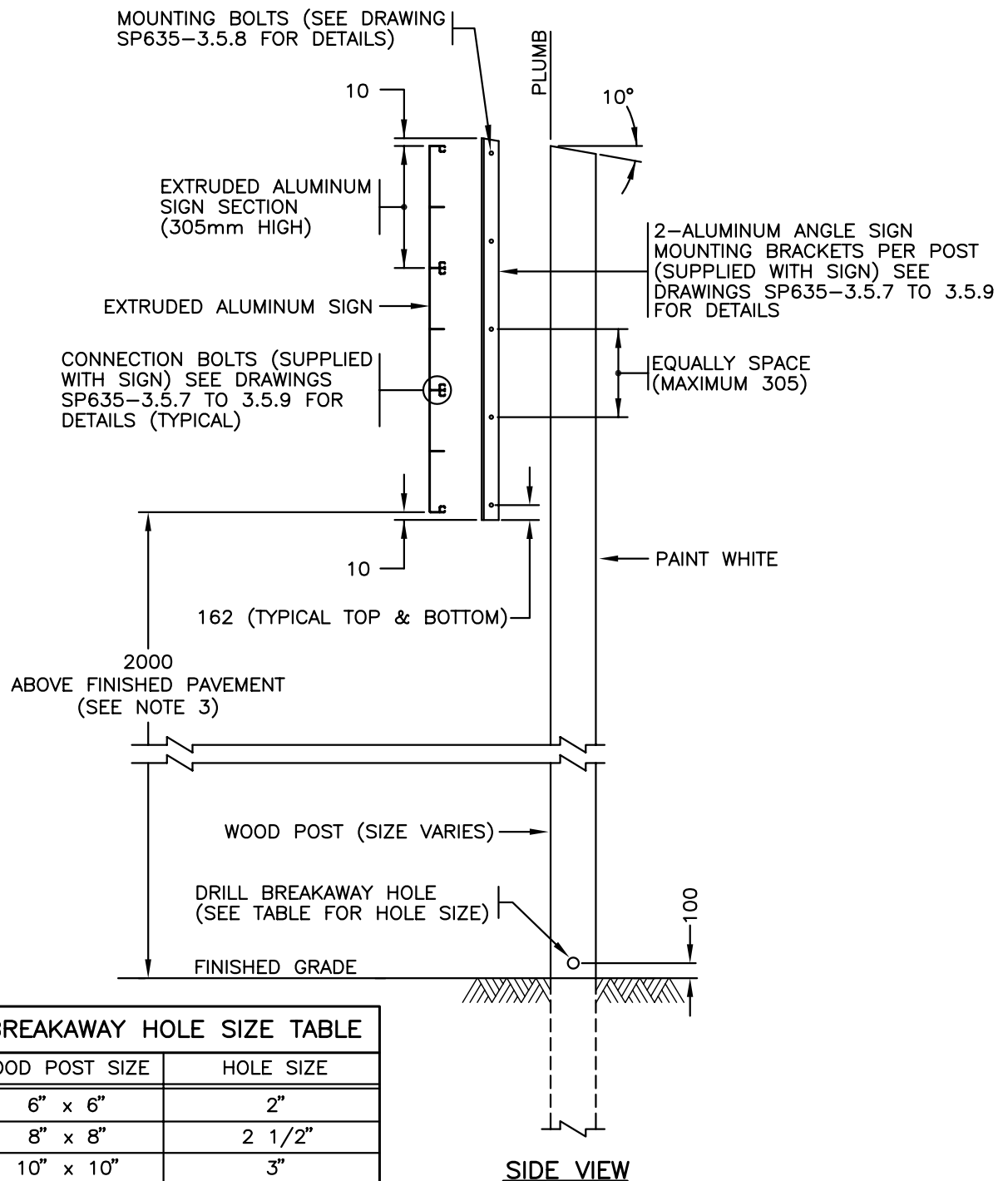
No.	Revision	Date
F		
E		
D		
C		
B		
A	GENERAL REVISION	AUG 94

## PLYWOOD SIGN INSTALLATION DETAILS ON WOOD POSTS

Date Approved  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.5.5**





#### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

NOT TO SCALE

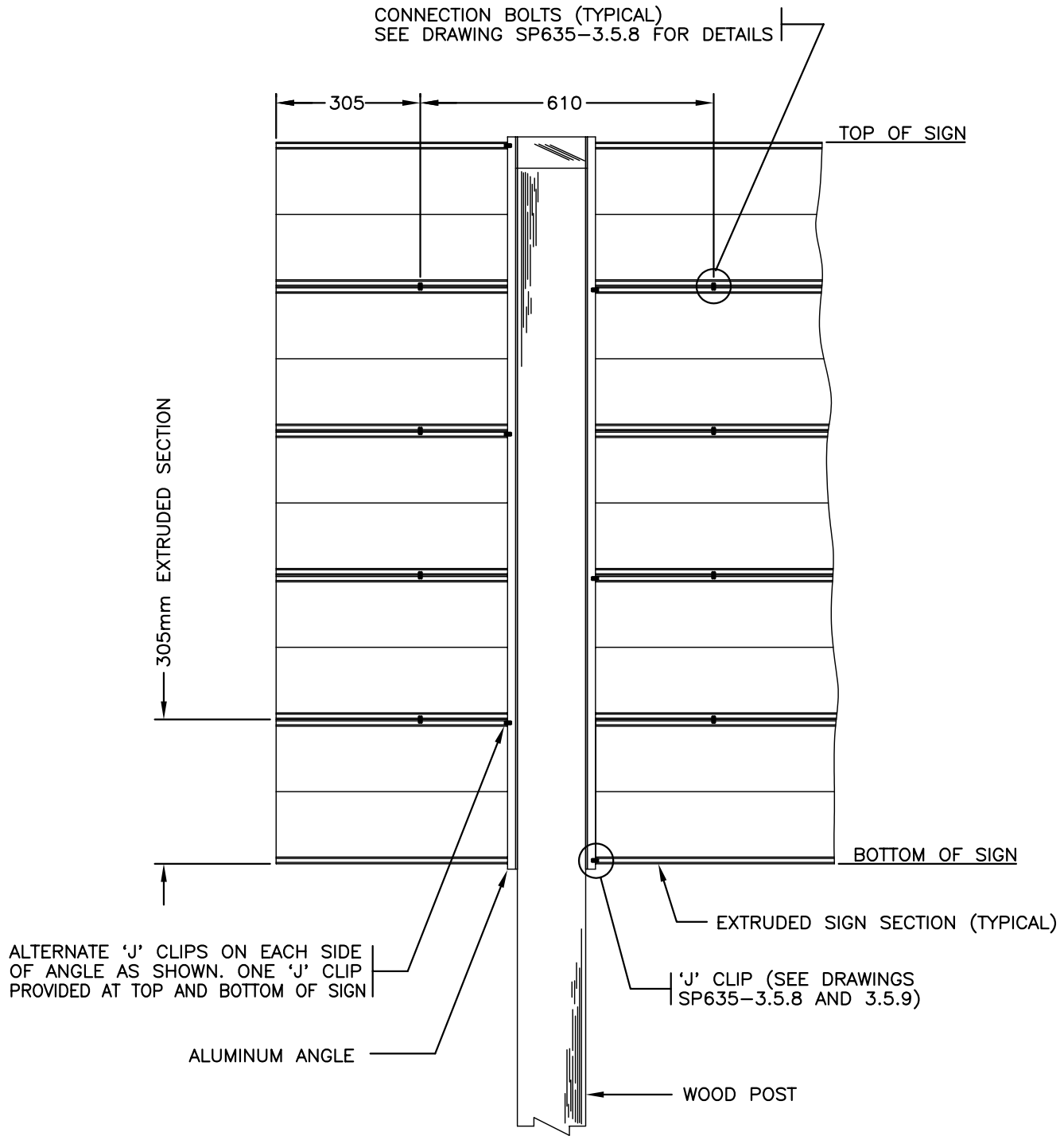
TOTAL MASS
EACH EXTRUDED ALUMINUM SIGN SECTION = 4 kg/m



No.	Revision	Date	EXTRUDED ALUMINUM SIGN INSTALLATION DETAILS ON WOOD POSTS		
E					
D					
C					
B	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
A	ANGLE CUT ADDED ON TOP OF POST	AUG 95	17/11/94	E.L. (Signature on File) Chief Highway Engineer	SP635-3.5.6



CONNECTION BOLTS (TYPICAL)  
SEE DRAWING SP635-3.5.8 FOR DETAILS



REAR VIEW OF SIGN

SEE DRAWING SP635-3.5.6 FOR  
NOTES AND ADDITIONAL DETAILS.

SCALE 1:12.5



No.	Revision	Date	EXTRUDED ALUMINUM SIGN INSTALLATION DETAILS ON WOOD POSTS	
F			Date	Approved
E			18/11/94	E.L. (Signature on File)
D			SPECIFICATION DRAWING No.	
C			SP635-3.5.7	
B				
A	END HOLE SPACING REVISED	AUG 95	Chief Highway Engineer	



76 x 51 x 5 ALUMINUM 6061-T6  
ANGLE (LENGTH TO SUIT) TYPICAL

'J' CLIPS (SUPPLIED WITH SIGN  
SECTION) SEE DRAWING SP635-3.5.9  
FOR DETAILS (TYPICAL)

ADJUST SIGN SECTIONS  
SO THAT SIGN MESSAGES  
LINE UP (TYPICAL)

305 SECTION  
(TYPICAL)

SLOTTED HOLES SUPPLIED  
IN EXTRUDED ALUMINUM  
SECTIONS

CONNECT SIGN SECTIONS  
TOGETHER EVERY 610  
(305 AT ENDS)  
WITH 3/8"Ø x 1" LONG  
STAINLESS STEEL JOINER  
BOLTS, NUTS AND  
FLATWASHERS (SUPPLIED  
WITH SIGN SECTIONS)

3/8"Ø x 2 1/2" LONG GALVANIZED  
STEEL HEX HEAD LAG BOLT  
(TYPICAL)

GALVANIZED STEEL  
FLATWASHER (TYPICAL)

**ASSEMBLY VIEW**

**TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.**

SEE DRAWING SP635-3.5.6 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

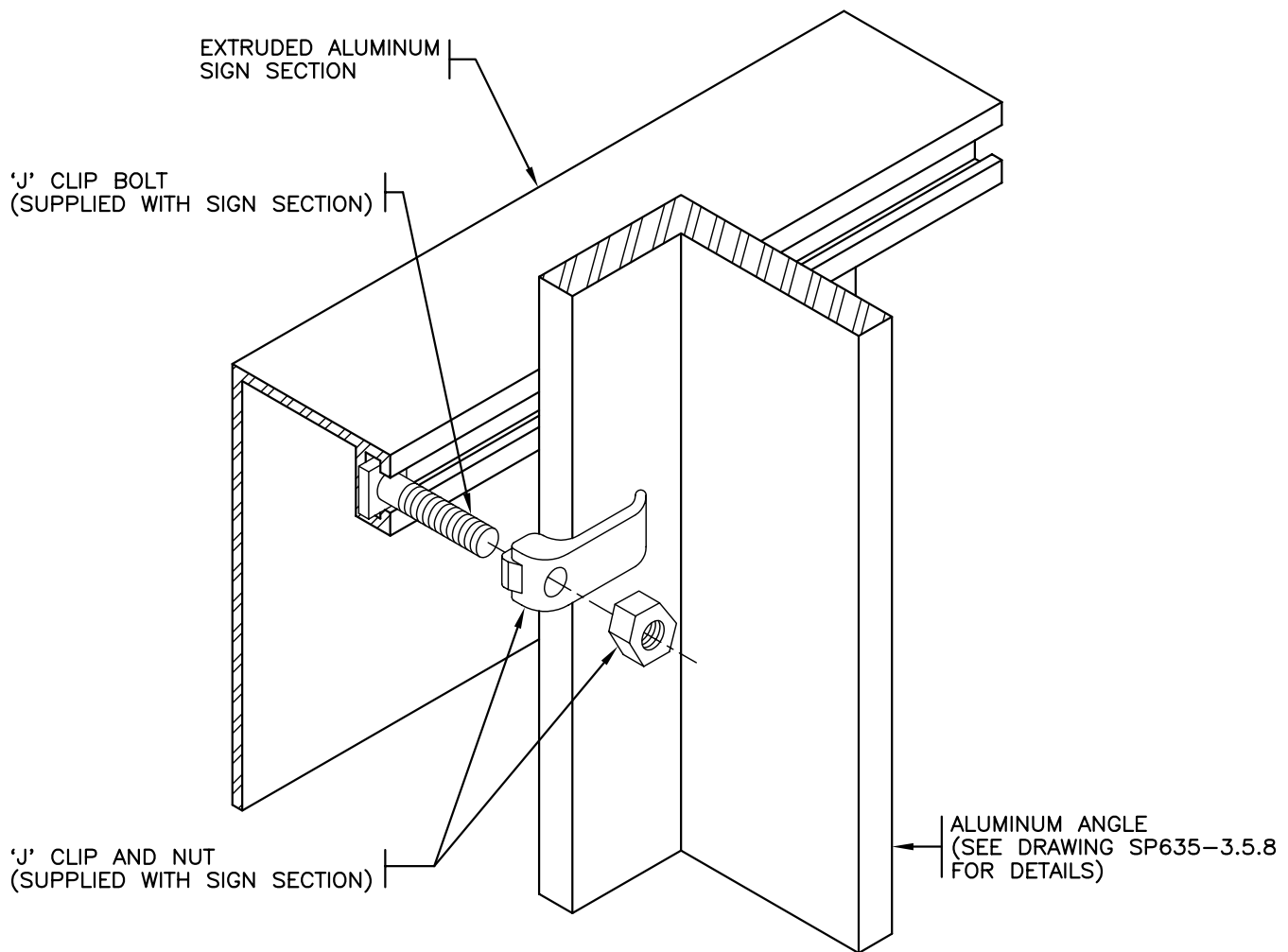
No.	Revision	Date
F		
E		
D		
C		
B		
A	END HOLE SPACING REVISED & ANGLE CUT ADDED	AUG 95

## EXTRUDED ALUMINUM SIGN INSTALLATION DETAILS ON WOOD POST

Date Approved  
**18/11/94 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.5.8**





ASSEMBLY VIEW

TORQUE JOINER BOLTS AND  
'J' CLIPS TO 19 ft. lbs.

SEE DRAWING SP635-3.5.6 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



No.	Revision	Date	EXTRUDED ALUMINUM SIGN INSTALLATION DETAILS ON WOOD POST	
F			Date Approved  <b>18/11/94</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No.  <b>SP635—3.5.9</b>
E				
D				
C				
B				
A				



SIGN HEIGHT	NUMBER OF BOLTS
UP TO 750 HIGH	2
751 TO 1260 HIGH	3

SIGNS SHALL NOT EXCEED 1260 IN WIDTH ON A SINGLE POST. WHERE WIDER THAN 1260 USE MULTIPLE POSTS.

PERFORATED SQUARE STEEL TUBING INNER SLEEVE FOR ALL POSTS EXCEPT 2 1/4" O.D. (SEE DRAWING SP635-3.6.3 FOR DETAILS)

3/8"Ø (U.N.C.) HEX HEAD BOLT, (LENGTH TO SUIT) 2 WASHERS AND 1 NUT.

1 1/2" (O.D.), 1 3/4" (O.D.), 2" (O.D.) OR 2 1/4" (O.D.) PERFORATED SQUARE GALVANIZED STEEL TUBING

SIGN(S) SHALL NOT OVERHANG ONTO ROADWAY OR SHOULDER

PLUMB

10

NUT (TYPICAL)  
FLAT WASHER (TYPICAL)  
NYLON WASHER AGAINST FACE OF SIGN (TYPICAL)  
FLAT WASHER (TYPICAL)  
3/8"Ø (U.N.C.) HEX HEAD BOLT, (LENGTH TO SUIT), TYPICAL  
SEE TABLE TO THE LEFT

7/16"Ø HOLES AT 1" CENTRE TO CENTRE

PLYWOOD OR ALUMINUM SIGN

SHEET ALUMINUM SIGNS SUPPLIED WITH PRE-DRILLED HOLES

SIDE VIEW

VARIES

SIGN MOUNTING HEIGHT VARY (SEE NOTE 3)

EDGE OF PAVEMENT OR CURB FACE

ROADWAY

OFFSET (SEE NOTE 3)

TYPE 1 OR 2 CONCRETE BASE (SEE DRAWING SP635-1.1.35)

REAR ELEVATION

ALL NUTS, BOLTS AND WASHERS SHALL BE STAINLESS STEEL

REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE

#### NOTES

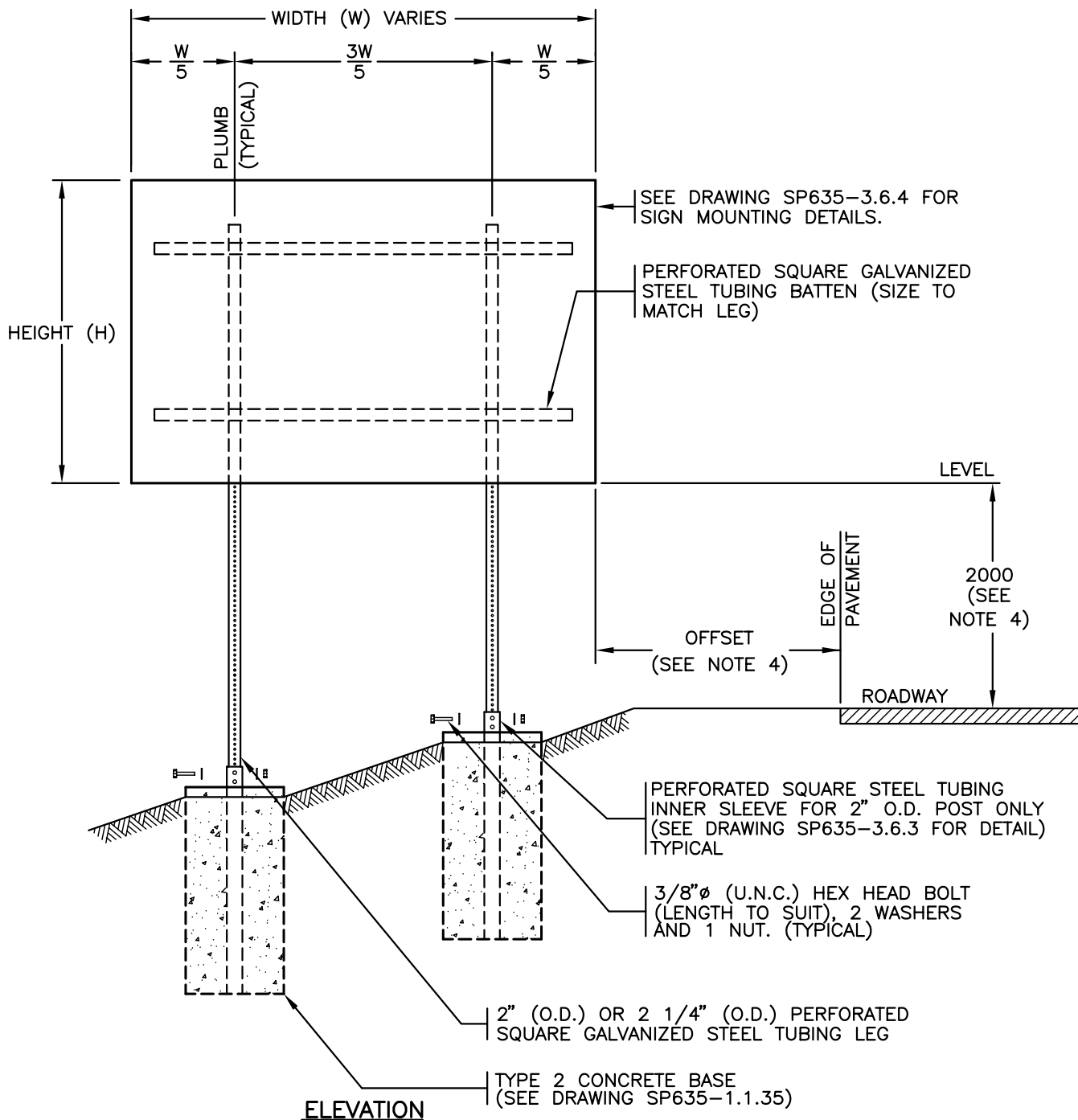
- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
- MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

NOT TO SCALE



No.	Revision	Date	PERFORATED SQUARE GALVANIZED STEEL SIGN POST INSTALLATION DETAIL (ONE POST)		
E					
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98			
C	SIGN MOUNTING HEIGHT REVISED	DEC 96			
B	SIGN HEIGHT/WIDTH REVISED & OFFSET ADDED	AUG 95			
A	GENERAL REVISION	AUG 94			
			Date	Approved	SPECIFICATION DRAWING No.
			30/09/93	E.L. (Signature on File)	SP635-3.6.1
			Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. ALL BOLTS, NUTS AND WASHERS SHALL BE STAINLESS STEEL.
4. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

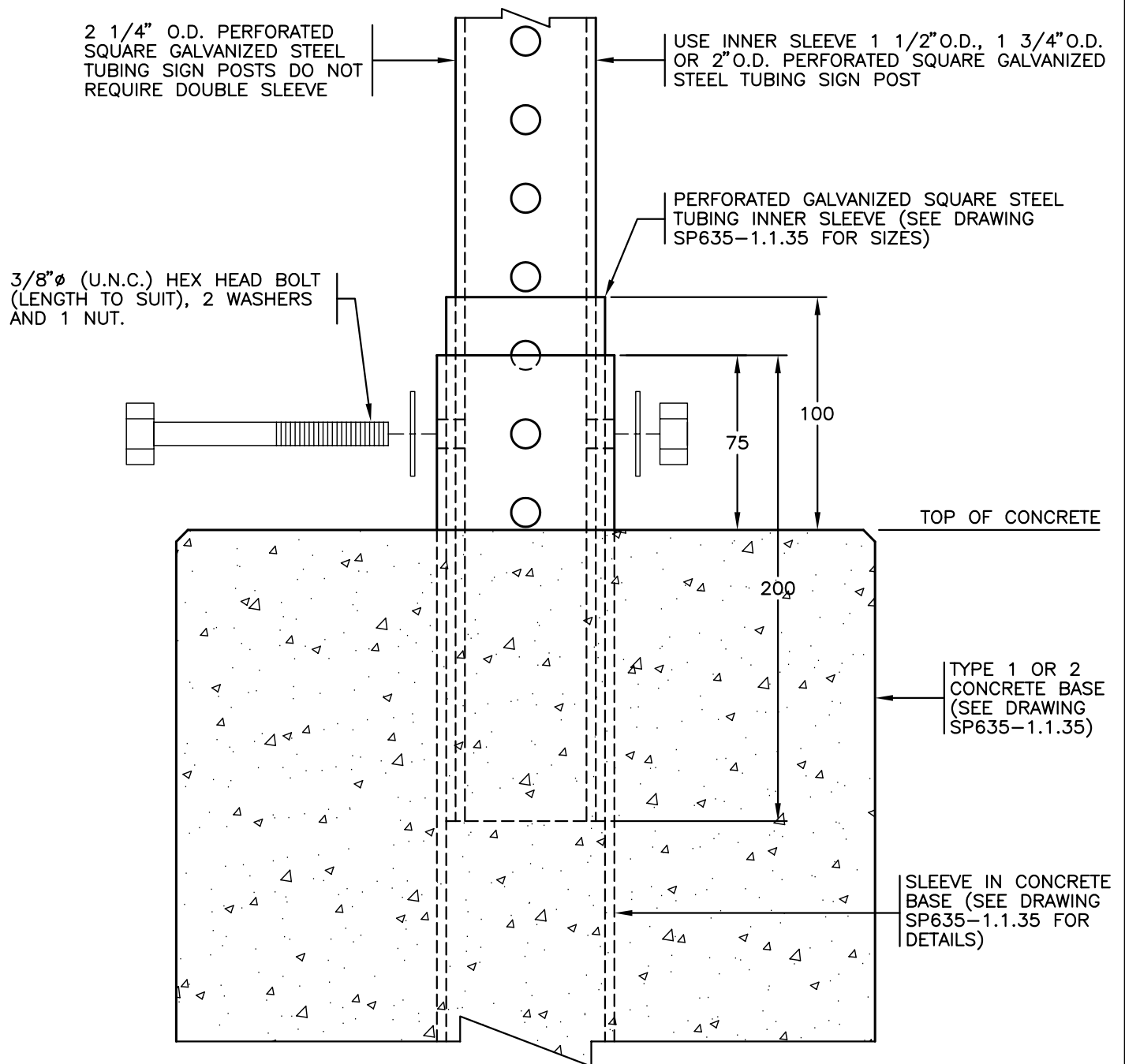
REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE

NOT TO SCALE



No.	Revision	Date	PERFORATED SQUARE GALVANIZED STEEL SIGN POST INSTALLATION DETAIL (TWO POST)		
E					
D					
C	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	BASE DWG. & LOADING TABLE REFERENCE NOTES REV'D	AUG 96	18/11/94	E.L. (Signature on File)	SP635-3.6.2
A	SIGN HEIGHT REVISED & OFFSET ADDED	AUG 95	Chief Highway Engineer		





#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

ALL NUTS, BOLTS AND WASHERS SHALL BE STAINLESS STEEL

NOT TO SCALE



No.	Revision	Date	PERFORATED SQUARE GALVANIZED STEEL SIGN POST INSTALLATION DETAIL			
F			Date	Approved	SPECIFICATION DRAWING No.	
E						
D						
C						
B	BASE DRAWING REFERENCES REVISED	AUG 96				
A	GENERAL REVISIONS	AUG 95	18/11/94	E.L. (Signature on File)	SP635-3.6.3	
			Chief Highway Engineer			



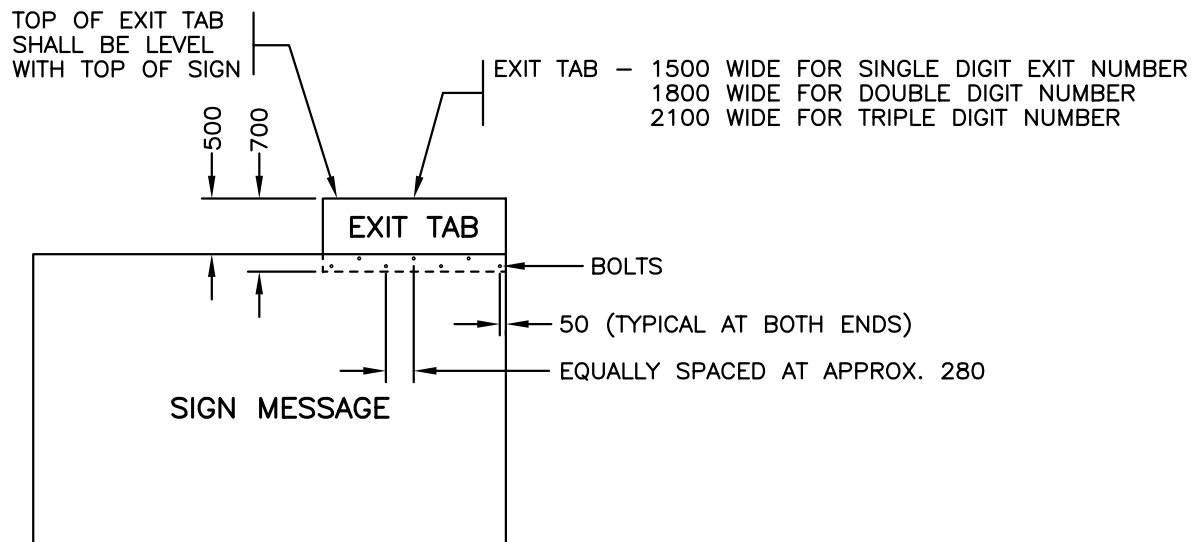
Diagram illustrating the vertical leg section of a structure, showing the placement of battens and dimensions:

- HEIGHT (H) MAXIMUM 1500**: Total height of the section.
- BOLT SIGN TO BATTENS EVERY 300± (TYPICAL)**: Dimension indicating the spacing between batten locations.
- 1/4 (H)**: Vertical spacing from the top edge to the first batten.
- 1/2 (H)**: Vertical spacing between the two battens.
- 1/4 (H)**: Vertical spacing from the bottom edge to the last batten.
- 50 (TYPICAL)**: Dimension indicating the width of the batten.
- BATTEN**: Label pointing to the horizontal reinforcement member.
- LEG**: Label pointing to the vertical reinforcement member.

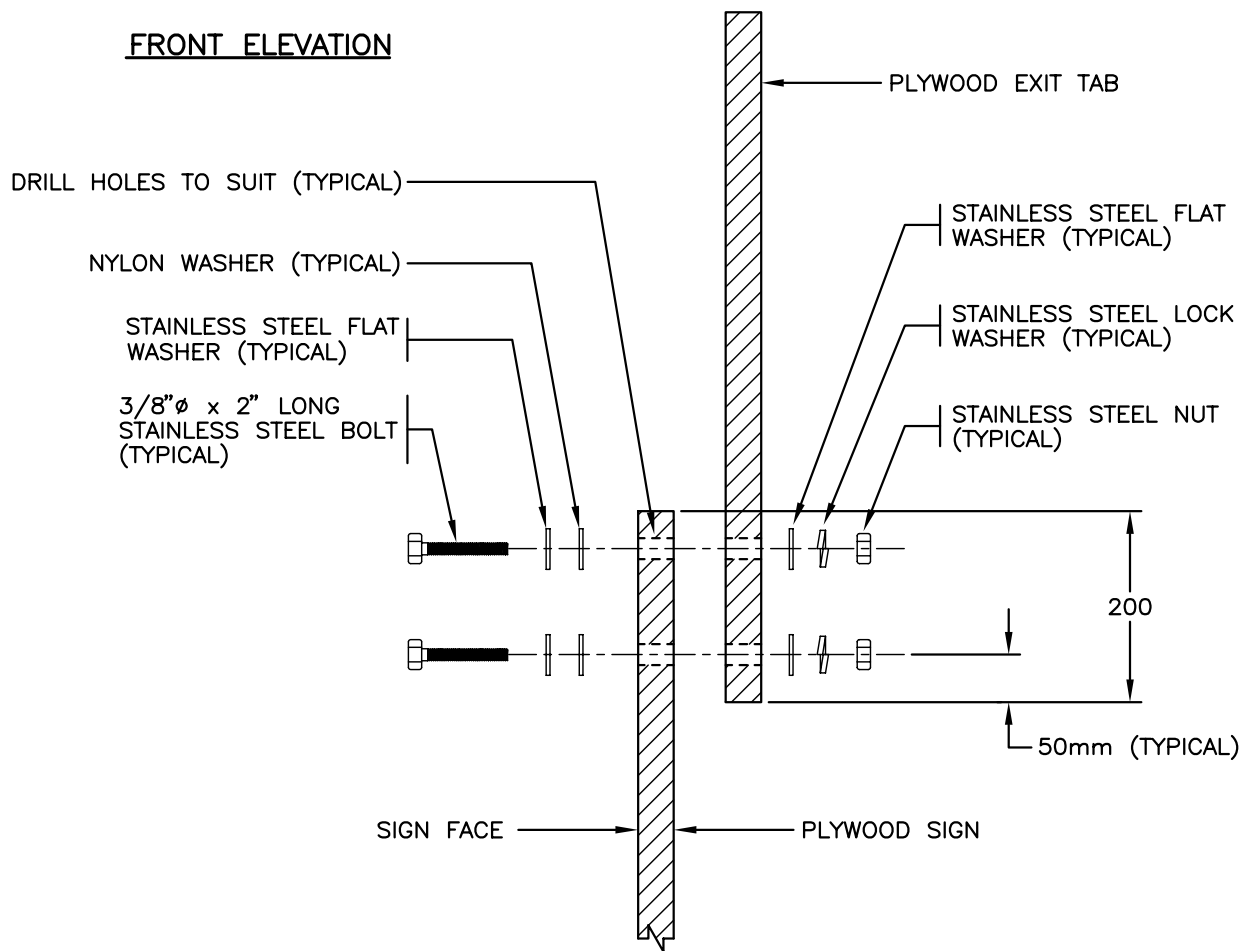
 **BRITISH COLUMBIA** Ministry of Transportation

No.	Revision	Date	PLYWOOD SIGN MOUNTING DETAILS ON PERFORATED SQUARE GALVANIZED STEEL TWO POST SIGN STRUCTURE	
F				
E				
D			Date	Approved
C				
B				
A				
			<b>18/11/94</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-3.6.4</b>





**FRONT ELEVATION**



**SIDE VIEW**

**NOTES**

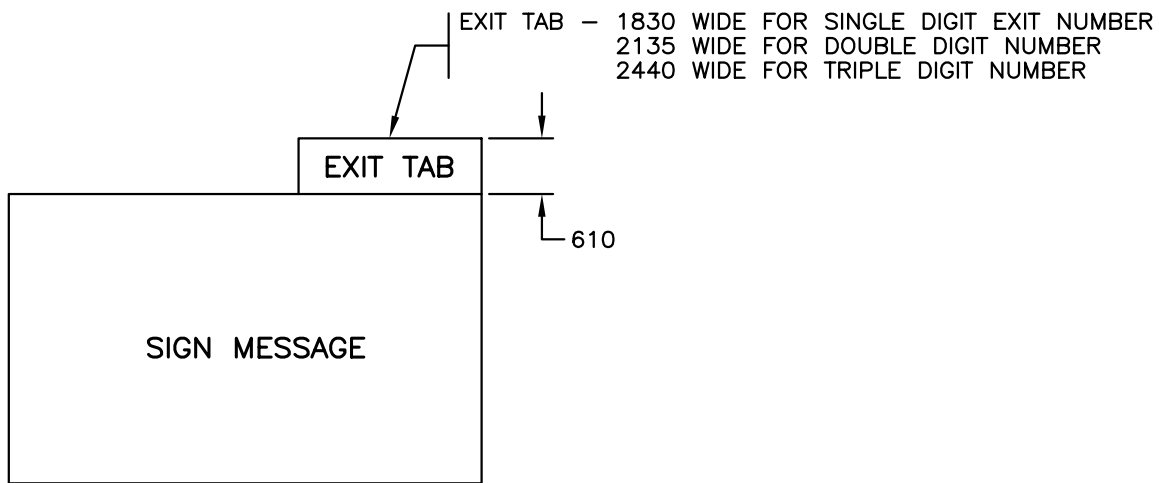
1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.

NOT TO SCALE

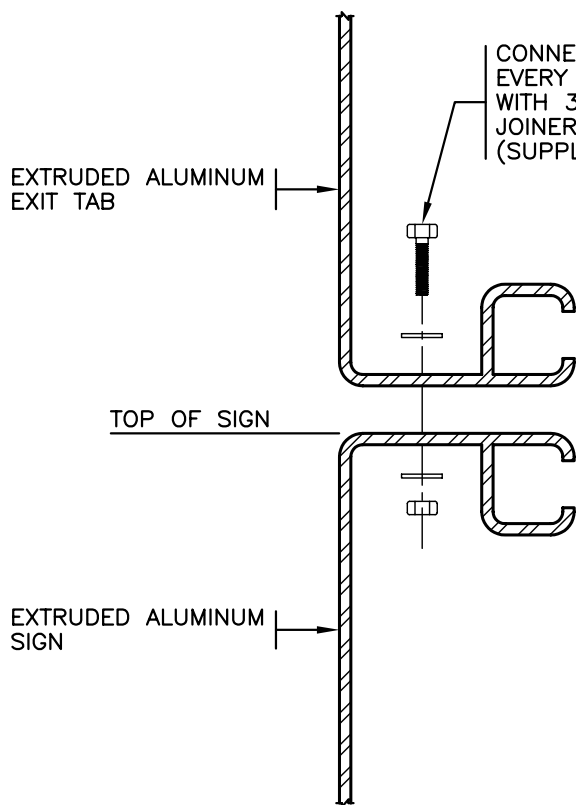


No.	Revision	Date	PLYWOOD EXIT TAB MOUNTING DETAILS	
F			Date	Approved
E				
D			30/09/93	E.L. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.7.1
A	GENERAL REVISION	AUG 94		

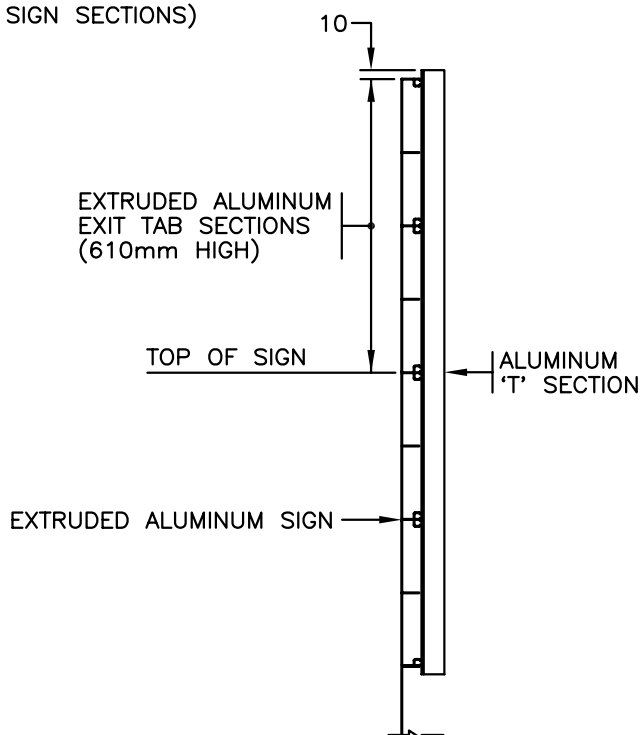




FRONT ELEVATION



SIDE VIEW



NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

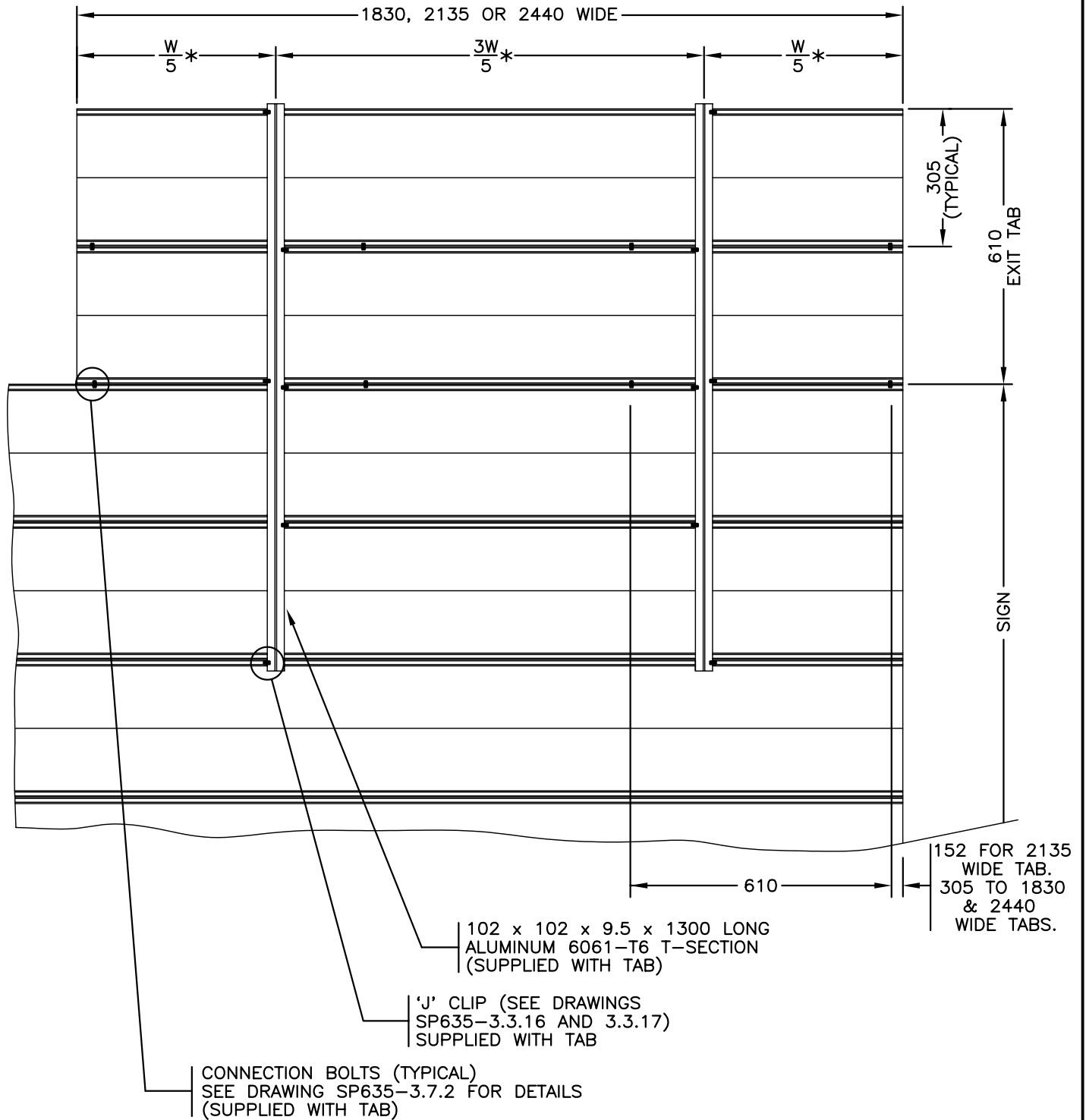
NOT TO SCALE



No.	Revision	Date	EXTRUDED ALUMINUM EXIT TAB MOUNTING DETAILS	
F			Date	Approved
E				
D			18/11/94	E.L. (Signature on File)
C				
B			Chief Highway Engineer	SPECIFICATION DRAWING No. SP635-3.7.2
A	TAB WIDTHS & END HOLE SPACINGS REVISED	AUG 95		



\* ADJUST SPACING TO SUIT VERTICAL  
SIGN SUPPORT T-SECTIONS



### REAR VIEW OF SIGN

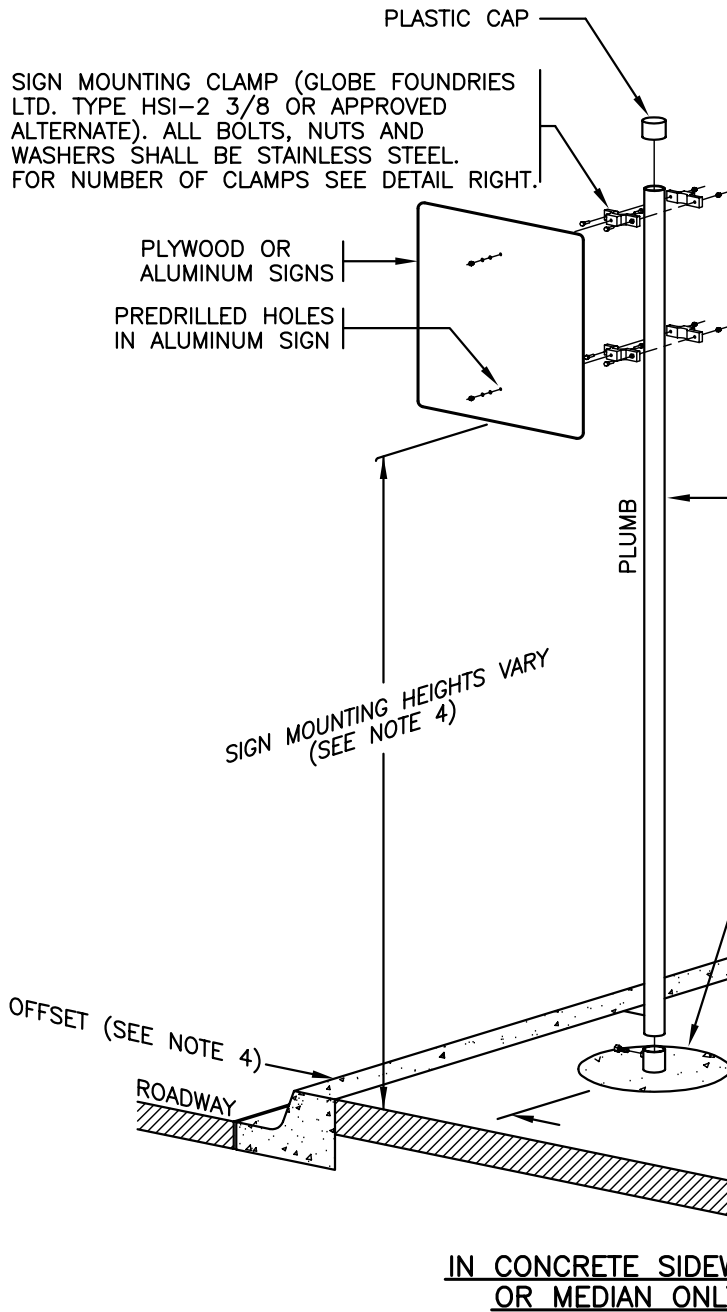
SEE DRAWING SP635-3.7.2 FOR  
NOTES AND ADDITIONAL DETAILS.

NOT TO SCALE



No.	Revision	Date	EXTRUDED ALUMINUM EXIT TAB MOUNTING DETAILS			
F			Date Approved		SPECIFICATION DRAWING No.	
E						
D						
C						
B	DRAWING REFERENCE NUMBERS REVISED	AUG 96				
A	SIGN WIDTHS & END HOLE SPACING REVISED	AUG 95	18/11/94 E.L. (Signature on File)		SP635-3.7.3	
			Chief Highway Engineer			



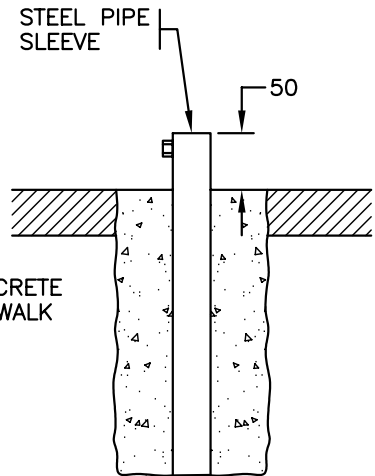


SIGN HEIGHT	NUMBER OF BOLTS
UP TO 750 HIGH	2
751 TO 1260 HIGH	3

MAXIMUM SIGN WIDTH
1260

REFER TO MINISTRY ELECTRICAL & TRAFFIC ENGINEERING MANUAL FOR SIGN STRUCTURE LOADING TABLE

CORE DRILL 200mmØ X 375mm DEEP HOLE IN CONCRETE SIDEWALK. INSTALL PIPE SLEEVE IN CONCRETE. TROWEL FINISH TOP OF CONCRETE FLUSH WITH FINISHED GRADE.



BACKFILL HOLE WITH CONCRETE | MAINTAIN HOLE FOR DRAINAGE

### SLEEVE INSTALLATION DETAIL

### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. CONCRETE SHALL HAVE A MINIMUM STRENGTH OF 30MPa PRIOR TO POST INSTALLATION.
4. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

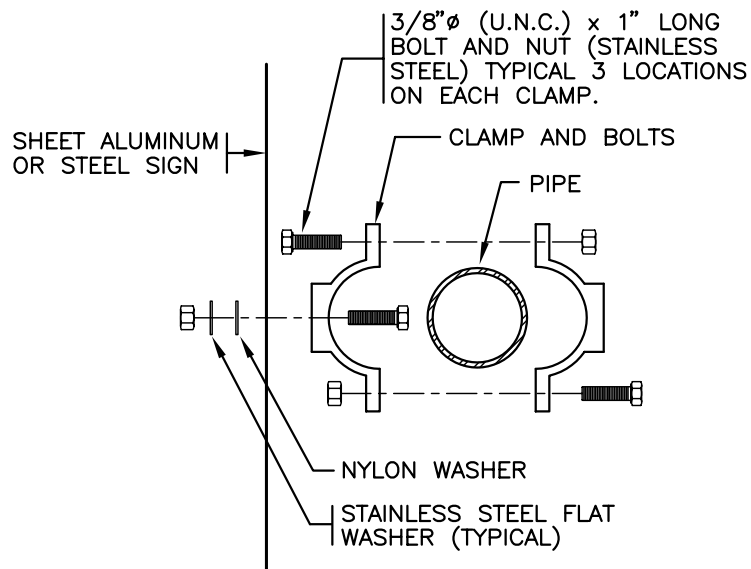
WHERE INSTALLED IN GRAVEL SHOULDER OR ASPHALT ISLANDS, INSTALL POST ON CONCRETE BASE AS PER DRAWING SP635-1.1.36

NOT TO SCALE

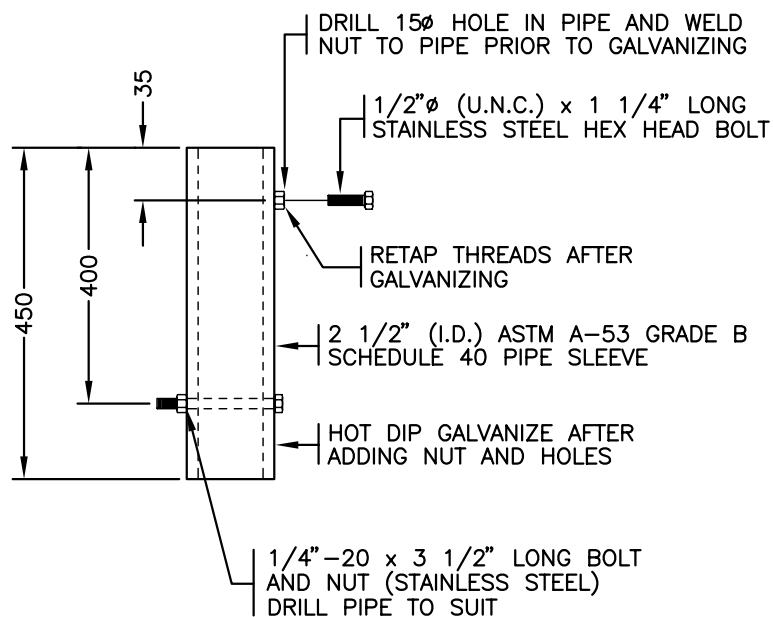


No.	Revision	Date	ROUND STEEL SIGN POST INSTALLATION DETAILS		
E					
D					
C	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98	Date	Approved	SPECIFICATION DRAWING No.
B	SIGN MOUNTING HEIGHT REVISED	DEC 96	30/09/93	E.L. (Signature on File)	SP635-3.8.1
A	GENERAL REVISION	AUG 94	Chief Highway Engineer		





### SIGN MOUNTING DETAILS



### GALVANIZED PIPE SLEEVE DETAIL

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



No.	Revision	Date	ROUND STEEL SIGN POST INSTALLATION DETAILS	
F			Date <b>18/11/94</b> <b>E.L. (Signature on File)</b> Chief Highway Engineer	SPECIFICATION DRAWING No. <b>SP635-3.8.2</b>
E				
D				
C				
B				
A				



SIGN MOUNTING CLAMP (GLOBE  
FOUNDRIES LTD. TYPE HSI-2 3/8 OR  
APPROVED ALTERNATE). ALL BOLTS,  
NUTS AND WASHERS SHALL BE STAINLESS  
STEEL. FOR NUMBER OF CLAMPS SEE  
DETAIL BELOW.

SHEET ALUMINUM  
OR PLYWOOD SIGN

PREDRILLED HOLES  
IN ALUMINUM SIGN

PLASTIC CAP

3/8"Ø (U.N.C.) x 1" LONG  
BOLT AND NUT (STAINLESS  
STEEL) TYPICAL 3 LOCATIONS  
ON EACH CLAMP

CLAMP AND BOLTS

PIPE

NYLON WASHER

STAINLESS STEEL FLAT  
WASHER (TYPICAL)

SHEET ALUMINUM  
SIGN

### SIGN MOUNTING DETAILS

2 3/8" (O.D.) ASTM A-53 GRADE B  
SCHEDULE 40 GALVANIZED STEEL  
PIPE (LENGTH VARIES TO SUIT SIGN  
& MOUNTING HEIGHT)

LOCKING BOLT (SUPPLIED WITH BARRIER STAND)

BARRIER SIGN STAND (SN2180) FOR

CONCRETE MEDIAN BARRIER (25kg)

BARRIER SIGN STAND (SN2181) FOR  
CONCRETE ROADSIDE BARRIER (21kg)

SLOTTED HOLES

PLASTIC CAP  
(SUPPLIED WITH  
BARRIER STAND)

300

3/4"Ø (U.N.C.)x 400mm LONG GALVANIZED  
READY ROD AND 2 GALVANIZED NUTS.  
(SUPPLIED WITH BARRIER STAND)

CUT ROD FLUSH WITH NUTS

CONCRETE MEDIAN BARRIER  
(810 HIGH) OR CONCRETE  
ROADSIDE BARRIER (690 HIGH)

SIGN MOUNTING HEIGHTS VARY  
(SEE NOTE 3)

REFER TO  
MINISTRY ELECTRICAL &  
TRAFFIC ENGINEERING  
MANUAL FOR SIGN  
STRUCTURE LOADING  
TABLE

SIGN HEIGHT	NUMBER OF BOLTS
UP TO 750 HIGH	2
751 TO 1260 HIGH	3

### NOTES

- SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE

- MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date
E		
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98
C	DWG. No. & MOUNTING HEIGHTS REV'D	DEC 96
B	SIGN MATERIAL & SIGN WIDTH REVISED	AUG 95
A	GENERAL REVISION	AUG 94

## ROUND STEEL SIGN POST ON BARRIER SIGN STAND INSTALLATION DETAILS

Date \_\_\_\_\_ Approved \_\_\_\_\_  
**30/09/93 E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.8.3**



DRILL AND TAP POLE TO SUIT.  
COAT HOLES WITH COLD  
GALVANIZING COMPOUND.  
(TYPICAL)

SHEET ALUMINUM SIGN

NYLON WASHER AGAINST  
SIGN FACE. (TYPICAL)

STAINLESS STEEL WASHER (TYPICAL)

3/8"Ø (U.N.C.) x 1" LONG  
STAINLESS STEEL HEX HEAD  
BOLT. (TYPICAL) SEE TABLE  
ABOVE

MAXIMUM 1-750W x 900H  
SIGN PER POLE (0.675m<sup>2</sup>  
OF SIGN AREA)

OPTIONAL TAB.  
MAXIMUM 1-750W x 300H  
SIGN PER POLE (0.225m<sup>2</sup>  
OF SIGN AREA)

STAINLESS STEEL BUCKLE  
(BAND-IT No. C255) TYPICAL

5/8" STAINLESS STEEL BANDING  
(BAND-IT No. C205) TYPICAL

STAINLESS STEEL  
SIGN MOUNTING  
BRACKET C/W  
BOLT AND WASHER  
(BAND-IT No. D021)  
TYPICAL

NYLON WASHER  
AGAINST SIGN  
FACE (TYPICAL)

GALVANIZED  
STEEL POLE

CONTACT MINISTRY  
ELECTRICAL TRADES  
SUPERVISOR FOR APPROVAL  
PRIOR TO INSTALLING SIGN

SIGN MOUNTING  
BY BOLTING

SIGN MOUNTING  
BY BANDING

INSTALL BANDING  
WITH BANDIT TOOL

SIGN MOUNTING HEIGHTS VARY  
(SEE NOTE 3)

POLE HANDHOLE

CONCRETE BASE

ELEVATION

#### NOTES

1. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. MOUNTING HEIGHTS & OFFSETS SHALL FALL WITHIN THE RANGES NOTED IN THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS & PAVEMENT MARKINGS.

NOT TO SCALE

SIGN HEIGHT	NUMBER OF BOLTS
UP TO 750 HIGH	2
751 TO 1200 HIGH	3



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

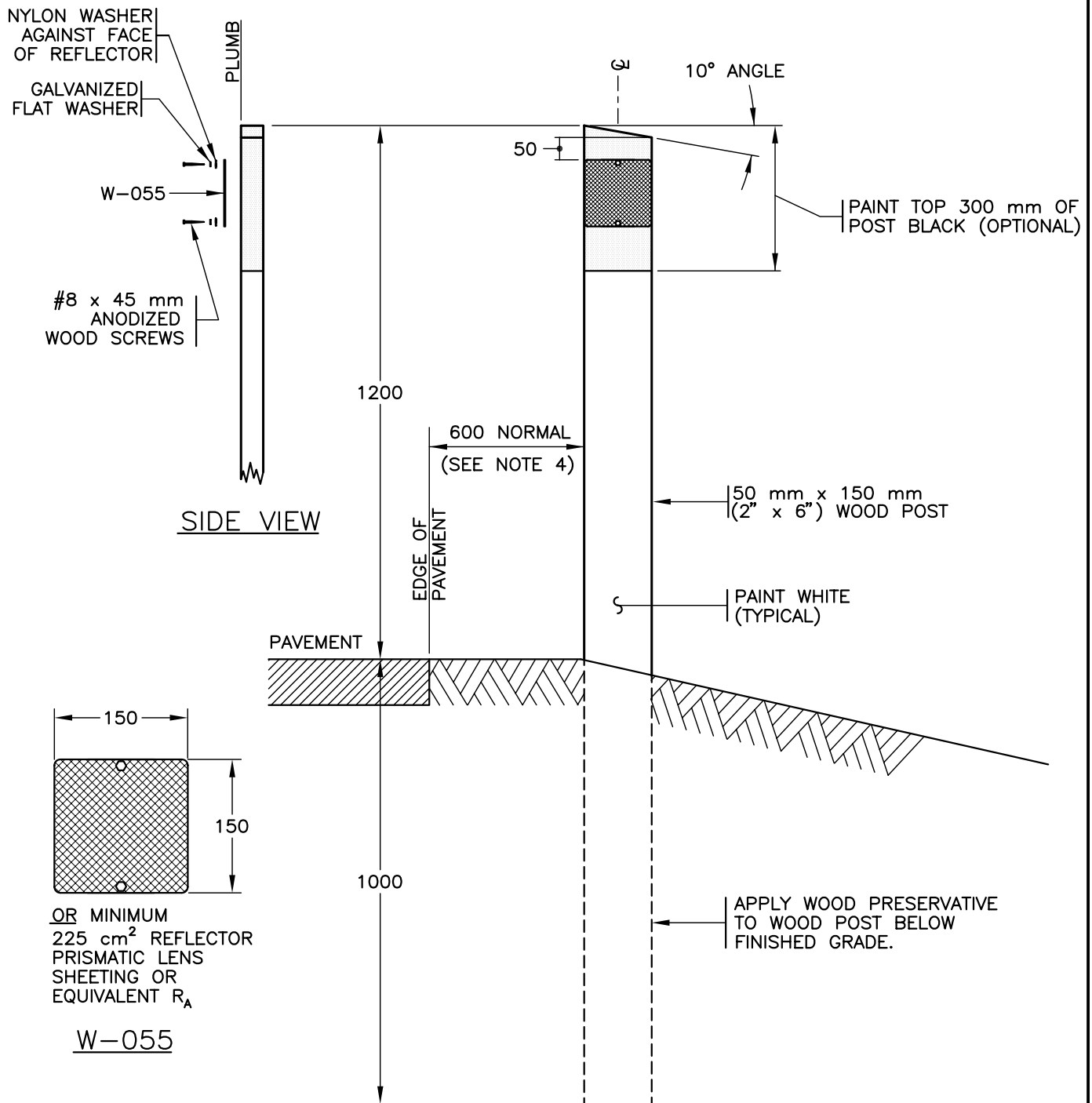
No.	Revision	Date
F	MINISTRY APPROVAL NOTE ADDED	NOV 01
E	BANDING SIGN MOUNTING ADDED	SEPT 00
D	MOUNTING HEIGHTS & OFFSETS REFERED THE MINISTRY MANUAL OF STANDARD TRAFFIC SIGNS	NOV 98
C	SIGN MOUNTING HEIGHT REVISED	DEC 96
B	BOLT LENGTH & SIGN REVISED	AUG 95

## SIGN INSTALLATION ON THE SIDE OF POLES

Date **30/09/93** Approved **E.L. (Signature on File)**  
Chief Highway Engineer

SPECIFICATION  
DRAWING No.  
**SP635-3.9.1**





#### NOTES

1. SEE THE MINISTRY'S "STANDARD TRAFFIC SIGNS AND PAVEMENT MARKING MANUAL" TABLE 7.4 FOR DELINEATOR SPACING ON HORIZONTAL CURVES.
2. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. POST PLACED A MINIMUM OF 1.0 m TO A MAXIMUM OF 3.6 m FROM EDGE OF TRAVELLED LANE.

NOT TO SCALE

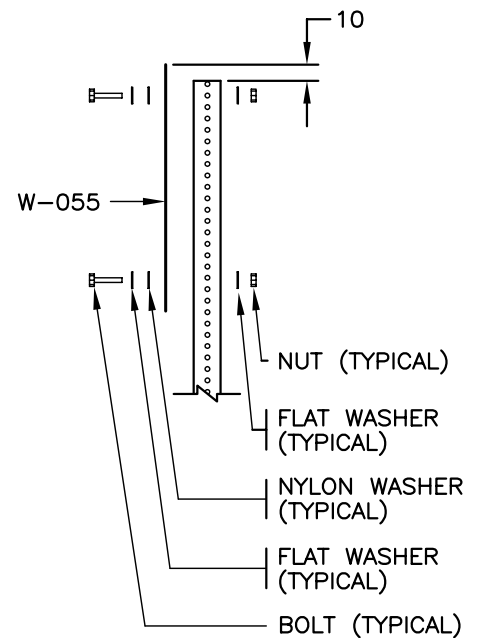
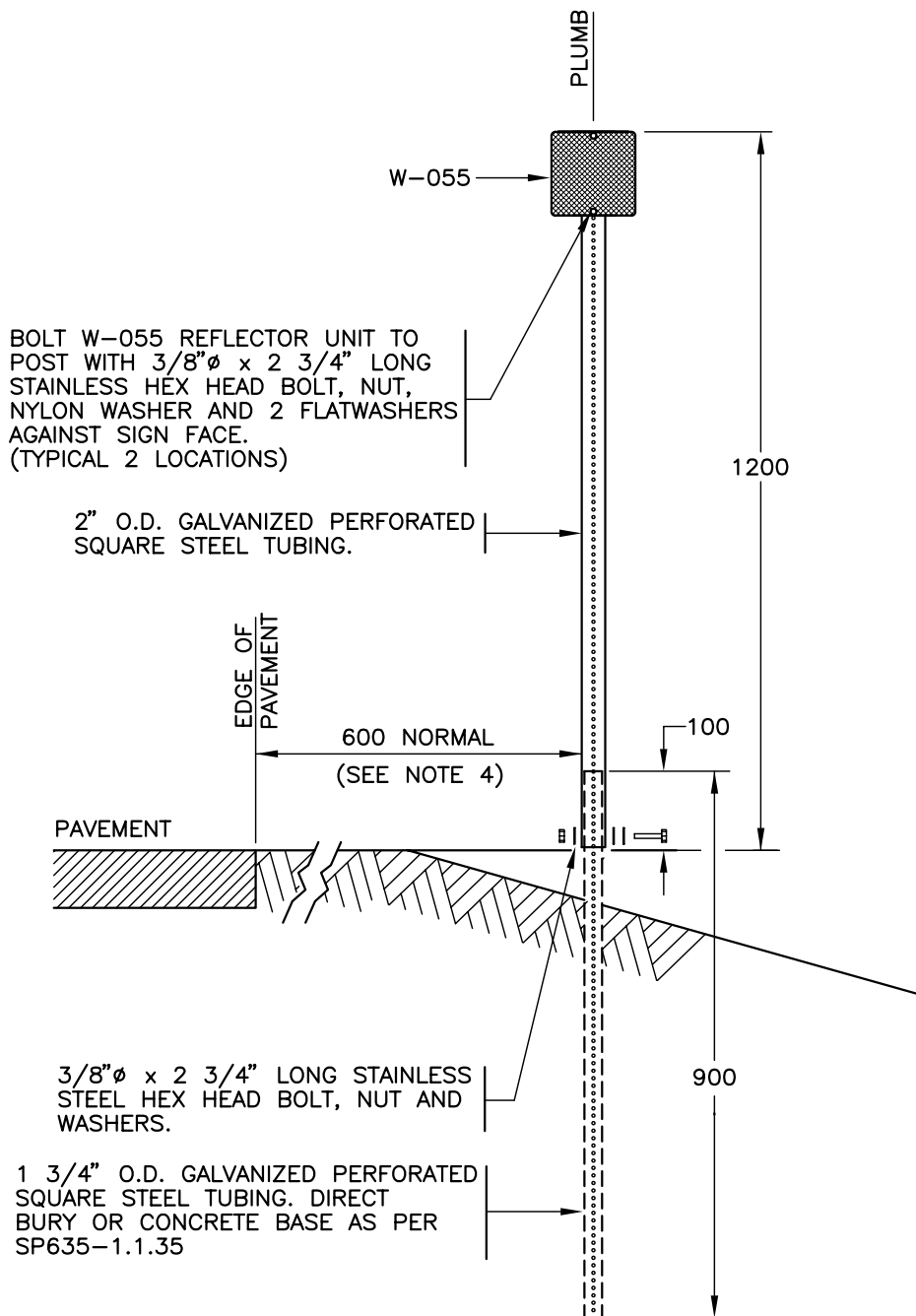


**BRITISH COLUMBIA**

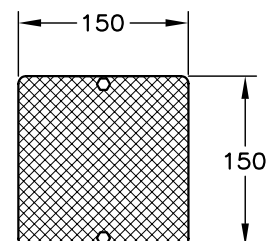
Ministry of  
Transportation

No.	Revision	Date	WOOD DELINEATOR POST INSTALLATION DETAILS		
F					
E					
D	SIZE & NUMBER OF REFLECTORS	NOV 01	Date	Approved	SPECIFICATION DRAWING No. <b>SP635-3.10.1</b>
C	SIGN NUMBER REVISED	AUG 96	30/09/93	E.L. (Signature on File)	
B	OFFSETS ADDED	AUG 95			
A	GENERAL REVISION	AUG 94		Chief Highway Engineer	





**SIDE VIEW**



OR MINIMUM  
225 cm<sup>2</sup> REFLECTOR  
PRISMATIC LENS  
SHEETING OR  
EQUIVALENT R<sub>A</sub>

**W-055**

**NOTES**

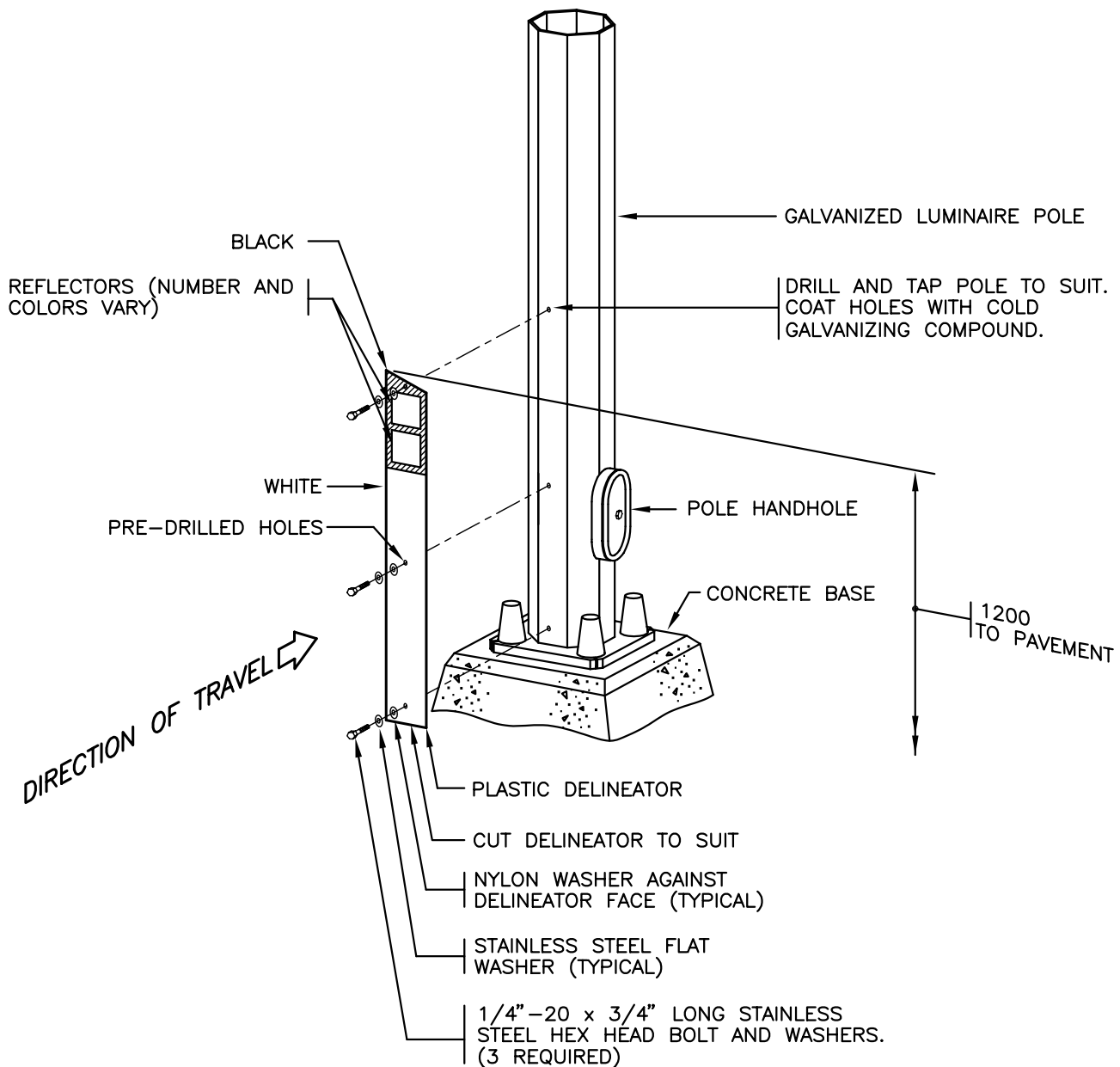
1. SEE THE MINISTRY'S "STANDARD TRAFFIC SIGNS AND PAVEMENT MARKING MANUAL" TABLE 7.4 FOR DELINEATOR SPACING ON HORIZONTAL CURVES.
2. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
4. POST PLACED A MINIMUM OF 1.0 m TO A MAXIMUM OF 3.6 m FROM EDGE OF TRAVELLED LANE.

NOT TO SCALE



No.	Revision	Date	PERFORATED SQUARE STEEL TUBING DELINEATOR POST INSTALLATION DETAILS		
F					
E					
D	SIZE & NUMBER OF REFLECTORS	NOV 01			
C	OFFSET & POST LENGTHS REVISED	OCT 99			
B	W-055 SIGN REFERENCES REVISED	AUG 96			
A	OFFSETS ADDED	AUG 95			
			Date	Approved	SPECIFICATION DRAWING No.
			18/11/94	E.L. (Signature on File)	SP635-3.10.2
			Chief Highway Engineer		





### ASSEMBLY DETAIL

#### NOTES

1. NUMBER, COLOUR, SIZE AND SHAPE OF REFLECTORS VARIES. SEE THE MINISTRY'S PAVEMENT MARKING MANUAL (JUNE 94 ISSUE) FOR MORE INFORMATION.
2. DELINEATOR MANUFACTURER MUST MEET MINISTRY APPROVAL.
3. SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

NOT TO SCALE



**BRITISH  
COLUMBIA**

Ministry of  
Transportation

No.	Revision	Date	PLASTIC DELINEATOR INSTALLATION ON POLE	
F			Date	Approved
E			30/09/93	E.L. (Signature on File)
D			SPECIFICATION DRAWING No.	
C			SP635-3.10.3	
B				
A	GENERAL REVISION	AUG 94	Chief Highway Engineer	



## SECTION 741

### FENCE CONSTRUCTION

#### DESCRIPTION

**741.01 Scope** - This Section covers the construction of wire fencing with wood and/or metal posts, gates, wood privacy and noise barrier fencing and, with reference to Drawings of the [SP741](#) series, is intended to specify acceptable standards and some optional features as may be required by the Special Provisions.

Alternative construction may be called for by the Plans, the Special Provisions or instructions of the Ministry Representative, and alternative methods may be acceptable upon submission to the Ministry Representative.

#### MATERIALS

**741.11 General** - Material for fencing including wire fabric, barbed and high-tensile wire, chain link mesh and metal posts are specified in Section [316](#). Wood fence posts are specified in Section [909](#).

Chain link fabric as protection on rock slopes is covered by Sections [207](#) and [316](#).

The types of standard wire and chain link fencing covered by this Section are designated in Table [741-A](#). Tentative requirements for High-tensile Smooth-wire Fences are included.

**Note:** Drawing [SP741-01.01](#) indicates the general requirements of Types A and B Fences, Drawing [SP741-02.01](#) indicates those of Type C Fences, and Drawing [SP741-05.01](#) indicates those for Type D. The requirements for Type C are acceptable to the Provincial Wildlife Branch and the B.C. Cattlemen's Association.

**TABLE 741-A TYPES OF STANDARD WIRE AND CHAIN LINK FENCING**

TYPE A	Special Wire Fabric Fence for use only on railway right-of-way
TYPE B	Standard Wire Fabric Fence
TYPE C	Standard Barbed Wire Fence
TYPE D	Chain Link Fence

**741.12 Standard Wire Type A, B & C Fences and Gates**

- Materials generally shall be in accordance with the requirements set out on Drawings [SP741-01.01](#) and [SP741-02.01](#), the relevant subsections of Sections [316](#) and [909](#) and/or the Special Provisions.

Preservative treatment for protecting field cuts and notches and for making good any superficial damage to treated wood posts, braces and anchors, where permitted by the Ministry Representative, shall be compatible with the original pressure treatment for application in two separate heavy coatings.

Touch-up treatment for damaged galvanizing of steel posts and braces shall be a heavy application of a zinc rich colour matched paint to CGSB Standard 1-GP-181M Specification for Ready Mixed Zinc Rich Coating.

**741.12.01 Gates** - Gates shown on the Drawings shall be of the prefabricated type indicated on Drawings [SP741-04.04](#), [SP741-04.05](#) and as specified in Subsection [316.11](#) and/or as specified in the Special Provisions.

**741.13 High-tensile Smooth-wire Fences** - Materials to be supplied by the Ministry f.o.b. the Contractor's job site yard or the Ministry's yard in accordance with the Purchase Order and Subsection [145.16](#) will include:

- high-tensile smooth galvanized wire 2.5 mm nominal diameter
- mechanical wire splices and fasteners for high-tensile wire
- in-line high-tensile wire tensioning devices
- metal or wood droppers for high-tensile fencing.

Wood posts and braces shall be supplied by the Contractor in accordance with the requirements of Section [909](#) together with steel posts, gates and hardware, brace wire, dowels, staples and the like in accordance with the relevant subsections of Section [316](#).

**741.14 Chain Link Type D Fences and Gates**- Chain link mesh, steel pipe and accessory materials generally shall be in accordance with the requirements set out on Drawings [SP741-05.01](#) and [SP741-05.02](#), the relevant subsections of Section [316](#), and/or the Special Provisions.

**741.14.01 Gates** - Gates shown on the Drawings shall be of the type indicated on Drawings [SP741-05.03](#) and [SP741-05.04](#) and/or specified by the Special Provisions, and shall be equipped with hinges (or sliding) and locking hardware.

**741.15 Wood Fences** - Materials used for the fabrication and installation of wood fences shall be as follows:

- Concrete footings:** Minimum 18 MPa compressive strength concrete, comprised of aggregate, sand and Portland cement (4:2:1).



**ii) Lumber:** Rough sawn or dressed, as specified, shall be of Western Red Cedar with:

- Wood posts and stringers of "No. 1 Structural" grade posts and framing or plank
- Boards and planks of "Quality Fencing" grade except where noise barrier fencing is specified for "Select Fencing" or plank equivalent.

Other species may be specified or approved and shall be of equivalent grades with pressure preservative treatment in accordance with CSA Standard 080 and compatible with staining requirements.

All lumber shall be in conformity with the NLGA "Standard Grading Rules for Canadian Lumber."

**iii) Galvanized steel pipe:** 48 mm OD for privacy fence posts shall conform to the requirements of Subsection [316.10](#) with weatherproof caps where open ends are not covered by wood members.

**iv) Steel:** Steel used as posts for noise barrier fences or as wood post supports shall be of the structural shape(s) indicated in accordance with CAS Standard G40.21M, grade 300W and where galvanized, hot dipped to the requirements of CSA G164.

**v) Fastenings:** Bolts generally shall conform to ASTM A 307, nuts to ASTM A 563 Grade A, plain washers to ANSI B27.2 Type A, plate washers, where required, to ASTM A 36; all galvanized according to CSA G164. Nails shall be casing headed heavy gauge of appropriate length, hot dip galvanized with deformed shank (annular, barbed or helical) for noise barrier fence plank fixing.

**vi) Finish:** Penetrating stain with preservative shall be of type and colour specified at least conforming to CGSB Standards 1-GP145M and 204M, to all surfaces prior to prefabrication or installation and on any cuts before final fitment.

## CONSTRUCTION

**741.31 Provision of Fencing -** Fencing of the type(s) called for shall be carried out at the locations and as shown on the Plans with the materials to the height, spacing and with accessories all in accordance with the details indicated on the Plans, Standard Specifications, Special Provisions and SP Drawings or to the direction of the Ministry Representative.

All material shall be supplied by the Contractor except where supply in whole or in part by the Ministry f.o.b. the Contractor's job site yard or Ministry's yard is specified.

Construction shall be carried out with all labour, tools, equipment and incidentals supplied by the Contractor, as necessary, to complete all fencing work in accordance with good work practice.

**741.32 Clearing & Grading -** All trees (other than any required by the Ministry Representative to remain), all brush and other obstacles which interfere with the construction and maintenance of fencing and not removed by the normal clearing operations, shall be removed prior to commencing fencing work so that both sides of the fence line are free of all clearing and grubbing debris.

Minor ground undulations shall be corrected to obtain a smooth uniform grade, but appreciable grade depressions may be backfilled only with the permission of the Ministry Representative.

The site shall be left in a smooth and tidy condition.

**741.33 Setting Out and Connections to Existing -** Fence line, as shown on the Plans, generally will be along the right-of-way boundary. Where undergrowth clearing is carried out to the right-of-way boundary, the fence line will be offset 0.5 m in from the boundary.

Post installation in fill material or minimum overburden shall be carried out to the Ministry Representative's directions. Where it is not possible to drive or set wood posts to proper depth or to relocate same along the fence line, steel fence posts as specified or, where permitted, multiple wood post and brace assemblies shall be substituted.

Existing cross fences shall be connected to new with posts and braces for tensioning fencing wire in every direction in accordance with Drawings [SP741-01.03](#) and [SP741-02.02](#).

## 741.34 Standard Wire Type A, B & C Fences and Gates

**741.34.01 Post Installation -** Fence posts shall be driven in place with equipment acceptable to the Ministry Representative, set in augered pilot holes or, where permitted by the Ministry Representative, set in dug holes with necessary well tamped backfill for a firm installation and post penetration to at least the depth indicated on Drawings [SP741-01.01](#) and [SP741-02.01](#).

On straight alignments all posts shall be plumb. On appreciable grades, posts shall be installed perpendicular to the slope.

On curved alignments, the posts shall be set 50 mm off plumb away from the curve centre, with a post spacing in accordance with Drawing [SP741-04.02](#) and increased post



lengths and bury depth for post stability where necessary.

Gate post sizes and stabilizing shall be as required by the Special Provisions and/or Drawing [SP741-04.04](#).

Steel fence posts, as specified by Subsection [316.09](#), are required on exposed rock or rock with "minimum overburden" (as defined on Drawing [SP741-04.01](#)) and shall be driven and/or wedged to the full depth in a vertical drilled hole of minimum diameter or set plumb and rigid in cement and sand or fine aggregate mortar all as indicated by Drawing [SP741-04.01](#).

**Note:** Assemblies of securely wire tied multiple wood posts/braces may be specified or permitted by the Ministry Representative especially for minor rock outcropping and unforeseen minimum overburden occurrences.

When full bury depth of wood posts is not attainable, the specified steel fence posts shall be used to the full penetration into rock, all as indicated on Drawing [SP741-04.01](#).

Tops of all posts shall be set to a uniform 50 mm above the level of the top wire of fencing and, where necessary, cut to line-up in vertical uniformity after inspection by the Ministry Representative. Wood post tops where cut, shall be bevelled and preservative treated in two heavy applications.

Wood posts which are burred, split or otherwise damaged from the installation, and which are not acceptable to the Ministry Representative shall be replaced at the Contractor's expense.

**741.34.02 Bracing for Fence Tensioning** - Braces of treated wood and twisted galvanized diagonal wire shall be installed between end posts and adjoining panel posts to stabilize the tensioning of the fencing fabric and/or barbed wire, all as indicated by Drawings [SP741-01.03](#) and [SP741-02.03](#). Corner and intersection assemblies shall be similarly tensioned in each fence direction.

Intermediate tensioning assemblies shall be provided within the maximum spacings indicated on Drawings [SP741-01.02](#) and [SP741-02.02](#) to make use of rolls of fabric etc. of standard length with a minimum of cutting and waste.

Steel corner, intersection and intermediate tensioning assemblies with steel angle posts and diagonal bracing are indicated on Drawing [SP741-04.01](#).

Horizontal alignment changes over 30° with wood posts and over 15° with steel posts shall be stabilized as for corners above. Where a change is less than 30° with wood posts, a

pair of line posts, set 2.4 m or 3.0 m apart, shall be stabilized with a horizontal wood brace and diagonal wire bracing both ways. For a change of less than 15° with steel posts, a steel line post at the change shall be stabilized in both directions with diagonal steel braces to adjoining line posts as indicated on Drawing [SP741-04.01](#).

Similar requirements shall be maintained at each change to or within any curved fence alignment where the closer post spacing indicated by Drawing [SP741-04.02](#) is not considered adequate.

**Note:** The previous requirements for alignment changes may be waived by the Ministry Representative wherever, from consideration of the soil conditions, the Ministry Representative directs that the stability and strength of the fence is not likely to be appreciably lessened by such change of alignment.

Vertical alignment changes shall be stabilized, and fence requirements at ditch and gully conditions shall be as called for by Drawing [SP741-04.03](#) or as the Ministry Representative may direct.

**741.34.03 Fabric and Wire** - Fence fabric shall normally be installed on the side of the posts away from the highway, stretched between end type assemblies and intermediate tensioning assemblies with proper equipment (tensioning directly by truck or tractor will not normally be permitted) and securely stapled in accordance with good practice to wood posts, as indicated by Drawing [SP741-01.01](#), or securely wired or clipped to steel posts to permit free wire movement on line posts. Similarly, barbed wire shall be installed so as to allow it to "prestretch" before final tensioning, and shall be securely stapled to tensioning assemblies.

For fencing on a curve requiring the fabric and/or barbed wire on the highway side of the posts, all line wires shall be double stapled and the top wire shall be securely wire tied to posts in addition where the adjoining property has livestock.

Barbed wire Type C fences shall normally have wood droppers "interwoven" and securely figure-of-eight wire tied to every line wire, as indicated by Drawing [SP741-02.01](#). Alternatively, proprietary galvanized sheet metal prefabricated droppers of pre-approved design for secure clip-on application may be approved.

**Note:** High livestock pressures may warrant Type C1 fencing and nursery livestock enclosures Type C1 or B fencing. Where such fences, 1200 mm and higher, are in wildlife sensitive areas, the top strand may be specified smooth (barbless) as Type C2 or B1 fences.



**741.34.04 Gates** - Hardware, of design to permit the gate to operate correctly, shall be securely attached to prevent the easy removal of the gate and hardware. Hinges shall be installed to permit the gate to swing back one-way against the fence. Locking hardware shall be of the type specified.

**741.35 High-tensile Smooth-wire Fences** - For rangeland and other locations with favourable terrain, soil conditions and fence alignment at the locations indicated on Drawings, construct high-tensile smooth-wire fencing between rigid end, gates, corner and any necessary intermediate tensioning assemblies in general accordance with Drawings [SP741-03.01 through SP741-03.03](#).

**741.35.01 Fence Style** - Fence style for wildlife crossing areas shall comprise 5 wires, the bottom wire for installation at 250 mm  $\pm$  50 mm above grade at and between posts, the next two wires at 200 mm spacing and the top two 225 mm for a total height of 1100 mm, as indicated by Drawing [SP741-03.01](#) for HT Fences. Elsewhere, and for nursery livestock enclosures and other areas of high livestock pressure, a 6-wire fence may be specified, having the bottom wire 200 mm  $\pm$  50 mm above grade at and between posts with the remaining wires at 200 mm spacing for a total height of 1200 mm indicated as HT-1 Fences.

**741.35.02 Post and Brace Installation** - Fence posts shall be driven in place with equipment acceptable to the Ministry Representative and set out in general accordance with the recommendations of the B.C. Ministry of Agriculture and Food (BCMAF) Publication #ISBN 0-7719-9824-4, good local trade practice and to the Ministry Representative's direction.

Terminal (end and gate) tensioning assemblies and any intermediate assemblies shall be "single" assemblies and at the spacings and post bury depths indicated by Drawing [SP741-03.02](#) (or such greater depths and/or decreased spacings as may be directed by Ministry Representative) with "double" assemblies used with scant bury depths all to form rigid, stable and accurately aligned assemblies for tensioning line wires.

Line posts 100 mm minimum diameter driven to a depth of not less than 650 mm in firm soil, or as otherwise required by Drawing [SP741-03.01](#), or directed, shall be spaced up to a maximum of 15 m where permitted, but normally at 10 m spacing and such closer spacing at changes in horizontal and vertical alignments to keep the bottom wire at the regular specified ground clearance.

**741.35.03 Wire and Dropper Installation** - Wires shall be installed on the side of the fence posts away from the highway except on such curves requiring the wires on the highway side so as to bear on the posts.

Stapling doubled at curves, etc. and mechanical fasteners at tied-off ends and splices (where permitted) shall be to BCMAF recommended practice.

With supplied tensioning devices installed in each line, all wires shall be individually tensioned in stages and after "wire-set" to 1.33 kN (300#) at completion.

Droppers, as supplied, shall be installed and securely clipped to all line wires at 3 to 4 m spacing.

### **741.36 Chain Link Type D Fences and Gates**

#### **741.36.01 Post and Rail Installation**

i) All terminal posts (posts at ends, gates, corners and intersections), all line posts and any intermediate tensioning posts shall be set plumb into concrete footings in augered or dug holes to the depths and regular spacing all as shown on Drawing [SP741-05.01](#), or as otherwise specified or directed.

ii) Gate post sizes and stabilizing shall be as required by the Special Provisions and/or Drawing [SP741-05.03](#).

iii) On exposed rock, posts shall be set without concrete footings to full depth and fully grouted in holes, 25 mm greater than the pipe diameter, drilled to a depth into solid rock of half the depth of pipe bury to that indicated for concrete footings on Drawing [SP741-05.01](#) (i.e. c/2 and f/2).

Grout shall be non-shrink cement and sand mortar. Standard length posts may be used where the overburden depth is such that the depth of bury into solid rock is less than that specified above, provided normal diameter concrete footings of the diameter indicated on Drawing [SP741-05.01](#) are formed from solid rock to grade level. Similarly, form concrete footings for posts set in loose or friable rock. Sleeves shall be provided to form holes similar in diameter and depth to above for casting into concrete where shown or specified.

iv) Tops of all posts shall be set or cut for an even height of top rail, which shall form a continuous brace and mesh support between terminal posts and any intermediate tensioning posts. Top rails shall pass through line post caps and be joined in the length with internal sleeves to allow expansion and contraction. All posts shall be fitted with appropriate weathertight caps securely fixed.

**741.36.02 Bracing for Fence Tensioning** - Bottom tension wire shall be securely fixed taut and sag free to terminal posts and any intermediate tensioning posts. Similarly,



provide top tension wire, when specified, in place of top rail to pass through line post tops except on uneven terrain where the height of the top tension wire shall be such that it is secured to all line posts and the mesh within the top 300 mm of the mesh.

Terminal posts, where more than 10 m apart in any fence run, shall have horizontal pipe braces to adjoining line posts. Diagonal pipe braces may be called for where soil conditions warrant, especially where fencing without top rails is specified, but no pipe bracing is normally required for residential height fences.

Intermediate tensioning assemblies shall be provided where terminal posts are more than 150 m apart, and at any subsequent 150 m maximum spacing, to consist of a straining post (to full height of fence where barbed wire on extension arms is specified) with horizontal pipe braces at the mid to two-thirds height above grade to adjoining line posts each way for the discontinuity of top rail, tension and/or barbed wire and mesh; provide similar tensioning assembly at abrupt vertical alignment changes.

Horizontal alignment changes where abrupt shall be considered as corners.

At changes in horizontal alignment and to curved fence alignments, where the top rail can be continuous by accurately bending to proper curvature without damage to the galvanized coating, a pair of line posts shall be stabilized and tensioned as follows:

- A horizontal pipe brace shall be securely fixed to adjoining line posts at the two-thirds height above grade.
- Crossed diagonal wire braces shall each be two strands of 3.5 mm nominal diameter galvanized wire securely fixed to the brace band fixing of the horizontal brace and to a brace band 100 mm above grade.
- Each pair of wires shall be twisted taut to mutually stabilize the assembly with the tensioning battens left in place.

Similar requirements shall be maintained within any curved fence alignment over 30 m in length.

**Note:** The previous requirements may be waived by the Ministry Representative wherever the Ministry Representative directs that, from consideration of the soil conditions and footing sizes, especially where with continuous top rail, the stability and strength of the fence is not likely to be appreciably lessened by the change in alignment.

Fencing where continuous over a creek or ditch shall be

stabilized with a horizontal pipe brace and diagonal brace wires as specified above, and the bottom tension wire shall be wire tied to a similar pipe brace. In addition, in-fill under where specified or required, shall be a hanging or rigidly fixed bent pipe of brace diameter hung or in-filled with closely spaced barbed wire or suitable fence fabric (similar to that indicated on Drawing [SP741-04.03](#)), all to the Ministry Representative's direction.

**741.36.03 Fabric and Wire** - Chain link fencing mesh shall be stretched between terminal posts and any intermediate tensioning posts with proper equipment (tensioning directly by truck or tractor will not normally be permitted), and secured with tension bars and bands, tie wire and clips all in accordance with the requirements shown on Drawing [SP741.05.02](#). The mesh shall be installed on the highway side of the fence posts, or as otherwise specified or directed, and joints in the length shall be made by weaving the meshes together with a single wire picket to form a neat continuous fabric mesh.

Security barbed wire, where specified, shall be installed in the slots of all extension arms and secured to extended height terminal and any intermediate tensioning posts taut and free of sag.

**741.36.04 Gates** - Hardware, of design to permit the gate to operate correctly, shall be securely attached to prevent the easy removal of the gate and hardware. Hinged gates shall be installed to permit the gate to swing back one-way against the fence.

### 741.37 Wood Fences

**741.37.01 Privacy Fences** - Galvanized pipe posts shall be set plumb in concrete footings in augered or dug holes to the depth and regular spacing all as shown on Drawing [SP741-06.02](#).

Wood fixing members for fence panels shall be securely nailed, "II-shaped" frames fixed and supported with 9.5 mm (3/8") galvanized bolts and nuts to pipe posts all as indicated on Drawing [SP741-06.01](#).

Metal fixing members for fence panels, when specified, shall be of named or otherwise pre-approved proprietary brand or detailed formed metal channel and strap, bolted on around pipe posts and securely machine screwed and tapped at the correct levels all as indicated on Drawing [SP741-06.03](#).

Fence panels of boards and stringers prestained, as specified, shall be prefabricated to the required design, as indicated by the Contract Drawings, Special Provisions and/or Drawings [SP741-06.01 through SP741-06.03](#), and shall be accurately



fitted and securely nailed to fixing members on steel posts to form uniformly level and/or stepped fencing.

**741.37.02 Noise Barrier Fences** - Posts of indicated type, size and length shall be set plumb in concrete footings in augered or dug holes to the depth and regular spacing all as shown on the Contract Drawings.

Stringers, to bear full width of post at each end of "alternating" or "zig zag" (on plan) panels, shall be securely bolted with large washers behind head and nut.

Planking shall be firmly secured to stringers with deformed shank nails to form close butted and battened or tightly overlapped vertical planked panels. All gaps, especially at bottom, shall not exceed 1% of the total area of the fencing. Ends of panels shall be closed over the gap between stringer and post with return plank material.

### MEASUREMENT

**741.81 Fencing** - Fencing will be measured by the LINEAL METRE. Measurements will be made parallel to the ground line of complete fencing, including any tensioning assemblies, but excluding gate openings.

**741.82 Gates and Cattleguards** - Gates and cattleguards will be measured by the unit for EACH type and size furnished and/or installed complete in place.

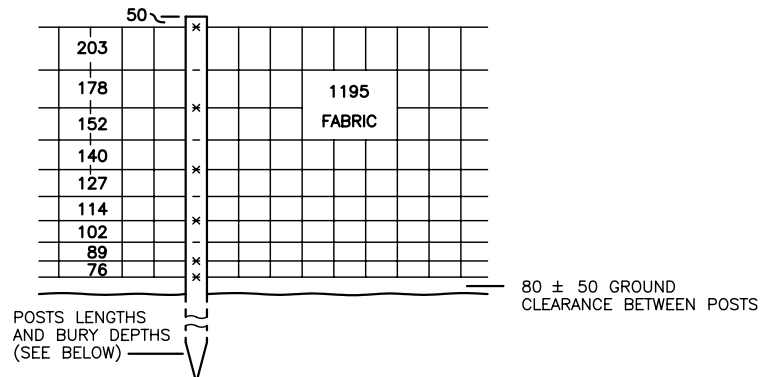
### PAYMENT

**741.91 Fencing** - Payment for FENCING will be at the Contract Unit Price per metre of complete fencing, including any tensioning assemblies, but excluding gate openings.

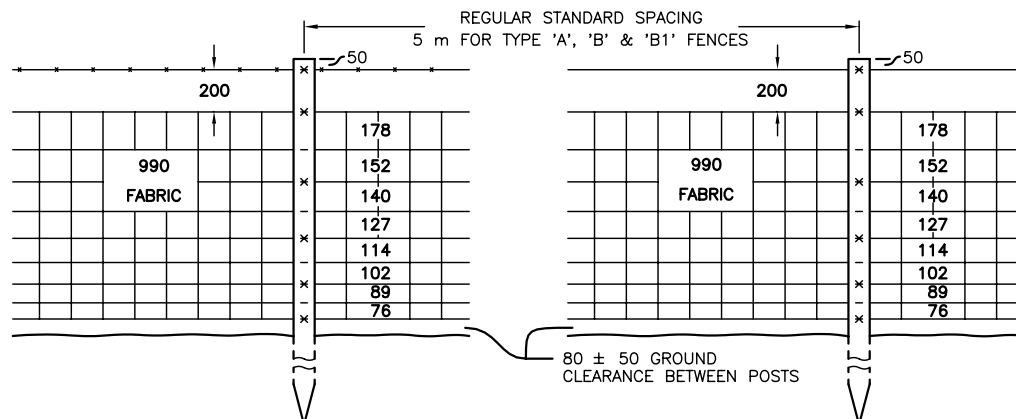
The Contract Unit Price(s) shall be accepted as full compensation for furnishing all material and/or taking delivery of Ministry supplied material; as and where noted, all labour, tools, equipment and incidentals to complete the required installation, including the clearing of any additional right of way, construction of temporary fencing, connection to existing fences and structures, and final clean up; but excluding any work as may be required to be separately paid for, such as the extra cost of extensive fencing on rock at the contract or agreed price for each hole drilled for metal posts.

**741.92 Gates and Cattleguards** - Payment for GATES and CATTLEGUARDS will be at the Contract Unit Price for each type and size furnished and/or installed complete in place.



**TYPE 'A' FENCE 10476**

(RAILWAY RIGHT OF WAY)

**\* TYPE 'B' FENCE 9396**

(HIGHWAY)

**TYPE 'B1' FENCE 9396**

(HIGHWAY - WILD-LIFE SENSITIVE AREAS)

\* USE OF TYPE 'B' FENCE REQUIRES A REVIEW BY THE CHIEF ENVIRONMENTAL OFFICER AND WRITTEN APPROVAL MUST BE RECEIVED PRIOR TO INSTALLATION.

**NOTES:**

1. FENCE CONSTRUCTION SHALL BE IN ACCORDANCE WITH SECTION 741 OR AS OTHERWISE SPECIFIED OR REQUIRED.
2. PRESSURE TREATED WOOD POST AND BRACE MATERIAL AS SPECIFIED IN SECTION 909.
3. DOUBLE STRANDED GALVANIZED BARBED WIRE AS SPECIFIED BY ASTM A 121 AND SUBSECTION 316.06 FOR TYPE 'B' FENCE.
4. SINGLE STRAND HIGH-TENSILE WIRE AS SPECIFIED IN SUBSECTION 316.07 FOR TYPE 'B1' FENCE.
5. WIRE FABRIC AS SPECIFIED BY ASTM A 116 AND SUBSECTION 316.03.
6. TYPE 'A' - HEAVY FARM-FIELD GALVANIZED WIRE FABRIC 1195 mm HIGH STYLE 10.47.6.
7. TYPE 'B' - HEAVY FARM-FIELD GALVANIZED WIRE FABRIC 990 mm HIGH STYLE 9.39.6.
8. STAPLES: 45 mm LONG OF 3.5 mm NOMINAL DIAMETER GALVANIZED WIRE TO EVERY LINE OF BARBED AND SMOOTH WIRE AND ALTERNATE LINE WIRE OF FABRIC FENCING AS INDICATED.
9. LINE POSTS: 100 mm MINIMUM DIAMETER, POINTED FOR DRIVING, SET PLUMB AND FIRM.

BURY DEPTH (mm)  
STANDARD 850  
PEAT SOIL 1050

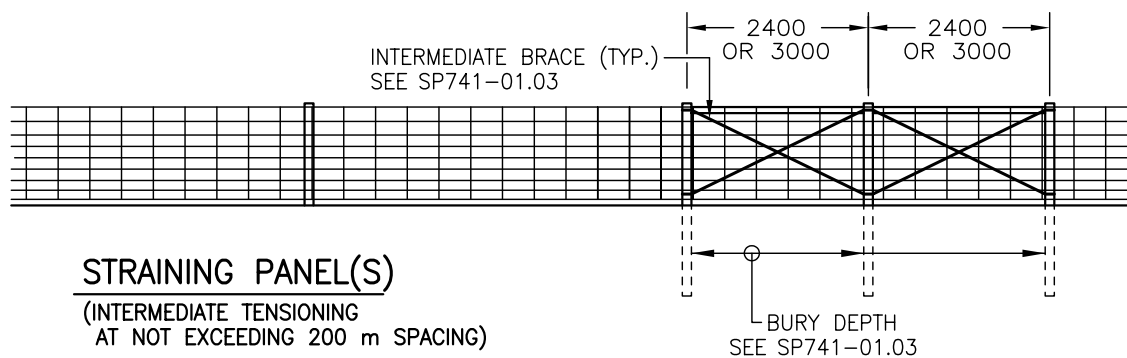
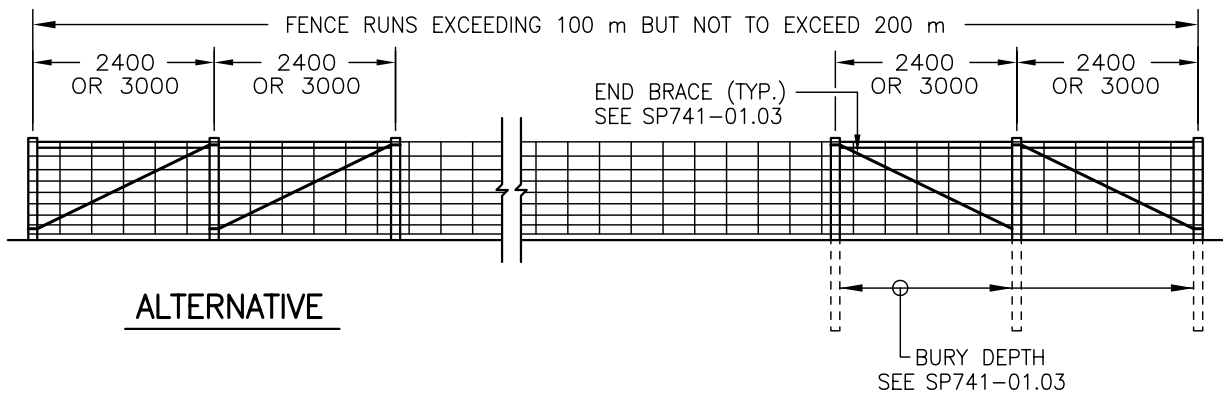
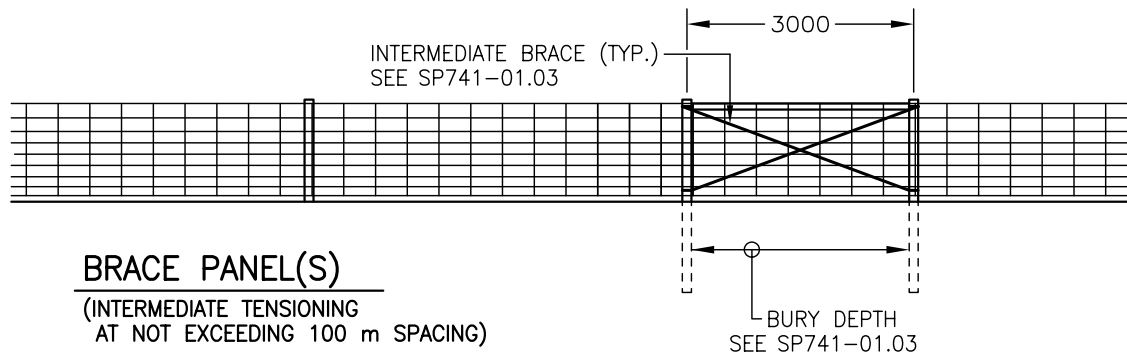
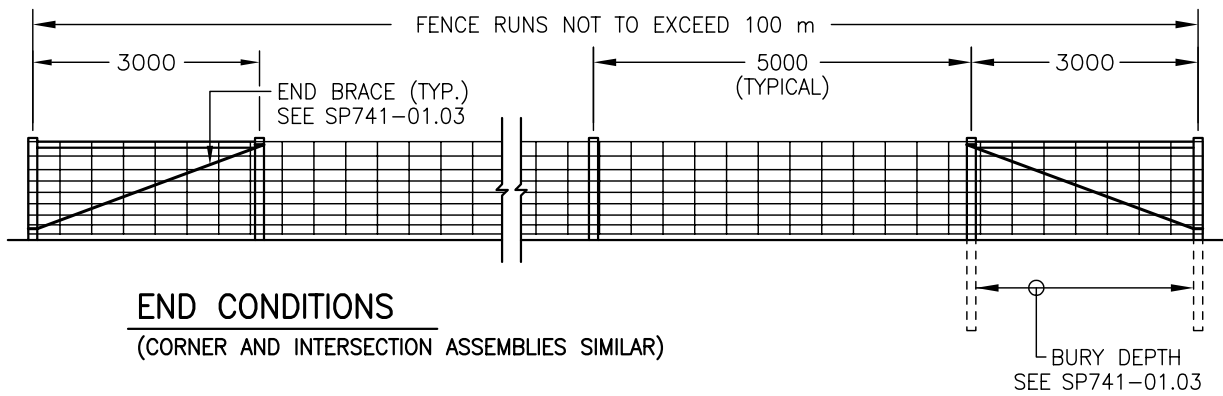
POST LENGTH (m)  
2.2  
2.4

NOTE: ROCK, SHALE AND FRIABLE ROCK CONDITIONS WARRANT METAL POSTS - SEE SP741-04.01 FOR MINOR ROCK OUTCROPPINGS AND UNFORESEEN MINIMUM OVERBURDEN OCCURENCES, WIRE TIED MULTIPLE WOOD POST/BRACE ASSEMBLIES MAY BE PERMITTED BY THE MINISTRY REPRESENTATIVE.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

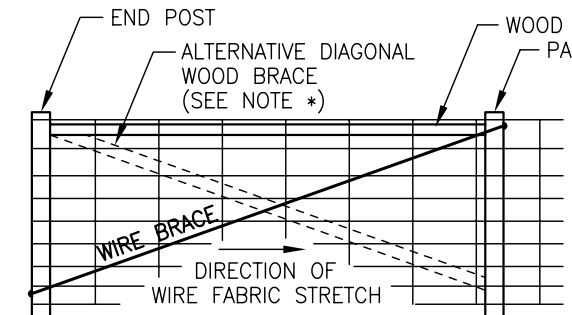




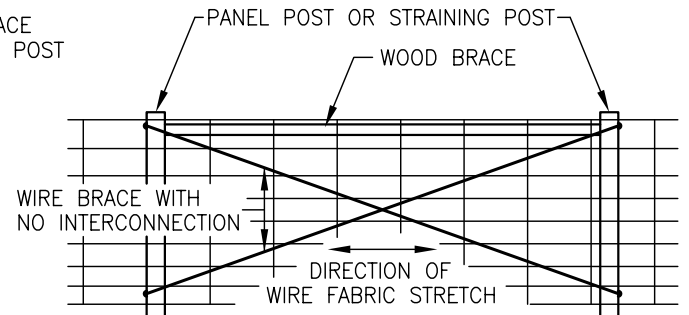
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

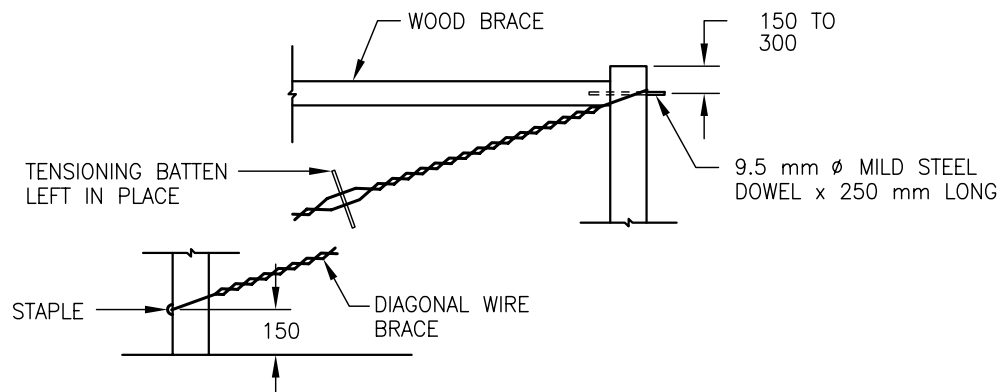


**END BRACE**

(BASIC END TENSIONING PANEL)

**INTERMEDIATE BRACE**

(BASIC INTERMEDIATE TENSIONING PANEL)

**WOOD AND WIRE BRACE DETAIL**GENERAL NOTES:

WIRE FABRIC ROLL LENGTH 100 m.

STRAINING PANELS AND/OR BRACE PANELS ARE REQUIRED FOR TENSIONING FABRIC AND AT SIGNIFICANT CHANGES IN FENCE ALIGNMENT.

POST SIZES: ALL POSTS - 120 mm (MIN.) DIAMETER EXCEPT:  
 LINE POSTS - 100 mm (MIN.) DIAMETER  
 CORNER POSTS - 140 mm (MIN.) DIAMETER

POST LENGTH: ALL POSTS TO BE THE SPECIFIED LINE POST LENGTH  
 (EXCEPT LINE POSTS (SEE SP741-01.01) PLUS 400mm FOR THE  
 AND GATE POSTS) STABILIZING INCREASED DEPTH OF BURY.

BURY DEPTH: DEPTH OF END AND PANEL POSTS NORMALLY NOT LESS THAN 1200 mm.  
 WHERE 1200 mm NOT ATTAINABLE BUT EXCEEDING 900 mm, USE  
 DOUBLE TENSIONING STRAINING PANEL ASSEMBLIES AT NOT EXCEEDING  
 200 m SPACING. GREATER MINIMUMS ARE REQUIRED FOR PEAT SOILS, ETC.

POST SPACING AND WOOD BRACES:

WOOD BRACE	SIZE	LENGTH	POST SPACING APPROXIMATE
HORIZONTAL	80 mm	2.4 m	2.5 m
HORIZONTAL	100 mm	3.0 m	3.1 m
* DIAGONAL	100 mm	3.0 m	2.9 m

\* NOTE: SOFT, MARSH AND/OR PEAT SOIL CONDITIONS MAY WARRANT DIAGONAL WOOD BRACES IN PLACE OF HORIZONTALS IN ADDITION TO THE LONGER POSTS.

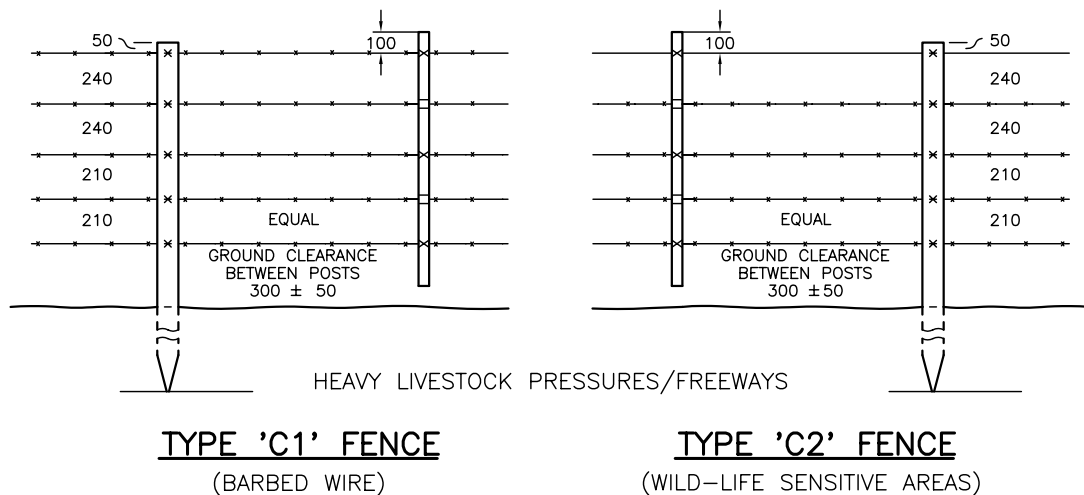
NOTE: ROCK, SHALE OR FRIABLE ROCK CONDITIONS SEE SP741-04.01 FOR METAL POSTS AND BRACES.

WIRE BRACES: 2 STRANDS OF 3.5 mm NOMINAL DIAMETER GALVANIZED WIRE WITH LOOPED ENDS AROUND DOWEL AND STAPLED TO POSTS - TWISTED TAUT ONE WAY OR BOTH WAYS AS INDICATED

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





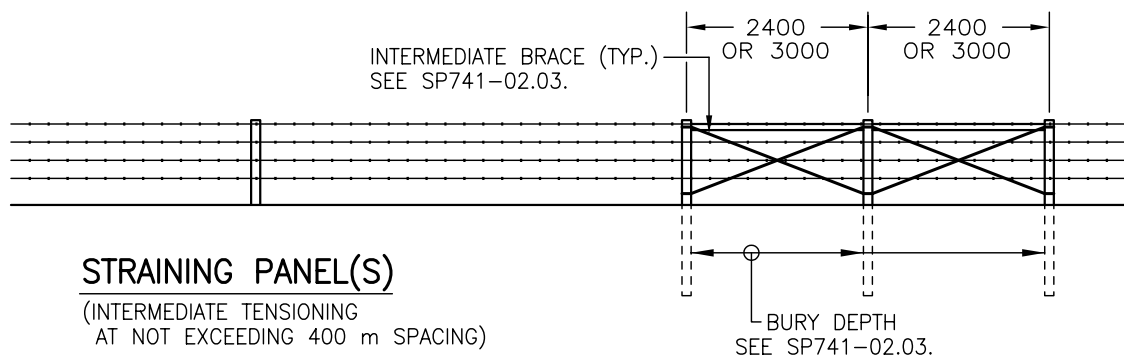
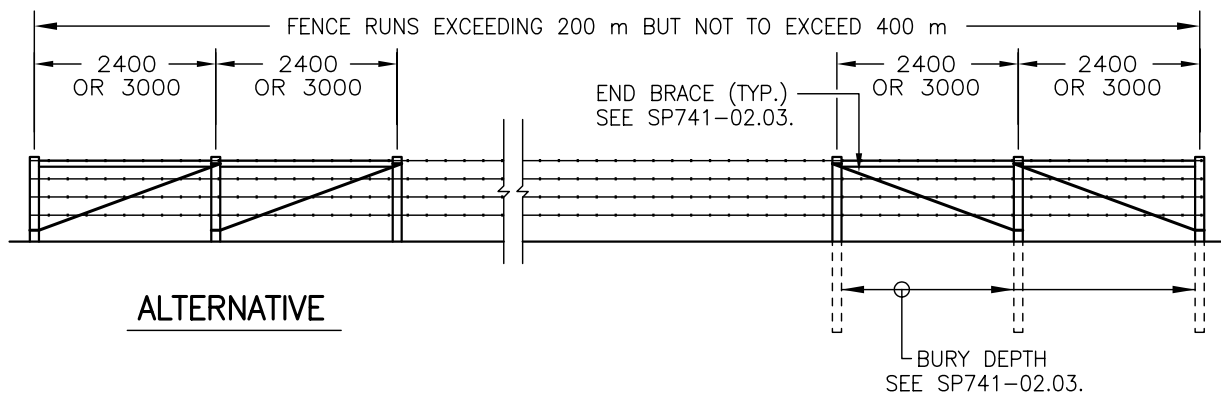
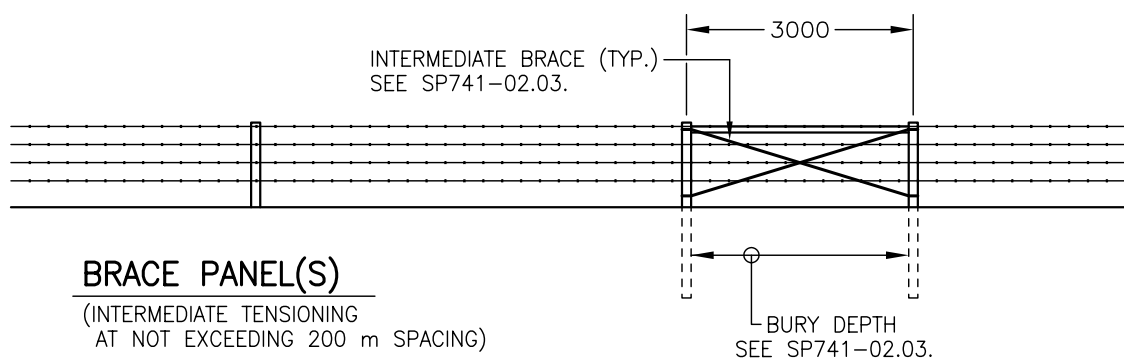
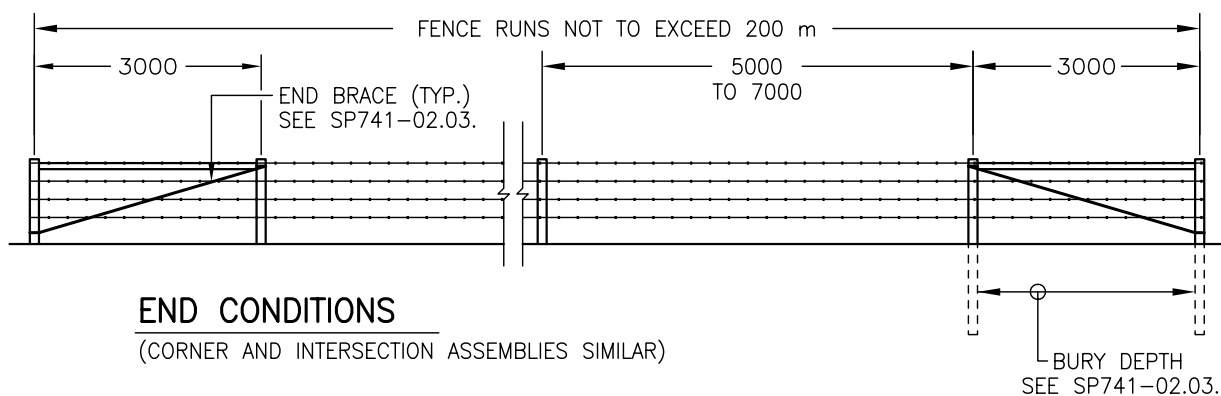
1. FENCE CONSTRUCTION SHALL BE IN ACCORDANCE WITH SECTION 741 OR AS OTHERWISE SPECIFIED OR REQUIRED.
2. PRESSURE TREATED WOOD POST AND BRACE MATERIAL AS SPECIFIED IN SECTION 909.
3. DOUBLE STRANDED GALVANIZED BARBED WIRE AS SPECIFIED BY ASTM A 121 AND SUBSECTION 316.06 FOR TYPE 'C' & 'C1' FENCE.
4. SINGLE STRAND HIGH-TENSILE WIRE AS SPECIFIED IN SUBSECTION 316.07 FOR TYPE 'C2' FENCE.
5. STAPLES: 45 mm LONG OF 3.5 mm NOMINAL DIAMETER GALVANIZED WIRE TO EVERY LINE OF BARBED AND SMOOTH WIRE.
6. DROPPERS: WOOD 50 mm DIAMETER OR OTHER ALTERNATIVE SPECIFIED BY SUBSECTION 909.08.
7. LINE POSTS: 100 mm MINIMUM DIAMETER POINTED FOR DRIVING SET PLUMB AND FIRM.

BURY DEPTH (mm)	POST LENGTH (m)	
	TYPE 'C'	TYPE 'C1 & C2'
STANDARD 850	2.0	2.1
PEAT SOIL 1050	2.2	2.3

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

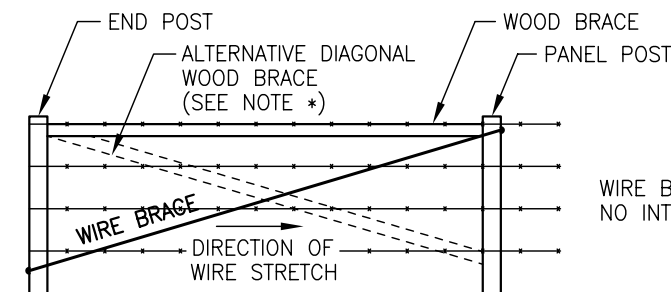




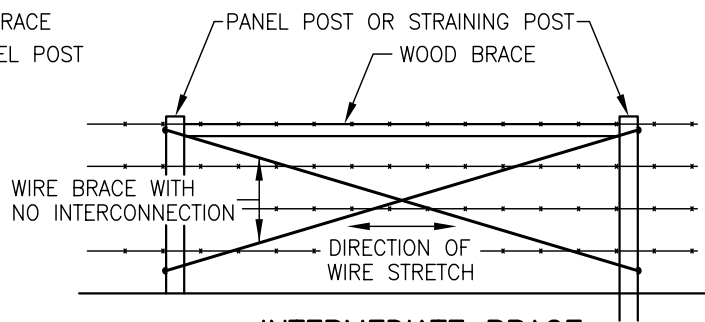
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

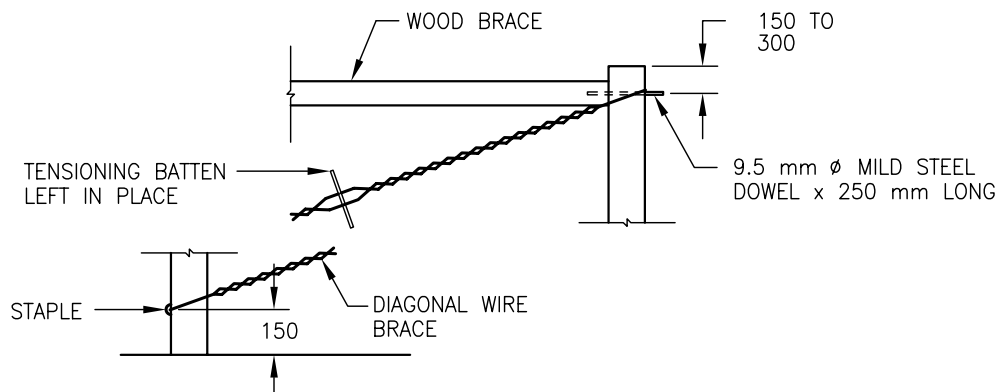


**END BRACE**

(BASIC END TENSIONING PANEL)

**INTERMEDIATE BRACE**

(BASIC INTERMEDIATE TENSIONING PANEL)

**WOOD AND WIRE BRACE DETAIL**GENERAL NOTES:

BARBED WIRE SPOOL LENGTH 400 m.

STRAINING PANELS AND/OR BRACE PANELS ARE REQUIRED FOR TENSIONING WIRE AND AT SIGNIFICANT CHANGES IN FENCE ALIGNMENT.

POST SIZES: ALL POSTS - 120 mm (MIN.) DIAMETER EXCEPT:  
 LINE POSTS - 100 mm (MIN.) DIAMETER  
 CORNER POSTS - 140 mm (MIN.) DIAMETER

POST LENGTH: ALL POSTS TO BE THE SPECIFIED LINE POST LENGTH  
 (EXCEPT LINE POSTS AND GATE POSTS) (SEE SP741-01.01) PLUS 400 mm FOR THE STABILIZING INCREASED DEPTH OF BURY.

BURY DEPTH: DEPTH OF END AND PANEL POSTS NORMALLY NOT LESS THAN 1200 mm.  
 WHERE 1200 mm NOT ATTAINABLE BUT EXCEEDING 900 mm, USE  
 DOUBLE TENSIONING STRAINING PANEL ASSEMBLIES AT NOT EXCEEDING  
 200 m SPACING. GREATER MINIMUMS ARE REQUIRED FOR PEAT SOILS, ETC.

POST SPACING AND WOOD BRACES:

WOOD BRACE	SIZE	LENGTH	POST SPACING APPROXIMATE
HORIZONTAL	80 mm	2.4 m	2.5 m
HORIZONTAL	100 mm	3.0 m	3.1 m
* DIAGONAL	100 mm	3.0 m	2.9 m

\* NOTE: SOFT, MARSH AND/OR PEAT SOIL CONDITIONS MAY WARRANT DIAGONAL WOOD BRACES IN PLACE OF HORIZONTALS IN ADDITION TO THE LONGER POSTS.

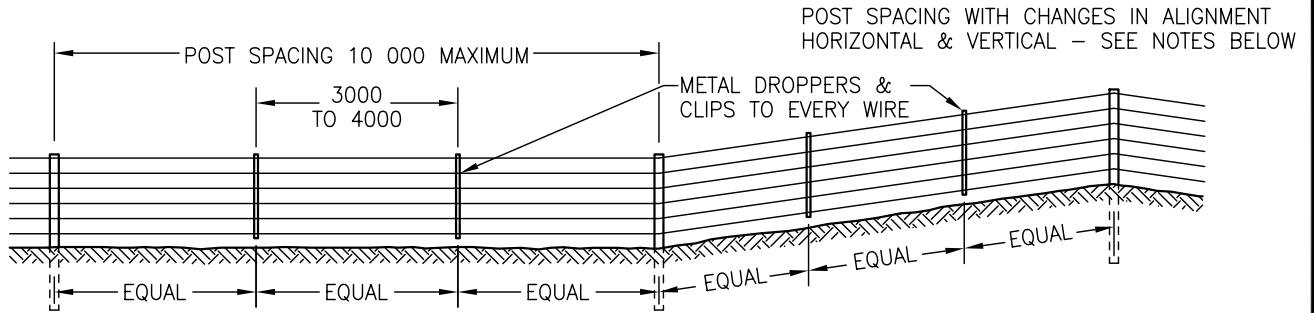
NOTE: ROCK, SHALE OR FRIABLE ROCK CONDITIONS SEE SP741-04.01 FOR METAL POSTS AND BRACES.

WIRE BRACES: 2 STRANDS OF 3.5 mm NOMINAL DIAMETER GALVANIZED WIRE WITH LOOPED ENDS AROUND DOWEL AND STAPLED TO POSTS - TWISTED TAUT ONE WAY OR BOTH WAYS AS INDICATED ABOVE.

NOT TO SCALE

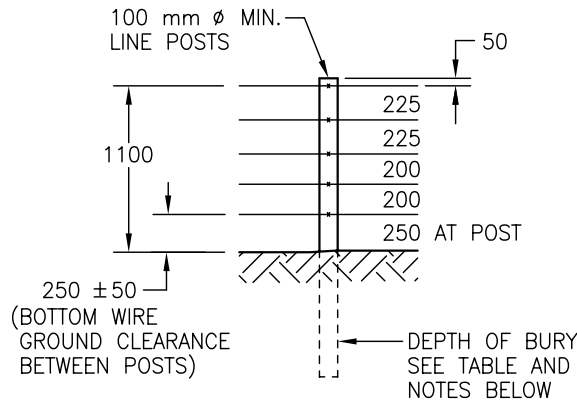
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





## HIGH-TENSILE SMOOTH-WIRE FENCING

FOR RANGE LAND AND OTHER LOCATIONS WITH FAVOURABLE TERRAIN, SOIL CONDITIONS AND FENCE ALIGNMENT.



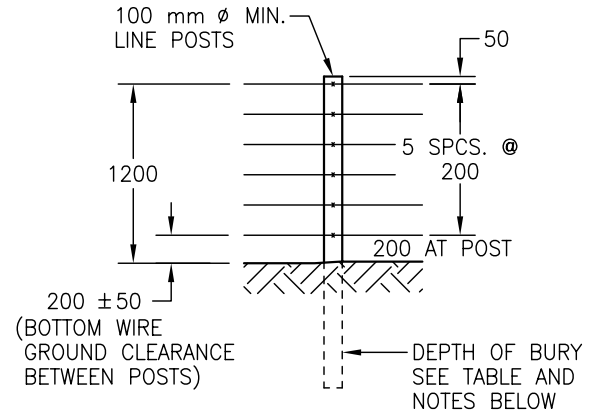
POST SPACING: 10 m MAX.  
(HIGH SNOW AREAS 7 m MAX.)

	DEPTH OF BURY	POST LENGTH
FIRM SOIL	650 mm	1.8 m
MEDIUM CLAY	850 mm	2.0 m
PEAT SOIL	1050 mm	2.2 m

## TYPE HT FENCE

RANGELAND AND WILD LIFE SENSITIVE AREAS

**NOTE:** REDUCE LINE POST SPACING FOR SUCH AS NURSERY LIVESTOCK ENCLOSURES (HT-1 FENCE) AND AT ALL MINOR HORIZONTAL AND VERTICAL ALIGNMENT CHANGES. SEE SP741-03.03 FOR "SHALLOW", "MEDIUM" CURVES AND CORNER CHANGES IN ALIGNMENT.



POST SPACING: 7 m MAX.

	DEPTH OF BURY	POST LENGTH
FIRM SOIL	750 mm	2.0 m
MEDIUM CLAY	950 mm	2.2 m
PEAT SOIL	1150 mm	2.4 m

## TYPE HT-1 FENCE

HEAVY LIVESTOCK PRESSURES/FREEWAYS (WHERE PERMITTED OR REQUIRED)

### GENERAL NOTES:

SETTING OUT AND CONSTRUCTION SHALL BE IN GENERAL ACCORDANCE WITH SECTION 741 AND MINISTRY OF AGRICULTURE AND FOOD PUBLICATION #ISBN 0-7719-9824-4 (BCMAF) PROCEDURES OR AS OTHERWISE REQUIRED.

POST AND BRACES: PRESSURE TREATED WOOD AS SPECIFIED IN SECTION 909.

WIRE: 2.5 mm NOMINAL DIAMETER HIGH-TENSILE GALVANIZED WIRE AS SPECIFIED BY SUBSECTION 316.07.

METAL DROPPERS AND CLIPS, SPLICERS AND FASTENERS & TENSIONING DEVICES. } PROPRIETARY MANUFACTURE TO SUBSECTION 316.12.

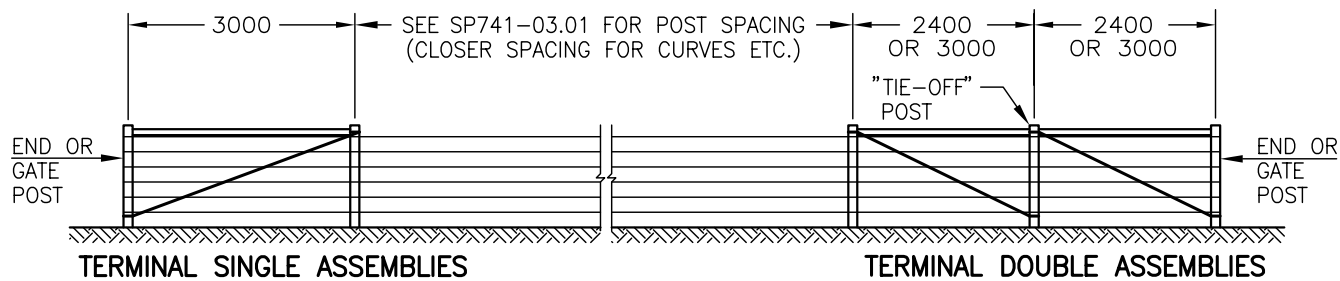
STAPLES: 45 mm LONG OF 3.5 mm NOMINAL DIAMETER GALVANIZED WIRE: DOUBLE STAPLE ON CURVES AND RISE AND DIP POSTS TO BCMAF RECOMMENDATIONS.

LINE POSTS: 100 mm MINIMUM DIAMETER SET FIRM BY DRIVING AND SET PLUMB EXCEPT FOR REQUIRED LEAN ON "MINOR" CURVES, SEE POST SIZE AND LENGTH FOR OTHER CURVES ON SP741-03.02 & SP741-03.03.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

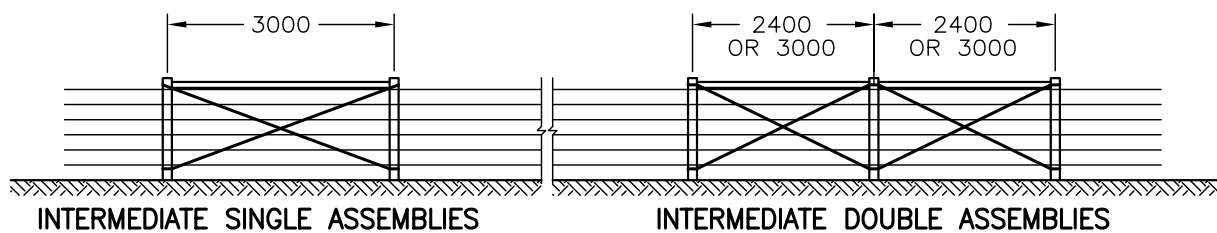




(FOR SCANT BURY DEPTH - SEE TABLE BELOW)

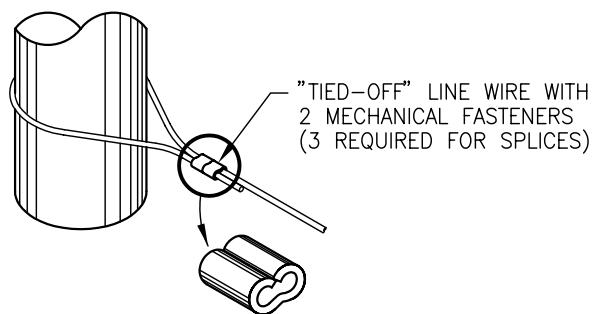
**TERMINAL (END AND GATE) TENSIONING ASSEMBLIES**

(CORNER AND INTERSECTION ASSEMBLIES SIMILAR)

**INTERMEDIATE TENSIONING ASSEMBLIES****GENERAL NOTES:**

COIL OF SMOOTH HIGH-TENSILE WIRE IN EXCESS OF 1000 m (APPROX. 100#)

POST SIZES: ALL 120 mm  $\phi$  MINIMUM EXCEPT  
 LINE POSTS 100 mm  $\phi$  MIN., CORNER POSTS 140 mm  $\phi$   
 MINIMUM AND GATE POSTS 190 mm  $\phi$  MINIMUM.  
 HORIZONTAL BRACES: 100 mm  $\phi$  MIN., 3.0 m LONG  
 (2.4 m LONG PERMITTED WITH DOUBLE ASSEMBLIES).



TERMINAL (END AND GATE) TENSIONING ASSEMBLIES SHALL BE PROVIDED TO TENSION EVERY LINE WIRE. WHERE TERMINAL SPACING IS IN EXCESS OF 1000 m \*, INTERSPERSE WITH INTERMEDIATE TENSIONING ASSEMBLIES, UTILIZING ANY REQUIRED INTERSECTION AND CORNER ASSEMBLIES AT NOT EXCEEDING 1000 m \* SPACINGS.  
 \* SEE REDUCED SPACING REQUIREMENTS BELOW: NORMALLY 400 TO 600 m BUT MINIMUM 150 m.  
 FOR CONSTRUCTION OF SINGLE AND DOUBLE ASSEMBLIES SEE SP741-01.02, SP741-01.03, SP741-02.02 & SP741-02.03 BUT USE HIGH TENSILE WIRE FOR WIRE BRACES.

DEPTH OF BURY AND POST LENGTH FOR SINGLE AND DOUBLE ASSEMBLIES.

	HT (5 WIRE) FENCE				HT-1 (6 WIRE) FENCE			
	SINGLE		DOUBLE		SINGLE		DOUBLE	
TYPICAL SOIL TYPE	BURY DEPTH (mm)	LENGTH (m)	BURY DEPTH (mm)	LENGTH (m)	BURY DEPTH (mm)	LENGTH (m)	BURY DEPTH (mm)	LENGTH (m)
FIRM SOIL	1050	2.2	850	2.0	1150	2.4	950	2.2
MEDIUM CLAY	1250	2.4	1050	2.2	1350	2.6	1150	2.4
PEAT SOIL	-	-	1250	2.4	-	-	1350	2.6

REDUCE SPACING OF TENSIONING ASSEMBLIES WHERE ABOVE BURY DEPTHS ARE NOT ADEQUATE FOR THE PARTICULAR SOIL CONDITION AND FOR CHANGES IN HORIZONTAL ALIGNMENT AT CURVES AND UNTIED-OFF CORNERS: 3 m REDUCTION FOR EVERY 1° OF DEFLECTION CHANGE

NOTE: ALL "CURVE" POSTS TO BE 120 mm  $\phi$  MIN. WITH LENGTHS AND BURY AS FOR END POSTS.

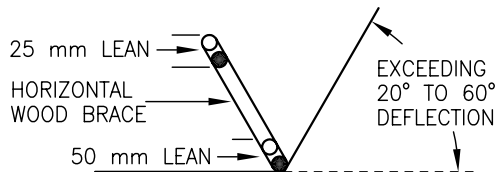
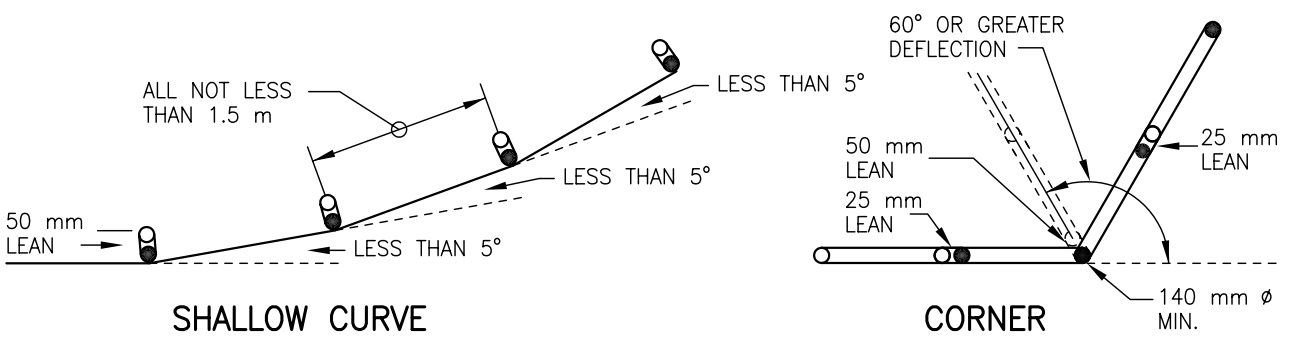
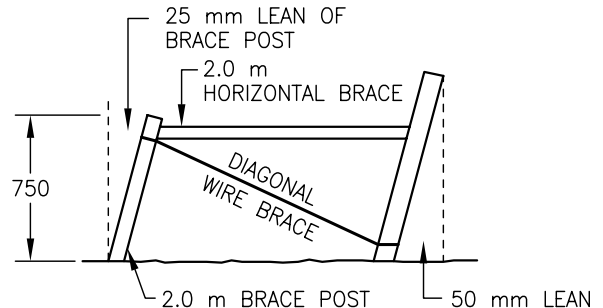
REDUCTION OF ASSEMBLY SPACING FOR UNEVEN TERRAIN CHANGE IN VERTICAL ALIGNMENT:

- 50 m PER HUMP AND DIP AND 100 m PER MAJOR HUMP AND DIP.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



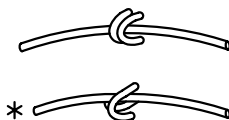
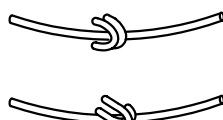
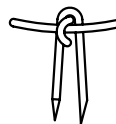
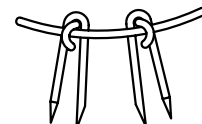
MINOR CURVEMEDIUM CURVESHALLOW CURVECORNER

NOTE: BRACES ON OUTSIDE OF CURVE WHERE NECESSARY WITH OPPOSITE LEAN AND WIRE BRACE.

TENSIONING DEVICES IN EVERY MECHANICALLY FASTENED "TIED-OFF" LINE WIRE. AT MID-SPAN OR TOWARDS END WITH THE MAJORITY OF ALIGNMENT CHANGES, BETWEEN ADJOINING ASSEMBLIES (FOR STRAIGHT AND LEVEL FENCE RUNS UNDER 200 m: DEVICES NEXT TO ONE TENSIONING ASSEMBLY).

DIP POSTS TO BE PROVIDED WITH STEEL POST(S) OR FOOTING BLOCKS TO BCMAF RECOMMENDATIONS TO RESIST POST LIFTING IN HOLLOW.

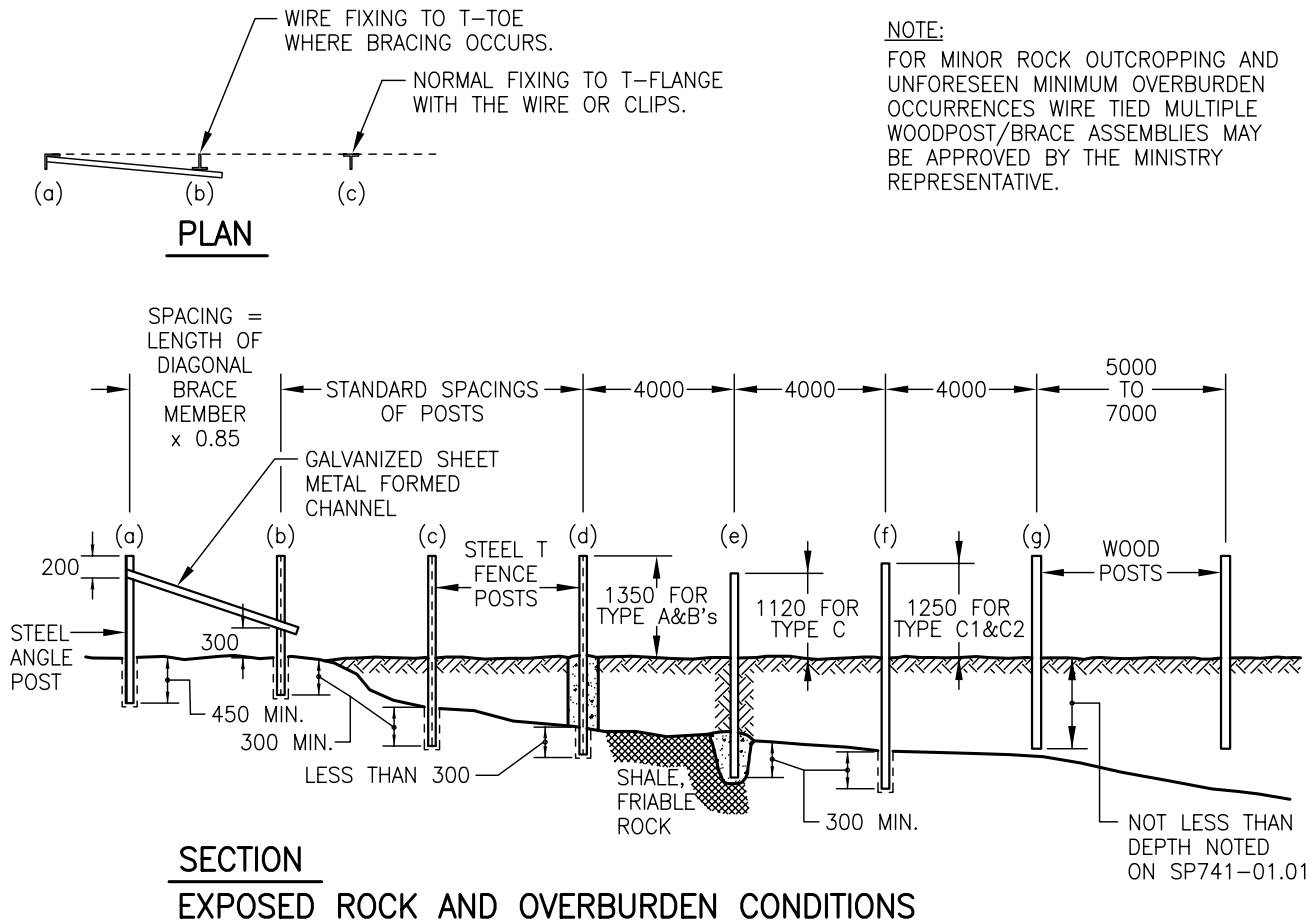
DOUBLE STAPLE ALL LINE WIRES AT CURVES, CORNERS, DIPS AND RISES AS INDICATED BELOW AND AS INDICATED \* FOR HEAVY SNOW AREAS.

RISE POSTDIP POSTSHALLOW CORNERRIGHT ANGLE

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**NOTES:**

STEEL ANGLE END POST (a) AND SIMILAR CORNER AND INTERSECTION POSTS SET IN CEMENT AND SAND NON-SHRINK MORTAR WITH STEEL BRACE(S) TO ADJOINING STEEL FENCE POST(S) (b) SECURELY AND BOLTED EACH END.

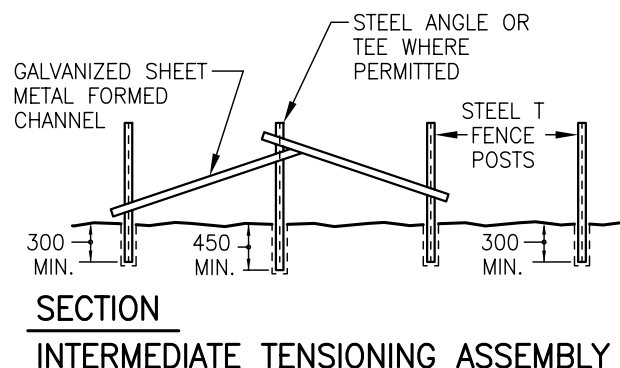
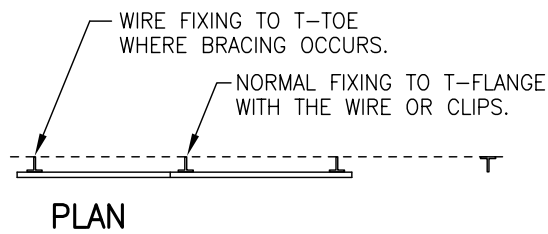
STEEL TEE FENCE POSTS SHALL BE USED ON:

- ROCK (b)
- MINIMUM OVERBURDEN (c) OR (d)
- WITH OVERBURDEN (f) LESS THAN THE NORMAL BURY
- DEPTH FOR WOOD POSTS REQUIRED ON SP741-01.01
- TO SHALE, LOOSE OR FRIABLE ROCK (e)
- ENLARGED DRILLED HOLE SET IN CEMENT MORTAR.

WHERE DEPTH OF BURY OF A STEEL POST INTO SOLID ROCK IS LESS THAN (a) & (b) ABOVE AS AT (d) CONCRETE FOOTING (4:2:1 MIX) OF ADEQUATE SIZE MAY BE APPROVED BY THE MINISTRY REPRESENTATIVE.

CURVED ALIGNMENT SPACING OF STEEL POSTS SEE SP741-04.02.

STEEL ANGLE AND TEE POSTS CHANNEL BRACES ARE SPECIFIED BY SUBSECTION 316.09 AND INSTALLATION BY SUBSECTION 741.34.



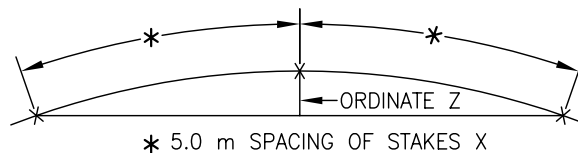
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

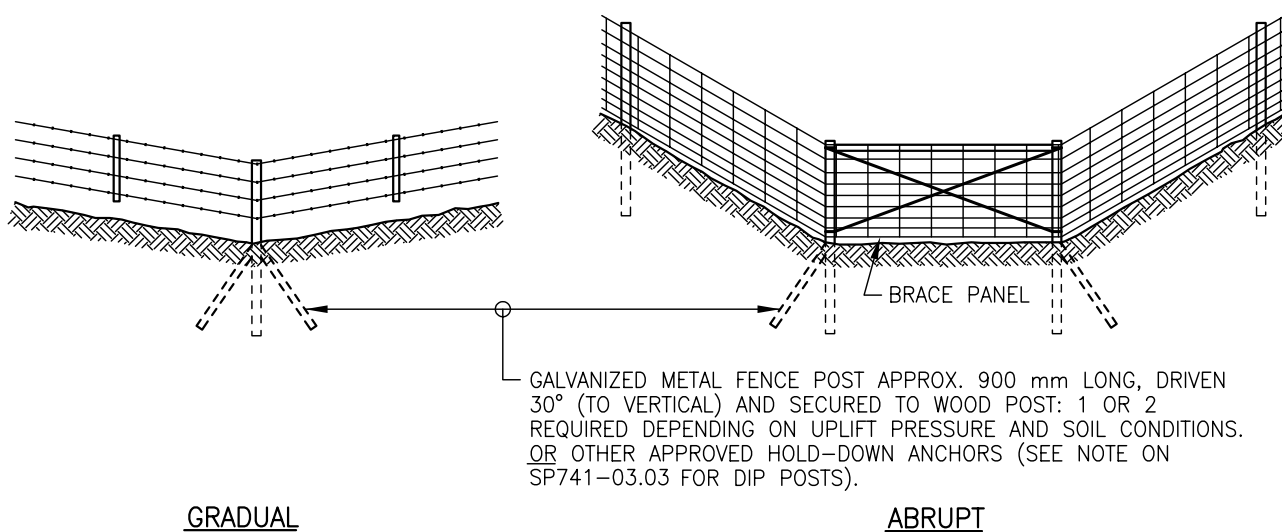


FENCE POST SPACING (m)

<u>ORDINATE Z (mm)</u>	<u>WOOD POST</u>	<u>STEEL POST</u>
LESS THAN 100	5.0	4.0
GREATER THAN 100 TO 150	4.5	3.6
GREATER THAN 150 TO 200	4.0	3.2
GREATER THAN 200 TO 350	3.2	2.6
GREATER THAN 350	2.4	2.0

CURVED HORIZONTAL ALIGNMENTS

REDUCED LINE POST SPACING

NOTES

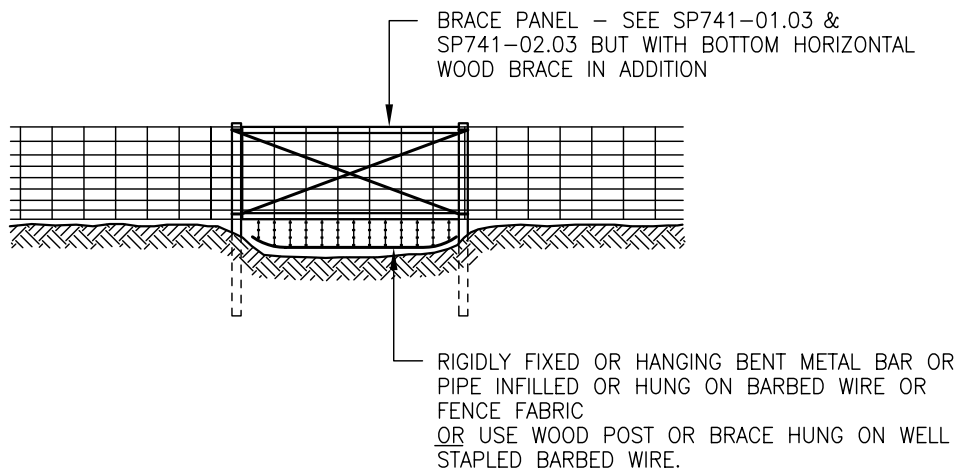
1. BRACE PANELS OR STRAINING PANELS, (SEE SP741-01.03 & SP741-02.03) ARE REQUIRED ON EITHER SIDE OF AN ABRUPT DEPRESSION TO RELIEVE FENCING TENSION AND MINIMIZE UPLIFT TENDENCY.
2. KEEP POST OR ASSEMBLY OUT OF WET CONDITIONS.

CHANGE OF VERTICAL ALIGNMENTDEPRESSION – AS SHOWNSUMMIT – SIMILAR EXCEPT NO HOLD-DOWN ANCHORS REQUIRED.

NOT TO SCALE

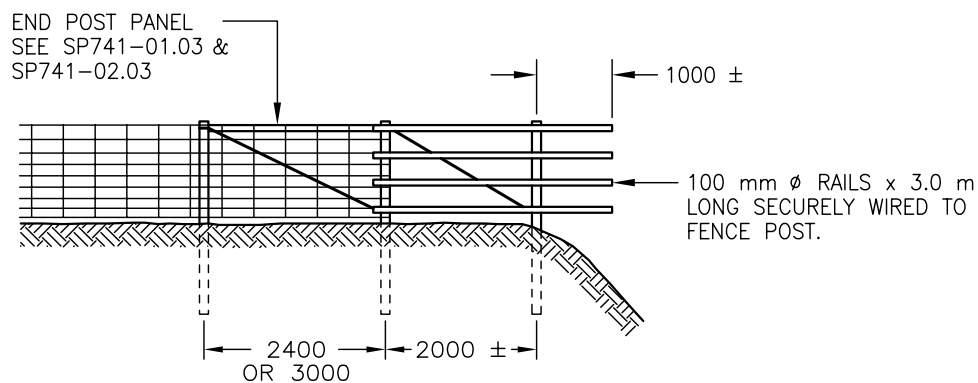
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





### CONTINUOUS FENCING

(AT DITCHES, ETC.)



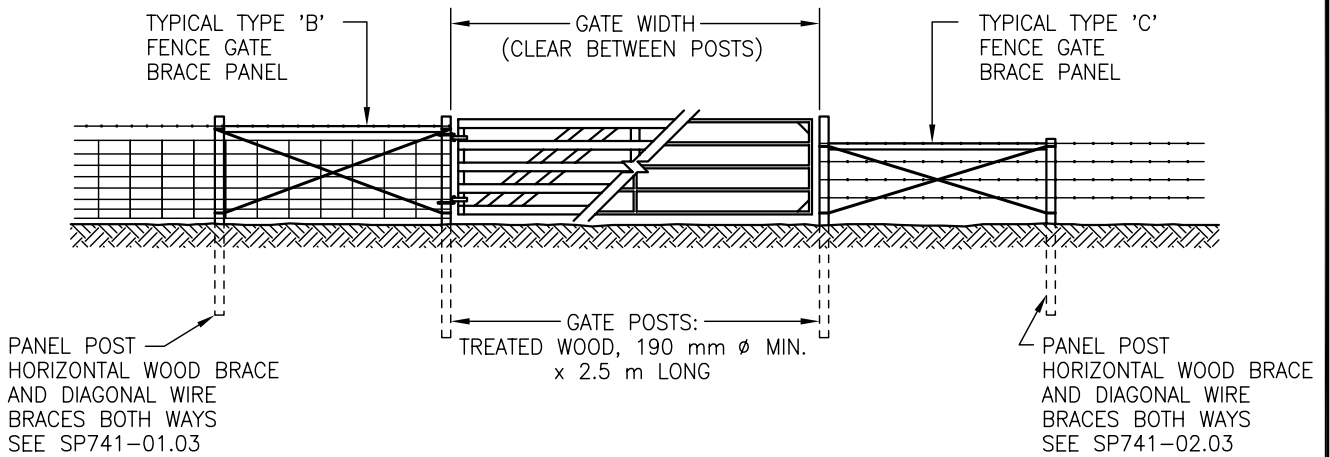
### INTERRUPTED FENCES

(AT GULLEY OR CREEK)

NOT TO SCALE

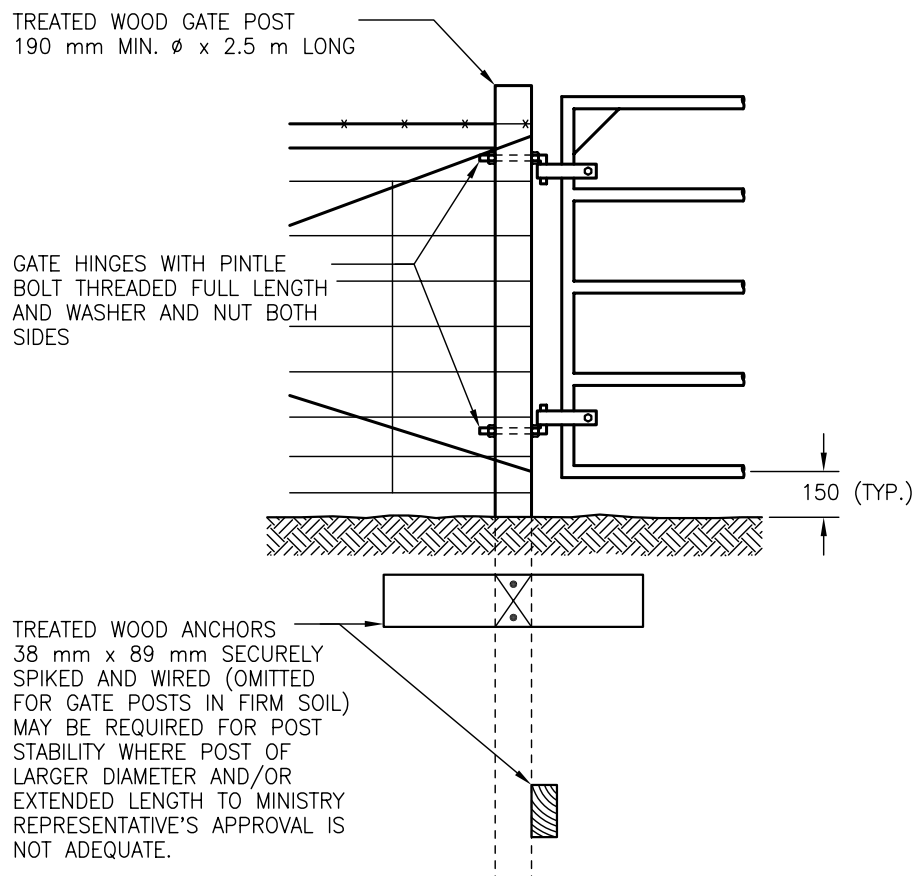
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





### GATES IN TYPE A, B, B1, C, C1 & C2 FENCES

(SEE SP741-05.03 FOR TYPE D FENCE GATE)



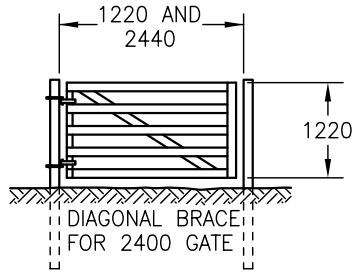
### TYPICAL HINGE DETAILS

NOTE: SEE SP741-04.05 FOR GATE TYPES AND APPLICATIONS

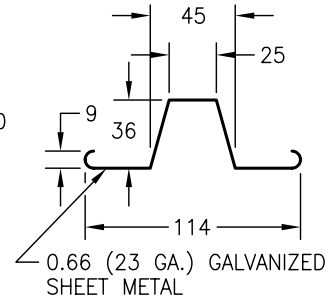
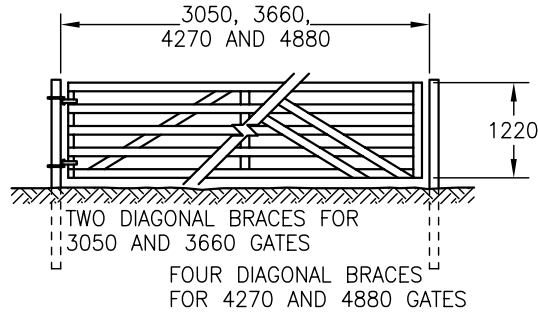
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

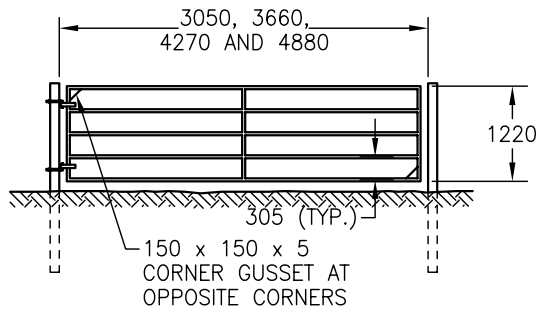




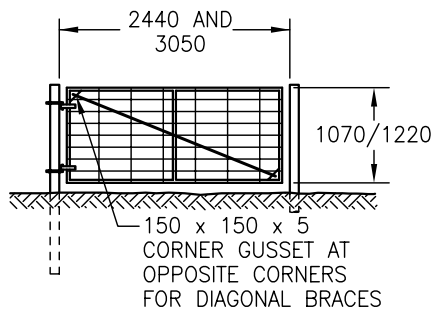
**TYPE 1 GATE**  
(SHEET METAL MEMBERS)



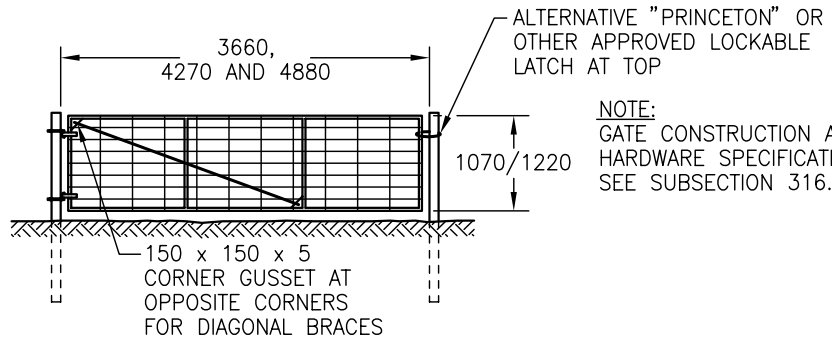
**GATE MEMBER**



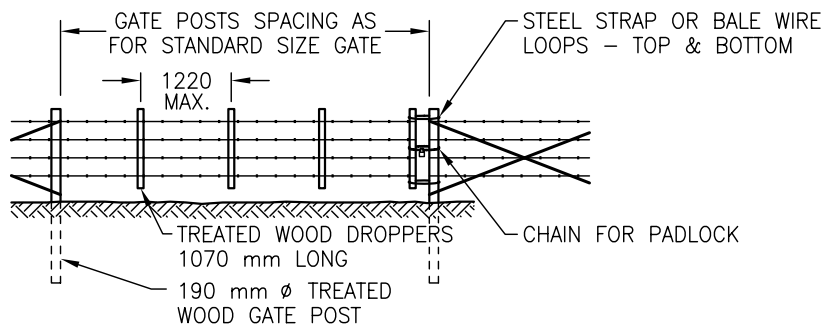
**TYPE 2 GATE**  
(ALL PIPE)



**TYPE 3 GATE**  
(PIPE AND WIRE FABRIC INFILL)



NOTE:  
GATE CONSTRUCTION AND  
HARDWARE SPECIFICATION  
SEE SUBSECTION 316.11



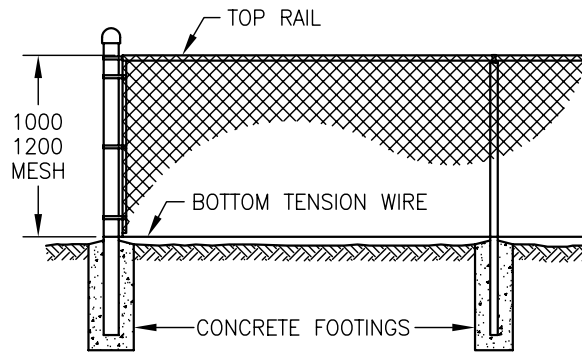
**TYPE 5 GATE**  
(RANGE SLIP-WIRE)

NOTE:  
SEE SP741-04.04 FOR GATE DETAILS

NOT TO SCALE

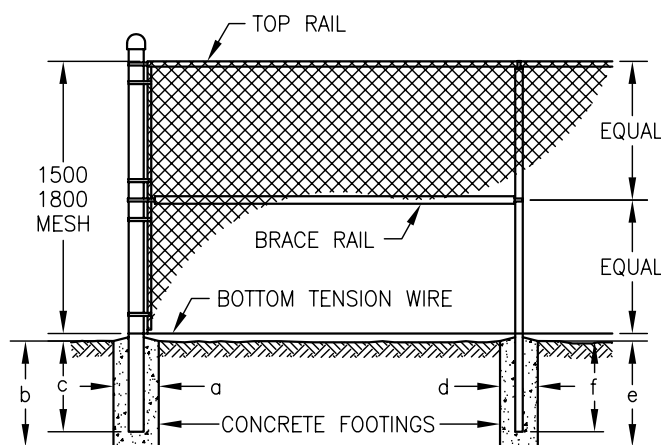
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





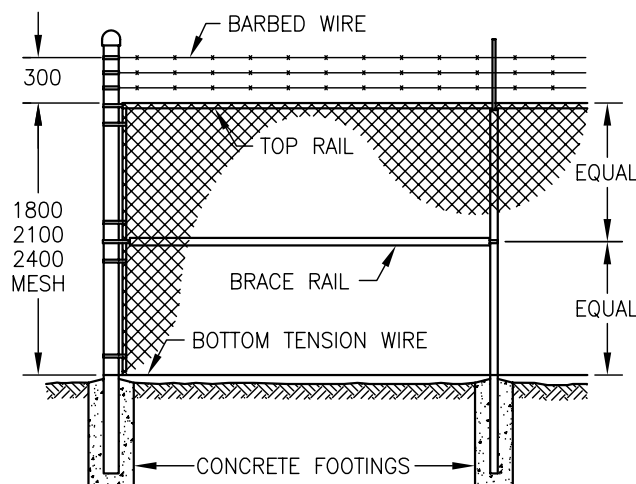
### RESIDENTIAL HEIGHT

(1.0 OR 1.2 m)



### STANDARD HEIGHT

(1.5 OR 1.8 m)



### SECURITY HEIGHT

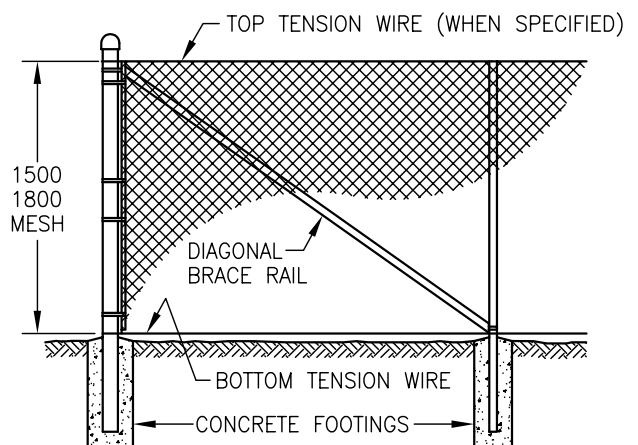
(1.8, 2.1 OR 2.4 m  
EXCLUSIVE OF BARBED WIRE HEIGHT)

### CONCRETE FOOTINGS

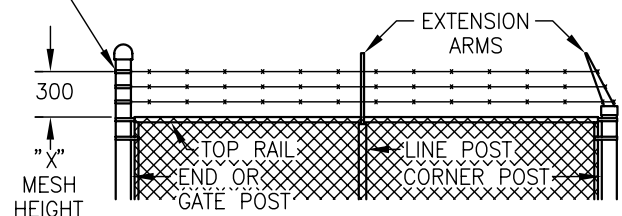
MIX: AGGREGATE, SAND AND PORTLAND CEMENT (4 : 2 : 1)  
MINIMUM STRENGTH 18 MPa

MESH HEIGHT "X" (mm)	CONCRETE FOOTINGS SIZE * (mm)			CONCRETE FOOTINGS SIZE * (mm)		
	TERMINAL POSTS			LINE POSTS		
	a	b	c	d	e	f
1000	200	750	600	200	600	450
1200	200	750	600	200	600	450
1500	300	1050	900	250	750	600
1800	300	1050	900	250	750	600
2100	350	1050	900	300	900	750
2400	350	1050	900	300	900	750

\* INCREASE FOR PEAT SOIL ETC.  
FOR ROCK AND OTHER CONDITIONS SEE  
SUBSECTION 741.36.01(iii)



### NOTE:

INTERMEDIATE TENSION ASSEMBLIES WITH TOP  
TENSION WIRE REQUIRE DIAGONAL BRACE ON  
EACH SIDE.


### SECURITY FENCE

(EXTENSION ARMS AND EXTRA HEIGHT END,  
GATE AND STRAINING POSTS FOR 3 STRANDS  
OF BARBED WIRE)

### GENERAL NOTES:

MATERIAL SPECIFICATIONS FOR PIPE, MESH AND BARBED WIRE  
SEE SECTION 316.

### MESH FABRIC SELVAGE EDGE:

- TWISTED EDGE UP FOR 1.8 m OR GREATER HEIGHT EXCEPT
- KNUCKLE EDGE UP FOR 1.8 m HEIGHTS FOR SCHOOL, PARK OR PLAYGROUNDS
- KNUCKLE SELVAGE BOTH EDGES FOR 1.5 m AND LESS.

ACCESSORY MATERIAL SEE SP741–05.02

INSTALLATION, INCLUDING STRAINING POST REQUIREMENTS

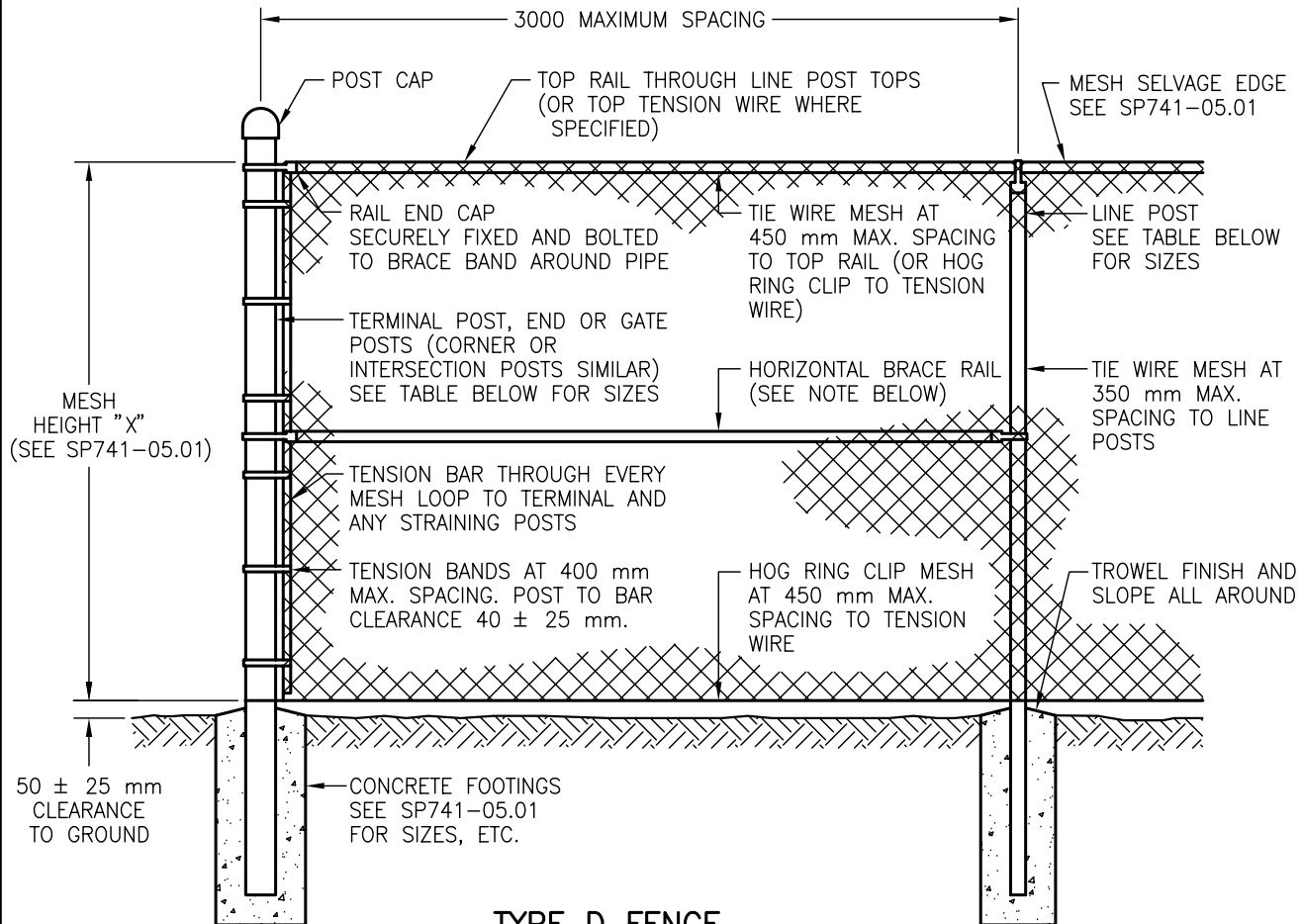
SEE SUBSECTION 741.36.

GATE DETAILS SEE SP741–05.03 &amp; SP741–05.04.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**TYPE D FENCE**

(CHAIN LINK WIRE MESH AND STEEL PIPE RAILS.  
RESIDENTIAL, STANDARD AND SECURITY HEIGHTS  
SEE SP741–05.01)

**ACCESSORY MATERIAL**

**POST AND RAIL CAPS:** OF APPROVED DESIGN OF PRESSED STEEL OR CAST OR MALLEABLE IRON AND GALVANIZED MINIMUM 600 g/m<sup>2</sup>, OR CAST ALUMINUM.

**GALVANIZING COATING:** TO STEEL WIRE, CLIPS, BARS AND BANDS, MINIMUM 360 g/m<sup>2</sup>.

**TENSION WIRE:** BOTTOM AND TOP WHEN SPECIFIED NOMINAL 5.0 mm  $\phi$  (6 ga.) MEDIUM TENSILE GALVANIZED WIRE; NOMINAL 3.5 mm  $\phi$  (9 ga.) FOR RESIDENTIAL HEIGHT FENCES.

**TIE WIRE:** NOMINAL 3.5 mm (9 ga.) ALUMINUM WIRE FOR MESH FIXING TO TOP RAIL AND LINE POSTS.

**HOG RING CLIPS:** NOMINAL 3.5 mm (9 ga.) GALVANIZED STEEL WIRE CLIPS FOR MESH FIX TO BOTTOM (OR TOP) TENSION WIRE.

**TENSION BAR:** MINIMUM 5 mm x 16 mm GALVANIZED MILD STEEL FLAT BAR.

**TENSION OR BRACE BANDS:** MINIMUM 3 mm x 16 mm GALVANIZED FORMED MILD STEEL FLATBARS WITH GALVANIZED BOLTS AND NUTS FOR ALL RAIL END CAP AND TENSION BAR FIXING.

**POST AND RAIL SIZES – O.D. MINIMUM (mm)**

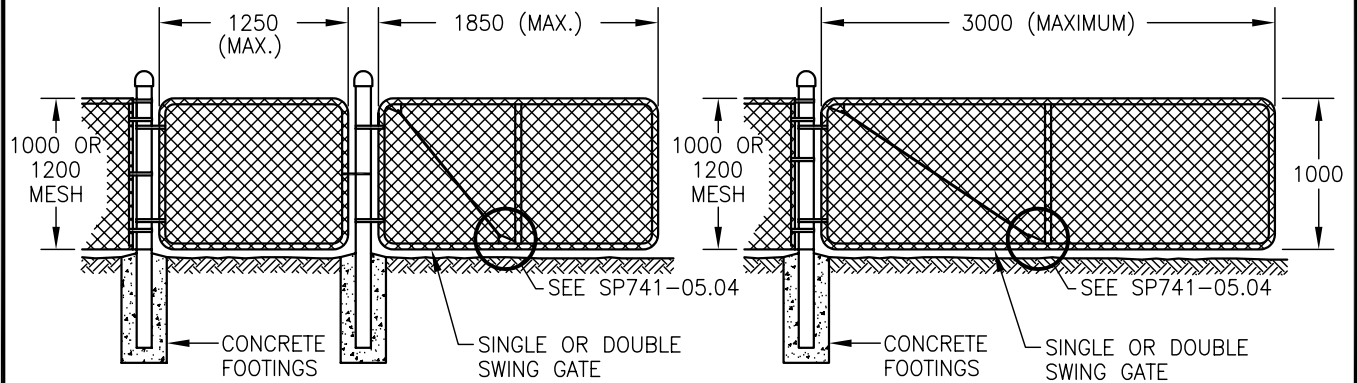
	RESIDENTIAL	STANDARD	SECURITY
LINE POSTS	38	48	60
END, CORNER & STRAINING POSTS	48	60	73
TOP RAILS	33	33	42
HORIZONTAL BRACE RAILS*	--	33	42

**\*NOTE:** DIAGONAL PIPE BRACES MAY BE SPECIFIED WHERE SOIL CONDITIONS WARRANT ESPECIALLY WHERE TOP TENSION WIRE IS CALLED FOR IN PLACE OF TOP RAIL. FOR GATE POST SIZES SEE SP741–05.04.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





GATES NOT EXCEEDING 1.85 m WIDTH OF OPENING

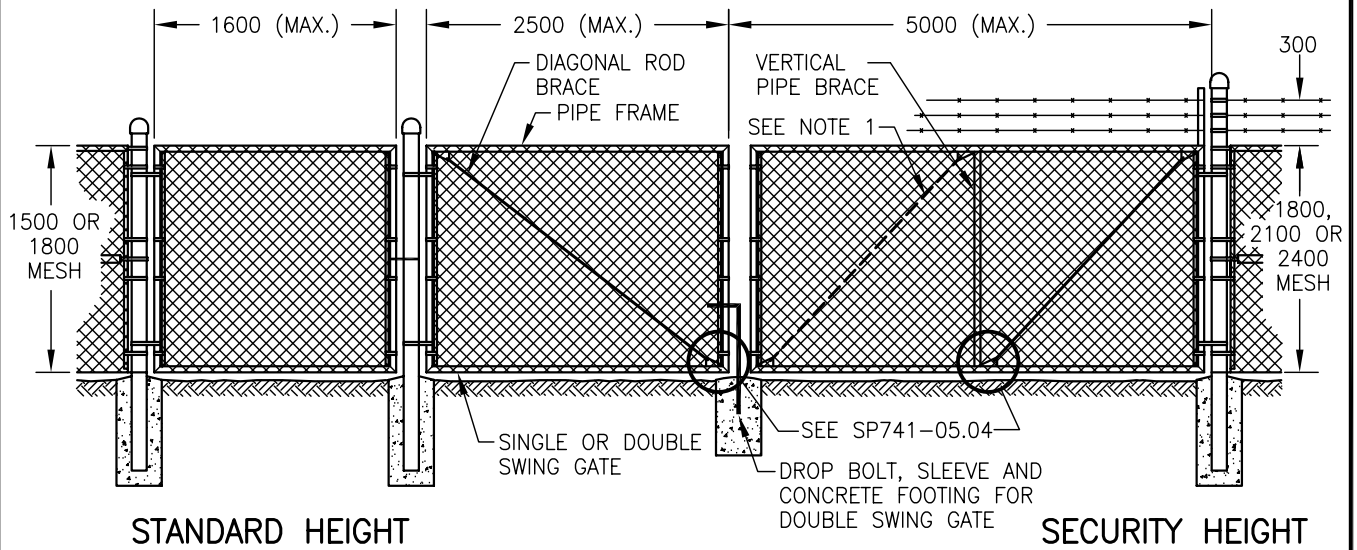
- GATE FRAME: 33 mm O.D. GALVANIZED TUBING 1.9 kg/m
- VERTICAL PIPE BRACE: 27 mm O.D. GALVANIZED TUBING 1.5 kg/m
- DIAGONAL BRACE: 5.0 mm NOMINAL DIAMETER GALVANIZED TENSION WIRE TO 5 mm CLEATS AS ON SP741–05.04.

GATES NOT EXCEEDING 3.0 m WIDTH OF OPENING

- GATE FRAME: 33 mm O.D. GALVANIZED TUBING 2.5 kg/m
- VERTICAL BRACE: 27 mm O.D. GALVANIZED PIPE 1.7 kg/m
- DIAGONAL BRACE: 9.5 mm NOMINAL DIAMETER GALVANIZED ROD WITH HOOKED ENDS TO 5 mm CLEATS AS ON SP741–05.04

**RESIDENTIAL HEIGHT GATES**

(TYPE IV – SEE SUBSECTION 316.11.05)



- GATE FRAME: 42 mm OD GALVANIZED PIPE 3.4 kg/m.
- VERTICAL PIPE BRACE: 33 mm OD GALVANIZED PIPE 2.5 kg/m
- DIAGONAL BRACE: 9.5 mm DIAMETER GALVANIZED ROD TO 5 mm CLEATS AS SHOWN ON SP741–05.04.

NOTE 1: SECOND DIAGONAL ROD BRACE REQUIRED FOR ALL GATES OVER 3.0 m TO 5.0 m WIDTH OF OPENINGS: REVERSE SLOPE OF SECOND ROD FOR ALL SLIDING GATES.

**STANDARD AND SECURITY HEIGHT GATES**

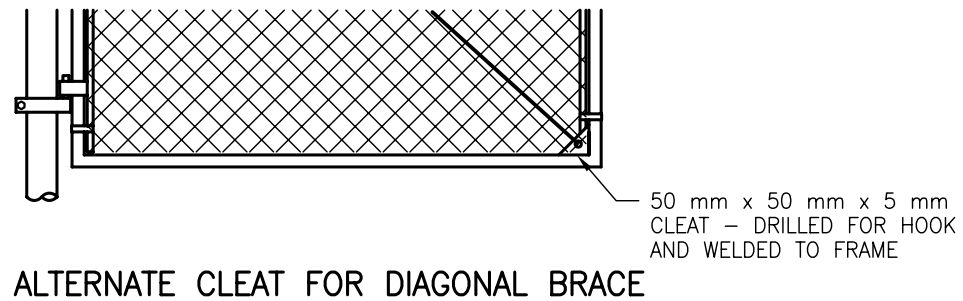
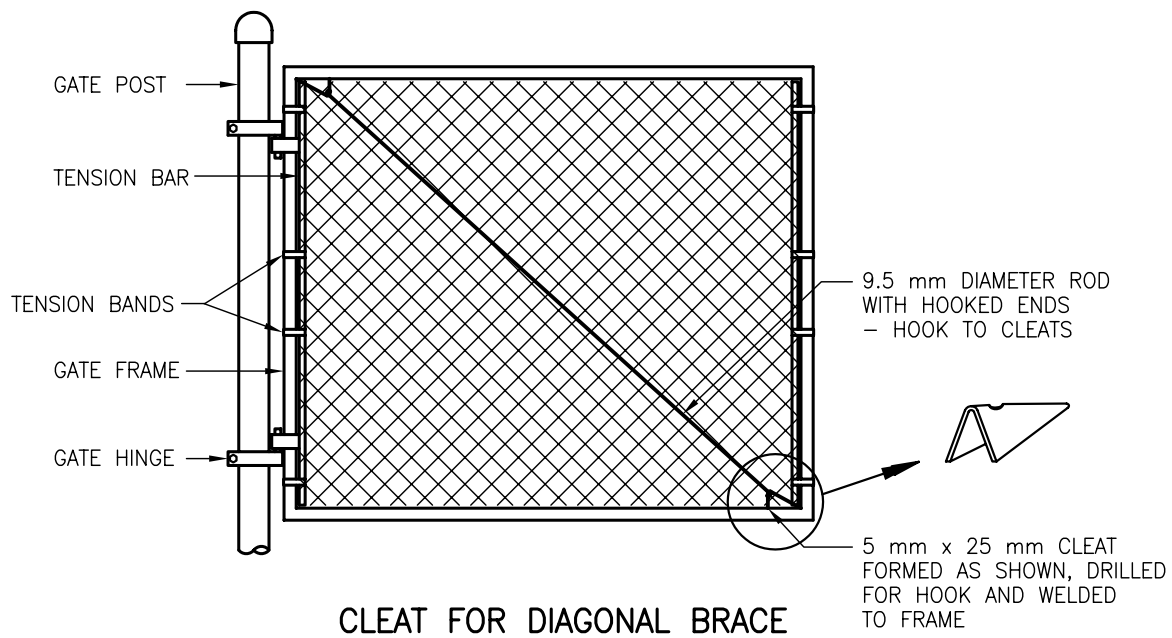
(TYPE IV – SEE SUBSECTION 316.11.05)

NOTE:  
FOR FENCE GATE DETAILS SEE SP741–05.04.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





GATE POST SIZES – NOMINAL OUTSIDE DIAMETER

RESIDENTIAL		48 mm
STANDARD HEIGHT FENCE GATE	NOT EXCEEDING 2.5 m	60 mm
	EXCEEDING 2.5 m	73 mm
SECURITY HEIGHT FENCE GATE	NOT EXCEEDING 2.5 m	73 mm
	EXCEEDING 2.5 m	89 mm

CONCRETE FOOTING SIZES – UP TO 2.5 m WIDE GATES SEE SP741–05.01.  
 – OVER 2.5 m WIDTH, FOOTINGS 400 mm Ø, 1250 mm DEEP

SECURITY HEIGHT FENCE GATES TYPE 4

SIMILAR TO STANDARD HEIGHT BUT WITH EXTENDED VERTICAL STILES (AND BRACE) FOR BARBED WIRE OVER.

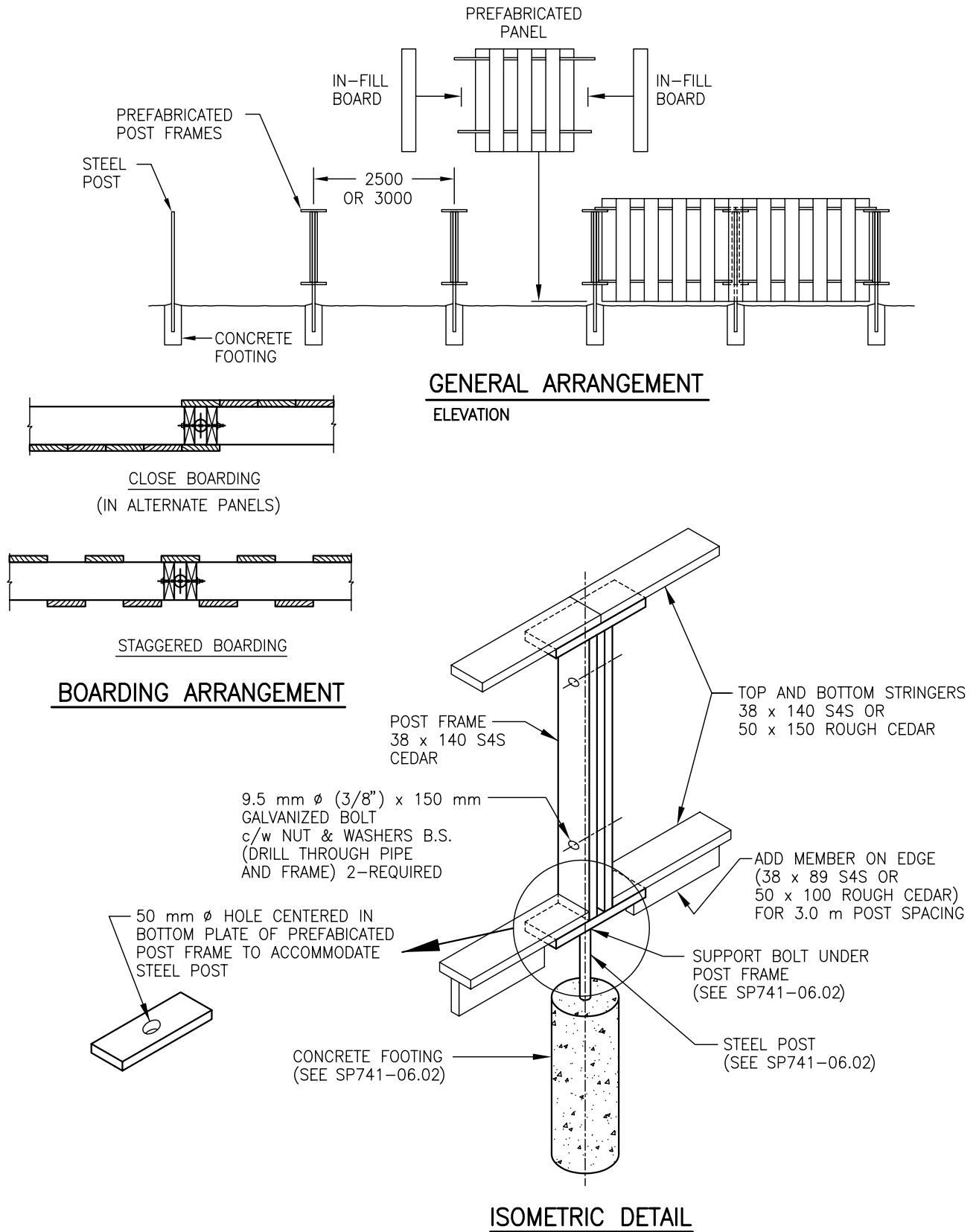
GENERAL NOTES

- MATERIAL SPECIFICATIONS FOR PIPE, MESH AND BARBED WIRE, SEE SECTION 316.
- CAPS AND ACCESSORY MATERIAL, SEE SP741–05.02.
- HARDWARE, SEE SUBSECTION 316.11.05.
- SLIDING GATE MAY BE DETAILED FOR GATE OPENINGS OVER 4.0 m WITH ROLLING HARDWARE AS REFERRED TO IN SUBSECTION 316.11.05.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

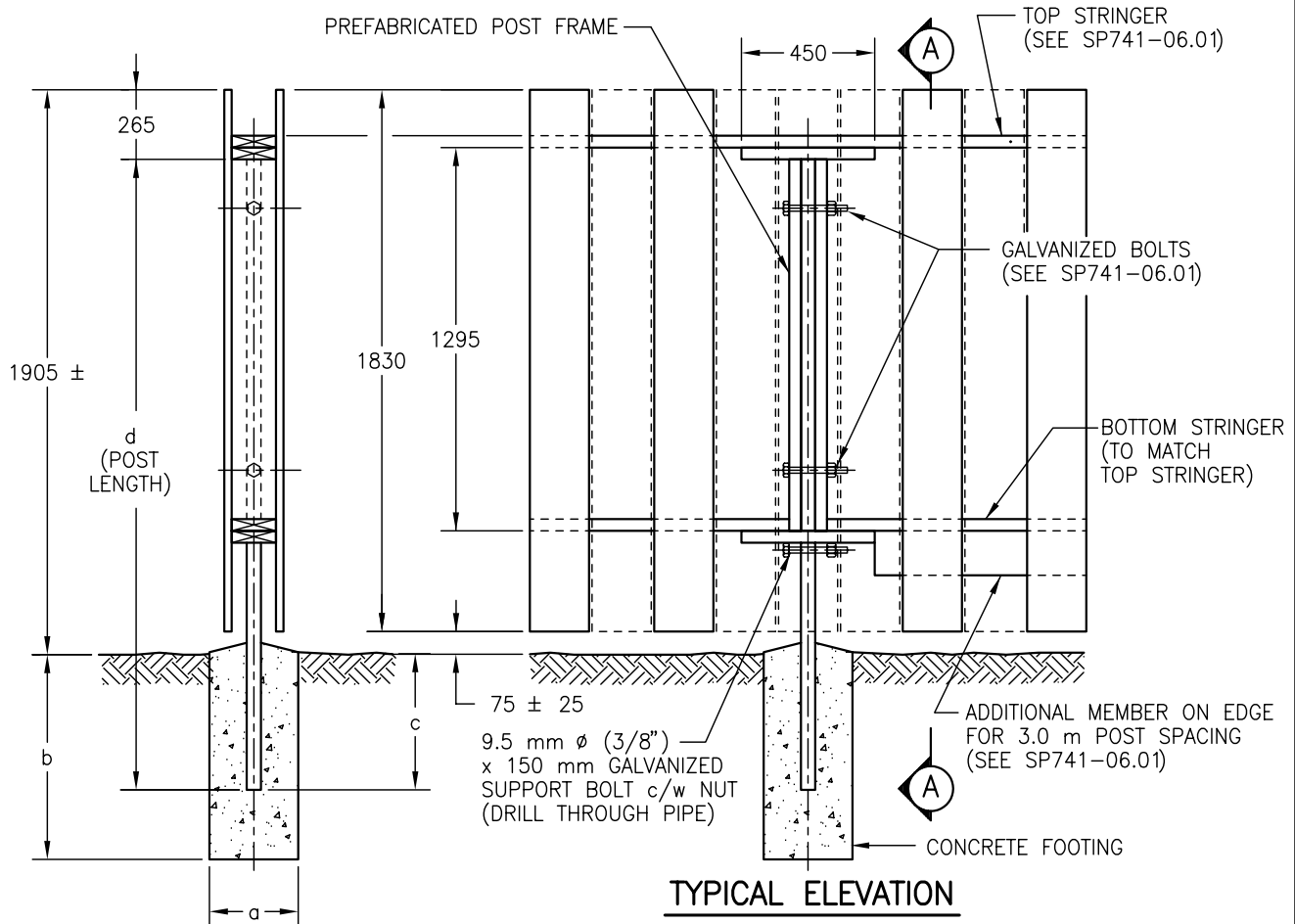




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





SECTION A

### CONCRETE FOOTING AND POST

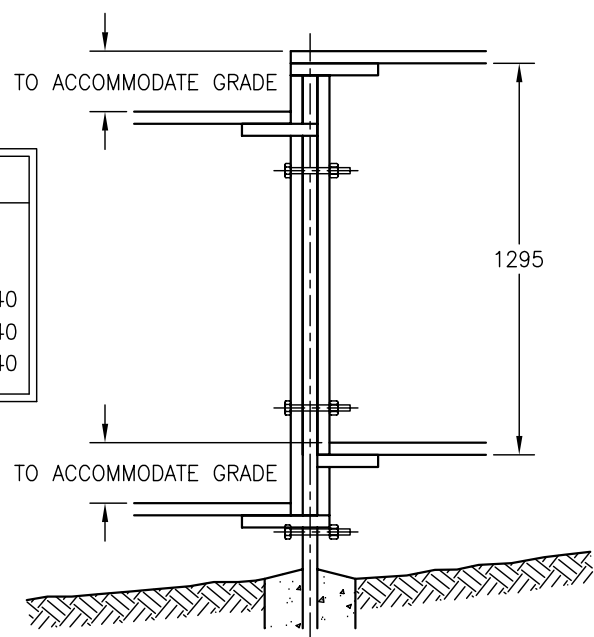
POST SPACING	2.5 m				3.0 m			
	a	b	c	d	a	b	c	d
FIRM SOIL	200	750	500	2140	250	750	500	2140
STANDARD	250	750	500	2140	300	750	500	2140
PEAT SOIL	300	750	500	2140	300	1000	800	2440

#### CONCRETE FOOTINGS:

MIX: AGGREGATE, SAND AND PORTLAND CEMENT (4:2:1)  
MINIMUM COMPRESSIVE STRENGTH 18 MPa.

#### STEEL POSTS:

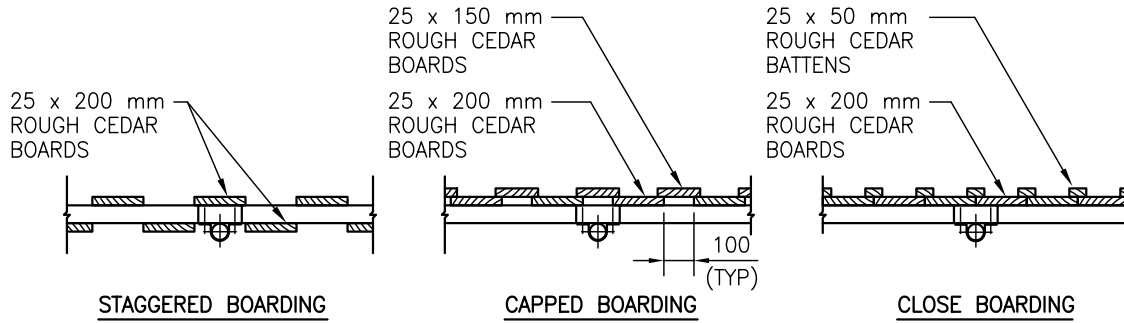
POSTS TO BE 48 mm O.D. GALVANIZED STANDARD WEIGHT TUBING.



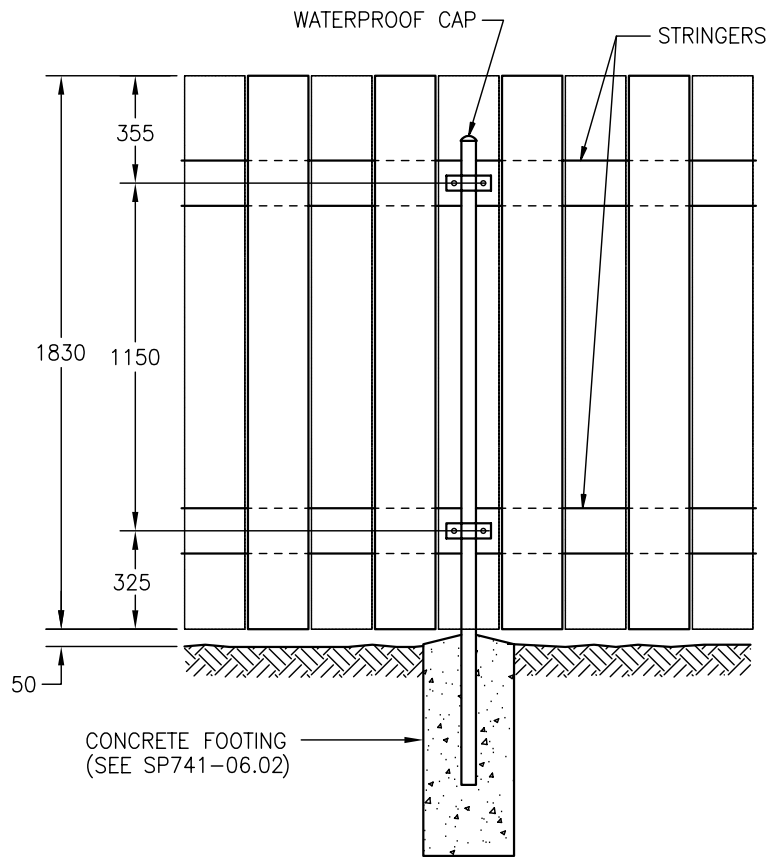
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

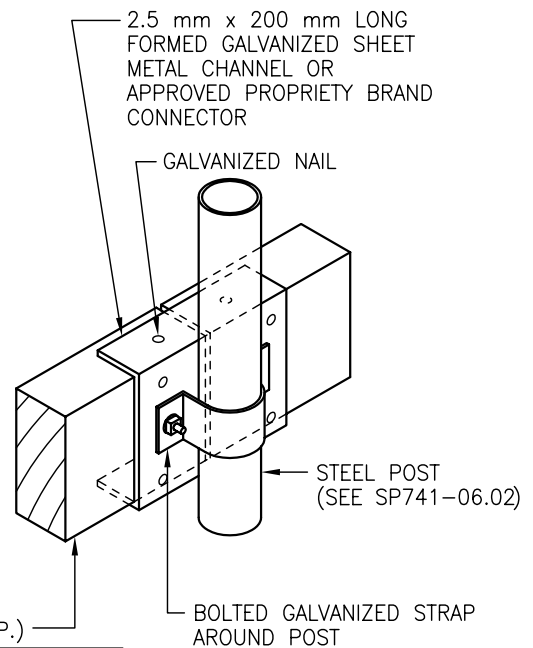




BOARDING ARRANGEMENT



TYPICAL ELEVATION



STRINGERS: (TYP.)

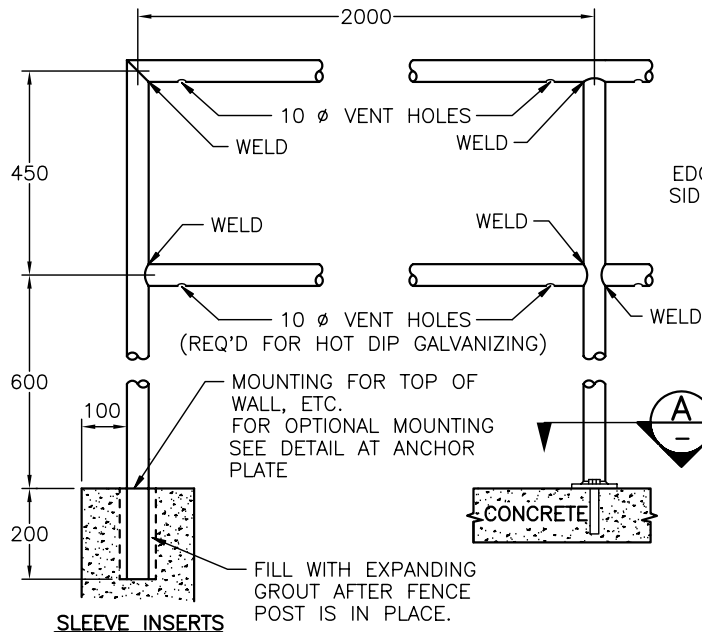
50 x 100 ROUGH CEDAR FOR 2.5 m POST SPACING
50 x 150 ROUGH CEDAR FOR 3.0 m POST SPACING

ISOMETRIC DETAIL

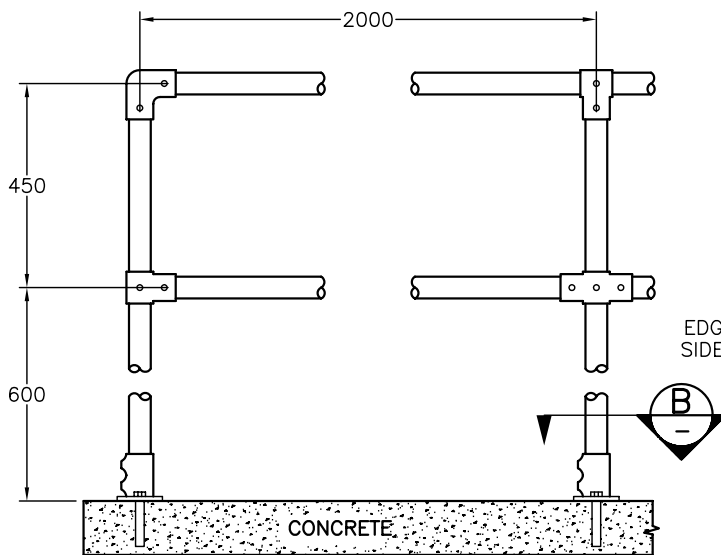
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





**WELDED FENCE**



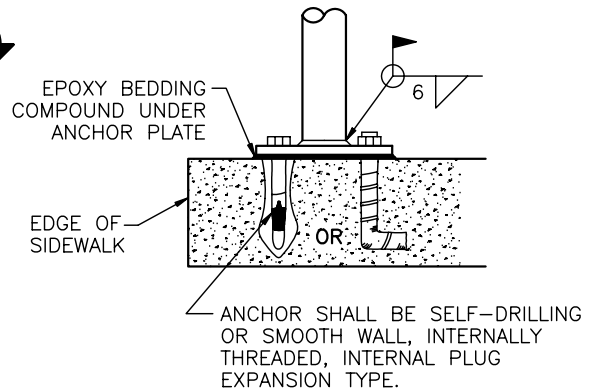
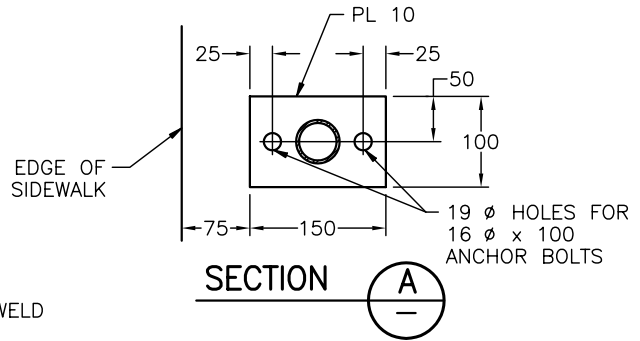
**SLIP-ON FENCE**

**NOTES:**

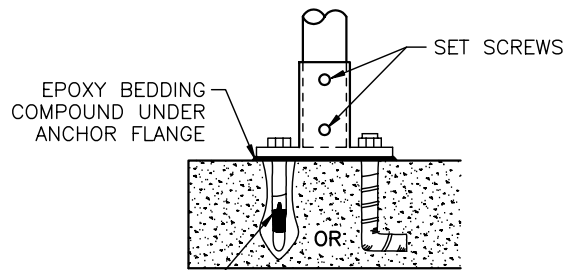
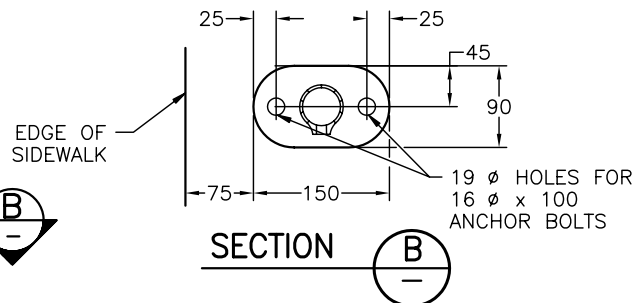
1. ALL POSTS AND RAILS TO BE 48 mm O.D. TO ASTM A 53 'STANDARD' WEIGHT (SCHEDULE 40) GALVANIZED PIPE.
2. WELDS SHALL BE FULL BEAD.
3. FIELD WELDS SHALL HAVE ROUGH EDGES GROUND SMOOTH IMMEDIATELY FOLLOWED BY TWO APPLICATIONS OF A ZINC RICH COATING CONFORMING TO CGSB 1-GP-181 M.
4. PIPE FITTINGS SHALL BE GALVANIZED MALLEABLE IRON WITH CASE HARDENED SET SCREWS CONFORMING TO ASTM A 47 GRADE 32510 AND ASTM A 153.
5. WELDED FENCE TO BE GALVANIZED AFTER FABRICATION.
6. GALVANIZING SHALL BE IN ACCORDANCE WITH CSA SPECIFICATION G164 TABLE 1.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**DETAIL AT ANCHOR PLATE**



**DETAIL AT ANCHOR FLANGE**



## SECTION 751

### TOPSOIL AND LANDSCAPE GRADING

#### DESCRIPTION

**751.01 Scope** - This Section refers to those portions of work that are unique to the supply and placement of topsoil and subsequent finish grading. In this Section, the term "topsoil" is used to identify either:

- a) On-site topsoil: material stockpiled for use, or
- b) Imported topsoil, or
- c) Manufactured topsoil (Growing Medium).

**751.02 Related Work** - Section 754, Planting of Trees, Shrubs and Ground Covers; Section 757, Revegetation Seeding.

**751.03 References** - Canadian System of Soil Classification, Canada Fertilizer Act, Canadian National Master Specification.

**751.04 Topsoil Supplied by the Contractor** - The Contractor shall advise the Ministry Representative of the sources of topsoil not less than seven days before any is used in the work.

The Contractor shall, at the Contractor's expense, acquire a soil analysis from an accredited soil testing laboratory, to verify that supplied material is within the requirements indicated. Results of the soil test are to be submitted to the Ministry Representative prior to installation.

The Ministry Representative will approve all topsoil once it has met the standard required at the source.

#### MATERIALS

**751.11 General** - In this Section, a range of measurable physical and chemical properties are set out as being acceptable in a topsoil. Compliance with this Section shall be determined by testing for those properties. When imported or on-site topsoil is used, it shall be tested and modified as necessary by a mixture of other components to bring its properties to within the range set in Subsection 751.16, or as stated in the Special Provisions. Topsoil shall not be prepared or handled in an excessively wet or frozen condition, or in any manner in which structure is adversely affected.

**751.12 Topsoil Types** - Three topsoil types are described in Subsections 751.13 through 751.15. Regardless of origin, all types shall conform to Subsection 751.16.

**751.13 On-Site Topsoil** - On-site topsoil may be used, as specified in the Special Provisions, provided that it meets the standard set for imported topsoil and can be modified to meet the requirements set out for the specified topsoil. On-site topsoil shall be defined as the existing "A" horizon containing accumulated organic matter. On-site topsoil shall be tested prior to stockpiling. Upon approval by the Ministry Representative of the suitability of the on-site topsoil for topsoil, a sufficient quantity of stripped on-site topsoil shall be stockpiled where shown on the Plans or in areas designated for stockpiling.

**751.14 Imported Topsoil** - Imported topsoil shall be of a sandy loam or loamy sand texture (no less than 50% sand by weight) containing between 4% and 15% organic matter (dry weight basis).

Imported topsoil shall be free of propagules of plant species designated as noxious weeds under the BC Weed Control Act and Regulation and other perennial, weedy plants such as couch-grass, horsetail, broom, Japanese Knotweed and blackberry species.

At least 80% of imported topsoil shall pass a Tyler #10 sieve after appropriate crushing of structural units using accepted laboratory test methods.

**751.15 Manufactured Topsoil** - Manufactured topsoil is any soil or growing medium mixture whose chemical and physical properties fall within ranges required by this Section for a particular application.

Manufactured topsoil shall conform to Subsection 751.16 or as specified in the Special Provisions.

**751.16 Requirements For Topsoil** - Commercial processing and mixing of topsoil components shall be done thoroughly by a mechanized screening process. No hand mixing shall occur. The resulting product shall be a homogenous mixture having the required properties throughout.

The general amendment of both natural topsoils and manufactured topsoils by mixing in situ with rototill cultivation equipment after placement, will be acceptable if carried out to the satisfaction of the Ministry Representative. Fertilizers typically used at time of seeding or planting will be surface applied and incorporated as described in Subsection 751.33, Applying Fertilizers.

The Contractor shall also require the laboratory to include recommendations for incorporating fertilizers and other amendments into the topsoil as needed for plant



## SECTION 751

## TOPSOIL AND LANDSCAPE GRADING

establishment and maintenance, and as they specifically relate to:

- grassed areas
- ground covers, shrubs and trees
- container or planter box installations, and to site conditions and season of planting.

Refer to Table 751-A for required properties of growing medium for different applications.

Other specific requirements are as follows:

### Fertility :

- Nitrogen - total nitrogen shall be 0.2% to 0.6% by weight.
- Phosphorus - available phosphorus shall be 20 to 100 ppm.
- Potassium - available potassium shall be 50 to 250 ppm.
- Boron - concentration in saturation extract shall not exceed 1 ppm

### General:

- Acidity - in accordance with Table 751-A. Maximum of 0.5 kg/m<sup>2</sup> of dolomite lime to achieve the required pH level.
- Salinity - saturation extract conductivity shall not exceed 3.0 mmho/cm at 25 degrees C. Sodium absorption ration (SAR) as calculated from analysis of saturated extract shall not exceed 8.0.
- C/N ratio - carbon to nitrogen ration shall not exceed 40:1.
- Texture - in accordance with Table 751-A.
- Organic content - in accordance with Table 751-A
- Cedar or redwood sawdust shall not be present in the topsoil.
- Soil shall be virtually free from subsoil, wood including woody plant parts, weeds, toxic materials, stones over 30 mm, and foreign objects.
- Drainage - in accordance with Table 751-A. Drainage of growing medium can be measured only after growing medium is in place. Mixing and handling of growing medium shall be done in such a manner that the minimum saturated hydraulic conductivity indicated is achieved.

**751.17 Soil Amendments** - The following amendments shall be added to the topsoil as required.

**751.17.01 Peat Moss** - Peat moss shall be Horticultural grade, partially decomposed fibrous or cellular stems and leaves of sphagnum mosses with a texture varying from porous to spongy fibrous, fairly elastic and substantially homogeneous with pH value not less than 3.5 and not

greater than 6.5, medium to coarse shredded, suitable for horticultural purposes.

**751.17.02 Sand** - Sand shall be clean river pump sand or alternative source approved by the Ministry Representative, free of impurities, chemical or organic matter.

Particle size in sand shall be as follows:

- 95 - 100% passing a 4.75 mm sieve;
- 0 - 40% passing a 0.600 mm sieve;
- 0 - 5% passing a 0.075 mm sieve.

**751.17.03 Manure and Compost** - Manure shall be well-rotted farm animal manure or mushroom manure, rotted to the extent that the material is crumbly. Manure shall be free from weed seeds, rocks, sticks, rubble and shall contain not more than 40% composted sawdust, straw or shavings. Manure shall be free of propagules of plant species designated as noxious weeds under the BC Weed Control Act & Regulation and other perennial, weedy plants such as couch-grass and horsetail.

**TABLE 751-A PROPERTIES OF TOPSOIL FOR DIFFERENT APPLICATIONS**

PROPERTIES	Low Traffic Lawn Areas Trees and Large Shrubs	Planting Areas, Planters, Shrub and Groundcover Areas
TEXTURE: Particle size classes by the Canadian system of soil Classification	Percent of Dry Weight Mineral Fraction (%)	
Gravel greater than 2 mm, less than 30 mm	0 - 10	0
Sand greater than .05 mm, less than 2 mm	50 - 70	50 - 70
Silt & Clay combined	Maximum 25%	Maximum 25%
ACIDITY (pH)	6.0 - 7.0	4.5 - 6.5
DRAINAGE: Minimum saturated hydraulic conductivity (cm/hr) in place	2.0	2.0
ORGANIC CONTENT: Percent of Dry Weight (%)	5 - 10	14 - 20



Commercial compost shall be free from all weed seeds, coliform, pathogens and chemical or toxic contaminants. Physical contaminants such as rocks, plastic, metal or glass shall be less than 0.5%. Compost shall not be derived from or contain processed municipal sewage sludge, unless such product is authorized for use by the Ministry of Water, Land and Air Protection, and meets all local regulations and approvals.

**751.17.04 Wood Residuals** - Raw sawdust and woodwaste are not acceptable components of topsoil. Wood residuals used as a component of topsoil, compost, farm animal manure or mushroom manure are acceptable provided they are rotted and the total Carbon to total Nitrogen ratio for the topsoil is a maximum of 40:1.

**751.18 Fertilizers** - Fertilizers shall be standard commercial brands, meeting the requirements of the Canada Fertilizer Act.

All fertilizers shall be in granular, pelleted or prill form, and shall be dry, free-flowing and free from lumps.

Fertilizers shall be packed in standard waterproof containers, clearly marked with the name of the manufacturer, weight and guaranteed analysis.

All fertilizer shall be stored in a weatherproof storage place and in such a manner that it will stay dry and its effectiveness will not be impaired.

The types, formulations, and rates of application for fertilizers and liming agents to topsoil supplied by the Contractor shall be as recommended by a laboratory soil specialist on the basis of tests of the topsoil, and as approved by the Ministry Representative.

Substitutions or variations in fertilizers and methods shall be made only upon pre-approval by the Ministry Representative.

**751.19 Fill Material** - Fill Material shall not be toxic to plant and animal life in part or in concentration.

## CONSTRUCTION

### 751.31 Area Preparation

**751.31.01 Stripping of Topsoil** - Existing top soil material, where specified or required by the Ministry Representative, shall be stripped and removed to stockpile(s) within the project area, kept properly drained, and maintained in a neat and presentable condition free of spoil and subsoil material for subsequent spreading on prepared rough graded areas.

The storage of topsoil shall not interfere with the effective utilization of a granular source or borrow pits.

### 751.31.02 Preparation of Landscape Area Subgrade -

This Section applies only to grading of landscaped areas outside the roadway prism.

Rough grading shall be carried out by necessary cutting and filling work to produce the lines and grades shown on the Plans and as directed by the Ministry Representative, allowing for the stipulated new topsoil thickness.

Surplus excavated material shall be removed from the site and disposed of at the Contractor's expense unless the Ministry Representative authorizes its use as fill elsewhere on the project.

The landscape area subgrade shall be prepared to a consistent 80 - 85% Proctor density.

Soft and unstable areas below the landscape area subgrade that cannot be compacted to this standard shall be excavated and filled with suitable fill material, except in locations where special environmental conditions have been identified. In such cases, appropriate alternative solutions shall be approved by the Ministry Representative and environmental agencies as required, and carried out.

Debris, roots, branches, stones, building material, contaminated subsoil, visible weeds and anything else that may interfere with the proper growth and development of the planned finished landscaping shall be removed.

Fill materials shall be placed so as to achieve stability. This may necessitate placing in lifts of 225 mm and compacting each layer to 80 - 85% standard proctor density.

Grade transitions of landscape area subgrade should be smooth and even and shall be such that ponding cannot occur on the landscape area subgrade surface.

Existing land forms shall be warped and blended into the landscaped areas with a minimum of visual disharmony.

**751.31.03 Fine Grading** - Areas requiring topsoil shall be fine graded by raking out spoil material and debris such as rocks, asphalt and concrete over 50 mm in diameter.

Naturalized areas not requiring topsoil shall be similarly cleaned, raked and manicured.

**751.31.04 Scarifying** - All landscape area subgrade shall be scarified to a minimum depth of 150 mm immediately before placing topsoil.



**751.31.05 Cleanup** - All unsuitable material and inorganic debris shall be removed from the project area by the Contractor unless the Ministry Representative authorizes its use in fill areas on the project.

All surplus or unsuitable organic waste and debris shall be removed from the site unless its complete burning is approved by the Ministry Representative in compliance with the B.C. open burning regulation.

**751.32 Placing Topsoil** - The landscape area subgrade shall be inspected and approved by the Ministry Representative, before topsoil is placed.

The topsoil shall be:

- placed over the prepared landscape area subgrade and shall be allowed to settle or be compacted by light rolling such that it is firm against deep footprints and shall not be compacted more than necessary to meet this requirement;
- moist (25% to 75% of field capacity) but not wet when placed, and shall not be handled if frozen or wet such that its structure will be altered;
- manually spread around trees, shrubs and obstacles;
- evenly spread to a depth which after settlement or light compaction will be that shown in the plans or as directed by the Ministry Representative.

During hauling and spreading, the paved roadway and other finished surfaces including subgrade under future base courses shall be kept clean and free of all topsoil.

**751.33 Applying Fertilizers** - Fertilizers shall be added to bring topsoil fertility within the ranges set out in this Section or as specified in the Special Provisions.

Manufactured topsoils and processed imported topsoils will typically have fertilizers and amendments incorporated at the time of mixing and screening, while other topsoils will receive in situ amendment.

Fertilizers normally applied at the time of seeding and planting are specified under the appropriate sections. These fertilizers are generally supplemental to the base fertility requirements outlined for topsoil and are applied after topsoil is in place.

Surface applied fertilizers shall be evenly spread over the topsoil with a suitable mechanical spreader and fully incorporated to a minimum depth of 50 mm.

Lime used for top dressing shall be thoroughly cultivated into the top 100 mm of topsoil.

**751.34 Finish Grading** - After placing the topsoil to the finish elevations and contours required, the grade shall be finished to a high standard, to the grades shown on the plans with a smooth and even surface. Rough spots and low areas shall be eliminated to ensure positive surface drainage, and the surface shall be left smooth, uniform, free of debris and firm enough to resist deep footprinting.

Topsoil placed in traffic islands and medians shall be crowned for drainage, as shown on Drawing [SP751-01](#).

## MEASUREMENT

**751.81 General** - Measurement for the supply of topsoil by the Contractor will be by the CUBIC METRE in the truck at the point of delivery. Topsoil removed from stockpiles will be measured in place in the stockpile.

The placing of topsoil will be measured by the SQUARE METRE for the stipulated topsoil thickness, unless stated otherwise in the Special Provisions.

## PAYMENT

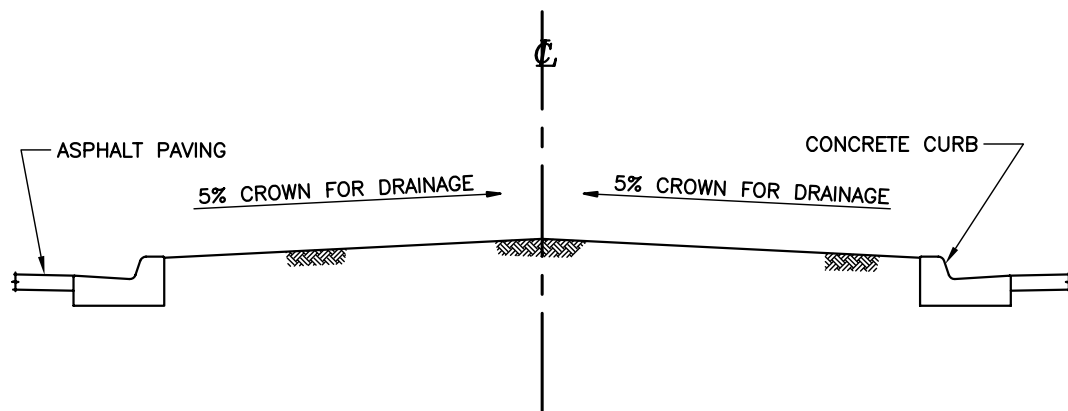
**751.91 General** - Payment for TOPSOIL supplied by the Contractor will be at the contract unit price bid per cubic metre. The unit price bid for topsoil supplied by the Contractor shall be accepted as full compensation for all handling, any necessary screening and testing of topsoil, and for delivery and off-loading on the area to be topsoiled.

Payment for TOPSOIL SPREADING will be at the contract unit price bid per square metre. The unit price bid for topsoil spreading shall be full compensation for all labour and equipment required for the specified preparation, spreading, and finish grading of the topsoil, and for all incidental work not required to be separately paid for.

Separate prices may be included in the Contract to cover the area preparation work such as:

- clearing and grubbing,
- stripping existing topsoil and removal to stockpile,
- rough grading and fill,
- naturalizing with fine grading,
- rotovating and soil conditioning, and
- trenching for irrigation and sub-soil drainage systems.





NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 754

### PLANTING OF TREES, SHRUBS, AND GROUND COVERS

#### DESCRIPTION

**754.01 Scope** - This Section refers to those portions of the work that are unique to the supply and planting of trees, shrubs and ground covers, including seeded and sodded areas that are not designated for treatment under Section 757 "Revegetation Seeding". This Section must be referenced and interpreted simultaneously with all other Sections pertinent to the works described herein.

**754.02 Related Work** - Section 751, Topsoil and Landscape Grading; Section 757, Revegetation Seeding; .

**754.03 References** - Canadian Standards For Nursery Stock (Canadian Nursery Trades Association), BC Weed Control Act & Regulations, Canada Seed Act, British Columbia Standard for Turfgrass Sod.

#### 754.04 Guarantee/Maintenance

**754.04.01** The Contractor shall guarantee and maintain all materials and quality of work for a period of one full year. The guarantee and maintenance period will commence when the following conditions have been met:

- the supply and installation of all plant materials have been completed as per Subsection 754.43,
- all seeding/sodding has been completed (but is not necessarily yet established) , and
- installation and hydrostatic testing of the irrigation system have been completed as per Subsection 766.42, and the system is fully operational.

**754.04.02** The guarantee includes replacing all plants as determined by the Ministry Representative which are found dead or failing during the entire maintenance and guarantee period. Replacements shall be made immediately unless otherwise directed by the Ministry Representative, and conditions of the guarantee shall apply to all replacement seeding for one full growing season.

Approval of plant material at the source does not preclude rejection of non-conforming stock on the site prior to, or after planting.

The guarantee shall not apply to plants and planted areas damaged after Acceptance by causes beyond the Contractor's control, such as vandalism, "acts of God", "excessive wear and tear", or abuse.

#### MATERIALS

**754.11 Source Quality Control** - The Contractor shall notify the Ministry Representative of the sources of plant

materials to be supplied at least two weeks prior to commencing the landscape work. All non-seed plant materials shall be made available for inspection at the nursery by the Ministry Representative upon at least three days notice. Field grown material is not to be dug prior to inspection.

Approval of plant material at the source does not preclude rejection of non-conforming stock on the site prior to, or after planting.

Imported plant material shall be accompanied by all necessary permits and import licences, and shall conform to federal and provincial regulations.

It shall be the Contractor's responsibility to ensure that all regulations pertaining to the import of plant materials or their movement to or from a particular region of the province are adhered to, and all inspection certificates required by the Ministry of Agriculture are completed to the satisfaction of that Ministry.

#### 754.12 Transporting Plants to Site

##### 754.12.01 Dormant Period

**Deciduous: Bare Root Stock** (only in dormant period): Adequate protection shall be given in order to preserve moisture around the root system. For short transit period, four hours or less, maximum temperature in the truck shall not be above 20°C. In all cases, at all times, roots should be protected from frost, wind and sun (e.g., a closed van with wet straw or other suitable packing material protecting the roots). The temperature shall be maintained as uniformly as possible by mechanical means, or in any event to prevent frost damage to roots. The appropriate temperature range shall be between 1°C and 10°C.

**Evergreens:** It is recommended that root balls not be subjected to freezing temperatures below -5°C for a period longer than four hours. Plants shall be protected to prevent desiccation by wind and sun.

**754.12.02 Non-Dormant period** - Deciduous and Evergreen plant material shall be transported in a closed van or well-covered truck with a tarp or similar material in order to protect the leaves or needles from windburn. When in transit, with protection of a tarp cover only, it is recommended that foliage be sprayed with an antidesiccant. For the above material in transit for more than three days, it shall be unloaded and then stored away from direct sun for 24 hours to avoid leaf burning.



Sod shall be protected during transportation to prevent drying out and shall arrive at the site in a fresh and healthy condition.

**754.13 Unloading and Handling Procedures** - Plants shall be carefully handled to minimize disturbance to root systems and damage to stems and branches. Plants shall not be dropped to the ground when unloading. Plant material that is mishandled and showing evidence of damage to root balls, or undue damage and breakage to top growth will be rejected.

Plants are to be kept in a moist condition at all times. All plants shall be well protected against physical damage and desiccation until they are planted on the site.

**B.R. (Bare Roots) Stock:** Roots shall be covered and protected immediately from frost, sun and wind.

**Stock in Pots/Containers:** Shall be handled as much as possible by pots only in order to reduce breakage of branches/leaves.

**Balled & Burlapped (B & B) Material:** Plants shall be handled by holding the root ball and supporting the stem to minimize disturbance to the root ball and damage to stems and branches.

**Material in Wire Basket:** Specimen trees shall be lifted and supported by the wire basket and not by the trunk.

All plants shall be promptly unloaded and their condition checked immediately upon arrival. Watering shall be provided as required and necessary pruning of minor breakage on branches performed.

**Protection Against Stem and Branch Damage** - During loading, transportation, off-loading and planting, all trees shall be protected against damage to stems and branches. This applies particularly to larger wire-basketed trees.

Bark shall be protected against chafing and cuts by providing a wrapping of cardboard, sackcloth or other material as appropriate and when required.

#### 754.14 Storage

**754.14.01 Storage During Growing Season** - All plants in containers, balled and burlapped, or in wire basket, if not planted within three days, shall be stored in an upright position in an area providing even light and offering protection from wind and sun scald. Enough space shall be provided between plants so that light reaches all around to the bottom of the plant in order to avoid leaf burning when planted out.

**Sod:** Sod shall be installed as soon as possible after delivery. If there is a delay of more than 24 hours, the sod shall be properly stored and kept moist and cool until it is placed. Sod shall not be stacked more than three levels high while being stored.

**Balled and Burlapped Material:** Special attention shall be given to the root ball, and unless weather is rainy or cool, root balls shall be protected by covering with material suitable to protect them from drying out (e.g. sawdust, peat moss, topsoil). Plants intended to be planted in the open shall not be kept stored in a building or any area of low light intensity for a period exceeding seven days. All plants shall be kept well watered and protected from heat and frost.

**Containerized Plants:** In extreme weather, freezing or high dry heat, the containers shall be buried in a protective medium. Plants intended to be planted in the open shall not be kept stored in a building, truck or any area of low light intensity for a period exceeding seven days during the growing season.

**754.14.02 Storage During Dormant Period** - Plants shall be cared for according to each plant's requirement for winter protection, and according to geographical location.

#### 754.15 Plant Material

**754.15.01 Species** - Selection of species shall be as specified. Every effort shall be made by the Contractor to obtain the plant material specified. Where evidence is submitted that a specified plant cannot be obtained, substitutions in kind, size and grade shall be made upon written approval by the Ministry Representative.

**754.15.02 Origin and Requirements** - All plant material shall be nursery grown stock or approved collected native plants unless specified otherwise. Plant material will be inspected by the Ministry Representative upon delivery to the site.

All nursery grown plants shall, as a minimum, comply with the Canadian Nursery Trades Association Specification "Canadian Standards for Nursery Stock" with respect to sizing, grading and quality.

Plants shall be true to name, type and form and shall be representative of their species and variety.

All plants shall be sturdy stock, with tree and shrub heights proportional to trunk caliper, overall plant width and size of root ball, as determined by the Ministry Representative. Plants that are weak and thin, and those showing effects of being grown too closely together or poorly maintained, will not be accepted.



Plants shall be vigorous and healthy with normal, well developed branches and good fibrous root systems and be free from decay, physical injury, disease and insect damage and infestation.

In particular, conifers shall have a healthy, single leader with well shaped whorls of vigorous, newly growing branches and shall exhibit natural growth habit characteristic of the species and variety. Trees sheared as Christmas trees are not acceptable.

The root balls of dug material and the soil of containerized plants shall be free from pernicious perennial weeds. All balled and burlapped plant stock shall be supplied in biodegradable root ball sacking.

The search area for plants shall include, but not necessarily be limited to, the provinces of British Columbia, Alberta and the states of Washington, Oregon, California (northern portion), Idaho and Montana. All plant material being sourced from milder areas shall be properly "hardened off" prior to shipping and planting.

**754.15.03 Nursery Grown Stock** - All plants specified "Container" shall be grown for the length of time necessary to permit the roots to fill and hold the soil within the container, as required by the Canadian Standards for Nursery Stock.

Similarly, all field dug material will show evidence of having been root pruned to encourage fibrous root system development and resulting in root balls that retain their integrity during handling.

Forestry seedlings shall be supplied and handled in accordance with the requirements of the Silvicultural Manual, Ministry of Forests, Province of B.C., 1993. This manual can be found on the Internet at: <http://www.for.gov.bc.ca/hfp/pubs/silvman/index.htm>.

All plant material shall be appropriately identified and individually labelled with weatherproof tags. In the case of small containerized plants such as ground covers and bundled bare root seedlings, which are supplied in large numbers, labelling shall be limited to identification of group lots as permitted by the Ministry Representative.

**754.15.04 Collected Plant Stock** - The Contractor shall provide either permits or verification that permission was obtained for collecting native and/or introduced plant materials. Information shall be supplied on where, when and how collection was made.

All collected plant material shall have been grown and maintained in a nursery environment for a minimum of one

growing season, unless, at the sole discretion of the Ministry Representative, certain species are approved for a lesser period of time. As for nursery grown stock, collected plants shall be held long enough prior to planting to allow roots to fill the container or the dug root ball and to retain the soil within.

Collected plant stock shall be appropriately labeled with weather proof tags for easy identification at the job site.

**754.15.05 Seed** - Seed quality and type shall conform to that specified in the Special Provisions.

All other requirements are per Section 757 Revegetation Seeding.

**754.15.06 Sod** - Sod shall be nursery grown, true to type and conform to the British Columbia Standard for Turfgrass Sod, and the general requirements of the Canadian Standards For Nursery Stock.

Sod grade shall be as specified in the Special Provisions.

**754.16 Water** - Water shall be clean and potable and shall be supplied by the Contractor.

**754.17 Fertilizer** - Fertilizer shall comply with the provisions of the Canada Fertilizers Act and Fertilizer Regulations. Fertilizer shall be supplied to the specifications in the Special Provisions.

**754.18 Bark Mulch** - Bark mulch shall be sized 25 mm and minus, Douglas Fir or Hemlock bark chips and fines, or a combination of both types and of the quality used for decorative landscape mulching purposes. It should be free of chunks and sticks, dark brown in colour and free of all soil, stones, roots or other extraneous matter.

**754.19 Backfill Topsoil** - Backfill topsoil for planting operations shall conform to the requirements of Section 751 - Topsoil and Landscape Grading.

**754.20 Other Materials** - When required, various other materials such as soil amendments, erosion control products, hydraulic mulches, etc. shall be supplied to the specifications in the Special Provisions.

## CONSTRUCTION

**754.31 Scheduling** - Work shall be scheduled to meet the milestone dates provided in the Special Provisions, and to ensure its execution meets the requirements of living plant material.

The work shall be co-ordinated with the schedule of other



trades, and be well integrated with other specific requirements such as Sediment and Drainage Management Plans, which may be provided for any given project.

**754.32 Preplanting Operations** - The plant material shall be approved by the Ministry Representative prior to installation. The Contractor shall ensure that all requirements of Sections 754.11 through 754.15 have been met and that any minor damage to plant stock is taken care of through appropriate pruning or other measure. When directed by the Ministry Representative, the Contractor shall apply anti-desiccant to large conifers and deciduous trees that are in leaf. Application will be in accordance with the manufacturer's instructions for the particular product.

**754.33 Location of Planting** - Locations, quantities and spacing of trees, shrubs, vines and groundcovers as shown on the Plans shall be considered approximate and may be adjusted by the Ministry Representative to meet field conditions. Tree numbers, spacings and locations will vary according to the site conditions and amenities. The Contractor may adjust plantings to meet field conditions, with the concurrence of the Ministry Representative. Locations shall be staked as shown on the Plans and verified on site with the Ministry Representative prior to planting. If underground obstructions are uncovered they shall be reported to Ministry Representative for resolution.

#### **754.34 Area Preparation**

**754.34.01 Finish Grade Preparation** - The Contractor shall verify that grades are correct. If discrepancies occur, the Ministry Representative shall be notified and work shall be halted until otherwise instructed by the Ministry Representative.

**754.34.02 Planting Beds and Grass Areas** - Prepare planting beds and grass areas in accordance with Section 751 - Topsoil and Landscape Grading.

**754.34.03 Planting Holes** - Planting holes shall be dug in accordance with the specific requirements described below. The bottom of planting holes shall be scarified and loosened to a depth of 100 mm prior to placement of plants and backfill soil.

Subsoil, rocks, roots and extraneous material shall be removed from excavated material that will be used as planting backfill soil. Unsuitable or excess material shall be disposed of.

Holes dug by a mechanical tree spade shall have their sides scarified to loosen any compaction glazing caused by the blades. Planting holes shall be tested by filling with water. Inadequate drainage conditions permitting the retention of

water in planting pits for more than 12 hours shall be reported to the Ministry Representative before proceeding with the work.

**i) Free Draining Sub-Grade:** Where the subgrade and existing native surface soils are of good drainage and of a non-compacted nature, planting holes shall be excavated and prepared to allow the following depth of topsoil backfill underneath and around the root ball:

- For plants up to and including 27 cm (#5) pot size - not less than 150 mm .
- For plants larger than 27 cm (#5) pot- size not less than 300 mm

**ii) Poor Draining Sub Grade:** Where the subgrade and existing native surface soils are of poor texture and conditions are generally compacted, planting holes shall be excavated and prepared to allow the following depth of topsoil backfill underneath and around the root ball:

- For plants up to and including 27 cm (#5) pot size not less than 300 mm
- For plants up to 45 cm pot size - not less than 450 mm
- For tree root balls larger than 45 cm - not less than 600mm

If severely compacted conditions are encountered, and surface or ground water entering the excavations does not drain, the Contractor shall correct the problem by;

- providing a means of sub-surface drainage
- utilizing elevated planting techniques where some of the planting soil will be placed into a partial excavation and the remainder on the surface to meet the depth requirement for growing medium, or
- considering alternate planting sites.

These alternatives shall receive prior approval by the Ministry Representative, as applicable to the site.

**754.35 Time of Planting** - All planting operations shall be performed during the normal planting season for each type of material, and within the milestone dates provided in the Special Provisions, unless otherwise authorized in writing. During the specified timeframe, plant operations shall, as far as practicable, take advantage of soil and weather conditions favourable to the work.

Planting into frozen ground is not acceptable.

#### **754.36 Planting Procedures - Trees and Shrubs**

**General Procedure** - Plants shall be installed so that after settlement they will be at the same planting depth they were at in the field or in containers. The soil mark on the stem is



an indication of this, and it shall be flush with the finished level allowing for settling of the topsoil after planting and settlement. The entire root ball shall be covered with growing medium.

Once the bottom of the planting hole is scarified and the initial lift of backfill topsoil is placed, the holes shall be pre-watered and allowed to drain prior to installation of plant material.

Plants shall be set plumb in the planting beds or in the centre of the pits except where the plant's character requires variation from this.

The growing medium shall be placed in layers around the roots or ball, preferably by hand. Each layer shall be firmed to eliminate air void and ensure good soil contact with the roots. The process shall be carried out carefully to avoid injuring the roots or ball, or disturbing the position of the plant.

Trees requiring staking shall have support stakes placed carefully between the roots before backfilling. Specifications for tree supports are described in Section 754.

After the planting hole is filled with soil to ground level, the plant shall receive a thorough watering. A final backfill layer shall be applied to form a saucer-like berm around the circumference of the planting hole in order to catch and hold rainwater. This rain basin shall be maintained until final acceptance of the work.

Once planting and mulching is complete, the site shall be cleaned of all excess soil, rock and debris.

#### **Specific Planting Requirements:**

**Bare Root Stock** - The roots of bare root plant material shall be soaked in water prior to planting. During installation, the plant roots shall be evenly spread out over a cone of soil in the bottom of the hole, and the plant supported to the correct depth as backfilling takes place. The plant shall be gently shaken in a vertical motion to ensure that soil particles sift into the root system and establish close contact with the roots

**Container Stock** - Non-perishable, impervious containers such as plastic pots and tubs shall be removed from plants before planting. Once plants are removed from these containers, root systems shall not be disturbed with the exception of unraveling any roots starting to spiral around the root ball.

Bio-degradable containers such as peat or paper fibre pots shall not be removed before planting, but shall be

thoroughly soaked with water prior to placement in the holes. This will ensure that containers absorb subsequent watering and not repel it due to the presence of a dry barrier. The rim of such containers shall be not be exposed to the air, and when necessary, shall be removed after planting.

**Balled and Burlapped Stock** - When backfill soil is placed to approximately two-thirds of the root ball height, the ties on the sacking shall be cut and the top portion of the burlap folded back carefully to avoid disturbing the integrity of the root ball. The sacking shall not be removed. The remainder of the hole will then be backfilled and firmed.

Where wire baskets are used to encase and support the root ball of supplied plant material, these shall not be removed. The top of the wire basket shall be cut away or completely folded back and buried without disturbing the integrity of the root ball.

**Forestry Seedlings** - Planting of forestry seedlings shall be in accordance with the Silvicultural Policy and Procedures Manual, Volume 3, of the British Columbia Ministry of Forests and Lands.

**Tree Support** - All trees of a size requiring staking or guy wiring shall be supported in accordance with the details and instructions provided on Drawings SP754-04 through SP754-07 of these Standard Specifications. All hardware required shall be installed without damage to plants.

Trees that are dislodged during the contract period shall be uprighted and re-secured as required. Trees that are damaged shall be replaced by the Contractor at the Contractor's expense.

**754.37 Seeding** - Application of seed, fertilizer, and other materials shall be at the rates specified in the Special Provisions.

The requirements for construction shall be in accordance with Section 757 Revegetation Seeding.

**754.38 Sodding** - The required fertilizer shall be applied at the rates specified in the Special Provisions, and worked well into the topsoil prior to laying the sod.

Sod shall be laid within 24 hours after delivery unless proper storage arrangements can be made.

The sections of sod shall be laid close together with joints staggered. No open joints are to be visible, and no pieces are to overlap.

Sod shall be laid smooth and flush with the adjoining grass areas, adjacent hard surfacing, and the tops of curbs and



planting bed liners, unless otherwise shown on the Plans. All necessary cutting shall be done using sharp implements.

On Slopes of approximately 2.5 to 1 and steeper, the sod shall be laid lengthwise across the slope, and the material secured with wooden stakes driven flush with the sod at intervals not exceeding 0.5 metres. There shall be at least three stakes per individual sod piece. On slopes of gradients between 2.5 and 1.5 to 1, the bottom three rows of sod and every third subsequent row shall be secured with stakes. For slopes steeper than 1.5 to 1, every sod course shall be staked.

Sodded areas shall be rolled or suitably tamped to ensure a good bond with the topsoil, and then subsequently protected from heavy foot traffic or equipment travel.

Unless otherwise indicated, sodded areas shall be evenly watered within 12 hours of installation, and with sufficient quantity to saturate the grass and the upper portion of the topsoil.

**754.39 Watering** - All trees, shrubs, groundcovers, vines, and designated grass areas, shall be watered immediately after planting, and regular watering shall continue as required for plant health until final acceptance of the work.

**754.40 Pruning** - Pruning shall be limited to the minimum necessary to remove dead or injured tissue and branches interfering with desirable growth habit and overall health of the plant.

Pruning shall be done in accordance with proper horticultural practice, using clean, sharp tools appropriate to the task and in a manner that preserves the natural character of the plant.

**754.41 Mulching** - When specified in the Plans and Special Provisions, individual tree pits and planting beds shall be mulched.

Mulching of tree pits and planting beds shall be carried out after watering, to an even depth of 50 mm after settlement, unless otherwise specified on the Plans and in the Special Provisions.

**754.42 Clean-up** - All plant containers and waste materials resulting from landscaping and planting operations shall be removed from the site and appropriately disposed of.

**754.43 Conditions for Acceptance** - The Contractor shall ensure that the following conditions are met for all planted and grassed areas:

- a) Topsoil quality, fertility levels, depths and surface

conditions are as set out in the Plans and Specifications;

- b) All plants are of the species and varieties specified and planted in the locations shown on Plans;

- c) All plants are healthy and growing vigorously. Seeded grass areas are sufficiently established into the underlying growing medium, are free of thin and bare patches, and are relatively free of weeds: not more than 5% in lawn areas, and not more than 15% in rough grass areas;

- d) The water content in the topsoil, i.e. – when irrigation is provided, is to the satisfaction of the Ministry Representative;

- e) Trees are supported, as specified;

- f) Pruning is complete, in accordance with proper horticultural practice and to the satisfaction of the Ministry Representative;

- g) All planting beds and tree pits are free of weeds;

- h) Mulch is in place, as required and;

- i) Unmulched areas are cultivated to leave a loose, friable, water-permeable surface;

- j) Maintenance procedures set out in Subsection [754.71](#) have been carried out.

## MAINTENANCE

**754.71 Maintenance** - The following maintenance operations shall be performed from the time of landscape installation, until the expiry of the landscape maintenance period as defined in the contract documents:

- a) When specified, water shall be applied in sufficient quantity and by appropriate method to maintain optimum soil moisture conditions for healthy plant establishment, without causing surface soil erosion.

- b) Weed control will be carried out, as required to prevent competition with establishing planted material and to maintain the aesthetic appearance of landscaped areas. The presence of weeds in plantation beds, individual planting pits, and designated lawn areas, is limited to a maximum of 5% of the surface area at any given time, unless otherwise stated in the Special Provisions. The use of herbicides for the control of weed growth is not permitted.

- c) Mowing shall be carried out at regular intervals, as



required, to maintain grass in the areas designated, and at the height(s) specified in the Special Provisions. Edges of areas designated "Lawn" shall be neatly trimmed. Excess clippings shall be removed immediately after mowing and trimming.

- d)** Fertility levels in planted and grassed areas shall be maintained in accordance with the requirements of the plant material.
- e)** Bark Mulch shall be maintained to the specified depth.
- f)** For non-mulched areas, the soil surface shall be cultivated, as required, to keep it loose and friable.
- g)** Insect and disease control shall be carried out as required by the Contractor with approval of the Ministry Representative. The Contractor shall secure all necessary Pesticide Use Permits in accordance with Ministry of Water, Land and Air Protection (MoWLAP) regulations, and possess a valid Pesticide Service License. When required, the Contractor shall provide a Pesticide Management Plan to MoWLAP.
- h)** Establishment pruning to encourage proper shape and health of plants by removing dead, or broken and interfering branches and diseased or damaged tissue.
- i)** Maintenance of tree stakes, guy wires and tree ties to prevent plant dislodgement and damage to trunk and branches.
- j)** All plant material shall be alive and maintained in a healthy growing condition during the entire establishment period. Plant material which has died or is not healthy, and in the opinion of the Ministry Representative, does not perform its function, will be removed and replaced by the Contractor at the earliest opportunity, weather and season permitting. Grassed areas that show deterioration or bare spots shall be repaired immediately. Unless otherwise directed by the Ministry Representative, all repair and/or replacement shall be in accordance with the original specifications and requirements.

The landscape maintenance period may run concurrently, in whole or in part, with the contract warranty period.

## MEASUREMENT

**754.81 Planting** - The unit of measurement for plants will generally be PER PLANT, unless otherwise specified in the Special Provisions.

**754.82 Seeding and Sodding** - The unit of measurement for seeded and sodded areas will generally be by the SQUARE METRE, unless otherwise specified in the Special Provisions.

**754.83 Mulch** - The unit of measurement for supply and installation of bark mulch will generally be by the SQUARE METRE for the stipulated mulch thickness, unless otherwise specified in the Special Provisions.

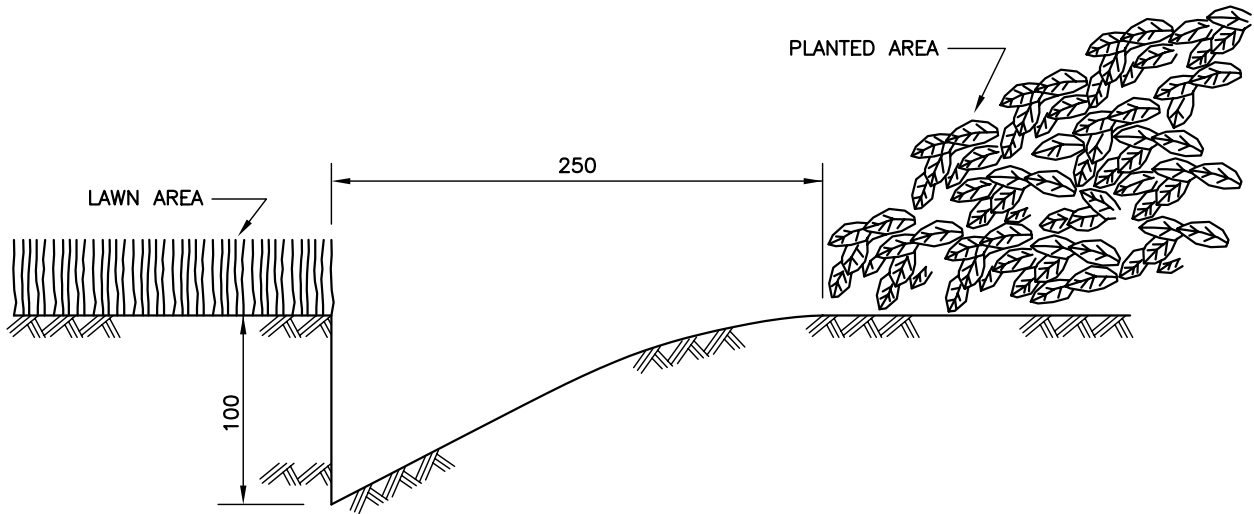
## PAYMENT

**754.91 General** - Payment for plants will be at the contract unit prices bid for PLANTING of the types, species and sizes called for, and shall constitute full compensation for supplying and delivering plants; for supplying and delivering topsoil for plant backfill, fertilizer and all incidental materials; for digging holes for plants; for planting, pruning, staking and guying, mulching, rain basinformation, clean up after planting and maintenance of plants; and for all labour, equipment and tools and incidentals necessary to complete the work prescribed in this Section.

Payment for SEEDING and SODDING will be at the contract unit price bid per square metre. The unit price shall be full compensation for work described and all work subsidiary and incidental thereto for which separate payment is not elsewhere provided.

Payment for MULCHING will be at the contract unit price bid per square metre. The unit price bid for mulching shall be full compensation for all labour and equipment required for supplying and spreading of the mulch and for all incidental work not required to be separately paid for.

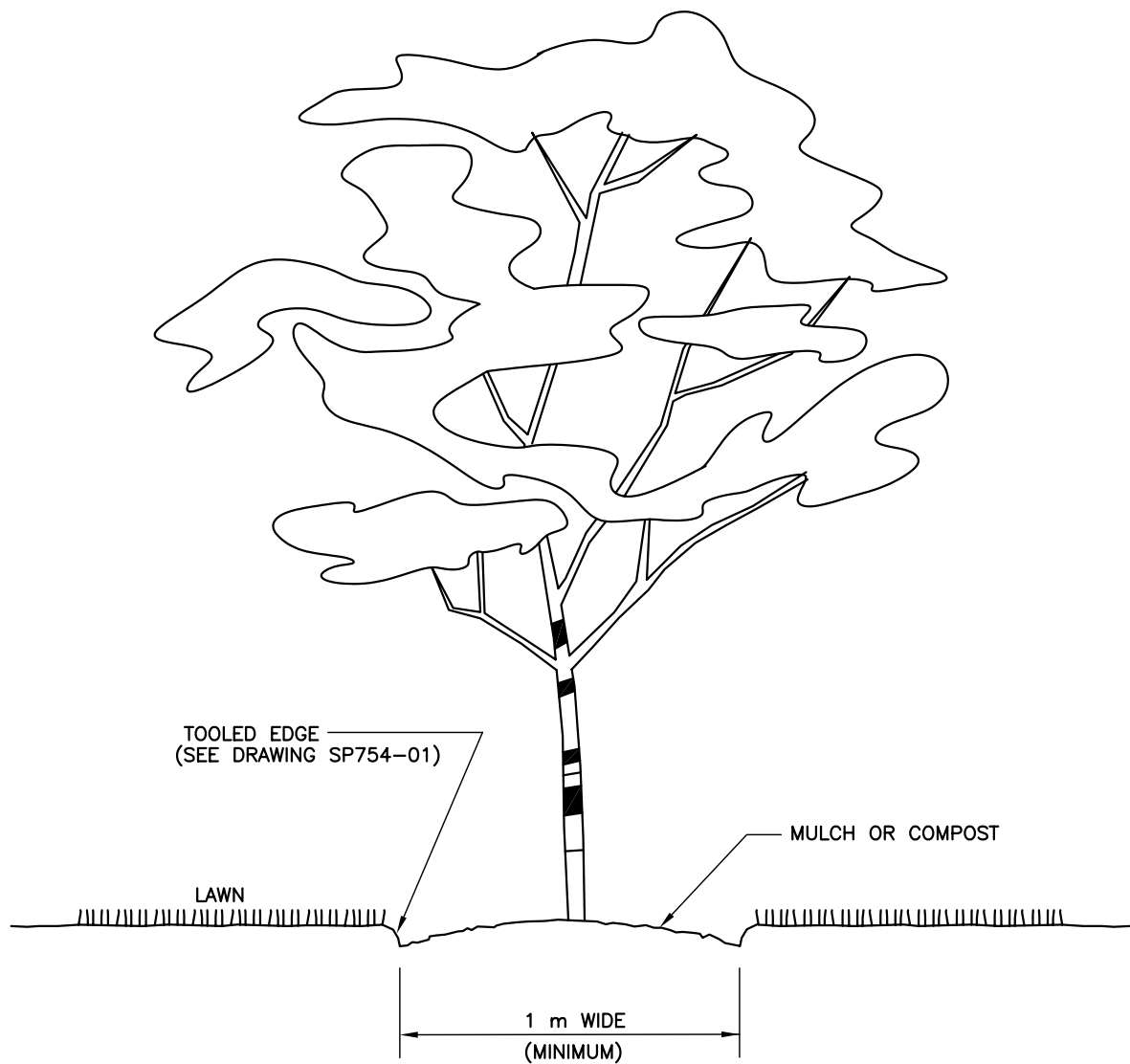




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



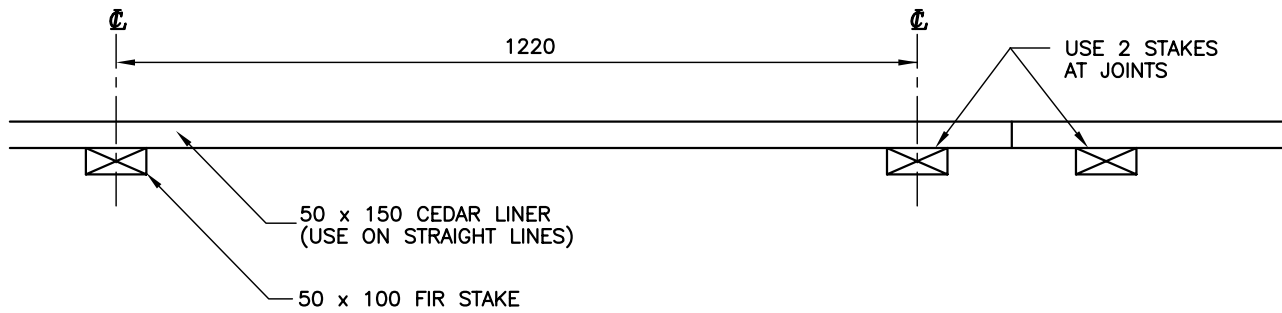
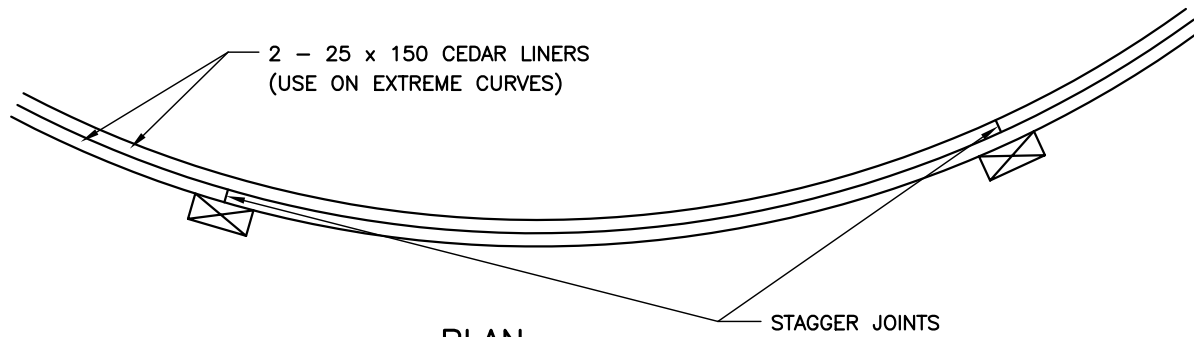
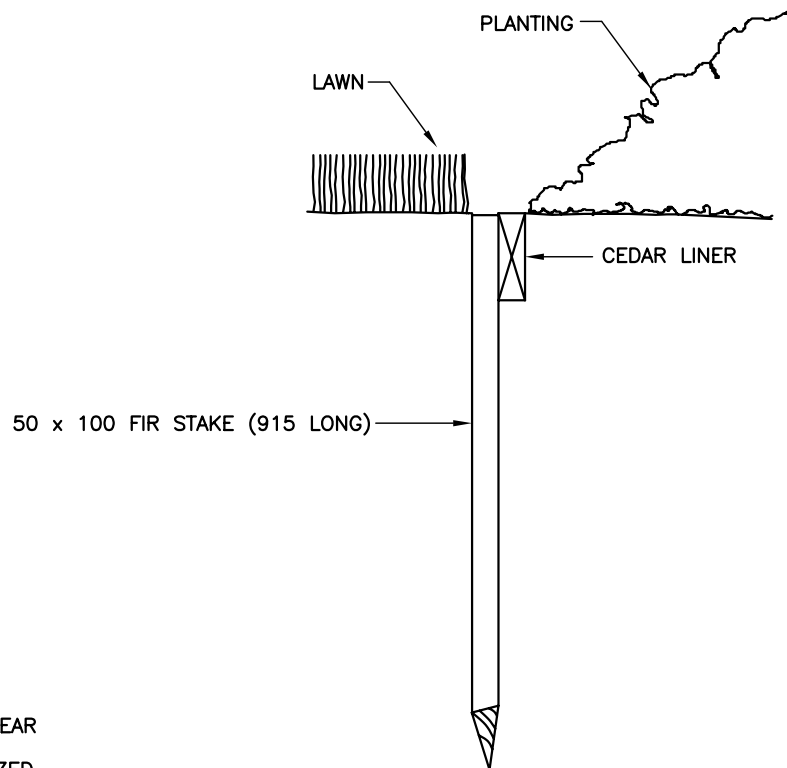


NOTE:  
MAINTAIN VEGETATION FREE BASE

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



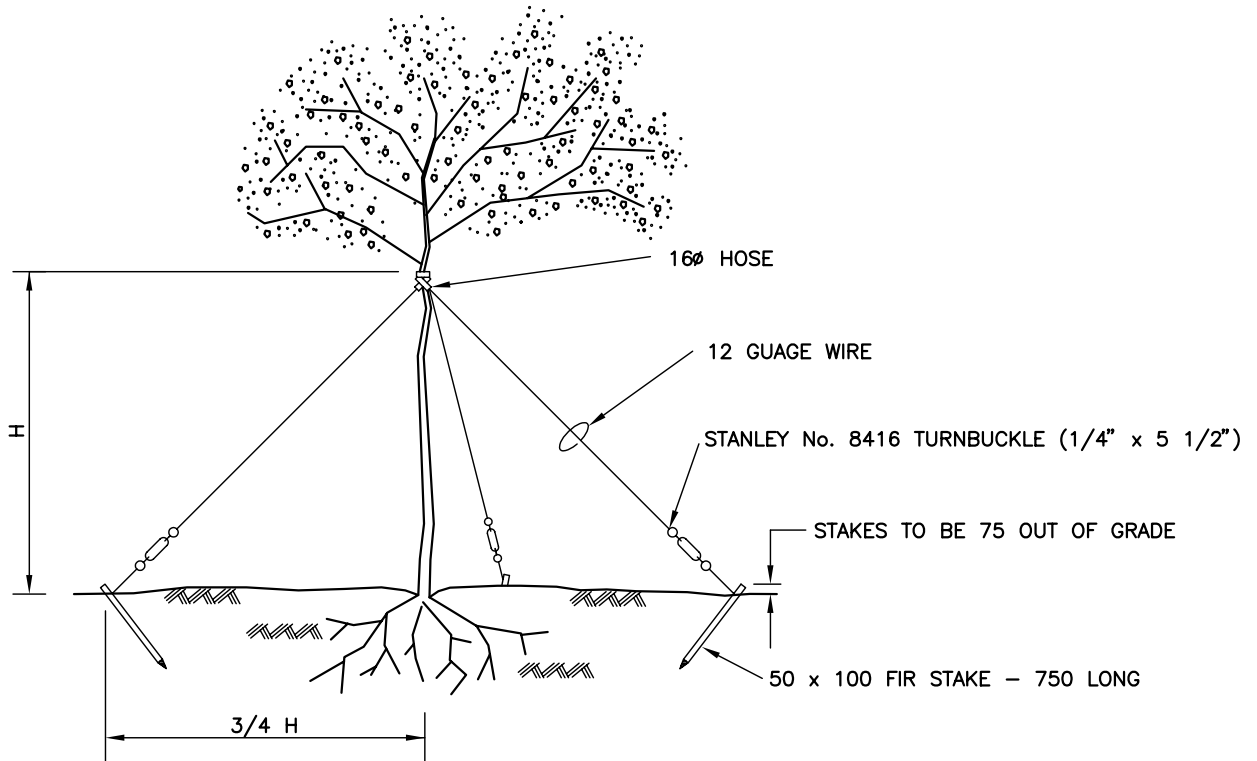
PLANPLANSECTIONNOTES:

1. ALL WOOD TO RECEIVE 2 COATS CLEAR CREOSOTE PRIOR TO CONSTRUCTION
2. ALL NAILS TO BE HOT-DIP GALVANIZED, 75 mm LONG

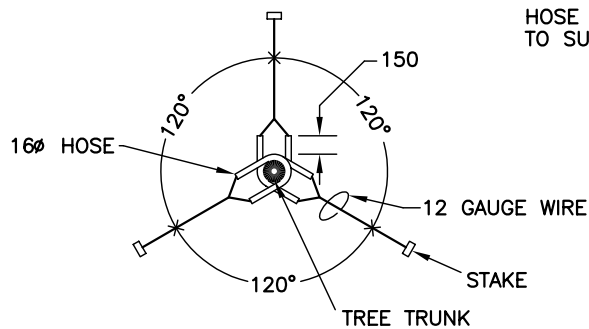
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





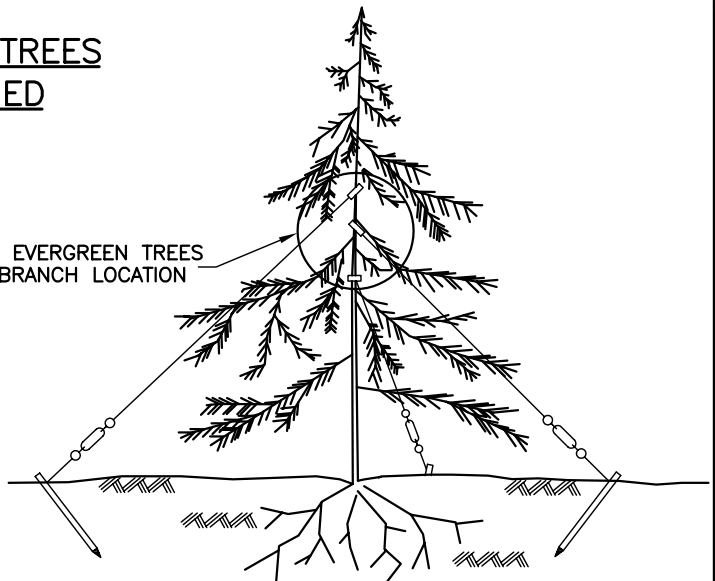
FOR DECIDUOUS TREES  
WHEN SPECIFIED



PLAN VIEW

TURNBUCKLES NOT SHOWN FOR CLARITY

HOSE ON EVERGREEN TREES  
TO SUIT BRANCH LOCATION



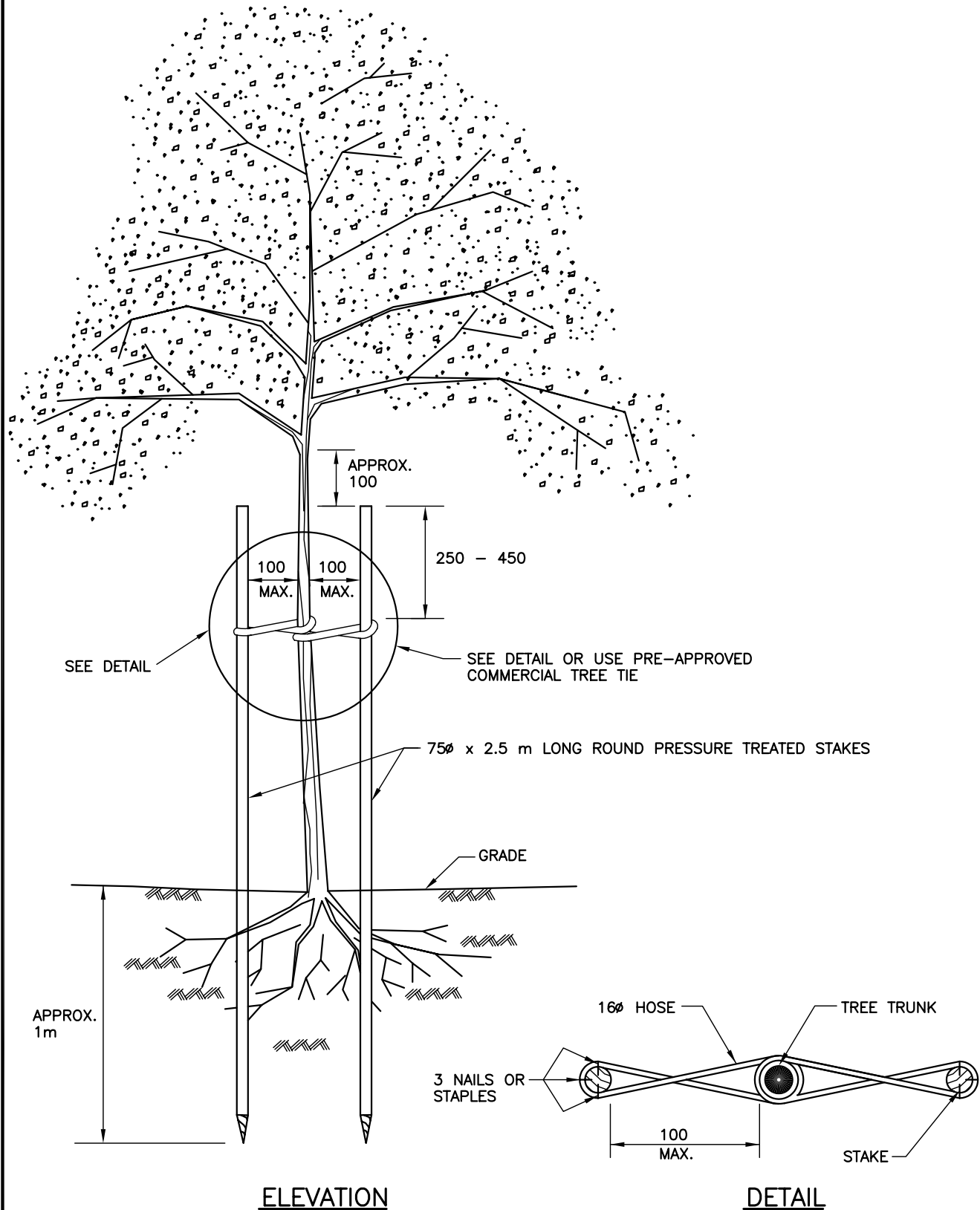
FOR CONIFEROUS TREES  
WHEN SPECIFIED

NOTE:  
TIGHTEN WIRE BY ADJUSTING TURNBUCKLES

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

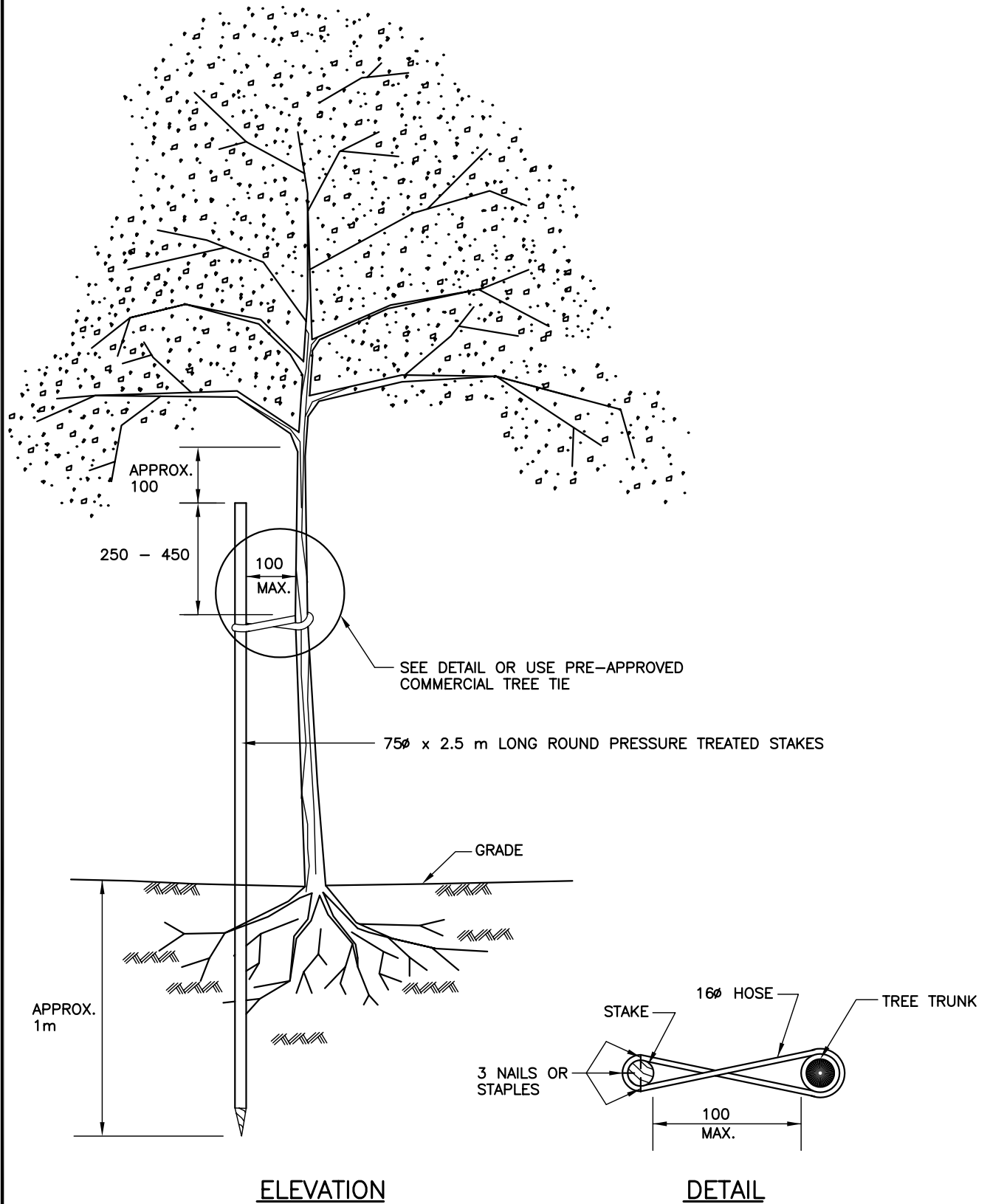




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

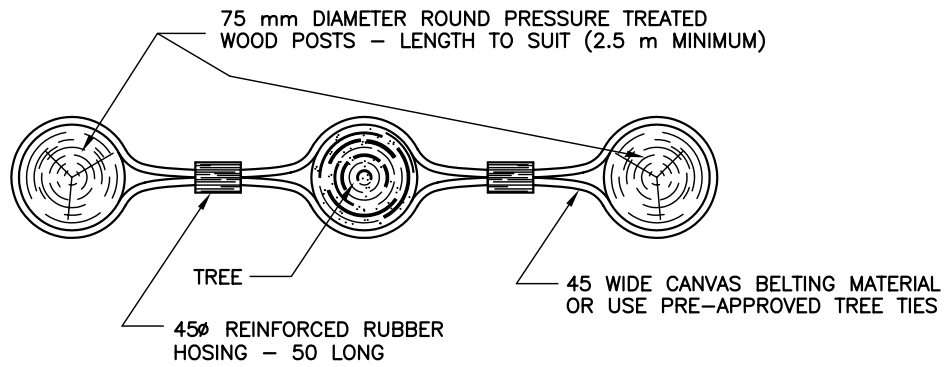




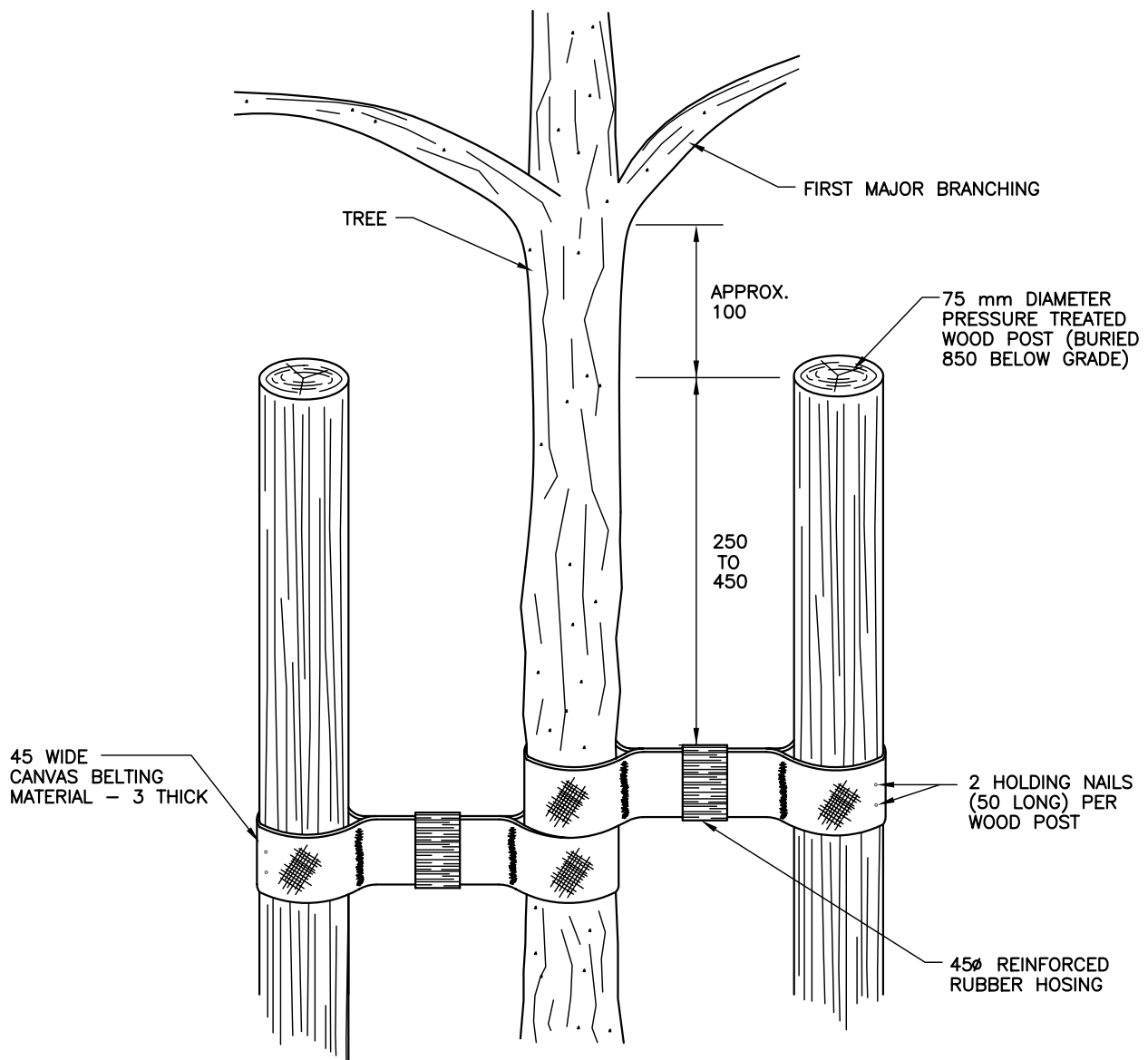
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





CROSS SECTION



NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 757

### REVEGETATION SEEDING

#### DESCRIPTION

**757.01 Scope** - This Section refers to those portions of the work that are unique to the supply and application of seed, fertilizer, mulch, tackifier, and other materials used for revegetating disturbed areas, and that are not designated for treatment under Section 754, Planting of Trees, Shrubs, and Ground Covers. This Section must be referenced and interpreted simultaneously with all other Sections pertinent to the works described herein.

**757.02 References** - Guidelines for Hydroseeding in Proximity to Hydro Lines, Canada Seed Act, and BC Weed Control Act & Regulation.

#### MATERIALS

**757.11 Handling and Storage** - All seed, mulch, fertilizers and other dry materials shall be stored in a dry, weather proof storage place and shall be protected from damage by heat, moisture, rodents or other causes until the time of seeding. Supplier labels or other identification are not to be removed or defaced.

#### 757.12 Seed

**757.12.01 Supply of Seed** - All seed specified shall be supplied by the Contractor and obtained from a recognized source.

**757.12.02 Seed Type and Grade** - All seed supplied either as individual species, or as a seed mix, shall comply with the requirements of the Canada Seed Act and Regulations, and the grade standards for that particular crop kind. Grass and legume seed shall meet or exceed Common No.1 grade prior to mixing with other species. Seed shall be free of propagules of plant species designated as noxious weeds under the BC Weed Control Act & Regulations.

All legume seed shall be inoculated with an adapted bacterial culture to ensure nitrogen fixation.

Seed mixes used for general roadside revegetation, and for the general conditions and areas indicated, shall be as shown on the table "Standard Grass Seed Mixes For Revegetation of British Columbia Highway Roadsides", unless otherwise specified in the Special Provisions.

When specified, wildflower and shrub seed shall be supplied to the requirements of the Special Provisions.

**757.12.03 Seed Analysis Report** - Upon request by the

Ministry Representative, the Contractor shall provide valid Certificates of Analysis for each species and seed lot used in a mix. These shall set out details of the seed as specified in the "Canadian Methods and Procedures for Testing Seed".

**757.12.04 Packaging and Labelling** - Seed shall be supplied in the original sealed packages, with legible labels securely attached, and providing the following information:

- Supplier's name and address
- Analysis of seed mixture – the grade, and the name and percentage by weight of individual seed species
- Percentage of Pure Live Seed (PLS) for each species
- Lot number and crop year for each species in the mix
- Net weight (mass)
- Date and location of packaging

**757.13 Fertilizer** - Fertilizer shall comply with the provisions of the Canada Fertilizers Act and Fertilizer Regulations. Fertilizer shall be supplied as noted on the table "Standard Grass Seed Mixes For Revegetation of British Columbia Highway Roadsides" unless otherwise specified in the Special Provisions.

**757.14 Hydraulic Mulch** - Hydraulic mulch shall be a wood fibre type, specifically designed for hydraulic seeding, and having demonstrated satisfactory past performance for this purpose. The product shall be dyed green for appearance and ease of monitoring application.

Mulch shall be supplied in packages bearing the manufacturer's label, clearly indicating the weight and product name.

Mulch may contain a tackifier, which shall adhere to mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydraulic mulching equipment.

**757.15 Water** - Water used for hydraulic seeding operations shall be free of impurities that would inhibit germination and growth or may be harmful to the environment. Unless otherwise noted in the Special Provisions, the Contractor shall be responsible for securing a water source for hydraulic application of materials, including obtaining use permits under the Water Act if water is to be drawn from waterbodies, and for all cost to supply.

**757.16 Other Materials** - Tackifiers, Bonded Fiber Matrix coverings, erosion control blankets, soil amendments and other materials shall be supplied to the specifications in the Special Provisions.



**EQUIPMENT**

**757.21 General** - Equipment used shall be capable of applying the materials listed in the Special Provisions uniformly over the designated areas.

Equipment shall not cause soil rutting or other site damage.

**757.22 Hydraulic Seeding/Mulching Equipment** - Equipment shall have the tank volume identified by an identification plate or sticker, which shall be affixed in plain view.

The hydraulic seeder/mulcher shall be capable of sufficient agitation to mix the materials into a homogenous slurry, and to maintain the slurry in a homogeneous state until application.

Equipment shall be adequately sized to the task, to complete work efficiently within the time frame specified, and to permit application of materials without excess water being applied, or undue time lapse between operations. Hydraulic mulchers should be capable of producing slurry viscosities containing approximately 18 to 30kg of mulch per 500 litres of water.

Extension hoses or pipes shall be provided to reach areas not accessible from the hydraulic seeder.

**CONSTRUCTION**

**757.31 Scheduling** - Work shall be scheduled to ensure a minimum duration of on-site storage of materials, minimum compaction of topsoil, and prompt mulching operations.

The work shall be co-ordinated with the schedule of other trades, and be well integrated with specific requirements such as Sediment and Drainage Management Plans, which may be provided for any given project.

**757.32 Protection** - Existing site equipment, roadways, landscaping, reference points, monuments, markers, utilities and structures shall be protected from damage.

**757.33 Timing of Material Application** - Material application shall be carried out in accordance with the milestone dates provided in the Special Provisions, and after fine grading has been completed and the prepared areas approved by the Ministry Representative.

**757.34 Methods** - The methods chosen for material application shall be at the Contractor's discretion, unless otherwise specified in the Special Provisions.

**757.35 Rates of Application** - Application of fertilizers,

seed mixtures, mulch and other materials shall be at the rates specified in the Special Provisions.

**757.36 Record of Application** - The Contractor shall maintain a record of all pertinent application information on the form supplied by the Ministry for this purpose, or similarly provided by the Contractor. Refer to Sample Form "Daily Seeding/Application Record".

**757.37 Application Method for Mechanical Drop or Broadcast Dry Seeding** - Seed shall be applied in two intersecting directions, except where conditions dictate seeding in one direction only.

Seeding shall overlap adjoining ground cover by 300mm.

Refer to the Special Provisions for specific instructions for installation of wildflower, shrub and other seed as may be applicable.

**757.38 Hydraulic Application of Materials**

**757.38.01 General** - The hydraulic seeder/mulcher shall be operated in compliance with Ministry safety standards including those detailed in the publication "Guidelines for Hydroseeding in Proximity to Hydro Lines."

Materials shall not be sprayed on objects not expected to support plant growth.

The Contractor shall be responsible for any overspray or damages incurred during hydroseeding. Any overspray or damage shall be made good at no cost, to the satisfaction of the Ministry Representative.

**757.38.02 Mixing** - The required quantities of seed, fertilizer, mulch, tackifier and other material shall be charged into the tank accurately by weight or by an acceptable system of mass calibrated volume measurement. The materials shall be thoroughly mixed into a homogeneous water slurry prior to application.

All seed shall be added last when mixing. Pellet inoculated seed shall be applied immediately after placement into tank, and if this is not possible, dry application methods must be used. Other seed shall not be left in the tank for unreasonable lengths of time prior to application, i.e. – exceeding one or two hours, particularly when in contact with fertilizer solution.

The Ministry Representative will determine if Seed that remains in the tank for periods longer than specified can be used. Rejected seed shall be replenished with fresh stock.

**757.38.03 Application** - The mulch and tackifier



components of hydraulically applied mixtures will generally be applied in stages. The initial pass of the hydraulic seeder will distribute the correct amount of seed and fertilizer for the area being done, as well as up to one third of the required mulch/tackifier. The subsequent pass(es) will complete the mulching/tacking process to the required rate.

Mulch shall be applied to form an even, uniform mat blended 150 mm into adjacent vegetated areas or previous mulch applications.

**757.39 Related Work** - Additional related work such as the application of erosion control blanket or other coverings, and harrowing or disking of soil following material application, shall be as specified in the Special Provisions.

**757.40 Clean-up** - All surplus and waste materials resulting from seeding operations shall be removed from the job site after empty product containers have been inspected by the Ministry Representative.

Hydraulic seeding and/or mulching overspray that may cause problems on areas or objects not designated for re-vegetation, shall be removed in an appropriate manner.

**757.41 Conditions for Acceptance** - Treated areas will be accepted by the Ministry when the following conditions have been met:

a) Treated areas are not thin with bare patches, or uneven in distribution.

b) Empty containers of materials used during the work are stored neatly on site for inspection by the Ministry Representative.

**757.42 Repairs** - Seeded areas that show thin application or bare spots shall be re-treated with the specified materials at the Contractor's expense and at the earliest opportunity, weather and season permitting.

## MEASUREMENT

**757.81 General** - Revegetation Seeding will be measured by the HECTARE treated. The treated areas will be measured to the nearest tenth of a hectare [0.1 ha].

## PAYMENT

**757.91 General** - Payment for REVEGETATION SEEDING will be at the Contract Unit Price per hectare. The Contract Unit Price shall be accepted as full compensation for the work described and all work subsidiary and incidental thereto for which separate payment is not elsewhere provided.



SHEET # \_\_\_\_\_

MINISTRY OF TRANSPORTATION AND HIGHWAYS

PROJECT # \_\_\_\_\_

DAILY SEEDING/APPLICATION RECORD

DATE	LOAD #	AREA COVERED IN HECTARES			SEED APPLIED* (IN KG.)			OTHER MATERIALS* (IN KG.)			REMARKS
		GRASS	MULCH	REFERT	GRASS	RYE	OTHER	FERT	MULCH	TACK	
	1										
	2										
	3										
	4										
	5										
	6										
	7										
	8										
	9										
	10										
	11										
	12										
	13										
	14										
	15										
	16										
	17										
	18										
	19										
	20										
	Total of Sheet										
*Provide details of seed mixes and other materials, as required, in this space:											
THIS SHEET CERTIFIED CORRECT:  FOR MINISTRY _____  FOR CONTRACTOR _____  DATE: _____											



**STANDARD GRASS SEED MIXES FOR  
REVEGETATION OF BRITISH COLUMBIA HIGHWAY ROADSIDES (BY WEIGHT)**

<u>CLIMATIC AREA</u>	<b>STANDARD MIXES (by weight)</b>	<b>APPLICATION</b>
<b>South Coast</b>	<b><u>Vancouver Island / Coast Mix</u></b>	
	Perennial Ryegrass 26%	General seeding coastal locations where mean annual precipitation is > 90 cm.  Fertilizer: 16-32-6
	Creeping Red Fescue 24%	
	Alsike Clover 14%	
	Hard Fescue 13%	
	White Clover 9%	
	Timothy 8%	
	Canada Bluegrass 4%	
	Redtop 2%	
	<b><u>Interior Forestland Mix</u></b>	
	Intermediate Wheatgrass 32%	General seeding inland where mean annual precipitation is >50 cm.  Fertilizer: 16-32-6
	Alfalfa ("Rambler") 20%	
	Perennial Ryegrass 15%	
	Annual Ryegrass 15%	
	Hard Fescue 10%	
	White Dutch Clover 5%	
	Canada Bluegrass 2%	
	Redtop 1%	
	<b><u>Interior Dryland Mix</u></b>	
	Crested Wheatgrass 40%	General seeding inland where mean annual precipitation is < 30 cm.  Fertilizer: 16-32-6
	Tall Wheatgrass 25%	
	Slender Wheatgrass 20%	
	Hard Fescue 15%	
<b>Thompson – Okanagan</b>	<b><u>Interior Forestland Mix</u></b>	
	Intermediate Wheatgrass 32%	General seeding inland where mean annual precipitation is >50 cm.  Fertilizer: 22-11-11
	Alfalfa ("Rambler") 20%	
	Perennial Ryegrass 15%	
	Annual Ryegrass 15%	
	Hard Fescue 10%	
	White Dutch Clover 5%	
	Canada Bluegrass 2%	
	Redtop 1%	
	<b><u>Interior Dryland Mix</u></b>	
	Crested Wheatgrass 40%	General seeding inland where mean annual precipitation is < 30 cm.  Fertilizer: 22-11-11
	Tall Wheatgrass 25%	
	Slender Wheatgrass 20%	
	Hard Fescue 15%	
	<b><u>Alkaline Tolerant Blend</u></b>	
	Crested Wheatgrass 35%	General seeding in alkaline soils.  Fertilizer: 22-11-11
	Sherman Big Bluegrass 20%	
	Hard Fescue 20%	
	Canada Bluegrass 15%	



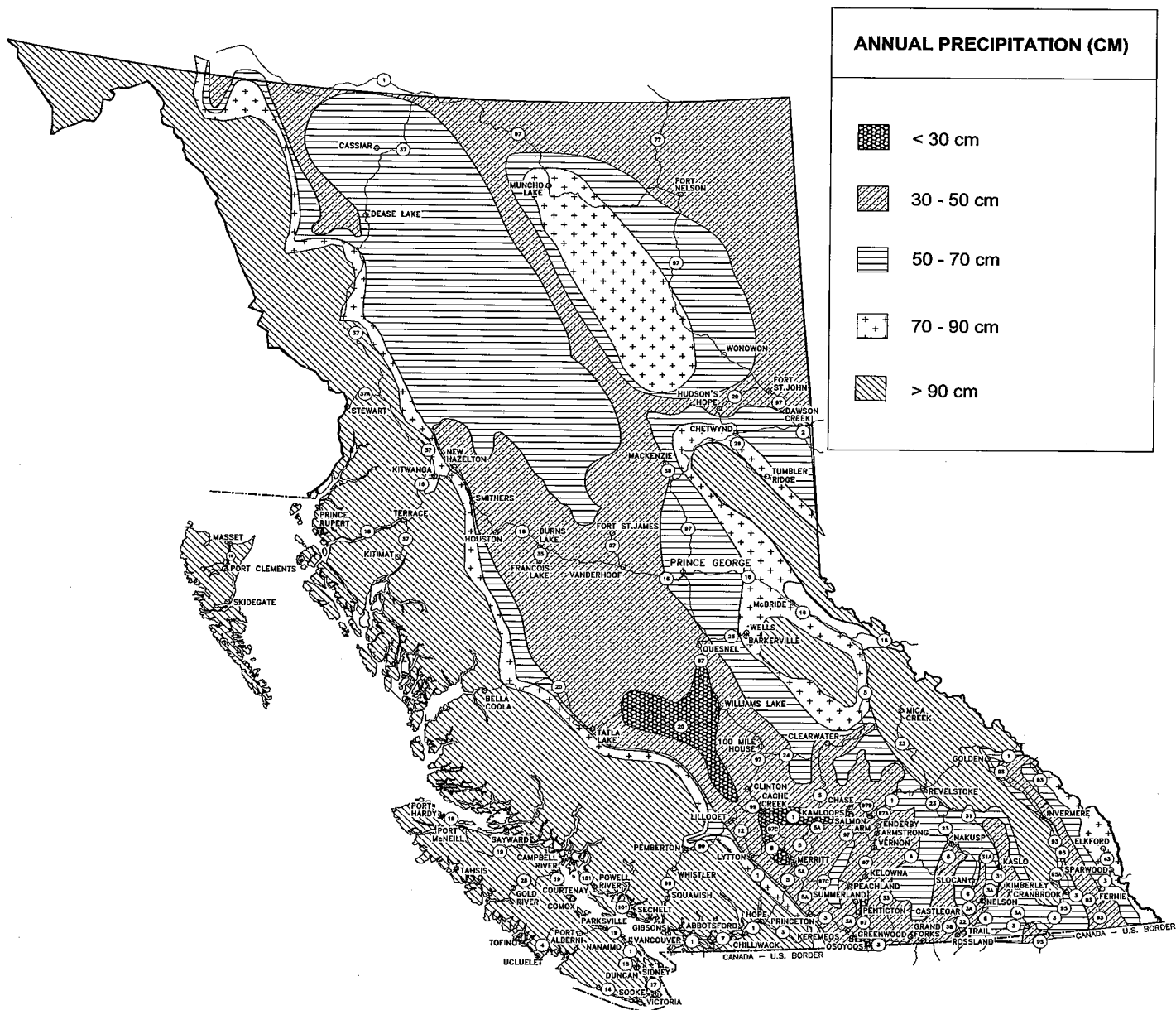
<u>CLIMATIC AREA</u>	<b>STANDARD MIXES (by weight)</b>	<b>APPLICATION</b>
<b>Kootenays</b>	<p><b><u>Interior Forestland Mix</u></b></p> <p>Intermediate Wheatgrass 32%  Alfalfa ("Rambler") 20%  Perennial Ryegrass 15%  Annual Ryegrass 15%  Hard Fescue 10%  White Dutch Clover 5%  Canada Bluegrass 2%  Redtop 1%</p> <p><b><u>Kootenay Dryland</u></b></p> <p>Tall Wheatgrass 45%  Crested Wheatgrass 20%  Alfalfa ("Rambler") 15%  Hard Fescue 7%  Sheep Fescue 5%  Alsike Clover 5%  Canada Bluegrass 2%  Redtop 1%</p>	<p>General seeding inland where mean annual precipitation is &gt;50 cm.</p> <p>Fertilizer: 22-11-11</p> <p>General seeding inland where mean annual precipitation is &lt; 50 cm.</p> <p>Fertilizer: 22-11-11</p>
<b>Northern (Prince George <u>Area</u>)</b>	<p><b><u>North East General Mix</u></b></p> <p>Smooth Brome grass 40%  Creeping Red Fescue 20%  Timothy 15%  Alfalfa 15%  Alsike Clover 10%</p> <p><b><u>North East Dryland Mix</u></b></p> <p>Crested Wheatgrass 35%  Intermediate Wheatgrass 25%  Alfalfa 15%  Smooth Brome grass 10%  Creeping Red Fescue 10%  Alsike Clover 5%</p>	<p>General seeding inland where mean annual precipitation is &gt; 50 cm.</p> <p>Fertilizer: 26-16-8</p> <p>General seeding inland where mean annual precipitation is &lt; 50 cm.</p> <p>Fertilizer: 26-16-8</p>
<b>Northern (Terrace <u>Area</u>)</b>	<p><b><u>North West General Mix</u></b></p> <p>Smooth Brome grass 70.6%  Alfalfa 18.0%  Creeping Red Fescue 3.9%  Alsike Clover 3.4%  Timothy 2.9%  Kentucky Bluegrass 1.1%</p> <p><b><u>North West Dryland Mix</u></b></p> <p>Intermediate Wheatgrass 47.7%  Alfalfa 19.1%  Crested Wheatgrass 17.9%  Orchardgrass 9.1%  Hard Fescue 3.0%  White Clover 2.1%  Kentucky Bluegrass 1.1%</p>	<p>General seeding inland where mean annual precipitation is &gt; 50 cm.</p> <p>For use in CWH and ICH biogeoclimatic zone.</p> <p>Fertilizer: 22-11-11</p> <p>General seeding inland where mean annual precipitation is &lt; 50 cm.</p> <p>For use in SBS biogeoclimatic zone (East of Moricetown to West of Endako)</p> <p>Fertilizer: 22-11-11</p>



<u>CLIMATIC AREA</u>	<b>STANDARD MIXES (by weight)</b>	<b>APPLICATION</b>
	<p><b><u>Northern Coastal Mix:</u></b></p> <p>Alfalfa 46.6%  Intermediate Wheatgrass 14.0%  Smooth Bromegrass 10.3%  Kentucky Bluegrass 9.0%  Sheep Fescue 8.2%  Birdsfoot Trefoil 6.2%  Timothy 5.7%</p> <p><b><u>Northern Mix:</u></b></p> <p>Hairy Vetch 57.3%  Crested Wheatgrass 16.4%  Alfalfa 13.1%  Creeping Red Fescue 5.3%  Orchardgrass 3.8%  Birdsfoot Trefoil 3.1%  Kentucky Bluegrass 1.1%</p> <p><b><u>Ditch Vegetation Seed Mixture</u></b></p> <p>Crested Wheatgrass 38.7%  Alfalfa 30.9%  Creeping Meadow Foxtail 15.8%  Birdsfoot Trefoil 6.9%  Reed Canarygrass 4.8%  White Clover 1.6%  Kentucky Bluegrass 1.2%</p>	<p>General seeding coastal locations where mean annual precipitation is &gt; 90 cm.</p> <p>For use in CWH biogeoclimatic zone (QCI, Prince Rupert to Pacific)</p> <p>Fertilizer: 22-11-11</p> <p>General seeding coastal locations where mean annual precipitation is &gt; 90 cm.</p> <p>For use in ICH and BWBS biogeoclimatic zones.</p> <p>(ICH – Pacific to Moricetown, Kitwanga to Thomas Creek 220 km N)</p> <p>(BWBS – Thomas Creek to Yukon border)</p> <p>Fertilizer: 22-11-11</p> <p>For use in revegetating roadside ditches following ditch maintenance operations.</p> <p>Fertilizer: 22-11-11</p>
<b>Vancouver Island</b>	<p><b><u>Vancouver Island / Coast Mix</u></b></p> <p>Perennial Ryegrass 26%  Creeping Red Fescue 24%  Alsike Clover 14%  Hard Fescue 13%  White Clover 9%  Timothy 8%  Canada Bluegrass 4%  Redtop 2%</p>	<p>General seeding coastal locations where mean annual precipitation is &gt; 90 cm.</p> <p>Fertilizer: 18-18-18</p>



## MEAN ANNUAL PRECIPITATION





## SECTION 766

### IRRIGATION

#### DESCRIPTION

**766.01 Scope** - The work consists of the supply of all material, labour and equipment to install a complete and operating irrigation system as shown on the Plans. The Contractor shall be responsible for obtaining all permits required.

**766.02 Site Security** - The Contractor shall be responsible for maintaining all security at the project site at all times, and shall ensure that no damage or breakage occurs to stockpiled materials or to the partially installed irrigation system. The Contractor shall make good all damage resulting from acts of vandalism throughout the period of installation and subsequent maintenance.

**766.03 Electrical Trades** - The Contractor shall contact the Electrical Trades Supervisor prior to performing work on any existing Ministry owned equipment. All AC electrical connections shall be done by a qualified electrician.

**766.04 Drawings and Instructions** - The Contractor shall install the irrigation system as shown and detailed on the Drawings and Specifications. No deviation from the indicated make and model or installed location of valves, mains, laterals or any other irrigation system component will be allowed without first obtaining written permission from the Ministry Representative.

The Contractor shall maintain a daily record of construction activities. Upon completion of the Contract, the Contractor shall incorporate all accumulated information relevant to the Contract into the required as-built Drawings. The as-built Drawings shall be to the Ministry Representative's satisfaction, shall be reproducible, and shall be compiled by a competent professional draftsman.

The Contractor shall prepare drawings showing the final location and make of all heads, emitter locations, pipe layout and other pertinent information, and shall submit two sets of these Drawings to the Ministry Representative. The Contractor shall prepare another Drawing showing the wiring and automatic controller station numbers with all electrical data. The Contractor shall submit two copies of this Drawing and one set of the operating instructions for the controller, complete with spare parts list to the Ministry Representative. All Drawings, spare parts lists, and operating instructions shall be cerlox bound into a plastic covered 8 1/2 x 11 booklet.

After the system has been completed, the Contractor shall instruct the Ministry Representative's agent in the proper use of the equipment.

Substantial completion will not be certified until adjustments and Drawings are approved.

**766.05 References - Codes & Standards** - In the absence of other instructions, the provisions of all the following codes and standards shall apply: The National Building Code of Canada; Current CSA Specifications for copper, steel and plastic pipe; AWWA Specification, current editions.

#### MATERIALS

**766.11 General** - Shipping, handling and installation of materials shall be to manufacturer's recommended instructions, and best work practice. Particular care shall be taken to avoid scratches and nicks on the plastic pipe. Pipe must be properly stacked and stored in a clean place on the site, keeping dirt out of the pipe at all times.

**766.12 Pipes and Fittings** - Galvanized pipe, Schedule 40, with galvanized fittings, shall be used inside culverts. The pipe shall be connected to the plastic main or lateral 450 mm clear of the culvert.

Plastic pipe shall be used for the submain and laterals of the irrigation system. Plastic pipe shall be semi-rigid extruded from PVC (Polyvinyl Chloride) resin, Type 1, grade 2, normal impact.

The minimum classes to be used are listed in Table 766-A.

**TABLE 766-A MINIMUM CLASSES OF PLASTIC PIPE**

Up to 25 mm diameter	Class 200 for excavated trenches
30 mm diameter and larger	Class 160 for excavated trenches
All sizes	Class 200 for pipe flow

Fittings shall be PVC plastic, Schedule 40 or 80, designed for solvent welding to PVC pipe.

All fittings must have 1/2 to 2/3 interface fit to ensure a fully seated joint. Individual fittings shall be selected to ensure a proper fit or they will be rejected.

All pipe and fittings shall be continuously and legibly marked with at least the following information:

- Manufacturer's name or trademark;
- Pressure rating;
- Type of material.



Pipe that is not marked to the satisfaction of the Ministry Representative will be rejected and shall be removed from the site by the Contractor.

**766.13 Cement** - Pipe cement for solvent welding shall be of the type and make recommended by the pipe manufacturer, supplied to the site in sealed containers clearly marked with the name of the manufacturer and the lot number. The Contractor shall comply with the manufacturer's instructions and safety procedures.

**766.14 Sprinkler Heads** - Risers for turf heads, lawn heads, impact heads, shrub heads and quick-coupling (QC) valves shall be swing joint type, fabricated from Schedule 80 PVC or Schedule 40 galvanised pipe and fittings, as detailed in the Specifications. Teflon tape shall be used on all threaded connections.

Sprinkler heads shall be as detailed on the Drawings.

**766.15 Valves** - Automatic valves shall be as detailed on the Drawings and the same make shall be used throughout. Automatic valves shall have flow control stems.

Valves shall be installed in Carson Industries No. 1419 valve boxes or other approved alternative complete with extensions and covers, as required. The top of all valve box covers shall be flush with the finished grade.

**766.16 Controllers** - Automatic controllers shall be supplied to operate the electrically controlled automatic valves. Controllers shall be 24 volt A.C. outlet, Class 2 rating, compatible with the valves used. Controllers and automatic valves shall be by the same manufacturer, unless otherwise noted. Controllers and transformers must bear CSA or Provincial stamps of approval. Controllers shall be as detailed on the Plans.

Controllers shall be installed in Ministry standard controller box 30-A-120/240V, weatherproof, stainless steel service panel SN1765A as shown on Drawing [SP635-2.4.8](#), or pre-approved equal complete with a Masterlock No. 15 padlock and two sets of keys for the lock.

**766.17 Wiring** - Wire between controllers and automatic valves shall be of a type approved for direct burial. Where control wires are exposed or pass through culverts, they shall be installed in rigid electrical conduit.

Wire shall be minimum 14 gauge single strand T.W.U.

**766.18 Selected Native Fill** - Native fill selected for backfilling shall be free of stones, gravel, wood or any other debris, and shall be approved by the Ministry Representative.

## CONSTRUCTION

**766.31 General - Damaged Material** - Damaged material shall be rejected on the decision of the Ministry Representative. The Contractor shall take care to prevent dirt from entering the pipe.

Plastic pipe shall not be repaired by patching. Where pipe has been damaged, the damaged section shall be removed and a new section shall be installed complete with new fittings.

**766.32 Line Location** - The Contractor shall ensure that all irrigation pre-ducts for passage of irrigation lines under roadways, medians, traffic islands and other surface impediments have been installed and are clearly marked at all entry points.

No irrigation line shall be installed parallel to and directly over another irrigation line or line of another trade. Lines laid in the same trench shall be a minimum of 50 mm apart. No pipe shall be installed closer than 300 mm to any parallel electric conduit as shown on Drawing [SP635-1.5.2](#).

**766.33 Compaction** - Before laying the pipe, the Contractor shall be satisfied as to the extent of compaction in the lawn and planting areas.

**766.34 Excavation** - Excavated soil shall be carefully placed adjacent to the trench for convenient backfilling. Topsoil and subsoil shall be piled separately to avoid contamination of the topsoil.

Stones or other objects larger than 75 mm at their widest point shall be removed from the trenches. Holes below grade lines, caused by the removal of stones, must be filled in and compacted uniformly with the adjacent trench.

**766.35 Laying the Pipe** - Pipe shall be laid by trench excavation or by an approved vibrating pipe plough. Plastic pipe shall be laid on sand or selected native fill to a compacted depth of 50 mm. A further 75 mm of sand or selected native fill shall be placed over plastic pipes prior to backfilling. Pipes shall be run in straight lines between fittings. Pipe must not be supported at intermediate points on stones, bricks or other hard material.

All mains and laterals shall have a minimum cover of 400 mm of soil as measured from the top of the pipe to the finished grade.

Lawn and planting areas shall be disturbed as little as possible.

The Contractor shall manicure the finished grade over all



mains and laterals upon completion of the pipe installation. All debris, rocks over 50 mm diameter, etc, that have been brought to the grade surface shall be removed to the Contractor's own tip. The area over all trenches shall be fine graded and shall conform to Subsection 751.34.

**766.36 Connections** - The Contractor shall make connection to the existing water supply where shown on the Drawings. The Contractor shall ensure that the recommended operating pressure of the irrigation system is not exceeded by the water pressure at the source, by installing pressure regulators as required.

**766.37 Inspection and Testing** - After the pipe is in place in the bottom of the trench with risers in place, the risers shall be capped where the sprinklers will be attached and all pipe fittings exposed. The maximum pressure shall be applied to the system and maintained for a minimum of one hour.

All fittings shall be visually inspected and any that leak shall be cut out and replaced. Leaks shall not be repaired by patching. The test pressure shall be maintained for one hour after replacing any defective sections. The section shall be re-inspected as before.

The system shall be flushed out to remove dirt and then the sprinklers shall be attached using Teflon tape or pre-approved non-setting pipe thread compound.

**766.38 Backfill** - After approval by the Ministry Representative, the trenches shall be backfilled, maintaining pressure in the line. If there is any indication of a leak, the defective section shall be located and replaced.

The trenches shall be carefully backfilled with the subsoil, followed by the topsoil. Both shall be compacted to the same density as the soil in the trench walls to minimize differential settlement. Backfill around turf heads with 0.03 m<sup>3</sup> of sand.

**766.39 Controller Installation** - The location of the controllers shall be determined on site in the areas indicated on the Plans. The Contractor shall have a qualified electrician connect the controllers to the electrical supply.

**766.40 Adjustments** - The sprinkler system shall be adjusted section by section to give satisfactory coverage to

all areas. Pressure at the heads and/or Q.C. valves shall be as noted on the Plans. Turf heads, lawn heads and Q.C. valves shall be set flush with the final turf grade by adjusting the swing joint riser, as required. During the landscape maintenance/guarantee period, the Contractor will return twice and adjust the heads, as required, to be flush with the final turf grade.

These callbacks shall be done within five days of notification by the Ministry Representative and shall be considered part of the Contract requirements.

**766.41 Surplus Material** - Surplus material shall be removed from the site.

**766.42 Conditions for Acceptance** - Substantial completion will not be certified until adjustments are completed and as-built Drawings prepared, approved, and bound into an approved booklet to the Ministry Representative's satisfaction. A copy of the inspection certificate issued by the Ministry of Competition, Science and Enterprise indicating compliance with the Electrical Code and a copy of the "Irrigation Systems Loss Calculation Sheet" found in the Ministry of Transportation Landscape Policy - Appendix 3 shall be included in the hardcover booklet.

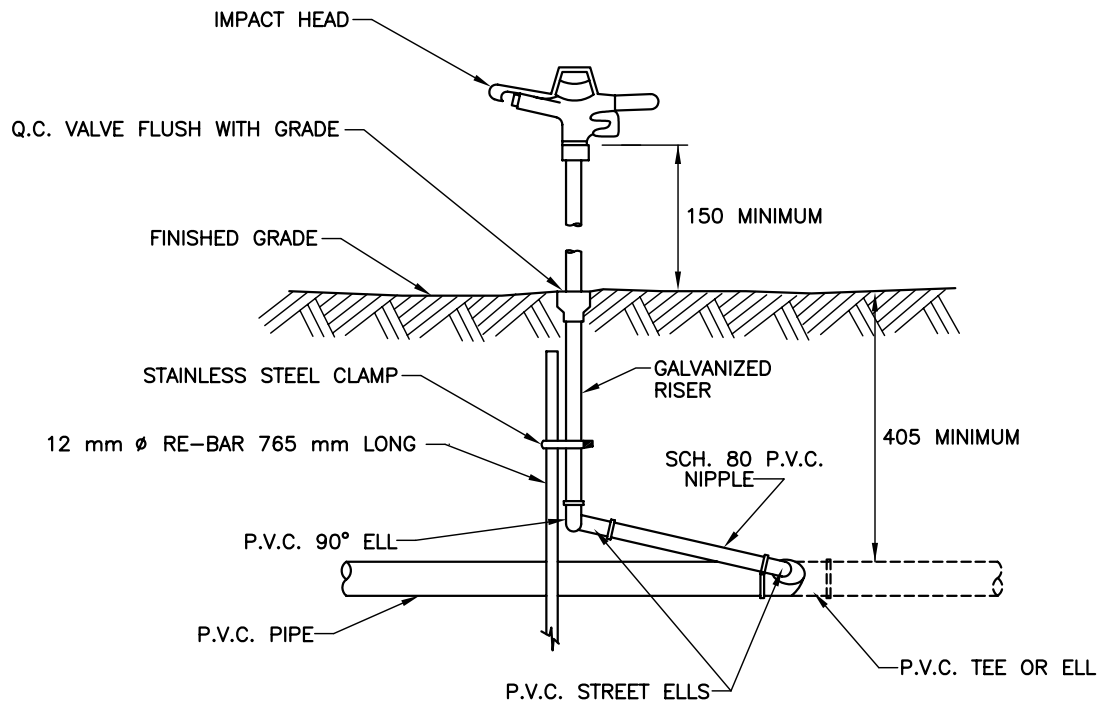
**766.43 General** - The Contractor shall monitor the operation of the system and carry out all minor repairs and required adjustments to the spray coverage of irrigation heads and operating times.

The irrigation system shall be properly winterized at the appropriate time of the season.

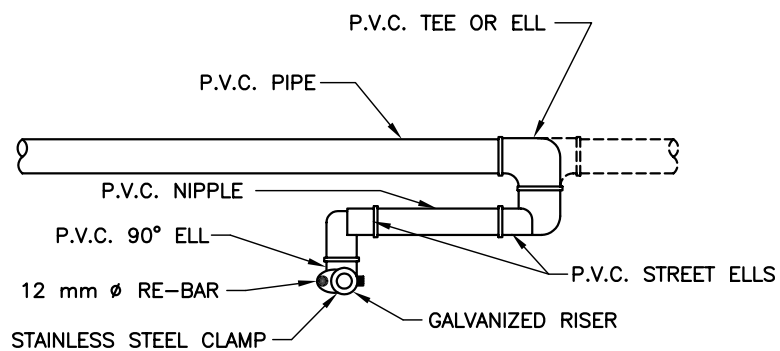
## PAYMENT

**766.91 General** - Payment for the supply and installation of the irrigation system will be at the lump sum bid. The lump sum price bid shall be full compensation for all labour and equipment required for the specified preparation, trenching, installation, testing, backfilling, clean-up, preparation of as-built Drawings, and instruction in the proper use of the equipment and for all incidental work not required to be separately paid for.





ELEVATION



PLAN

SHOWN FOR IMPACT HEAD  
QUICK-COUPLING VALVE SIMILAR

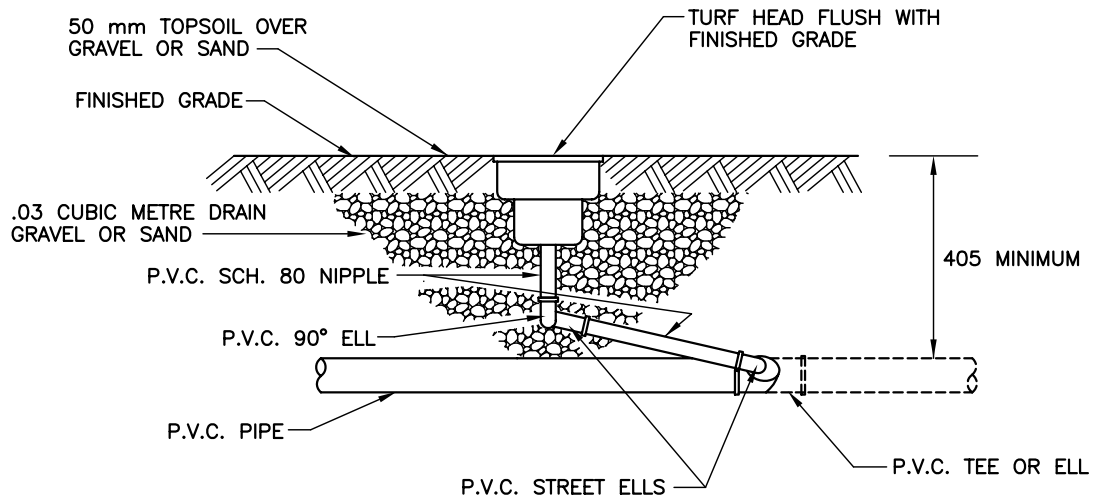
NOTE:

USE TEFLON TAPE ON ALL THREADED CONNECTIONS

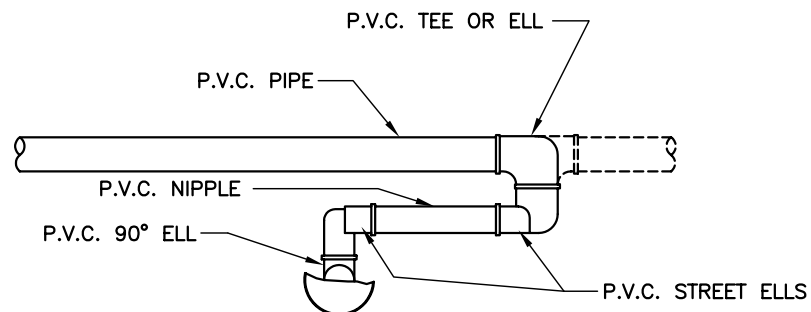
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





ELEVATION



PLAN

SHOWN FOR TURF HEAD  
LAWN HEAD SIMILAR

NOTE:

USE TEFLON TAPE ON ALL THREADED CONNECTIONS

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 769

### PROTECTION AND RETENTION OF VEGETATION

#### DESCRIPTION

**769.01 Scope** - This Section refers to the protective measures required to safeguard vegetation from construction operations, equipment and vehicles, where vegetation is not designated for removal under the Contract, and covers the installation of barriers.

**769.02 Related Work** - Section 165, Protection of the Environment; Section 200, Clearing and Grubbing; Section 201, Roadway and Drainage Excavation; Section 751, Topsoil and Landscape Grading.

#### 769.03 Definitions

**Specimen Trees** - means trees so designated in the Contract Documents.

**Native Vegetation** - means areas of existing and/or indigenous shrubs, trees and groundcover.

**Dripline** - means the location on the ground surface directly beneath a theoretical line described by the tips of the outermost branches of trees.

**Barrier** - means fence consisting of approved material, supported by steel posts and being a minimum of 2.0 m high, without breaks or unsupported sections.

#### MATERIALS

**769.11 Water** - Water shall be free of impurities that would inhibit germination and growth or may be harmful to the environment.

The Contractor shall supply the water.

**769.12 Fertilizer** - Fertilizer shall be supplied to the specifications of the Special Provisions and to Subsection 751.18.

#### CONSTRUCTION

**769.31 Operational Constraints** - The Contractor's operations shall not damage vegetation designated for retention.

Existing vegetation shown on the Plans or designated by the Ministry Representative to be retained shall be marked by the Contractor and inspected by the Ministry Representative, who may adjust the limits. A minimum of 48 hours notice shall be given to the Ministry

Representative for this purpose.

Areas shown on the plans adjacent to streams or as designated by the Ministry Representative as "Vegetation to remain" areas are not to be disturbed, cleared or logged.

The Contractor's operations shall not cause flooding, sediment deposits or deposition of debris in "Vegetation to Remain" areas.

Where construction procedures substantially alter natural drainage patterns, interim drainage or irrigation shall be provided as necessary to compensate for construction interference.

Construction procedures, stockpiling of materials or debris burning or disposal shall not be undertaken adjacent to designated trees and/or native vegetation retained.

Unless the Contract requires work within the dripline of trees designated to remain, equipment shall not be operated within that dripline. When the Contract requires work within the dripline of trees designated to remain, operation of equipment within that dripline area shall be kept to the minimum necessary to perform the work required, as required by the Ministry Representative. Tree roots shall be protected from compaction by temporary placement of hogfuel or other lightweight insulative material, as required by the Ministry Representative.

Equipment or vehicles shall not be parked, repaired or refuelled, construction materials shall not be stored and earth materials shall not be stockpiled within the dripline area of any tree designated to remain.

**769.32 Clearing and Grubbing** - No clearing and grubbing shall be conducted for a radius of 3 m from the trunks which lie on the edge of clearing and grubbing zones, or as directed by the Ministry Representative.

Trees to be removed shall be felled toward the centre of an area, away from selectively cleared or retained vegetation.

**769.33 Barriers for Existing Vegetation Protection** - Barriers for vegetation protection shall be erected prior to commencement of construction operations, at locations specified in the Plans, to provide a continuous barricade between vegetation and the area of work. The barriers shall be maintained erect and in good repair throughout the duration of construction operations, and shall be



removed upon completion of the work, and disposed of outside the project by the Contractor.

The barrier shall be placed at the dripline of trees or forest edges unless this is inadequate space to provide a 1.5 m buffer zone between the barrier and the limit of grading. The barrier shall be placed within the dripline if necessary to provide a buffer zone of up to 1.5 m. Under no circumstance shall it be placed less than 0.75 m from the circumference of the trunk. When the trunks of trees are less than 4.5 m apart, the trees shall be considered a group, and the barrier shall be placed to form a continuous barricade as specified in the Plans.

A barrier is not required where an existing fence will serve the same purpose. At such locations, the barrier shall terminate at the existing fence so that a continuous barricade is provided between the trees and the area of work.

**769.34 Pruning and Repair of Specimen Trees -** Specimen trees and trees safeguarded by barriers shall be repaired in accordance with this Subsection.

One third of the tree branches shall be selectively removed to reduce transpiration and compensate for dieback of roots in fill conditions and damage to the root system in cut conditions.

Within five calendar days of damage, branches 25 mm or greater in diameter that are broken as a result of the Contractor's operations shall be cut back cleanly at the break, or to within 10 mm of their base, if a substantial portion of the branch is damaged.

Roots 25 mm or larger in diameter that are exposed by the Contractor's operations, shall be cut back cleanly to the soil surface within five calendar days of exposure.

Bark that is damaged by the Contractor's operations shall be neatly trimmed back to uninjured bark, without causing further injury, within five calendar days of damage.

## MAINTENANCE

**769.71 Watering -** The retained specimen trees shall be watered three times during the summer or as stated in the Special Provisions or as directed by the Ministry Representative. The area immediately below the tree crown shall be soaked sufficiently to reach the feeder roots.

**769.72 Fertilizing -** Where specified or directed by the Ministry Representative, fertilizer shall be applied at a rate of 50 g/mm of caliper to existing specimen trees to be retained. The caliper measurement shall be taken 0.3 m above the grade. The fertilizer shall be applied once early in the growing season unless specified otherwise.

## MEASUREMENT

**769.81 General -** Measurement for barriers will be made in metres according to the length of barrier installed to protect vegetation.

## PAYMENT

**769.91 General -** Payment at the unit price bid for barriers shall be full compensation for work described and all work subsidiary and incidental thereto for which separate payment is not elsewhere provided. Compensation for all costs other than installation of barriers associated with the work of protecting vegetation to be retained shall be deemed to be included in the contract prices for the various tender items of the contract.



## **SECTION 903**

### **TIMBER - MATERIALS**

**903.01 General** - All timber shall be graded in accordance with the current Standard Grading Rules of the National Lumber Grades Authority. Timber must be grade stamped with the exception of unfinished or rough timber, which may prove too difficult to stamp, in which case a grading certificate may be requested.

**903.02 Species and Grade** - Timber species and Grade shall be as specified on the Purchase Order, Work Order or drawings.

**903.03 Inspection** - All timber may be inspected before shipment to the construction site, or at the construction site, or both. The Supplier or Contractor shall provide the necessary facilities to enable the Ministry Representative or the Ministry Representative's authorized alternate to expeditiously examine as many pieces as are deemed necessary. All material rejected shall be replaced at the Supplier's or Contractor's expense including shipping charges and removal of rejected material at the construction site, if applicable. Inspection of timber before shipment shall not be a bar to its subsequent rejection at the construction site if found to fail any requirements of this specification.

No material shall be shipped prior to inspection or until a release for shipment has been issued by the Ministry Representative.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 904

### TIMBER (TREATED AND UNTREATED) - FABRICATION AND HANDLING

**904.01 General** - All timber shall conform to the requirements of Section 903, Timber - Materials. Timber to be treated shall be treated in accordance with Section 908, Preservative Treatment - Wood Products. Except as modified herein, preservative treated wood products shall be handled in accordance with CSA Standard 080-M4.

**Note:** CSA Standards are obtainable from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3

**904.02 Framing** - All the cutting, boring, framing, match marking, etc. required on all timber shall be done by competent bridge framers in a thorough manner, in accordance with good work practice. It shall be done such that surfaces in contact shall bear evenly and fully; no shims or open joints are permitted. All measurements shall be accurate. Gains and daps shall have plane, smooth surfaces.

**904.03 Bridge Iron** - The Ministry will supply all iron that is necessary for use in the framing operations.

**904.04 Handling of Untreated Timber** - All materials shall be handled with reasonable care. Timber shall not be bashed, bruised, gouged, cracked, split or otherwise damaged. Minor damage, in the opinion of the Ministry Representative, shall be repaired at the Contractor's expense; severely damaged materials will be rejected and replaced entirely at the Contractor's expense including all shipping and disposal charges.

**904.05 Preparation of Timber Before Treatment** - All cutting, such as boring, chamfering, framing, gaining, surfacing, trimming etc., shall be done prior to treatment.

In the event that cutting becomes absolutely necessary after treatment, the cut surfaces shall be saturated with preservative according to CSA Standard 080-M4 Paragraph 1.5.

**904.06 Condition After Treatment** - After treatment, timber with checks exceeding the limiting sizes specified for the appropriate grade shall be rejected (see Section 903, Timber-Materials).

**904.07 Handling of Treated Timber** - Pointed tools or equipment such as dogs, hooks, peavies, etc. shall not be used on the side surfaces of treated timber. The use of pointed tools shall be confined to the end grain and shall be such as to avoid damage to the pressure-treated surface.

Treated timber shall not be dragged along any surface.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 905

### TIMBER - GLUED LAMINATED

**905.01 General** - The requirements of the current CSA Standard 0122 - Specification for Glued Laminated Softwood Structural Timber shall apply to all glued laminated members. Wood species shall be as specified on the drawings, purchase order or work order, except that if the members are to be pressure treated in accordance with CSA 080-28 (See Section 908) they may only be of Coast Region Douglas Fir or Western Hemlock.

**Note:** CSA Standards are obtainable from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3

**905.02 Classification** - Unless otherwise specified on the drawings, purchase order or work order the appearance grade shall be Industrial and the service grade shall be Exterior. The stress grade shall be as shown on the drawings, purchase order or work order.

**905.03 Quality Control** - Laminations shall be grade-marked and the marking shall be visible until the glue has been applied.

The shear tests described in Appendices "A" and "B" of CSA Standard 0122 shall be carried out by the Contractor. Copies of the shear test results shall be forwarded to the Ministry Representative.

Vacuum-pressure cycle tests may be carried out by the Ministry, and the Contractor shall supply the Ministry with a full section cut-off, 75 mm long, from each end of the member for this purpose.

**905.04 Incising** - The end bearing surfaces of members shall be incised prior to pressure treatment.

**905.05 Handling of Treated Glued Laminated Members** - Members shall be protected to avoid damage due to handling: dogs, hooks, peavies or other equipment shall not be used on the side surfaces of treated timber. All handling of treated timber with pointed tools shall be confined to end grain and shall be such as to avoid damage to the original pressure-treated surface.

Subject to the approval of the Ministry Representative, the Contractor shall make good superficial damage of treated timber by the methods outlined in the current edition of CSA Standard 080 - Wood Preservation. Timber which, in the opinion of the Ministry Representative, cannot be made good by such methods will be rejected.

**905.06 Storage of Glued Laminated Members** - Members lying in storage shall be supported evenly on a flat surface. When stored for a prolonged time, they shall be gapped to permit air circulation.

**905.07 Inspection** - All timber and all phases of the work including pressure treatment, if applicable, may be inspected by the Ministry Representative or the Ministry Representative's authorized alternate. The Ministry shall be given 48 hours notice of commencement of gluing and pressure treating, if applicable. The Contractor shall provide the necessary facilities to enable the Ministry Representative or the Ministry Representative's authorized alternate to expeditiously examine as many pieces as are deemed necessary by the Ministry Representative. All material rejected shall be replaced at the Contractor's expense including shipping charges and removal of rejected material at the construction site, if applicable. Inspection of glued laminated timber before shipment shall not be a bar to its subsequent rejection at the construction site if found to fail any requirements of the Specification.

No material shall be shipped prior to inspection or before a release for shipment has been issued by the Ministry Representative.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 906

### ROUND TIMBER PILES

**906.01 Scope** - This Section covers the quality and manufacture of untreated and pressure-treated round timber piles.

Where convenient, the requirements contained in this Section use the wording of the current CSA Standard CAN3-056-M "Round Wood Piles", in particular for term definition (see [Appendix A](#)) and the majority of measurement and material requirements.

**Note:** CSA Standards are obtainable from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3.

Preservative treatment of piles shall conform to the requirements of Section [908](#), Preservative Treatment - Wood Products.

#### 906.02 Species

**906.02.01 Untreated Piles** - This specification does not restrict the species used for untreated piles except as may be specified on the Purchase Order, Work Order or drawing.

**906.02.02 Pressure Treated Piles** - Species of piles to be pressure treated shall be as specified on the Purchase Order, Work Order or drawing and restricted to those for which pressure treating specifications are included in CSA Standard 080, Wood Preservation. Pressure treatment of piles shall be according to Section [908](#).

**906.03 Size** - The size of a pile shall be designated by

length and either minimum and maximum butt diameter or minimum and maximum tip diameter, or both. Sizes of piles normally available are shown in Table [906-A](#).

#### 906.04 Diameter

- a) All measurements of diameter shall be made inside the bark.
- b) The diameter of treated piles shall be measured after treatment.
- c) Butt diameters shall be measured at the extreme butt.
- d) Tip diameters shall be measured at the extreme tip.
- e) The diameter of a pile shall be determined either by measuring the circumference in millimetres and dividing the result by 3.14 or by taking the average of the maximum and minimum diameter.
- f) A variation of -15 mm in the diameter at the tip or at the butt but not in both, shall be allowed in not more than 25% of the piles when the specification of four or more piles is to be determined.
- g) If allowances are specified on the order, they shall supersede Subsection [906.04 \(f\)](#).

#### 906.05 Length

- a) Pile lengths shall be measured in metres.

**TABLE 906-A SIZES OF TIMBER PILES**

Size Designation	36	33	30	27	24
Minimum Diameter at Extreme Butt or Large End (mm)	360	330	300	270	240
Length in Metres	Minimum Diameter at Small End Tip (mm)				
Up to 6	250	250	230	200	180
6 to 11	250	230	200	180	150
12 to 14	230	200	180	150	-
15 to 18	200	180	180	-	-
19 to 21	200	180	150	-	-
22 to 27	180	150	-	-	-
28 to 32	150	130	-	-	-

**Note:** Diameters are minimum except for tolerance permitted in Subsection [906.04 \(f\)](#). Maximum diameter at butt shall not exceed 500 mm for any pile size.



- b) A variation of  $\pm 150$  mm from designated lengths will be permitted, unless allowable over and under lengths are stated on the order.

**906.06 General Material Requirements** - Piles shall be cut from sound live trees. Sides and end surfaces of the piles shall be free of ice, snow and mud, and exposed for visual inspection.

Untreated piles shall be sound and close-grained.

Treated piles shall:

- have not less than 25 mm sapwood, and shall be cleanly peeled;
- not be cored until 24 hours after treatment;
- be cored in the middle third of the length of the pile.

#### 906.07 Prohibited Defects

- Through checks
- Bird holes
- Cross-breaks of grain (cracks)
- Decay
- Nails, spikes and other metal or foreign substance.
- Holes in treated piles (except holes for test purposes, which shall be properly plugged). Holes for brailing purposes shall be drilled prior to treatment.
- Shakes in the tip.
- Splits in the tip
- Insect damage
- Any abnormal change in cross-section (including ground swell)
- Knot clusters
- Unsound scars (cat faces)
- Short crooks (see Drawing [SP906-01](#))
- Reverse sweep (see Drawing [SP906-02](#))
- Burst - unsound piling which have 15 mm or more of a concentration of oil in the deadwood.

#### 906.08 Permitted Defects

- Firm red heart
- Hard stain
- Compression wood

#### 906.09 Limited Defects

- a) Checks caused by treating and normal seasoning shall not exceed the following:
- i) Checks in the tips of the pile from the pith to the circumference shall not be wider than 10 mm at the circumference.
  - ii) If checks are wider than 10 mm but not deeper than  $1/3$  of the diameter of the pile, not more than three of these checks shall occur in the circumference

of the pile at that point. If checks are deeper than  $1/3$  of the diameter of the pile but not to the heart, and not wider than 10 mm, then only two such checks shall occur in the circumference of the pile at that point. The sum of all the widths of checks in a pile shall not exceed  $1/4$  of the diameter where they occur.

b) Sound Knots will be permitted as follows:

i) For piles 15 m and less in length, knots up to 100 mm in diameter will be permitted provided that the sum of all knot diameters does not exceed  $1/3$  of the diameter of the pile at the section where they occur;

ii) For piles more than 15 m in length, knots between:

- mid-length and butt shall conform to the requirements for piles of 15 m or less;
- mid-length and the tip, up to 120 mm in diameter, will be permitted provided that the sum of all knots does not exceed  $1/2$  of the diameter of the pile at the cross-section where they occur.

c) Shakes in the butt end of a pile are permitted provided that they are not closer than 50 mm to the surface of the pile and the length of any single shake, or the total length of any number of shakes measured along the line of the shake does not exceed  $1/3$  of the measured diameter of the butt.

d) Splits in the butt end of a pile are permitted provided that they are not longer than the diameter of the butt.

e) Sweep is permitted provided that it cannot be classified as short crook or reverse sweep and provided that:

i) For piles less than 20 m in length, a straight line joining the mid-point of the butt and the mid-point of the tip does not at any intermediate point pass outside the surface of the pile;

ii) for piles 20 m and up to 24 m in length, a similar straight line does not lie more than 30 mm outside the surface of the pile; or

iii) for piles over 24 m in length, a similar line does not lie more than 60 mm outside the surface of the pile.

**Note:** See Drawing [SP906-01](#)

f) Holes for untreated piles less than 10 mm in average diameter will be permitted provided that:



- i) they are scattered over the surface of the pile; and
- ii) the sum of the average diameter of all holes in any square 300 mm x 300 mm of pile surface does not exceed 40 mm and the depth of any one hole does not exceed 40 mm.

g) Spiral Grain shall not exceed 1/2 turn in any 6 m length of pile.

**906.10 Manufacturing Requirements** - All piles shall be cut above the ground swell and have a uniform taper throughout their whole length.

Completely overgrown knots rising more than 30 mm above the pile surface, branch stubs, and partially overgrown knots shall be trimmed close.

Peeling of piles by hand or machine shall be done carefully so as not to gouge or otherwise damage the surface of the pile, and the reduction in thickness of sapwood shall be the minimum possible.

Sawing of butts and tips shall be cut perpendicular to the axis of the pile. Bevelling at the ends of the piles shall not be permitted.

**906.11 Storage** - Piles shall be stacked in treated or other non-decaying skids of such dimensions, and so arranged as to support the piles without producing noticeable distortion of any of them. A cover should be put over them to protect against the elements.

**906.12 Handling** - Handling damage will be unacceptable if it reduces the depth of sapwood so as to render the pile untreatable.

- a) All piles shall be handled with reasonable care. Piles shall not be bruised or otherwise damaged. Minor damage shall be repaired and severely damaged piles shall be replaced as per Subsection 906.12 (d).
- b) During lifting, long piles shall be supported at a sufficient number of properly located points to prevent damage due to excessive bending.
- c) Dogs, hooks, peavies or other equipment shall not be used on the round surface of treated piling, except in the last one metre of the butt end.
- d) The Contractor shall make good any superficial damage of treated piles by methods outlined in the current edition of CSA 080 "Specification of Wood Preservation". Piles, which, in the opinion of the Ministry Representative, cannot be made good by such

methods, will be rejected.

**906.13 Inspection** - All piles may be inspected before shipment to the construction site, at the construction site or both. The Supplier shall provide the necessary facilities to enable the Ministry Representative or authorized Inspector to expeditiously examine all parts of each pile. All piles rejected shall be replaced at the Supplier's expense, including shipping charges and removal of reject piles from the construction site, if applicable. Inspection of the piles before shipment shall not be a bar to their subsequent rejection at the construction site if found to fail any requirements of this Section.

The Ministry Representative shall be informed by the Supplier in sufficient time before treatment, and, in all cases, before shipment to the construction site, so that necessary inspection may be carried out.

Treated piles being supplied from previously treated stock shall have been clearly stamped with the applicable Charge Number or other positive identification, and the appropriate treatment records shall be made available to the Ministry Representative for inspection. All piles being supplied from previously treated stock shall be subject to re-inspection.

Piles to be supplied from previously treated stock which have been stored in water shall, if ordered by the Ministry Representative, be removed from the water if such action is required to provide adequate inspection. At the Supplier's option, such inspection may be carried out at the construction site. All piles rejected at the construction site shall be removed and replaced at the Supplier's expense.

## 906 APPENDIX A - Definitions

**Check:** separation of the wood along the grain, the greater part of which occurs across the rings of annual growth.

**Through check:** a check, which extends from surface to surface of the pile, usually through the pith centre.

**Compression wood:** wood which has grown abnormally as often occurs on the lower side of branches and inclined trunks of coniferous trees.

Compression wood:

- is denser and harder than normal wood but may be lower in strength for its mass.
- is characterized by relatively wide annual rings, usually eccentric.
- has a relatively high proportion of summerwood (frequently more than 50% of the width of the annual rings in which it occurs).
- exhibits little contrast in colour between springwood



- and summerwood, and
- shrinks excessively lengthwise as compared with normal wood.

**Crack:** separation of the wood cells across the grain (this may be due to internal strains resulting from unequal longitudinal shrinkage or to external forces).

**Decay(rot, dote):** the disintegration of the wood substance, due to the action of wood-destroying fungi (rot and dote mean the same as decay).

**Grain:** the direction, size, arrangement, and appearance of fibres in a pile.

**Spiral grain:** a type of growth in which the fibres take a spiral course about the bole of a tree instead of the normal vertical course. The spiral may extend right-handed or left-handed around the tree trunk. The amount of spiral grain in a pile is measured as the distance in metres, along the axis of the pile in which one complete twist of the spiral occurs, and is expressed as, for example, 1 turn in 12 m.

**Hole:** an opening, perforation or cavity in a pile.

**Bird holes:** holes and damage caused by woodpeckers and other species of birds.

**Plugged holes:** holes that have been filled by forcing in another piece of wood.

**Insect damage:** result of boring in the pile by insects or insect larvae. Scoring or channelling of the surface is not classified as insect damage.

**Knot:** that portion of a branch or limb that has become incorporated into the body of a tree.

**Knot cluster:** two or more knots grouped together as a unit with the fibres of wood deflected around the entire unit.

**Knot diameter:** the diameter of a knot as it appears on the surface of a pile measured in a direction at right angles to the lengthwise axis of the pile.

**Unpeeled:** no attempt is made to remove the bark from the pile, but does not mean that all of the bark is on the pile as it may be scuffed, knocked, or worn off after the pile is cut.

**Rough peeled:** all of the outer bark is removed from the

pile.

**Clean peeled:** all of the rough bark is removed from the pile, and all of the inner bark from at least 80% of the surface of the pile, no piece of inner bark more than 200 mm long remains on the surface of the pile, and there is at least 30 mm of clean wood surface between any two strips of inner bark.

**Red heart:** a condition caused by fungus (*Fomes pini*, *Trametes pini*) which occurs in the living trees of some conifers. It is characterized in the early stages of infection by a reddish or brownish colour in the heartwood. Later the wood in the living tree disintegrates (decays) in small, usually distinct areas that develop into white-lined pockets.

**Firm red heart:** the early stages of infection, characterized by a reddish or brownish colour in the heartwood, which does not affect the strength of the pile.

**Scar (cat face):** a depression in the surface of the pile resulting from a wound where healing has not re-established the normal cross-section of the pile.

**Shake:** a separation along the grain, the greater part of which occurs between the rings of annual growth.

**Short crook:** a localized deviation from straightness which, within any section 2 m or less in length, is more than 70 mm (see Drawing [SP906-01](#)).

**Sound:** free from decay and insect holes.

**Split:** a lengthwise separation of the wood due to the tearing apart of the wood cells which usually extends from surface to surface of the pile.

**Stain:** a discolouration on or in the wood other than its natural colour, caused by the action of certain moulds and fungi.

**Hard stain:** a stain, which is not accompanied by softening or other disintegration of the wood.

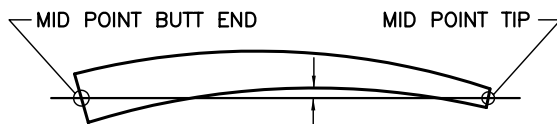
**Sweep:** the deviation of the pile from straightness (see Drawing [SP906-01](#)).

**Reverse sweep:** a deviation from straightness, which changes direction or reverses direction in the length of the pile (see Drawing [SP906-02](#)).

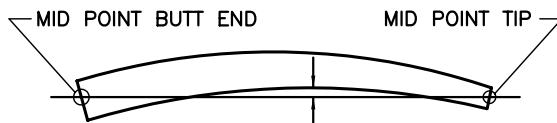




LESS THAN 20 m

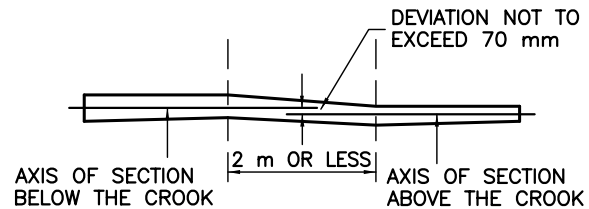
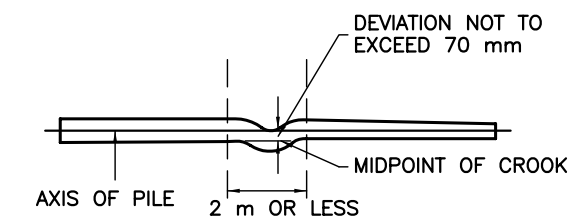
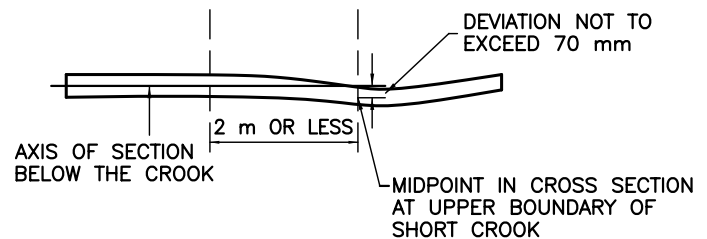


20 TO 24 m



OVER 24 m

## MEASUREMENT OF SWEEP

CASE 1: WHERE THE REFERENCE AXES  
ARE APPROXIMATELY PARALLEL.CASE 2: WHERE AXES OF SECTIONS ABOVE  
AND BELOW THE CROOK COINCIDE  
OR ARE PRACTICALLY COINCIDENT.CASE 3: WHERE AXIS OF SECTION ABOVE SHORT  
CROOK IS NOT PARALLEL OR COINCIDENT  
WITH AXIS BELOW THE CROOK.

## MEASUREMENT OF SHORT CROOK

NOTE:

THE THREE CASES SHOWN ARE  
TYPICAL AND INTENDED TO ESTABLISH  
THE PRINCIPLE OF MEASURING SHORT  
CROOKS. THERE MAY BE OTHER CASES  
NOT EXACTLY LIKE THOSE ILLUSTRATED.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





## REVERSE SWEEP IN PILES

NOTES: WHEN CONDITIONS OF DESIGN REQUIRE, THE FOLLOWING REQUIREMENTS APPLY:

1. FOR PILES LESS THAN 10 m IN LENGTH, A STRAIGHT LINE CONNECTING THE MID-POINT AT THE BUTT AND THE MID-POINT AT THE TIP SHALL NOT LIE LESS THAN 80 mm INSIDE THE SURFACE OF THE PILE;
2. FOR PILES 10 m AND UP TO 12 m IN LENGTH, A SIMILAR STRAIGHT LINE SHALL NOT LIE LESS THAN 50 mm INSIDE THE SURFACE OF THE PILE;
3. FOR PILES 12 m AND UP TO 15 m IN LENGTH, A SIMILAR STRAIGHT LINE SHALL NOT LIE LESS THAN 30 mm INSIDE THE SURFACE OF THE PILE; OR
4. FOR PILES OVER 15 m IN LENGTH, A SIMILAR STRAIGHT LINE SHALL NOT PASS THROUGH THE SURFACE OF THE PILE.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 908

### PRESERVATIVE TREATMENT - WOOD PRODUCTS

**908.01 Materials** - Timber, piles and glued laminated members shall conform to the requirements of:

Section 903, Timber - Materials; Section 904, Timber (Treated and Untreated) - Fabrication and Handling; Section 905, Timber -Glued Laminated; Section 906, Round Timber Piles as applicable.

Preservative shall conform to the requirements of the current CSA Standard 080-M, "Wood Preservation".

**Note:** CSA Standards are obtainable from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3.

**908.02 Treatment** - All aspects of preservative treatment shall conform to the requirement of CSA Standard 080.1-M "Preservative Treatment of All Timber Products by Pressure Processes".

The type of preservative, conditioning, treatment, penetration and retention shall be appropriate for the species, size and end use of the product, and shall be as specified on the Purchase Order, Work Order or drawings.

**Note:** The type of preservative, treatment and retention will normally be selected by reference to Table 908-A as applicable.

**TABLE 908-A TYPE OF PRESERVATIVE, TREATMENT AND RETENTION**

CSA Standard 080.14 - M	Pressure preserved wood for highway construction. Table I.	
CSA Standard 080.3 - M	Preservative treatment of piles by Pressure Processes.	
	Table I	Land and Fresh Water Piles
	Table II	Marine Piles
	Table III	Foundation Piles
CSA Standard 080.2 - M	Preservative treatment of lumber, timber, bridge ties, and mine ties by pressure processes. Table I.	
CSA Standard 080.18 - M	Pressure treated piles and timbers in marine construction.	
	Table I	Piles and Timbers
	Table II	Timber Substructure and Superstructure

Should it be necessary to use species, commodities or end uses not included in the above standards, then the preservative, treatment and retention shall be selected by reference to CSA Standards 080.4-M, 080.6-M, 080.9-M, 080.11-M, 080.15-M, 080.16-M, 080.25-M, as applicable.

Glue laminated beams shall be treated in accordance with CSA Standard 080.28-M "Preservative treatment of Coast Region Douglas Fir and Western Hemlock structural glued - laminated members and laminations before gluing by the pressure processes." (See Section 905.)

Fence posts shall be treated in accordance with CSA Standard 080.5-M "Preservative treatment of posts by pressure processes."

Preservation treatment by the thermal process shall be done in accordance with and to the requirements of current



CSA Standard 080-M, "Wood Preservation", and shall be limited to the products and species covered in CSA 080.7-M, 080.8-M and 080.10-M.

**908.03 Inspection** - The Ministry shall be given a minimum of 48 hours notice prior to commencement of the treating process. All facilities and reasonable assistance shall be afforded by the supplier, free of cost, to the Ministry Representative or the Ministry Representative's authorized alternate for the proper execution of the work. They shall have free entry at all times while work of the contract is being performed, to all parts of the treating plant which concern the treatment (and all related work) of the materials ordered.

No material shall be shipped prior to inspection or a release for shipment has been issued by the Ministry Representative.



## SECTION 909

### TREATED WOOD FENCE POSTS

**909.01 General** - This Section covers the quality and manufacture of wood fence and gateposts, braces and droppers.

Wood posts and the like for fences and gates shall be supplied pressure treated in the sizes, species and grading all as required by the Purchase Order, Work Order, Contract Drawing or Specifications in conformity with this Section and as generally shown on the applicable [SP741](#) Drawings.

**Note:** CSA Standards may be obtained from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Road, Rexdale, ON M9W 1P3

**909.02 Species** - Round fence posts (including line, straining, corner, intersection, gate and end posts) and any required round wood braces and droppers shall be Lodge Pole Pine (Western Jack Pine) cut from live growing trees. Use of other species must be approved in writing by the Ministry Representative (cedar, either split or whole, will not be approved).

#### 909.03 Size and Measurement

- a) Round fence posts and braces shall be classified as to size on the basis of the smaller diameter and length. The diameter specified shall be minimum with a tolerance of +20 mm and the length shall not vary by more than 25 mm from that specified.
- b) The maximum permitted taper shall be such that the larger diameter shall not exceed that of the specified diameter by more than 25 mm over a 2 m length of post or brace. The maximum permitted taper shall be proportional for posts and braces of lengths other than 2 m.
- c) All dimensions shall apply inside the bark and to the fully seasoned and treated fence posts or braces.
- d) In cases where the post or brace is not truly circular, the diameter shall be obtained by measuring the circumference and dividing by 3.14.

#### 909.04 Prohibited Defects

All round fence posts and braces shall be free of the following defects:

- Decay
- Shakes in the top or butt
- Cracks, splits, through checks
- Spike knots and knot clusters
- Unsound scars
- Reverse sweep

#### 909.05 Limited Defects

All round fence posts and braces are permitted limited defects as follows:

- Seasoning checks less than 10 mm in width if less than 500 mm in length, or less than 5 mm in width if more than 500 mm in length
- Sound scars permitted except within 150 mm from the ends
- Sound, tight, well-spaced knots permitted provided they do not exceed 35 mm in diameter
- Sweep less than 2% of the length of the post



- Short crook less than 2% of the length of the post
- Insect damage consisting of holes 1.6 mm or less in diameter and surface scoring or channelling are permitted. All other forms of insect damage are prohibited.

**Note:** Defects listed above are as defined in Section [906 - Appendix A](#).

**909.06 Manufacturing Requirements - Round Fence Posts and Braces** - Ends of posts and braces shall be cut square to the specified length and unless otherwise specified on the Purchase Order, Work Order, or drawings, one end of posts shall be machine pointed before treatment to permit driving of posts. The diameter at the point shall be not less than 18 mm and not more than 35 mm, and the taper shall extend over a length of 150 mm to 200 mm of the post, or opposite sides shall be tapered to a "chisel point" of similar basic dimensions.

Posts and braces shall be clean peeled with minimum removal of sapwood for their full length and all rough bark and inner bark removed.

All knots or projections shall be shaved smooth and flush with the surface of the surrounding wood.

All round fence posts and braces shall be air seasoned in accordance with CSA Standard 080-M1 Para. 1.31 to a moisture content of 15% to 22% before pressure treatment. In exceptional circumstances, the Ministry Representative may permit conditioning by steaming for a total of not more than six hours at a temperature not in excess of 115°C.

**909.07 Sawn Lumber Posts and Braces** - Gate posts and braces not stipulated as round, together with any anchor cleats shall be Standard and better S4S Lodgepole Pine/Western Jack Pine or Coast Douglas Fir, to the current N.L.G.A. grading rules and in the required lengths and sizes.

**909.08 Fence Droppers** Wood droppers to stabilize barbed wire fencing (Type C) between posts may be:

- Round Fence Posts Lodgepole Pine/Western Jack Pine of 50 mm (smaller) diameter, or
- 25 mm x 50 mm Sawn Lumber, Standard and better S4S Lodgepole Pine/Western Jack Pine or Coast Douglas Fir, to the current N.G.L.A. grading rules.

All droppers 1100 mm  $\pm$  25 mm long for 4-wire Type C fences and 1200 mm  $\pm$  25 mm for Type C and C2 fences shall be selected for freedom from knots and other imperfections injurious to strength.

Approved proprietary grooved wood droppers with necessary wire clips may be specified or approved for high-tensile smooth-wire fencing.

**Note:** For Type C fencing proprietary prefabricated galvanized sheet metal and clip droppers may be approved as an alternative to the above wood droppers. Galvanized twisted wire fence stays may be specified or permitted only for the extension of normal fence heights to deer height and the like.

**909.09 Pressure Treatment** - All round fence posts, braces and round droppers shall be pressure treated in accordance with CSA Standard 080.5 "Preservative Treatment of Posts by Pressure Processes", except that the sample zone for assay shall be 0 to 16 mm from the surface and the requirement that all borings for use in the extraction sample shall have at least 25 mm of sapwood shall be waived. If species other than Lodgepole Pine are approved, these exceptions may be altered.

All sawn fence posts, braces, anchor cleats and droppers shall be pressure treated in accordance with CSA Standard 080.2 "Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes".



Unless otherwise specified or stipulated on the Purchase Order, Work Order or Drawings, the preservatives and retention of preservatives shall conform to the recommendations of CSA Standard 080.14 Table I "Minimum Retention of Preservatives in Pressure Treated Wood for Highway Construction" under the heading "Fence Posts - All Species" as listed in Table 909-A.

**TABLE 909-A PRESERVATIVES AND RETENTION OF PRESERVATIVES**

PRESERVATIVE	MINIMUM RETENTION
Creosote	80.0 kg/m <sup>3</sup>
Creosote-Petroleum	95.0 kg/m <sup>3</sup>
Pentachlorophenol (Hydrocarbon Solvent) (Type A, or Type D - Methylene Chloride)	4.0 kg/m <sup>3</sup>
Ammoniacal Copper Arsenate (ACA)	6.4 kg/m <sup>3</sup>
Chromated Copper Arsenate (CCA)	6.4 kg/m <sup>3</sup>
All the above preservatives shall meet the requirements of the relevant CSA Standard(s) in the P-Series.	

**909.10 Inspection** - All processing of the material shall be open for inspection by the Ministry Representative or the Ministry Representative's authorized inspector and they shall have free entry to the treating plant while the work is being performed.

No material shall be shipped prior to inspection or the written release for shipment by the Ministry Representative.

Material inspected before shipment shall not bar its subsequent rejection after delivery if found to fail any requirements of this Specification. Rejected material shall be replaced at the Supplier's expense including shipping charges and removal of rejected materials, if applicable.

**Note:** Inspection of material already in bundles ready for shipment shall be considered as "incomplete", and the material will be subject to final inspection by the Ministry Representative only when the bundles are opened immediately prior to use.

The Supplier shall advise the Ministry Representative at least two full working days before the material is ready for inspection prior to shipment. A Supplier in a distant location or outside B.C. shall advise the Ministry Representative at least one full week before the material is ready for inspection prior to shipment. After inspection the Ministry reserves the right to conduct whatever tests are deemed necessary to confirm that the material complies with the requirements of this Specification before a release for shipment is issued.



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 913

### REINFORCEMENT FOR CONCRETE

**913.01 Requirements** - Concrete reinforcement shall conform to the requirements of the following CSA Standards:

- G30.3.....Cold-Drawn Steel Wire for Concrete Reinforcement
- G30.4.....Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- G30.5.....Welded Steel Wire Fabric for Concrete Reinforcement
- G30.14.....Deformed Steel Wire for Concrete Reinforcement
- G30.15.....Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- G30.17.....Welded Steel Plain Round Bar or Rod Mats for Concrete Reinforcement
- G30.18-M.....Billet Steel Bars for Concrete Reinforcement

The type and grade required shall be as specified on the Purchase Order, Work Order or Drawings.

**Note:** CSA Standards are obtainable from:

Canadian Standards Association, Standards Sales,  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## **SECTION 917**

### **WIRE ROPE**

**917.01 Wire Rope** - Wire Rope shall conform to the requirements of CSA Standard G4-M "Steel Wire Rope for General Purpose and for Mine Hoisting and Haulage."



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 931

### PORTLAND CEMENT

**931.01 General-** Portland Cement shall conform to the requirements of CSA Standard CAN3-A5-M "Portland Cement".

The Type shall be as specified on the Purchase Order, Work Order or Drawings and as required from Table [931-A](#).

**TABLE 931-A TYPES OF PORTLAND CEMENT**

NAME	TYPE	APPLICATION
Normal	10	For use in general concrete construction when the special properties of the other types are not required.
Moderate*	20	For use in general concrete construction exposed to moderate sulphate action, or when moderate heat of hydration is required.
High Early Strength	30	For use when high early strength is required.
Low Heat of Hydration	40	For use when low heat of hydration is required.
Sulphate Resistant	50	For use when high sulphate-resistance is required.
* Moderate with respect to sulphate-resistance and heat of hydration.		



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 933

### ADMIXTURES FOR PORTLAND CEMENT CONCRETE

**933.01 Scope** - This Section covers general requirements for air entraining and chemical admixtures and Specification requirements for pozzolan admixtures.

Standards referred to in this Section are obtained from:

CSA: Canadian Standards Association, Standards Sales,  
178 Rexdale Road, Rexdale, ON M9W 1R3

ASTM: American Society for Testing and Materials,  
1916 Race Street, Philadelphia, PA 19103.

#### 933.02 Air-Entraining and Chemical Admixtures

- a) Air-entraining admixtures shall conform to the requirements of CSA Standard CAN3-A266.1-M, Air-Entraining Admixtures for Concrete.
- b) Chemical Admixtures shall conform to the requirements of CSA Standard CAN3-A266.2-M, Chemical Admixtures for Concrete.

#### 933.03 Pozzolan Admixtures

##### 933.03.01 Definitions

- i) **Type N Pozzolan** - A natural pozzolan consisting of siliceous or alumino-siliceous material which when finely ground will react with calcium hydroxide liberated during the hydration process of Portland cement to form calcium silicates and aluminates.
- ii) **Type F Pozzolan** - A fine glassy and siliceous residue resulting from the combustion of pulverized coal, referred to as Fly Ash. This material also reacts with calcium hydroxide liberated from Portland cement to form calcium silicates and aluminates.

**933.03.02 General** - When types N or F pozzolans are used in Ministry concrete either as a cement replacement, addition, or both, they shall contribute to the beneficial physical and chemical properties of the hardened concrete through pozzolanic activity. Before a pozzolan is accepted for use in Ministry concrete, pozzolan shall first meet the physical and chemical requirements herein specified.

If suitable, the pozzolan shall then be evaluated upon its performance in laboratory concrete trial mixes at various usage rates. Any pozzolan, which does not produce the specified effects or produces adverse effects to concrete shall not be used.

**933.03.03 Sampling and Testing** - Types N and F pozzolans shall be sampled and tested for chemical and physical properties in accordance with ASTM C 311 for "Sampling and Testing of Fly Ash or Natural Pozzolans For Use as a Mineral Admixture in Portland Cement Concrete", unless otherwise specified in these specifications.

**933.03.04 Chemical Requirements** - The chemical requirements for types N and F pozzolans shall be as shown in Table [933-A](#).

##### 933.03.05 Physical Requirements

- i) **Fineness** - The fineness of either types N or F pozzolan will be determined in accordance with ASTM C 311



**TABLE 933-A CHEMICAL REQUIREMENTS FOR TYPES N AND F POZZOLANS**

CHEMICAL REQUIREMENTS:	POZZOLAN TYPE	
	N	F
Silicon dioxide (SiO <sub>2</sub> ) plus aluminum oxide (Al <sub>2</sub> O <sub>3</sub> ) plus iron oxide (Fe <sub>2</sub> O <sub>3</sub> ), minimum %	70.0	70.0
Sulphur trioxide (SO <sub>3</sub> ), maximum %	4.0	5.0
Moisture content, maximum %	3.0	3.0
Loss on ignition, maximum %	10.0	12.0
Magnesium oxide (MgO), maximum %	5.0	5.0
Available alkalis, as Na <sub>2</sub> O, maximum %	1.5	1.5

Section 21, "Fineness, Amount Retained When Wet-Sieved on No. 325 (45 µm) Sieve" and/or ASTM C 204 for "Fineness of Portland Cement by Air Permeability Apparatus". In this latter procedure, fineness shall be determined by use of the Blaine permeability apparatus except that pozzolan will be used in place of cement.

The degree of fineness of either type N or F pozzolan shall be that which produces the optimum pozzolanic activity with the Portland cement with which the pozzolan is to be used. The pozzolanic activity index shall however not be less than 75% of the control at 28 days. After six months storage pozzolans shall be retested for fineness. If accepted, the fineness requirements shall be as specified in the Special Provisions.

**ii) Water Requirements** - Water requirements of mortar made with the pozzolan in accordance with ASTM C 311 Section 33 shall not be greater than 115% of water used in the control mix.

**iii) Drying Shrinkage** - Increase in drying shrinkage of mortar bars made and tested in accordance with ASTM C 311 Section 22 shall not be greater than 0.03%.

**iv) Soundness** - When tested for soundness in accordance with ASTM C 311 the expansion or contraction after autoclaving shall not be greater than 0.08%.

#### **933.03.06 Performance Evaluation of Types N or F Pozzolans in Concrete**

**i)** Only pozzolans which meet the physical and chemical requirements of these specifications shall be evaluated for use in concrete.

**ii)** Evaluation of pozzolans in concrete shall be made with laboratory concrete trial mixes preferably with concrete ingredients to be used on the job where the pozzolanic concrete is to be used.

**iii)** Evaluation shall be made by comparing test results of the pozzolanic mixes with test results of similar concrete mixes without pozzolan.

**iv)** Tests, which the Ministry Representative may specify to evaluate the performance of a pozzolan in a specific concrete, are given in Table [933-B](#).

**933.03.07 Basis of Evaluation** - Types N and F pozzolans shall be evaluated in concretes by comparing results of tests performed on "job design" Portland cement concrete with similar class Portland cement concrete without pozzolan. Types N and F pozzolans will only be accepted when they produce equal or better test results than those



obtained with similar class concrete without pozzolan at reasonable cost. When accepted, types N and F pozzolans shall only be used at dosage rates determined from test results and approved by the Ministry Representative.

**TABLE 933-B TESTS FOR EVALUATING THE PERFORMANCE OF A POZZOLAN IN A SPECIFIC CONCRETE**

<b>QUALITY REQUIREMENTS</b>	<b>TITLE OF TEST</b>	<b>TEST DESIGNATION</b>
Air Entrainment	Limits of Amount of Air-Entraining Admixture in Concrete	ASTM C 311 Section 23
Bleeding	Bleeding of Concrete	ASTM C 232
Setting Time	Time of Setting of Concrete Mixtures by Penetration Resistance	ASTM C 403
Compressive Strength	Concrete Test Specimens Making and Curing in the Laboratory	ASTM C 192
Flexural Strength	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)	ASTM C 78
Drying Shrinkage	Length Change of Hardened Cement Mortar and Concrete	ASTM C 157
Thermal Volume Change	Early Volume Change of Cementitious Mixtures	ASTM C 827
Alkali Reaction	Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction	ASTM C 441
Resistance to Freezing and Thawing	Resistance of Concrete to Rapid Freezing and Thawing	ASTM C 666
Resistance to De-icing Chemicals	Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals	ASTM C 672



**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 941

### PRECAST REINFORCED CONCRETE BARRIERS

**941.01 Scope** - This Section covers the quality and manufacture of precast reinforced concrete roadside and median barriers for highway and other off-highway traffic confinement use.

The concrete traffic barrier units shall be supplied in the sizes and types as required by the Purchase Order, Work Order or Drawing in strict conformity with this Section and pertinent Standard Drawings of the [SP941](#) Series.

#### 941.02 Concrete Quality

- a) Concrete quality shall conform to CSA Standard CAN3-A23.1-M except where amended hereafter.
- b) A compressive strength test result is defined as the average of the strengths of three 28 day compressive test cylinder breaks with standard cylinders of 150 mm diameter and 300 mm high size.
- c) The strength level of the concrete represented by the test shall be considered satisfactory if the test result equals or exceeds 30 MPa and no individual cylinder strength is less than 27 MPa. If this condition is not met, the concrete will be considered to have failed the strength requirements. No other form of testing to prove the relative strength at a later date will be allowed without the approval of the Ministry Representative.
- d) Cylinders shall be cast by the Ministry Representative or his authorized representative at the time of placing concrete. Frequency of testing will be at the discretion of the Ministry Representative.
- e) Calcium chloride or admixtures containing calcium chloride shall not be used in the concrete.
- f) Concrete shall meet the following additional requirements:
  - i) Minimum cement content of 320 kg per cubic metre.
  - ii) Maximum water/cement ratio of 0.45.
  - iii) Coarse aggregate of a nominal maximum size not exceeding 28 mm.
  - iv) Slump of 50 mm  $\pm$  20 mm.
  - v) Entrained air of 5 to 8%.

#### 941.03 Reinforcing Steel, Attachment Hardware & Miscellaneous Items

- a) Welded steel wire mesh reinforcement shall be

supplied and installed in each section as shown on the Standard Drawings, and in accordance with Section [412](#). Additional reinforcement may be installed to assist handling during the precasting operations but shall be subject to prior approval by the Ministry Representative.

- b) Reinforcing steel for bent and hooked connections shall conform to CSA CAN3-G40.21-M Grade 260W and shall be carefully bent to the radii detailed and installed as shown on the Standard Drawings.

Bending shall be done by methods that will not produce fracture or other injury. The metal heating shall not be to a higher temperature than that producing a "dark cherry red" colour. After heating, the metal shall be cooled as slowly as possible. Following the bending, the surface of the metal shall be carefully inspected for evidence of fracture, and any fractured pieces shall be replaced.

Prior to delivery, exposed surfaces of connections shall be prepared for and given a heavy application of zinc rich coating to CGSB Standard 1-GP-181M.

- c) Pick-up points for handling units shall be formed with accurately placed rigid P.V.C. pipe recessed 15 mm from both finished surfaces as detailed.

**941.04 Optional Features** - Where barrier is ordered with drainage slots or grouting holes or both, they shall be accurately cast-in as detailed. Facilities for the installation of anti-glare screens will be detailed as and when required.

#### 941.05 Placing and Finishing of Concrete

- a) Concrete shall be placed in the forms and carefully consolidated in strict accordance with CSA CAN3-A23.4-M, Clause 19.
- b) Curing and protection shall be carried out strictly according to CSA CAN3-A23.4-M Clause 21.
  - i) Curing shall be considered complete when test cylinders reach the specified 28 day compressive strength provided such strength is reached not later than 28 days after the barriers are cast.
  - ii) Steam curing is permissible for either the entire curing period or portion thereof and shall be carried out in accordance with CSA CAN3-A23.4-M Clause 21.4.
  - iii) At no time during or at completion of the curing period shall the temperature differential between the concrete surface and the ambient temperature be



greater than 20°C.

iv) If steam is used for a portion of the curing period, additional normal curing shall be carried out after the steam curing, according to CSA CAN3-A23.4-M Clause 21.3 until such time as strength tests of concrete test cylinders that have been both steam and normally cured with the barriers reach the specified concrete strength.

c) Exposed surfaces shall be uniform in texture and colour as produced from well maintained steel form surfaces and proper vibration methods without excessive surface fines or laitance.

d) Defects of the exposed surface will normally be cause for the rejection of any unit except where such are within the permissible limits or are subject to making good as follows:

- i) Unobtrusive defects of any kind where their total area is not in excess of 2% of the exposed surface area of the unit.
- ii) Air holes not greater than 3 mm in diameter and not more than 20 in any isolated 300 mm X 300 mm area.
- iii) Sharp arises at the edges of the exposed surfaces where necessary shall be softened by careful rubbing or grinding.
- iv) Patching of isolated small holes, cavities and similar self-confining defects may be permitted when authorized in writing by the Ministry Representative.

e) Patching, only when authorized, shall have the defective area well saturated with water and the defect prepared with cement paste and filled with mortar. The mortar, properly proportioned of the same sand and cement as the original concrete and reasonably colour matched to the cured dry unit with the addition of white cement where necessary, shall be pre-shrunk for about

one hour before retempering and use. The patching mortar shall be well tooled in, finished flush and smooth and the area covered to cure adequately.

f) End connection surfaces shall be cleared out.

g) All concrete surfaces prior to shipment shall be accurate to detail and, in particular at the end connections, true to dimension tolerances.

**941.06 Tolerances** - Tolerances allowable in concrete dimensions of the barriers shall be  $\pm 3$  mm except as otherwise indicated on the detail drawings.

**941.07 Procedure of Manufacture** - The Supplier shall notify the Ministry in advance concerning the date when the order is to be manufactured, so that detailed inspection can be carried out. All processes shall be open for inspection and approval by the Ministry Representative. No material shall be shipped prior to the inspection or written release for shipment by the Ministry Representative.

The manufacturer's name or trade mark, year of manufacture and form number shall be embedded on the end of each unit in a manner, size and depth that they are permanently legible.

Authorized patching or making good may be inspected before shipment or upon delivery and the rejected unit(s) shall be replaced at no cost to the Ministry.

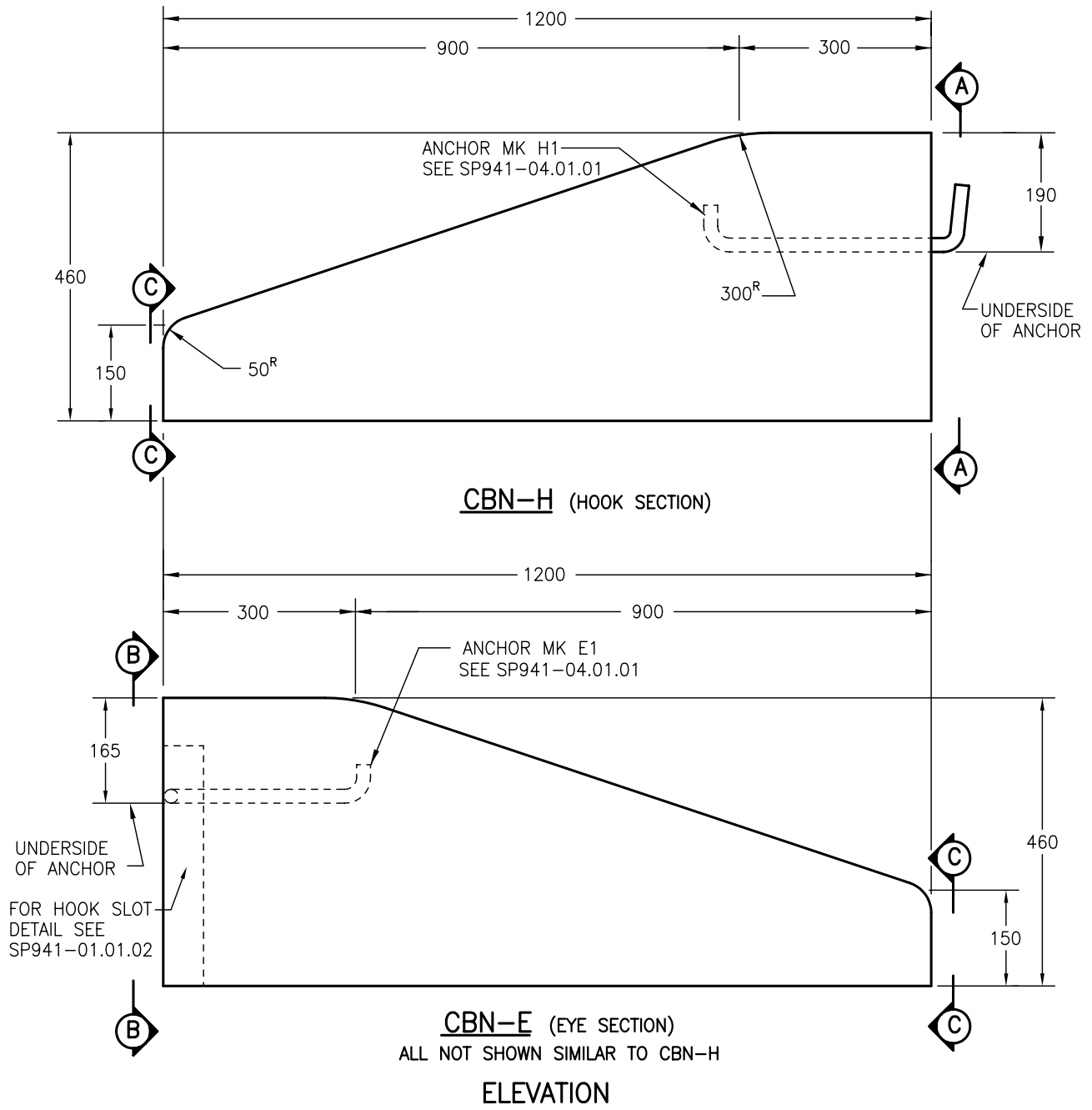
**941.08 Handling** - In handling the finished product, the concrete and connecting devices shall not be damaged or distorted.

**941.09 Payment** - Payment shall be at unit price bid per unit (section). The price bid shall be full compensation for everything furnished and done including supply of forms and all materials, placing, vibrating and curing air entrained concrete, stripping, finishing, general clean-up and delivery.



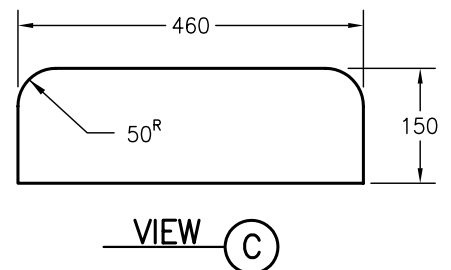
PRECAST CONCRETE BULL-NOSE  
460 mm – CBN-H & CBN-E

SP941-01.01.01



GENERAL NOTES:

1. FOR VIEW (A) & (B) SEE SP941-01.01.02
2. FIBRILATED FIBRE STRAND REINFORCED CONCRETE TO BE USED FOR BULL-NOSE (CBN).
3. FIBRILATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR STEEL REINFORCED CONCRETE IN LOW BARRIER (CLB-H & E).
4. MATERIALS AND QUALITY OF WORK TO BE IN ACCORDANCE WITH SECTION 941.
5. STANDARD CBN-E MAY BE MANUFACTURED ONLY WITH PRIOR WRITTEN PERMISSION FROM THE HIGHWAY SAFETY BRANCH.

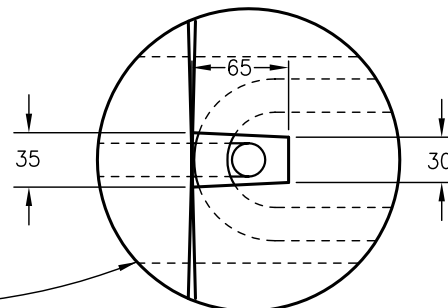
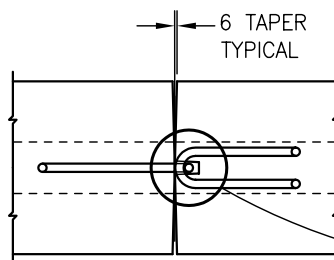
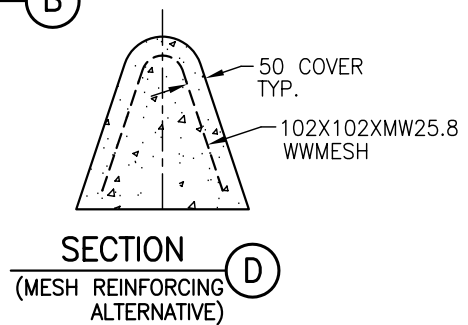
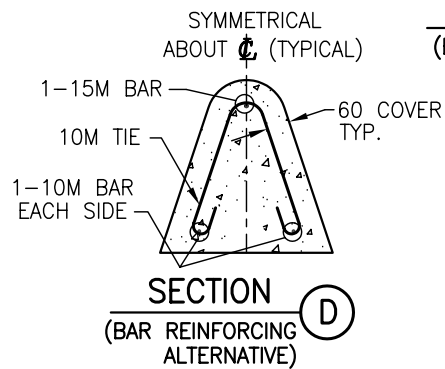
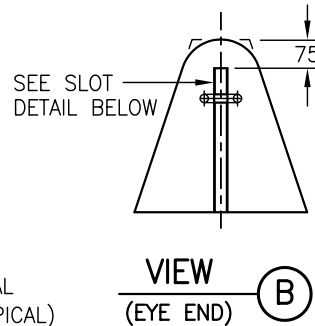
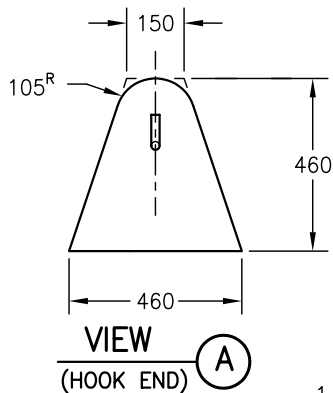
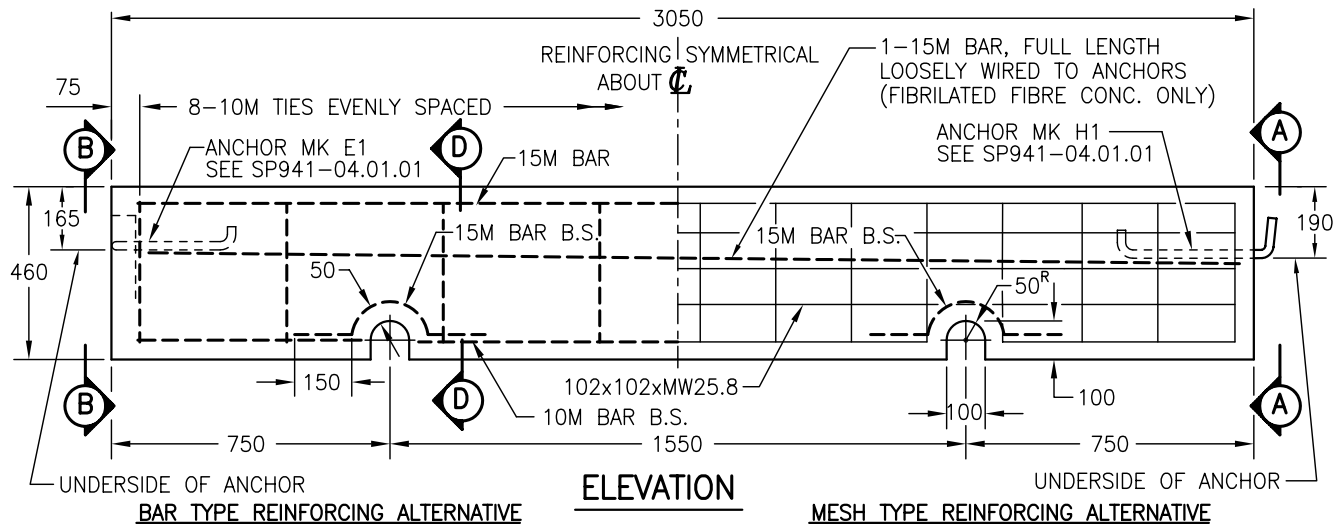


NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



SP941-01.01.02



NOTE: FOR GENERAL NOTES SEE SP941-01.01.01

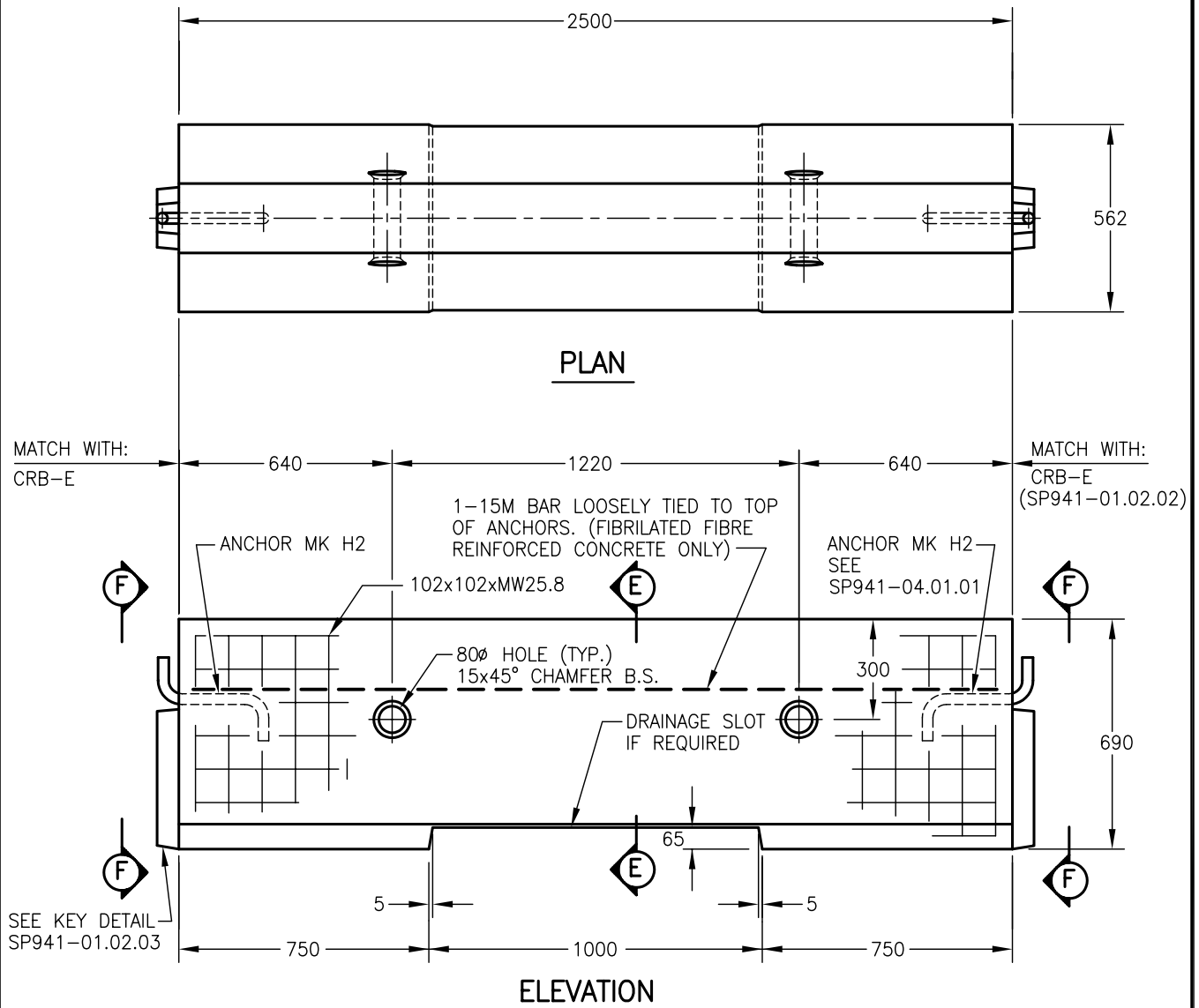
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE ROADSIDE BARRIER  
690 mm – CRB-H

SP941-01.02.01



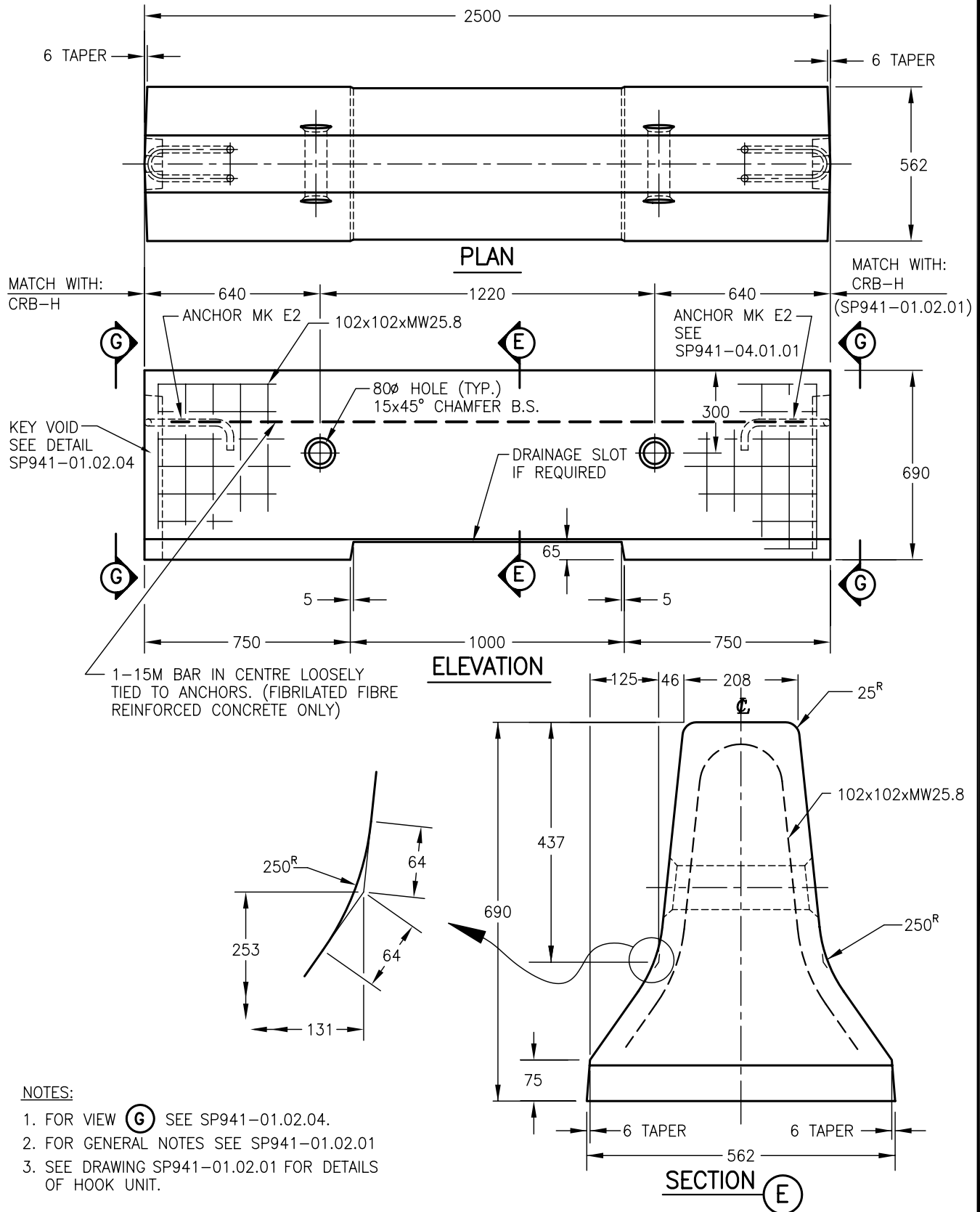
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE ROADSIDE BARRIER  
690 mm – CRB-E

SP941-01.02.02



NOTES:

1. FOR VIEW (G) SEE SP941-01.02.04.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. SEE DRAWING SP941-01.02.01 FOR DETAILS OF HOOK UNIT.

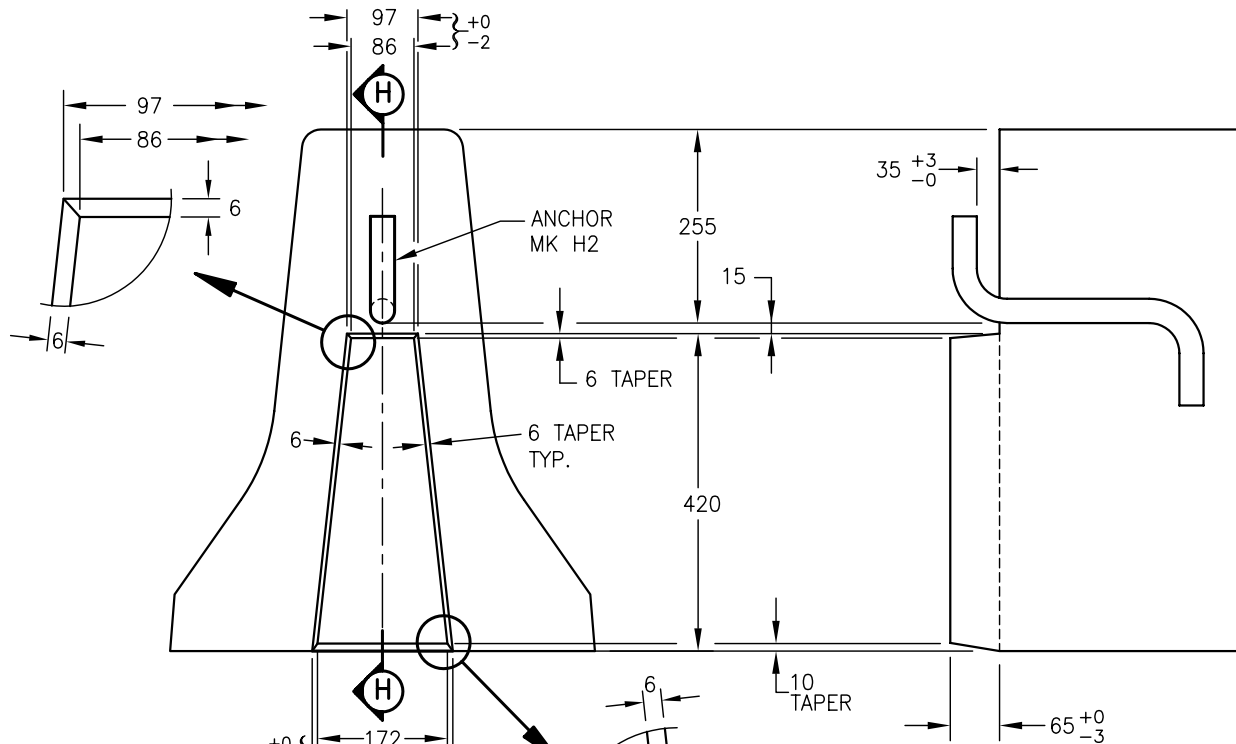
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE ROADSIDE BARRIER  
690 mm – CRB–H DETAILS

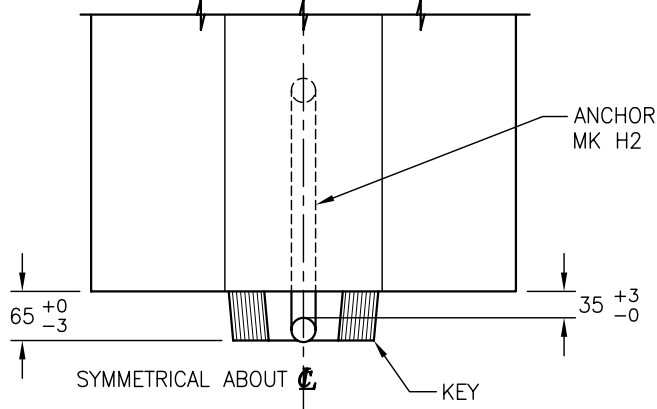
SP941–01.02.03



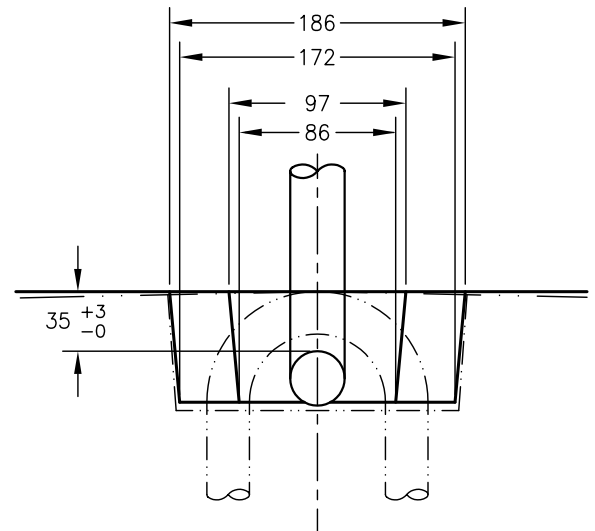
VIEW (HOOK UNIT) (F)

SECTION (H)

NOTE:  
FOR DIMENSIONS NOT  
SHOWN SEE SECTION (E)  
SP941–01.02.02



PLAN – END – HOOK UNIT



CONNECTION DETAIL

NOTES:

1. FOR LOCATION OF VIEW (F) SEE SP941–01.02.01, SP941–03.02.01, SP941–03.03.01 & SP941–03.03.03.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941–04.01.01.

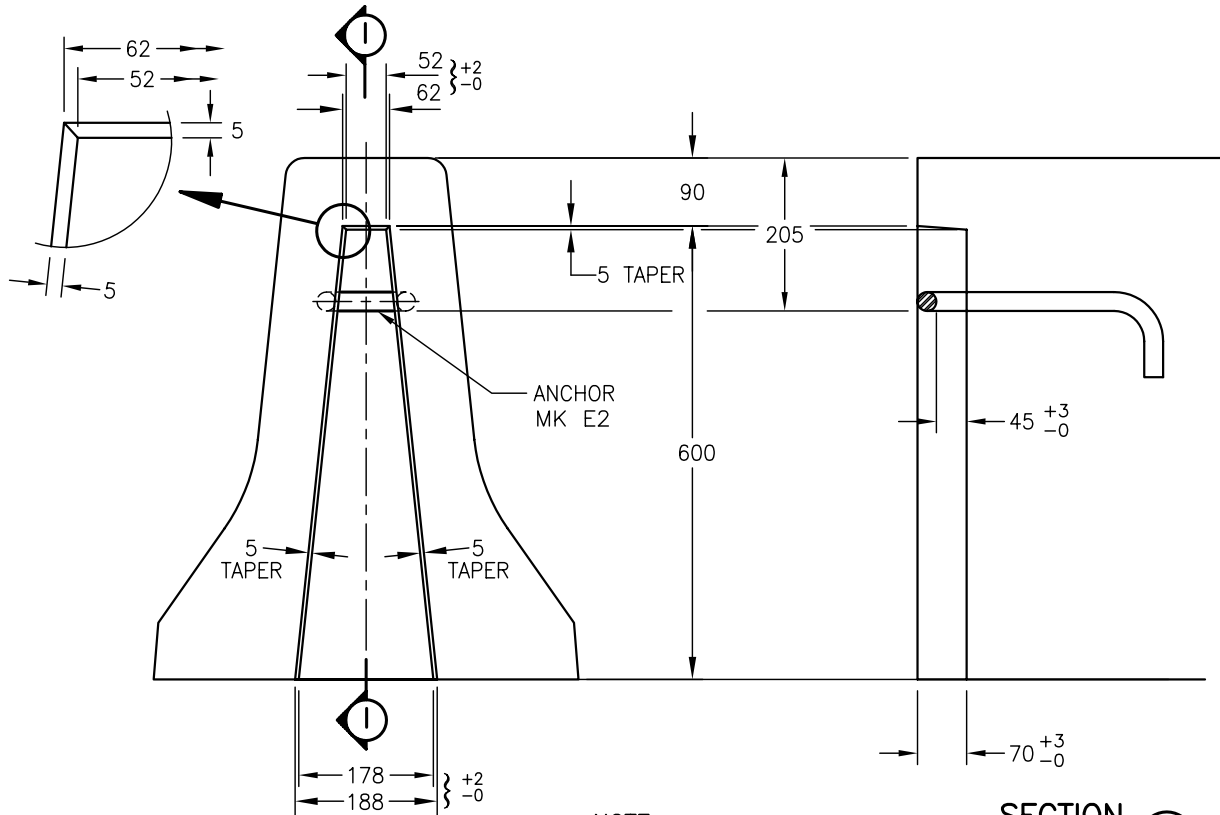
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



# PRECAST CONCRETE ROADSIDE BARRIER 690 mm – CRB-E DETAILS

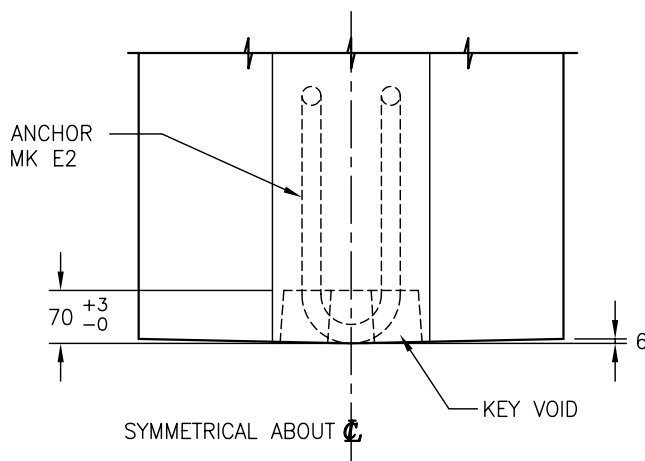
SP941-01.02.04



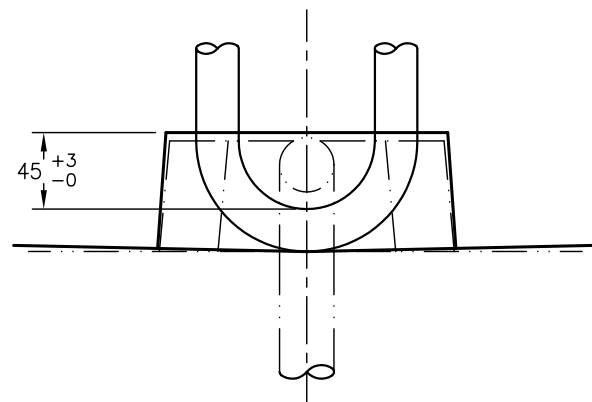
VIEW  
(EYE UNIT) (G)

NOTE:  
FOR DIMENSIONS NOT  
SHOWN SEE SECTION (E)  
SP941-01.02.02

SECTION (I)



PLAN – END – EYE UNIT



CONNECTION DETAIL

## NOTES:

1. FOR LOCATION OF VIEW (G) SEE SP941-01.02.02, SP941-01.02.05 & SP941-03.01.01.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941-04.01.01.

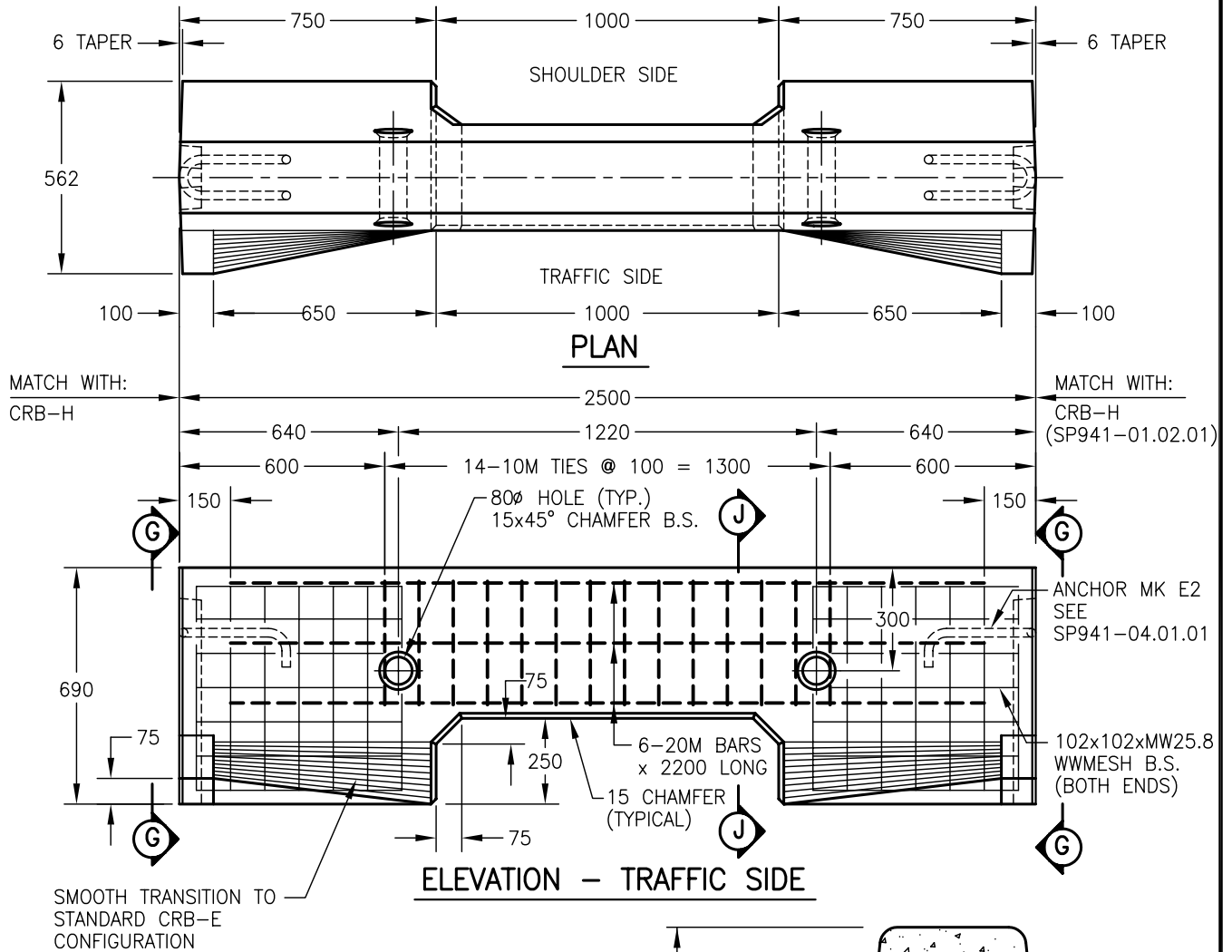
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



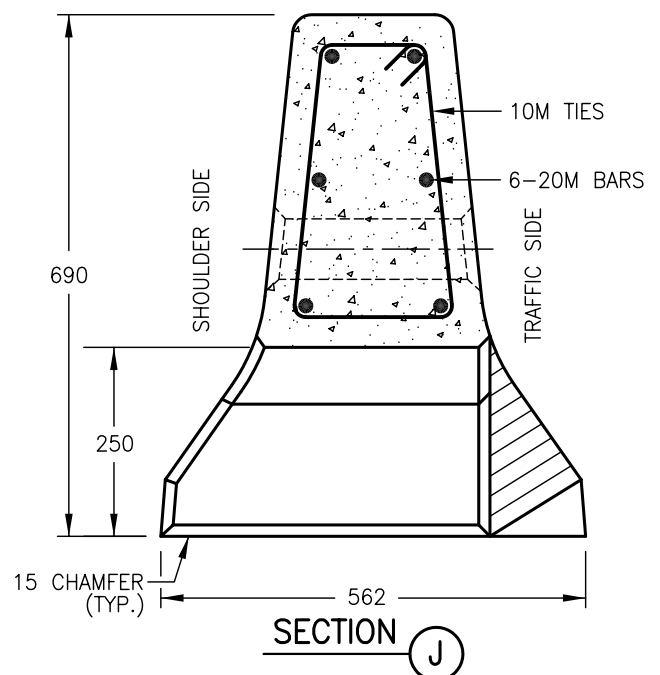
# PRECAST CONCRETE DRAINAGE BARRIER 690 mm – CDB-E DETAILS

SP941-01.02.05



## NOTES:

1. FOR VIEW (G) SEE SP941-01.02.04.
2. SEE SP941-01.02.01 FOR DETAILS OF CONNECTING HOOK UNIT.
3. FOR GENERAL NOTES SEE SP941-01.02.01
4. FIBRILATED FIBRE STRAND REINFORCED CONCRETE MAY BE SUBSTITUTED FOR WELDED WIRE MESH REINFORCED CONCRETE. ADDITIONAL BARS AND TIES WILL STILL APPLY.



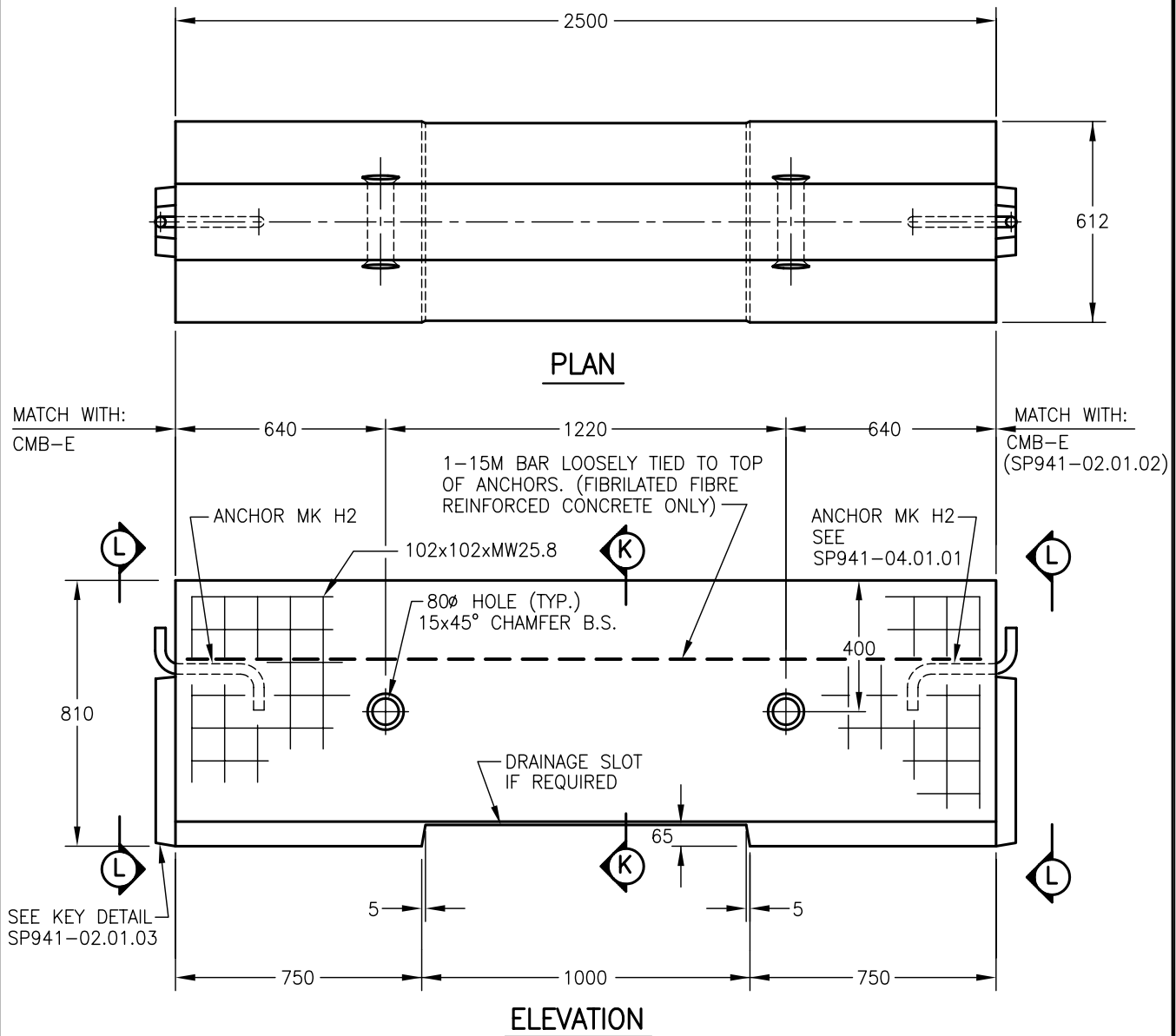
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE MEDIAN BARRIER  
810 mm – CMB-H

SP941-02.01.01



NOTES:

1. FOR SECTION (K) SEE SP941-02.01.02 FOR VIEW (L) SEE SP941-02.01.03.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. SEE DRAWING SP941-02.01.02 FOR DETAILS OF EYE UNIT.

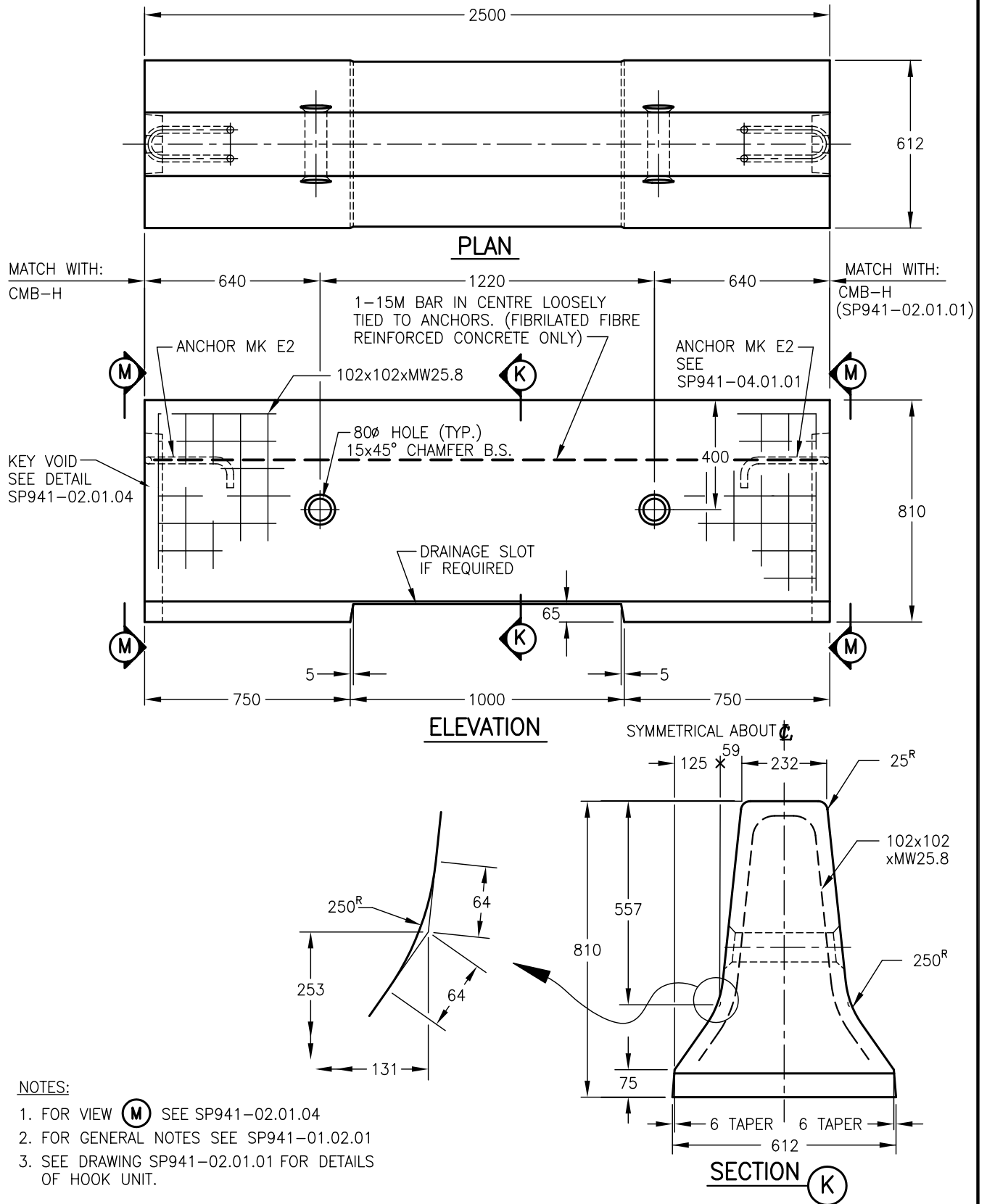
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE MEDIAN BARRIER  
810 mm – CMB-E

SP941-02.01.02

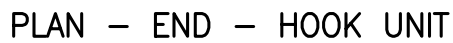


NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



SP941-02.01.03



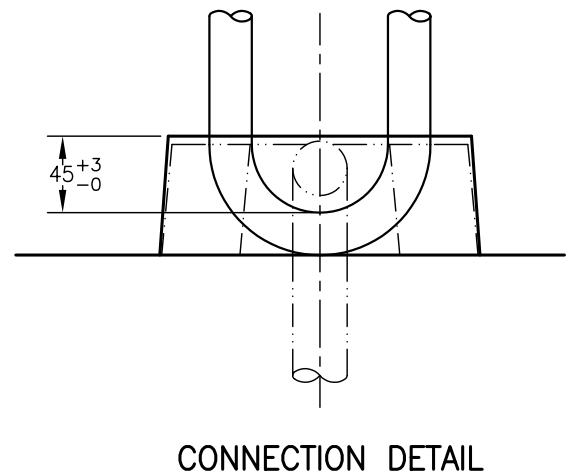
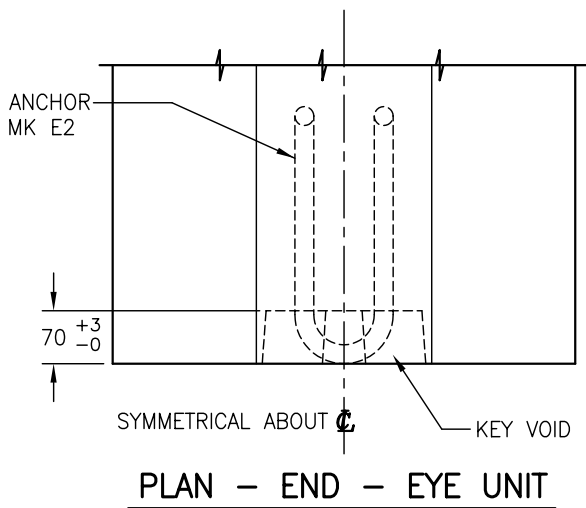
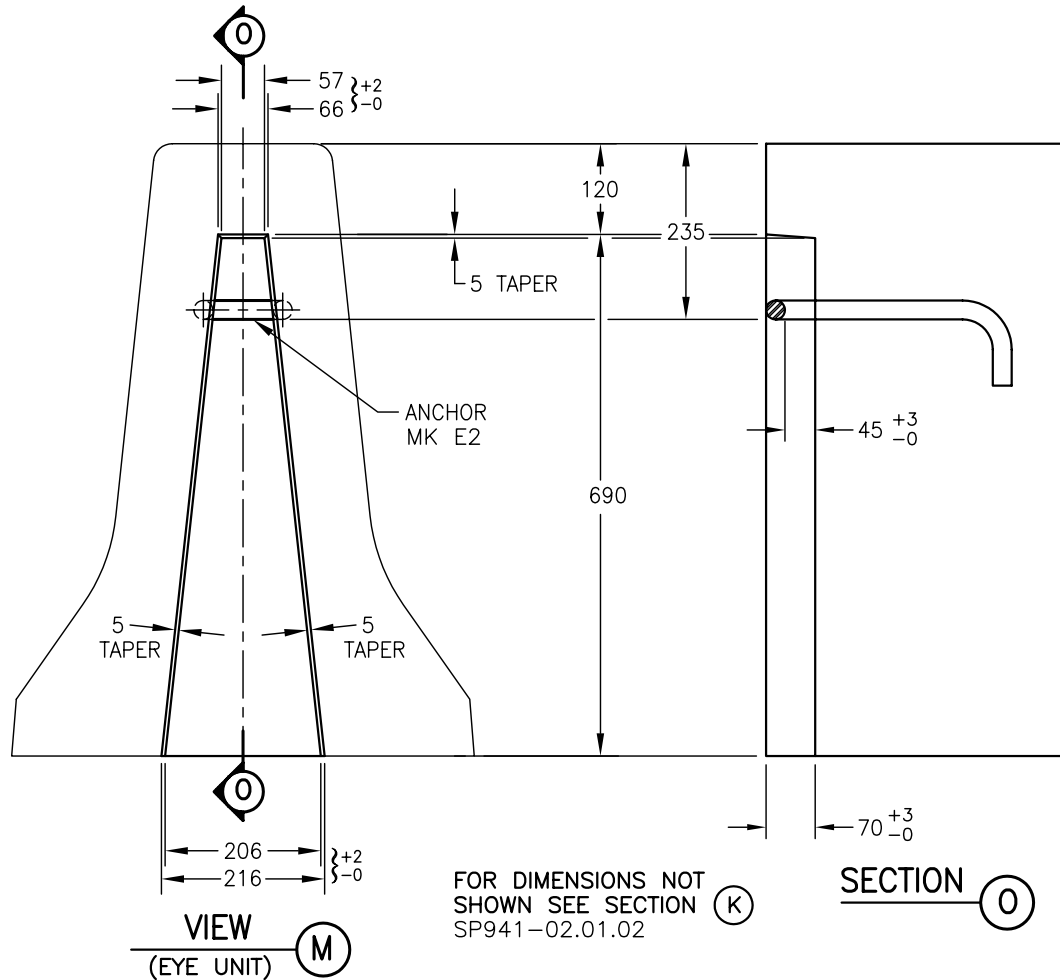
1. FOR LOCATION OF VIEW (L) SEE SP941-02.01.01 & SP941-03.02.01.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941-04.01.01.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE MEDIAN BARRIER  
810 mm – CMB–E DETAILS

SP941–02.01.04



NOTES:

1. FOR LOCATION OF VIEW (M) SEE SP941–02.01.02.
2. FOR GENERAL NOTES SEE SP941–01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941–04.01.01.

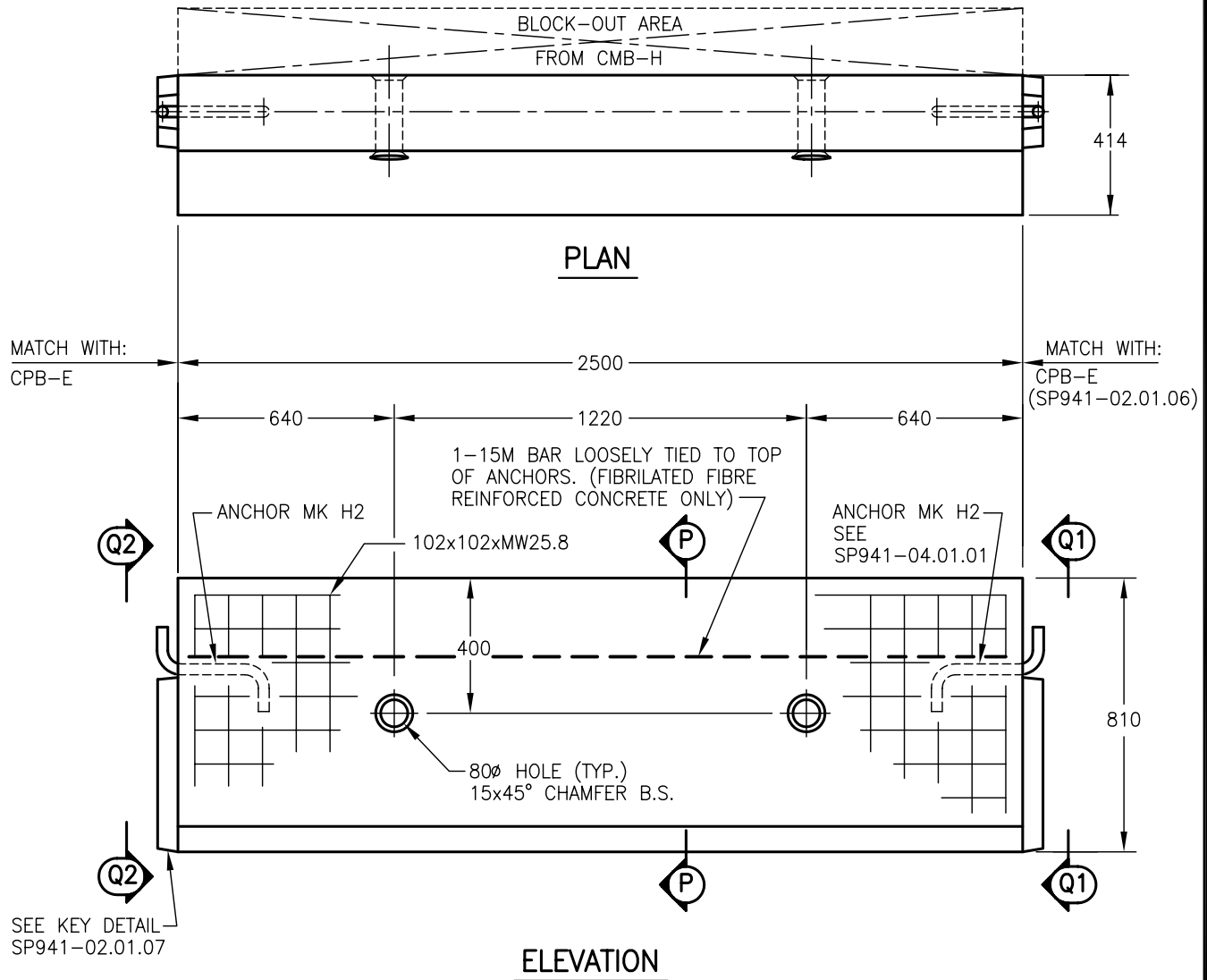
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE PIER BARRIER  
810 mm – CPB-H

SP941-02.01.05



NOTES:

1. FOR SECTION (P) SEE SP941-02.01.06.  
FOR VIEW (Q1) & (Q2) SEE SP941-02.01.07.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. SEE DRAWING SP941-02.01.06 FOR DETAILS OF EYE UNIT.
4. THESE UNITS ARE INTENDED TO BE USED AGAINST BRIDGE SUPPORT STRUCTURES AND SIMILAR WALLS.
5. IT IS INTENDED THAT EXISTING CMB MOLDS WILL BE ADAPTED TO PRODUCE THESE CPB UNITS.

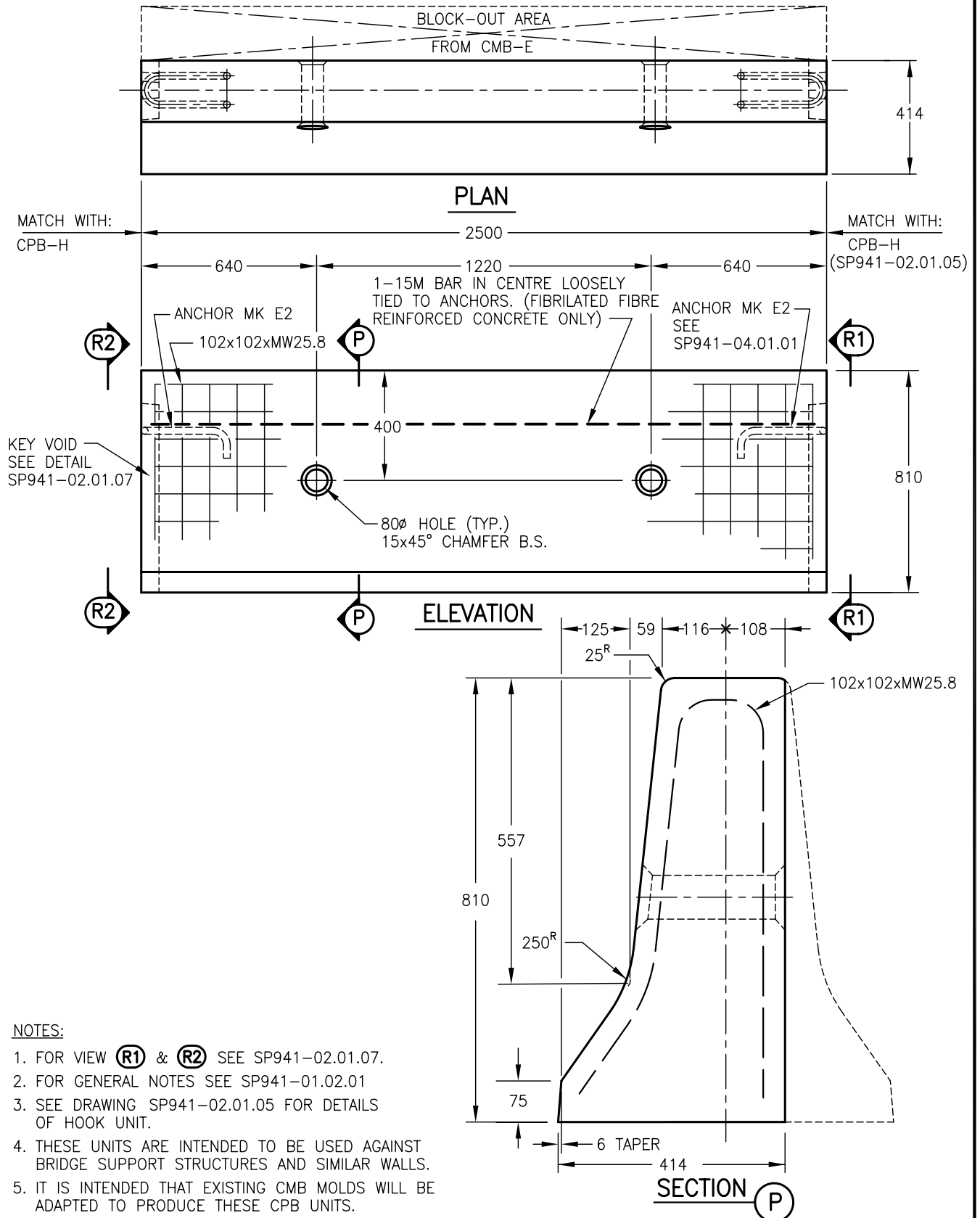
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE PIER BARRIER  
810 mm – CPB-E

SP941-02.01.06

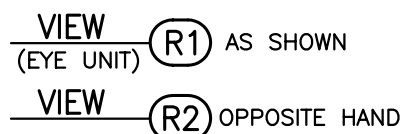
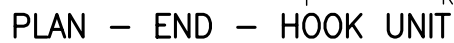
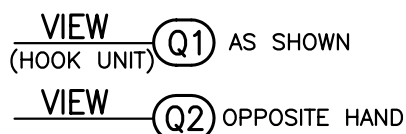


NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SP941-02.01.07



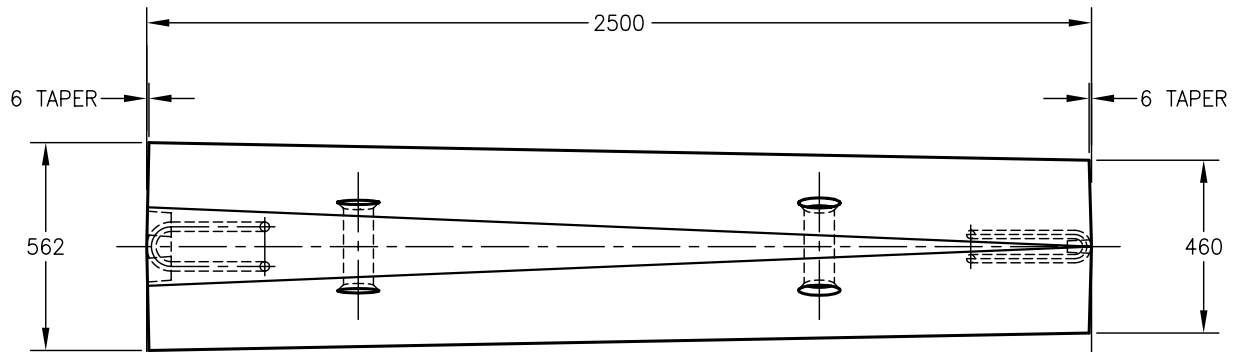
1. FOR LOCATION OF VIEW **(Q1)** & **(Q2)** SEE SP941-02.01.05.
2. FOR LOCATION OF VIEW **(R1)** & **(R2)** SEE SP941-02.01.06.
3. FOR GENERAL NOTES SEE SP941-01.02.01
4. FOR DETAILS OF ANCHORS SEE SP941-04.01.01.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

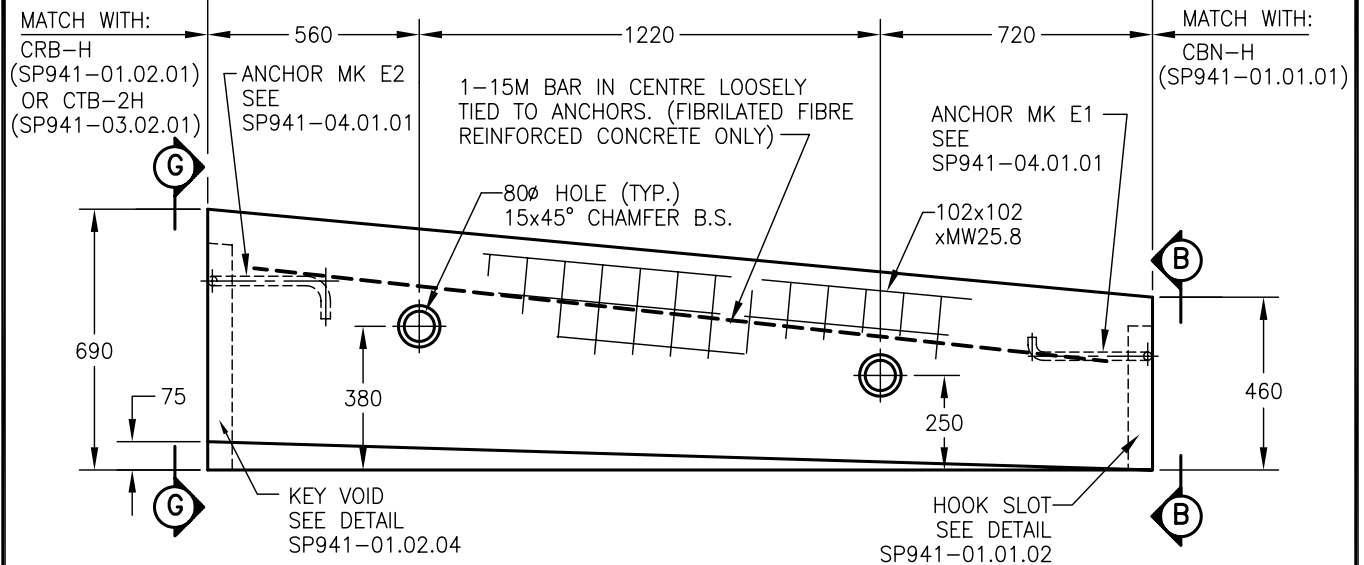


PRECAST CONCRETE TRANSITION BARRIER  
690 mm TO 460 mm – CTB-1E

SP941-03.01.01



PLAN



ELEVATION

NOTES:

1. FOR VIEW (B) SEE SP941-01.01.02. FOR VIEW (G) SEE SP941-01.02.04.
2. FOR GENERAL NOTES SEE SP941-01.02.01.
3. SEE DRAWINGS SP941-01.01.01 AND SP941-01.01.02 FOR DETAILS OF 460 mm UNIT AND BULLNOSE.  
SEE DRAWING SP941-01.02.01 FOR DETAILS OF 690 mm HOOK UNIT  
OR SP941-03.02.01 FOR DETAILS OF 810 TO 690 TRANSITION UNIT.

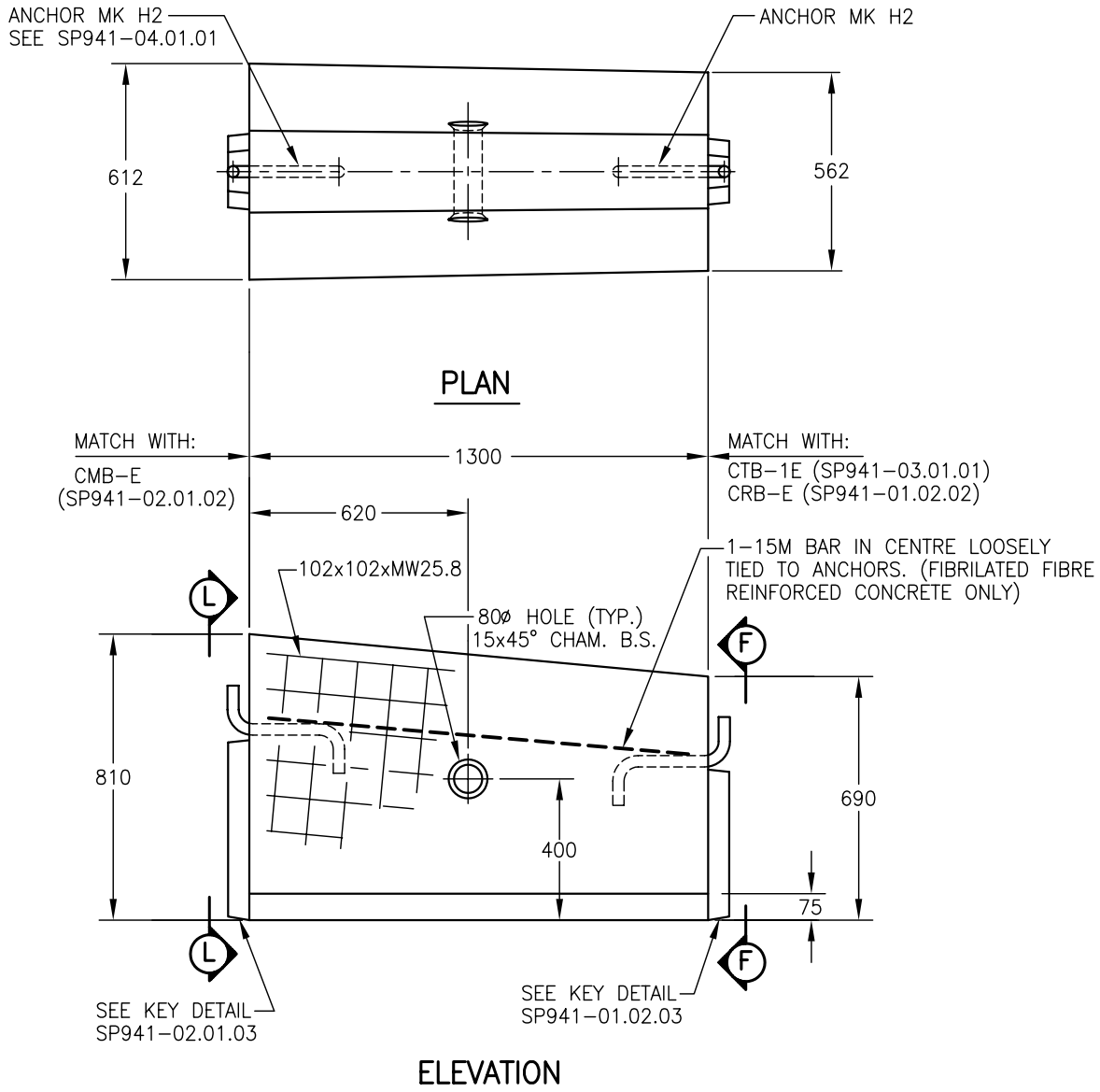
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE TRANSITION BARRIER  
810 mm TO 690 mm – CTB-2H

SP941-03.02.01



NOTES:

1. FOR VIEW (F) SEE SP941-01.02.03.  
FOR VIEW (L) SEE SP941-02.01.03.
2. FOR GENERAL NOTES SEE SP941-01.02.01.
3. SEE DRAWING SP941-02.01.02 FOR DETAILS OF 810 mm EYE UNIT.  
SEE DRAWING SP941-01.02.02 FOR DETAILS OF 690 mm EYE UNIT  
OR SP941-03.01.01 FOR DETAILS OF 690 TO 460 TRANSITION UNIT.

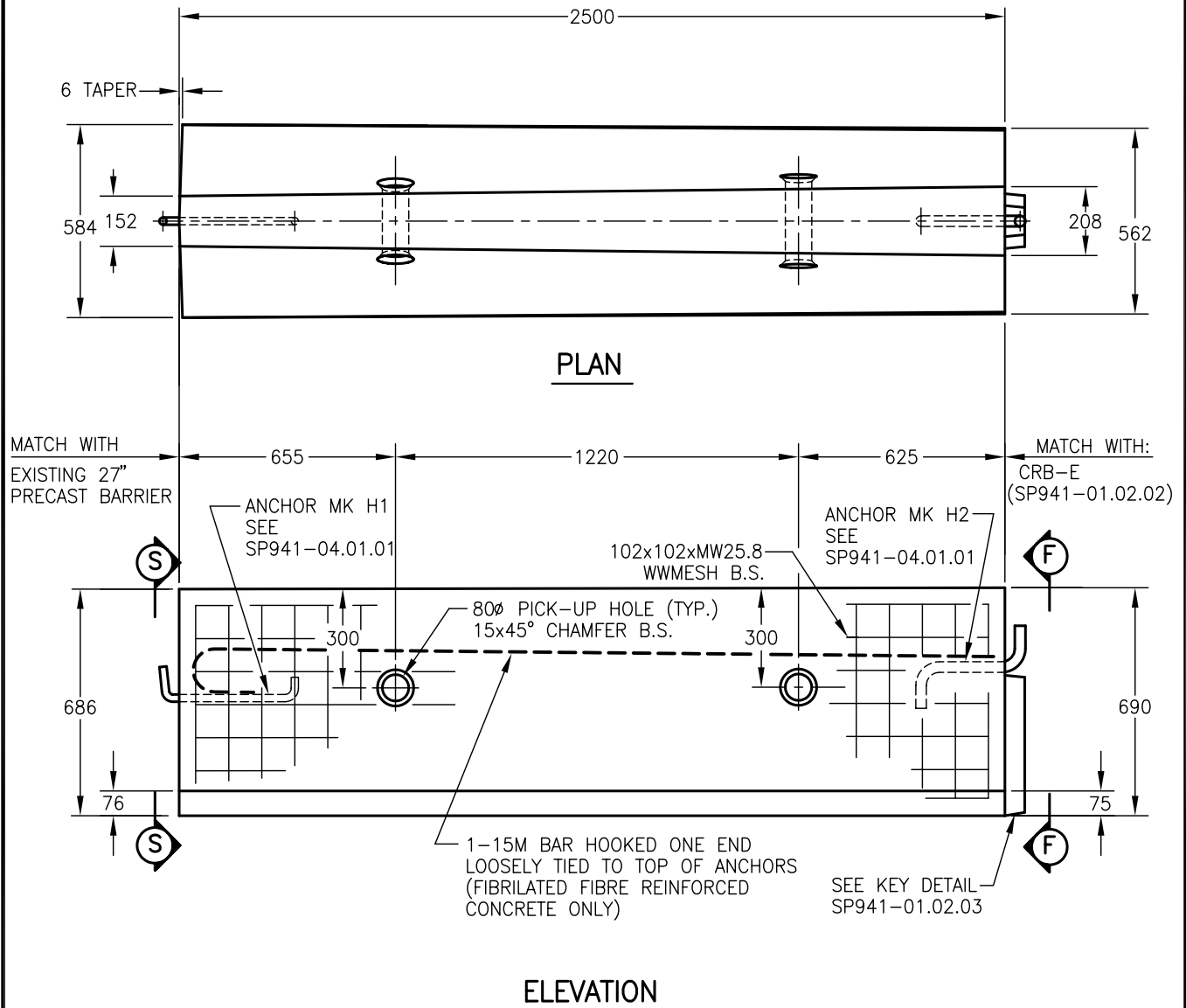
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE TRANSITION BARRIER  
686 mm TO 690 mm – CTB-3H

SP941-03.03.01



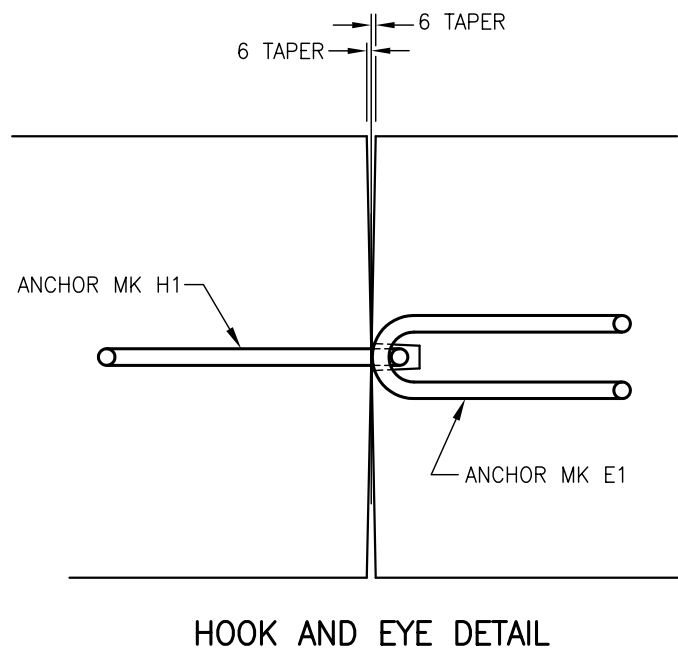
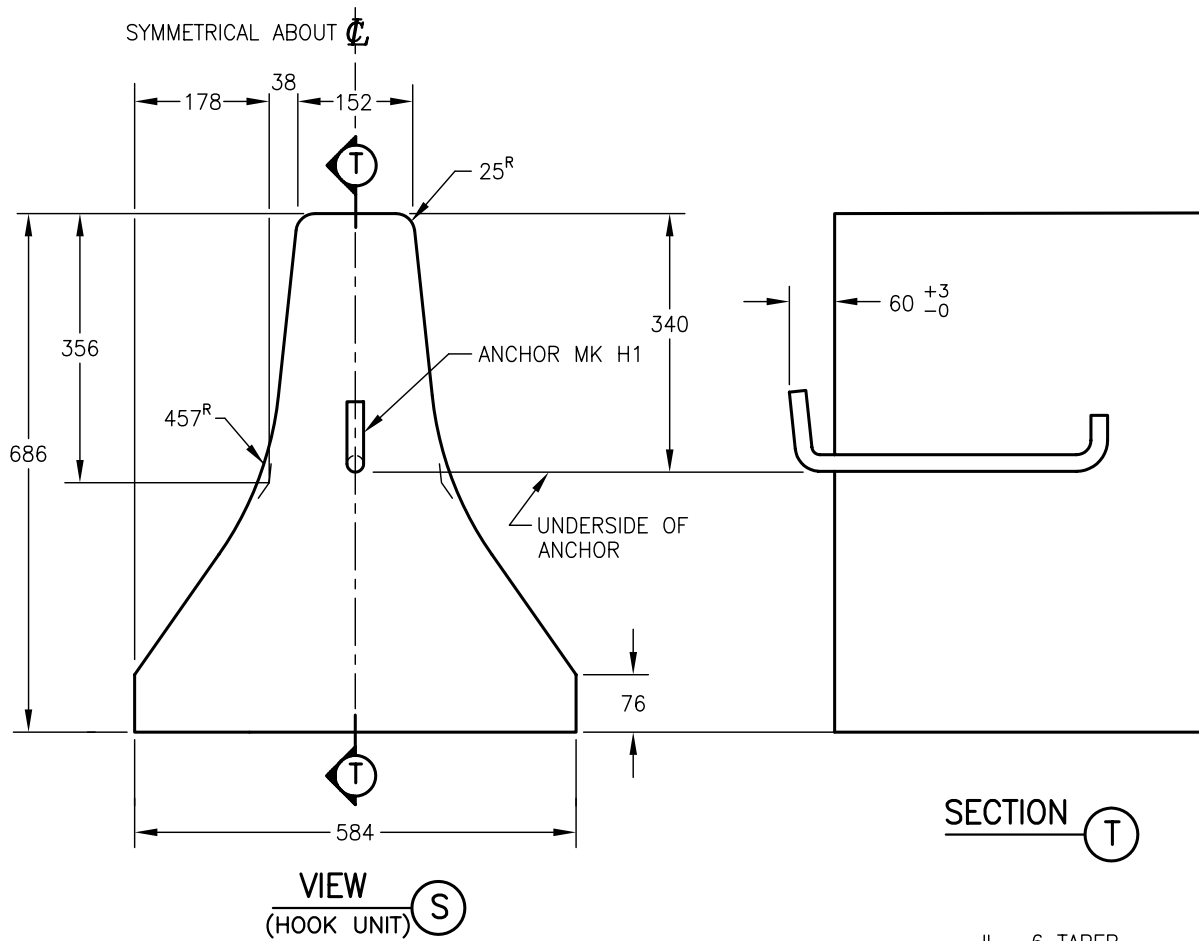
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE TRANSITION BARRIER  
686 mm TO 690 mm – CTB-3H DETAILS

SP941-03.03.02



NOTES:

1. FOR LOCATION OF VIEW (S) SEE SP941-03.03.01
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941-04.01.01.

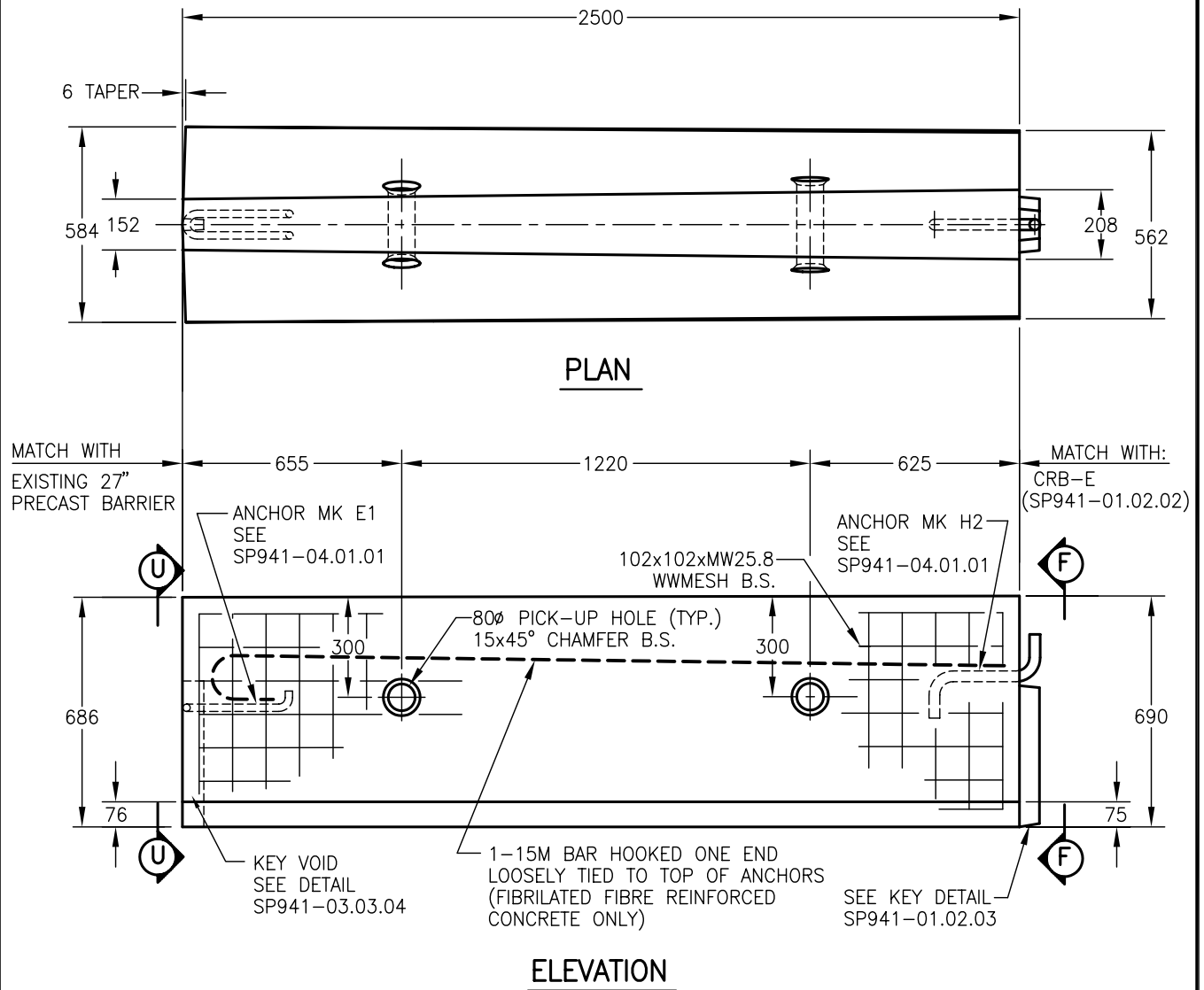
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE TRANSITION BARRIER  
686 mm TO 690 mm – CTB-3E+H

SP941-03.03.03



NOTES:

1. FOR VIEW (F) SEE SP941-01.02.03.. FOR VIEW (U) SEE SP941-03.03.04
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. SEE DRAWING SP941-01.02.01 FOR DETAILS OF 690 mm HOOK UNIT.
4. THIS UNIT TO BE USED WITH EXISTING 27" BARRIER. 27" BARRIERS ARE NO LONGER USED IN NEW INSTALLATIONS

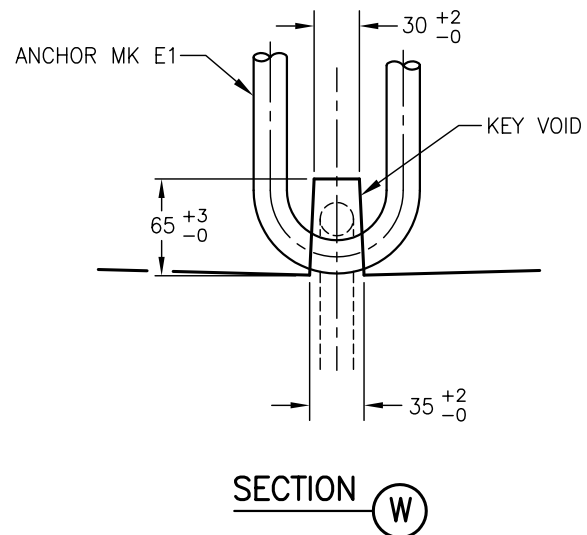
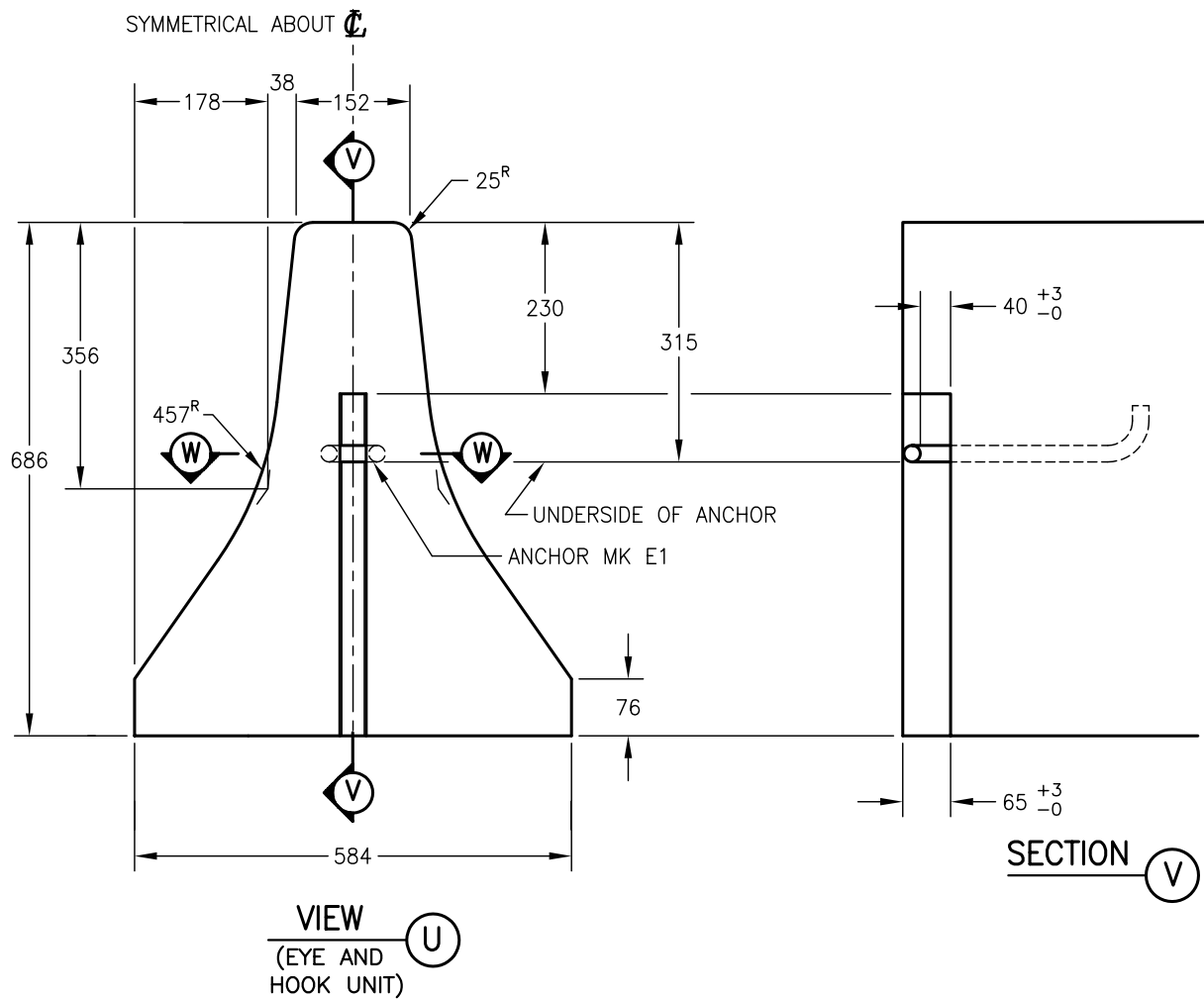
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



PRECAST CONCRETE TRANSITION BARRIER  
686 mm TO 690 mm – CTB-3E+H DETAILS

SP941-03.03.04



NOTES:

1. FOR LOCATION OF VIEW  $\text{U}$  SEE SP941-03.03.03.
2. FOR GENERAL NOTES SEE SP941-01.02.01
3. FOR DETAILS OF ANCHORS SEE SP941-04.01.01.

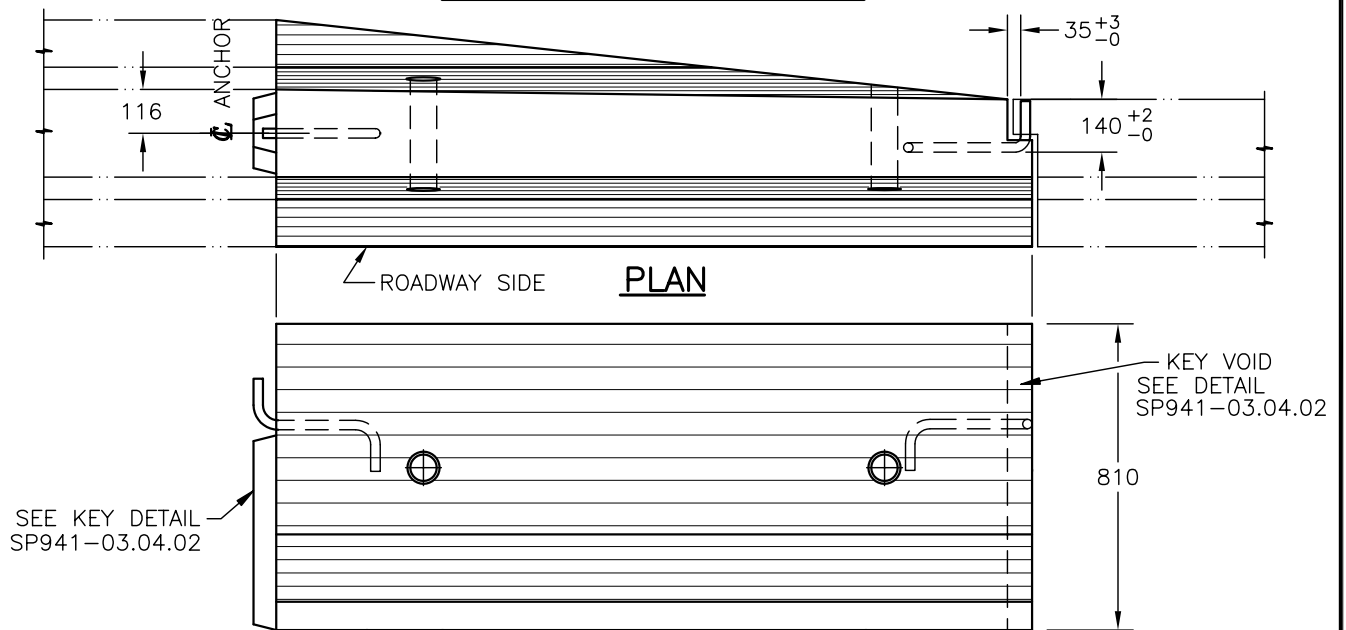
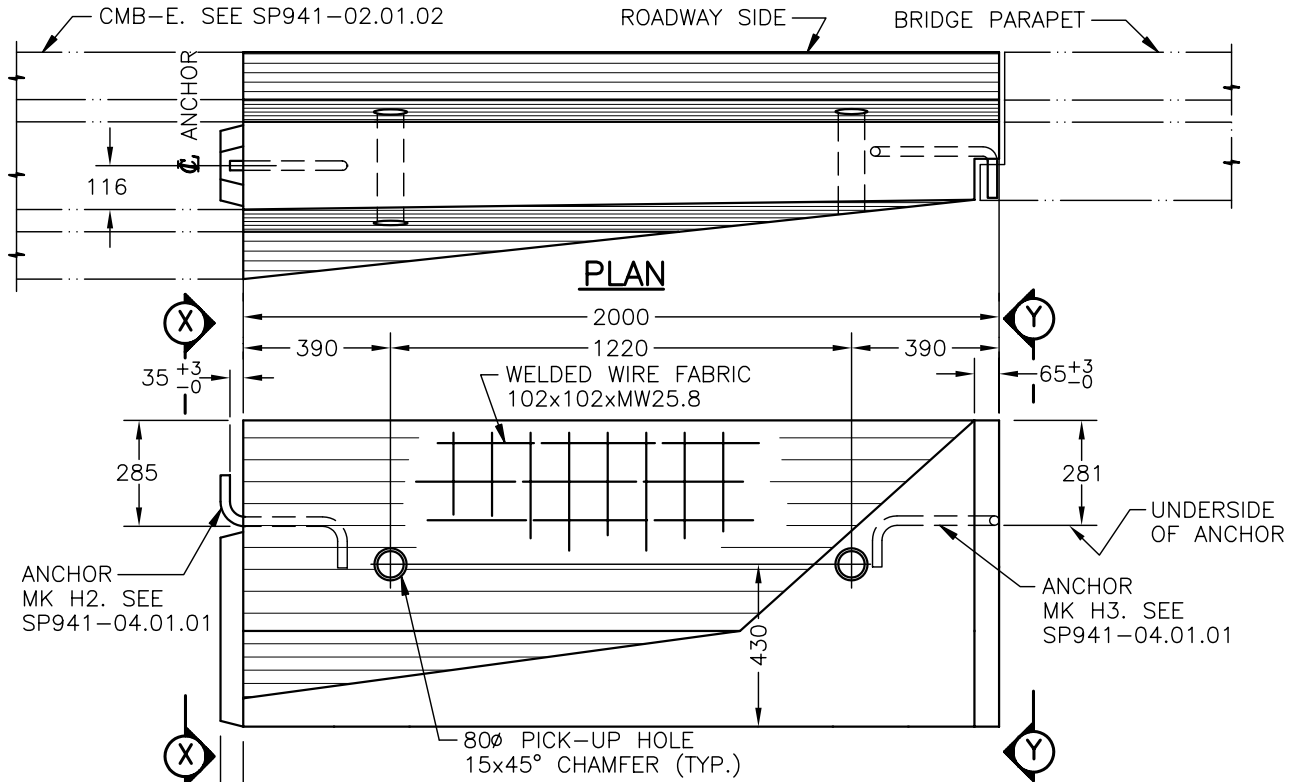
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



# STANDARD BRIDGE PARAPET 810 mm HIGH TRANSITION

SP941-03.04.01



## NOTES:

1. FOR VIEW (X) AND (Y) SEE SP941-03.04.02
2. FOR GENERAL NOTES SEE SP941-01.02.01

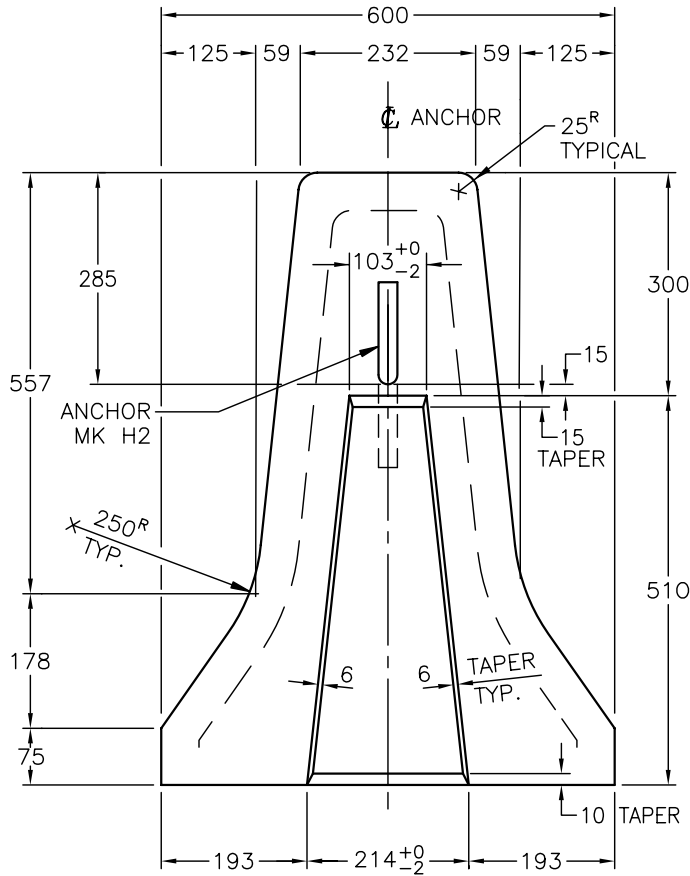
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



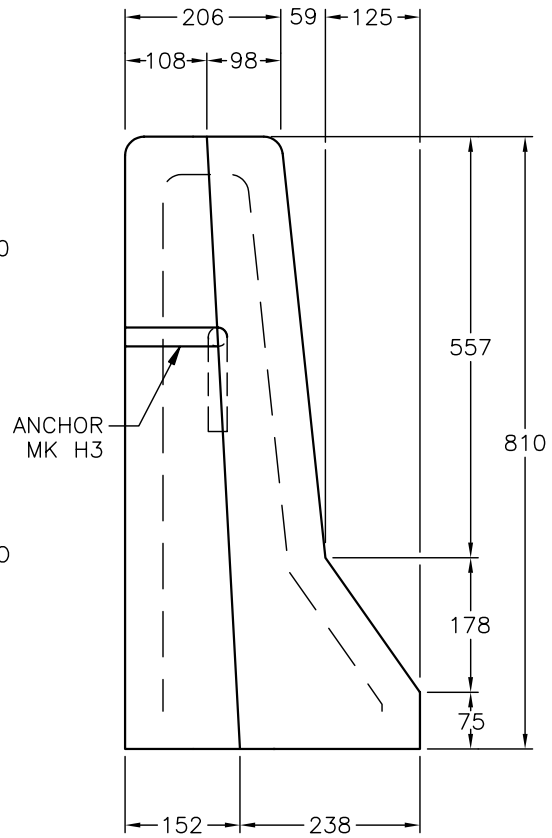
# STANDARD BRIDGE PARAPET 810 mm HIGH TRANSITION – DETAILS

SP941–03.04.02



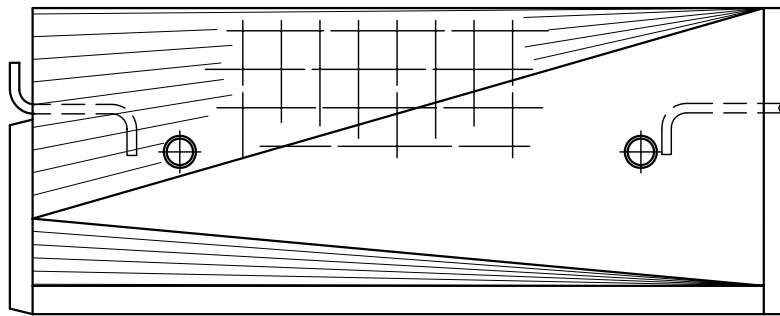
VIEW (X)

RIGHT HAND TRANSITION SHOWN  
LEFT HAND TRANSITION SIMILAR



VIEW (Y)

RIGHT HAND TRANSITION SHOWN  
LEFT HAND TRANSITION OPP. HAND



## ACCEPTABLE ALTERNATE SIDE CONFIGURATION

RIGHT HAND TRANSITION ELEVATION SHOWN  
LEFT HAND TRANSITION ELEVATION OPPOSITE HAND

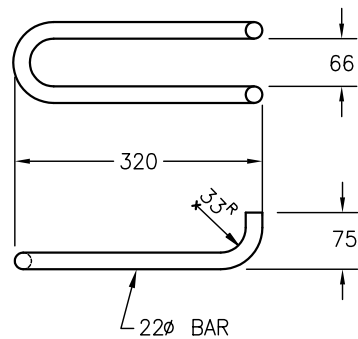
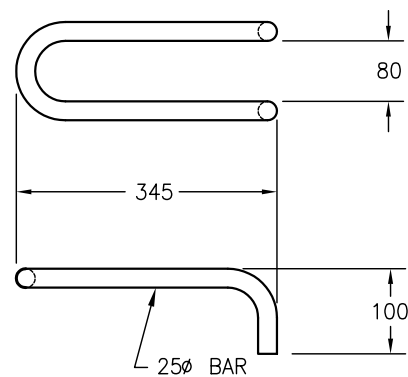
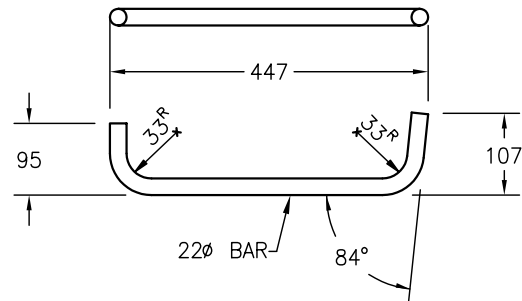
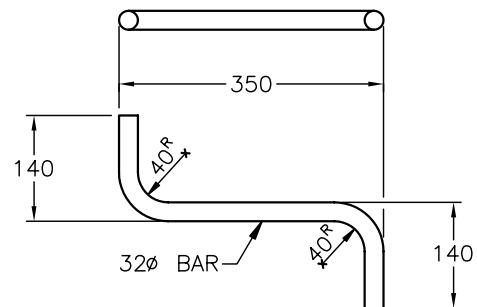
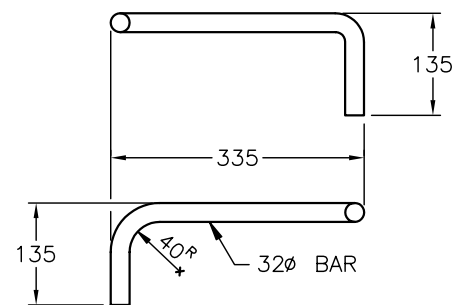
### NOTES:

1. FOR LOCATION OF VIEW (X) AND (Y) SEE SP941–03.04.01
2. FOR GENERAL NOTES SEE SP941–01.02.01

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



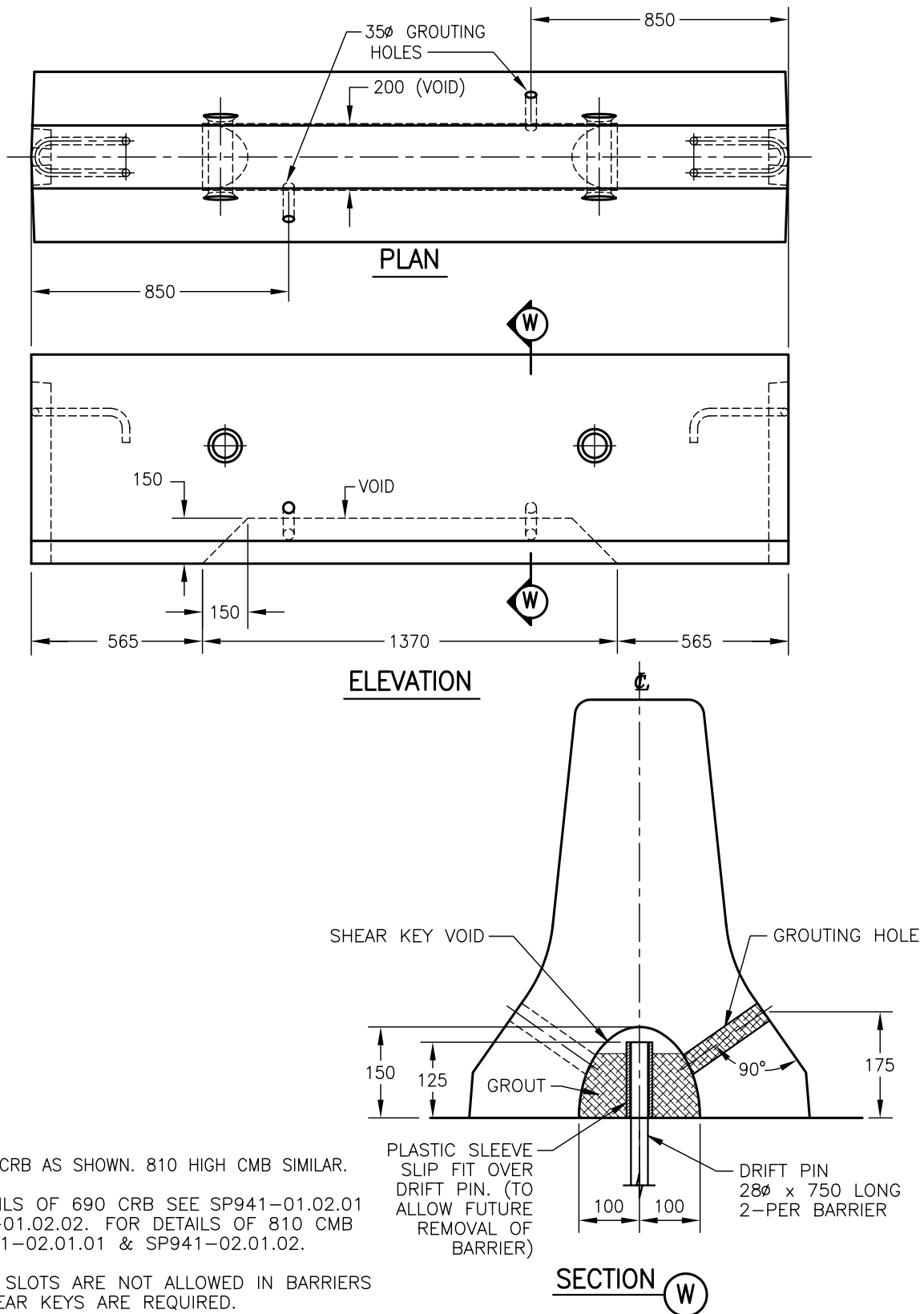
**ANCHOR MK E1****ANCHOR MK E2****ANCHOR MK H1****ANCHOR MK H2****ANCHOR MK H3****NOTES:**

1. STEEL FOR ANCHORS TO CONFORM TO CSA SPECIFICATION CAN3-G40.21M.
2. ANCHORS TO BE GALVANIZED AFTER FABRICATION. GALVANIZING TO BE IN ACCORDANCE WITH CSA SPECIFICATION G164 TABLE 1.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED





**NOTES:**

1. 690 HIGH CRB AS SHOWN. 810 HIGH CMB SIMILAR.
2. FOR DETAILS OF 690 CRB SEE SP941-01.02.01 & SP941-01.02.02. FOR DETAILS OF 810 CMB SEE SP941-02.01.01 & SP941-02.01.02.
3. DRAINAGE SLOTS ARE NOT ALLOWED IN BARRIERS WHEN SHEAR KEYS ARE REQUIRED.

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



## SECTION 951

### ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE

#### 951.01 Scope

a) This Section describes the requirements for the different types and grades of asphalt and paving materials to be supplied for highway use.

b) The materials so described are generally classified as follows:

- Asphalt Cements
- Cutback Asphalts
- Asphalt Emulsions
- Tall Oil Pitch
- Emulsified Products

#### 951.02 Quality Control Requirements

##### 951.02.01 Quality Control System

a) The supplier shall develop a proven quality control system in accordance with the provisions of this Specification. The system shall ensure that adequate inspection coverage is maintained throughout the entire process of manufacture and shipping. All supplies processed or manufactured within the supplier's plant or procured from any other source shall receive sufficient inspection to ensure conformance to contractual requirements. Evidence of such inspection shall be available to the authorized inspector of the Ministry prior to delivery under a BC Government Purchase Order.

b) Supplies not conforming to contractual requirements shall not be offered for highway use until the deviations have been authorized by the requisitioning Ministry Representative.

c) The Ministry reserves the right to maintain surveillance over the supplier's quality control system to ensure conformance to the requirements of this Specification.

d) It shall be a responsibility of the manufacturer and supplier to ensure that all materials supplied to the Ministry satisfy the related Environmental and Health and Safety Regulations.

**951.02.02 Quality Control Procedure** - The supplier may be required to furnish the Ministry Representative with an outline of the quality control procedures detailing the method of implementing the requirements of this Specification. This outline shall include the following operations:

- sampling and testing
- storage and handling

- shipping
- recording and reporting.

**951.02.03 Technical Requirements** - The supplier shall maintain quality control throughout the facility during the following phases of manufacture:

a) **Batching and Batch Analysis:** Each batch of product covered by this Specification shall be given a batch number, and sampled and tested in accordance with the applicable Specification.

The batch analysis must show the Specification requirements for the product tested, test method employed, and the pertinent test results, as listed on [Appendix A](#).

b) Certified batch analysis shall be dispatched to the field representative of the requisitioning Ministry Representative with the first load of material delivered. Provided the batch from which shipments are drawn remains the same and provided that the batch number is shown on the Bill of Lading, no further batch analysis will be required for subsequent remaining shipments. If, during the course of delivery, it is necessary to draw material from a different batch or batches of product, the analysis of the replacement batch shall be sent out with the first load of material from each and every replacement batch.

c) Product discharged directly into tank cars or tank trucks from "in line blending" facilities will be sampled as required to ensure uniformity and satisfy quality requirements.

#### 951.03 Sampling and Testing

a) The supplier shall retain adequate sampling equipment, employ satisfactory sampling procedures, and maintain sampling program and records. Representative samples from filled shipping containers will be examined to ensure quality.

b) Test methods for asphalt and paving materials shall conform to the standard British Columbia Ministry of Transportation (BCH) tests listed in [Table 951-A](#), supplemented by such special tests as may be described elsewhere to cover special or experimental type materials.

c) On request, suppliers shall provide samples of the product to be supplied in such reasonable quantities (not less than 4 ℓ) as may be required for independent testing purposes.



**951.04 Storage and Handling**

a) Adequate bulk storage tanks shall be provided to ensure continuity of supply, uniformity of product, satisfactory temperature control, or to satisfy any other special requirements for which storage must be provided.

b) Adequate records shall be kept to provide the Ministry Representative with evidence that incoming products meet the quality requirements and that the products were properly handled during storage and shipping. These records shall also show the amounts and destination of all shipments made to the Ministry.

**951.05 Ordering and Accounting for Materials**

a) A Purchase Order will be issued by the Purchasing Commission.

b) Each serially numbered Purchase Order will name the highway official or Contractor (hereafter referred to as the Consignee) to whom the asphalt and paving materials are to be delivered, the official to whom invoices shall be submitted and the f.o.b. points of delivery.

c) If, after an order has been placed, the Consignee should arrange for a material supplier to ship asphalt by an alternative and less economical means than the one specified, in order to satisfy the Consignee's method of operation, the supplier shall be responsible for collecting directly from the Consignee such extra charges that may arise and shall have no claim against the Ministry by reason of such change.

d) In order to expedite ordering and shipment, the supplier shall, immediately upon receipt of a Purchase Order for asphalt and paving materials, forward to the highway official named in the Purchase Order three copies of an information sheet giving the names, telephone numbers and addresses of the shipping officers who will be handling shipments of material under the Purchase Order.

The information sheet shall also detail normal delivery time to be expected and the railway schedules which will be used to effect shipments of asphalt and paving materials under the order.

e) Where shipments of asphalt and paving materials are made by rail tank car, the supplier shall notify both the Consignee and the highway official by telegram of each and every shipment, stating the tank car number, type of product, quantity loaded (at 15°C), time and date shipped, bill of lading date and freight train schedule, if available.

**TABLE 951-A TEST METHODS**

TITLE OF TEST	TEST DESIGNATION	
	B.C.H.	ASTM
Penetration	III - 1	D 5
Absolute Viscosity of Asphalts	III - 3	D 2171
Kinematic Viscosity of Asphalts	III - 4	D 2170
Effect of Heat and Air on Asphalt	III - 5	D 1754
Distillation of Cutback Asphalt	III - 6	D 402
Residue of 100 Penetration	III - 2	D 243
Relative Density of Asphalt Cement and Cutback Asphalt	III - 7	D 70
Ductility	III - 8	D 113
Float Test	III - 9	D 139
Flash Point by Tag Open Cup	III - 10	D 1310
Flash Point by Cleveland Open Cup	III - 11	D 92
Solubility in Trichloroethylene	III - 12	D 2042
Water in Asphalt	III - 13	D 95
Softening Point in Ethylene Glycol	III - 14	D 2398
Saybolt Furol Viscosity	III - 15	D 88
Testing Emulsified Asphalts	IV - 1	D 244
Testing High Float Asphalts	IV - 2	

f) Every bill of lading must show:

- Purchase Order number
- Carrier number and description
- Shipping destination (both project and delivery point)
- Type of product
- Batch number
- Mass
- Relative density at 15°C
- Time out at refinery or plant
- Time order phoned in
- Requested time of delivery.

g) In order to avoid delays in payments, two copies of the bill of lading shall be left at the delivery point with the requisitioning Ministry Representative, who in turn will sign one copy and mail it to Headquarters immediately. The supplier shall mail the invoices, in triplicate, as directed on the purchase order.

**951.06 Delivery of Asphalt and Paving Materials**



**951.06.01 Expediting**

- a) The supplier of the asphalt and paving materials shall be responsible for the proper and prompt delivery of asphalt and paving materials in good condition and at correct temperature to the specified delivery point. The supplier shall ensure that the Consignee shall suffer no loss of production.
- b) Asphalt and paving materials may be shipped from the supplier's refinery or plant by rail tankcar, motor transport truck, waterborne tanker or in steel drums, as may be specified.

Trucks shall be equipped with a submerged sampling valve system installed generally as shown on Drawing [SP951-01](#) for each compartment in which asphalt material is to be carried out.

- c) The Consignee shall make all arrangements with the supplier or the appointed carrier for the scheduling of deliveries.

Advance notice shall reach the appointed shipping officer:

- For tank truck deliveries, 24 hours before dispatch of load, or
- For rail tank car deliveries, 72 hours before dispatch of a load, except that the period between 17:00 Saturday and 8:00 Monday shall not be included in the 72 hour notice time.

Notice of cancellation of shipments must reach the Supplier 4 hours before the dispatch time of a load.

The original order to ship or cancel may be given by telephone, but a confirmatory telegram telex, or facsimile must reach the Supplier's shipper 4 hours before the time for dispatch of a shipment or the telephone order may be considered to be cancelled. Cancellation shall also be confirmed by telegram before the dispatch time for a shipment. The cost of all telephone calls, telex or telegrams shall be to the account of the Consignee .

- d) Delivery temperature of the shipment shall meet the viscosity requirement shown in Table [951-B](#).
- e) Asphalt Emulsions and emulsified products contain water and become unstable, break and separate if frozen. Therefore, to retain the homogeneity of these materials, they shall be kept at temperatures above 5°C.

**Note:** In no case shall asphalt materials or Tall Oil Pitch be received at a viscosity outside the specified viscosity

range.

**951.06.02 Receiving**

- a) The Consignee shall supply all labour and equipment to remove asphalt and paving materials from tank trucks or tank cars, if pertinent.
- b) The demurrage free unloading period for trucks hauling asphalt and paving materials to the job will be two hours.
- c) Although reasonable efforts will be made to accept tank truck delivery of asphalt and paving material products at all times, no compensation will be made for demurrage on motor tank truck deliveries made between 22:00 and 06:00 of the local time at the delivery point.
- d) When demurrage is incurred due to the Consignee method of operation, the driver will ensure that the time involved is countersigned by the Consignee. Delays caused by Ministry personnel will be countersigned by the Ministry Representative's alternate. The carrier will issue a claim notice (a signed bill of lading is acceptable as proper documentation) for all properly documented claims. The carrier shall notify the supplier within three weeks of the occurrence, and the supplier will invoice the Ministry directly.

**951.06.03 Returned Products** - Freight costs deriving from delivery to the Project and return of asphalt and paving material products to the refinery or plant are to be invoiced to the Ministry at the haul rates contracted between the supplier and the carrier for that particular project.

**951.07 Asphalt Cement**

Asphalt cements shall:

- a) Be products prepared by the refining of petroleum oils.

**TABLE 951-B VISCOSITY REQUIREMENTS FOR SHIPMENT DELIVERY TEMPERATURE**

CLASS OF MATERIAL	KINEMATIC VISCOSITY, mm <sup>2</sup> /s
Cutback Asphalt for Surface Spraying	100 - 200
Cutback Asphalt and Asphalt Cement for Plant Mixing	100 - 500
Tall Oil Pitch	20 - 40



b) Be homogeneous, free from water and shall not foam when heated to 175°C.

c) Conform to the requirements specified in Tables 951-C and 951-D.

The supplier shall forward a 4 ℓ sample of the product to the Pavement Design Centre of the appropriate Regional Highways office.

**NOTE:** Values for penetration and viscosity are point values only. Intermediate values for Group A, B and C grades shall be obtained by interpolation between the tabulated values on a straight line basis. Minimum viscosity at 60°C for other penetrations within each group can be read from the corresponding straight line on Drawing SP951-04.

#### 951.08 Cutback Asphalts

a) Cutback asphalts shall consist essentially of petroleum derivatives and shall be substantially free from water and other impurities.

b) Cutback asphalts shall be of the type and grade described in Tables 951-E through 951-H.

#### 951.09 - 951.15 Not Used

**951.16 Asphalt Emulsions** - Asphalt materials in the form of aqueous emulsions shall be of:

- Anionic Type
- Cationic Type
- High Float Type

**951.17 Anionic Type Emulsion for Road Purposes** - Anionic type of emulsion requirements are as follows:

- The asphalt emulsion shall be homogeneous.

**TABLE 951-C GRADES OF ASPHALT CEMENT**

PENETRATION GRADE ASPHALT CEMENT	80 - 100		150 - 200		200 - 300		TEST METHOD ASTM
Requirements	Min	Max	Min	Max	Min	Ma	D 5
Penetration at 25°C 100 g and 5 s, 0.1 mm	80	100	150	200	200	300	
Group A Group B Group C	Minimum viscosity values defining boundaries for groups A, B, & C are listed in Table 951-D and illustrated in Drawing SP951-04						
Flash Point, °C Cleveland Open Cup	230	---	220	---	175	---	D 92
Thin Film Oven Test % Loss in Mass	---	0.85	---	1.3	---	1.5	D 1754
Penetration of Residue at 25°C 100 g, 5 s, 0.1 mm, % of Original Penetration	55	---	50	---	45	---	After T.F.O.T.
Solubility in Trichloroethylene % by Mass	99.5	---	99.5	---	99.5	---	D 2042
Ductility, 25°C 5 cm/min, cm	100	---	100	---	---	---	D 113
Ductility, 15°C 5 cm/min, cm	---	---	---	---	100	---	

**TABLE 951-D VISCOSITY AND PENETRATION VALUES DEFINING GROUP BOUNDARIES**

Penetration 25°C	80	100	150	200	300	TEST METHOD - ASTM
						D 5
	Minimum Viscosity at 60°C					D 2171
Group A	150	115	70	50	31	
Group B	110	85	---	---	---	
Group C	75	55	---	---	---	



- It shall show no separation of asphalt after thorough mixing within 30 days (crack filler 20 days) after delivery provided separation has not been caused by freezing.
- The emulsion shall conform to the requirements listed in Table 951-I.

**951.18 Cationic Type Emulsions for Road Purposes -**

Cationic type emulsions shall conform to the requirements listed in Table 951-J and shall be uniform throughout.

**951.19 High Float Emulsified Asphalt -** Storage stability - High float emulsified asphalt shall show no separation of asphalt within 30 days after delivery and shall be homogeneous after thorough mixing.

The emulsion shall conform to the requirements listed in Table 951-K.

**951.20 Tall Oil Pitch (TOP) -** Tall oil pitch, co-product of the pulp and paper industry is a residual fraction from the crude tall oil vacuum distillation process. It shall be a dark

**TABLE 951-E SLOW CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE					
	SC - 70		SC - 250		SC - 3000	
	Min	Max	Min	Max	Min	Max
Flash Point °C	65	---	80	---	105	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	70	140	250	500	3 000	6 000
Residue from Distillation to 360°C, volume % by difference	70	90	80	94	95	---
Distillation Residue, Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	400	7 000	800	10 000	4 000	35 000
<b>ASPHALT RESIDUE:</b>						
Residue of 100 Penetration, % by Mass	50	---	60	---	80	---
Ductility of 100 Penetration residue at 25°C, cm	100	---	100	---	100	---
Solubility in Trichloroethylene	99.0	---	99.0	---	99.0	---
Water, % by Mass or Volume	---	0.5	---	0.5	---	0.5

**TABLE 951-F MEDIUM CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE			
	MC - 30		MC - 250	
	Min.	Max.	Min.	Max.
Flash Point °C	38	---	65	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	30	60	250	500
Distillation Test, % of Total Distillate to 360°C: to 225°C	---	25	---	10
Distillation Test, % of Total Distillate to 360°C: to 260°C	40	70	15	55
Distillation Test, % of Total Distillate to 360°C: to 315°C	75	93	60	87
Residue from Distillation to 360°C, volume % by difference	50	---	67	---
<b>PROPERTIES OF RESIDUE FROM DISTILLATION:</b>				
Penetration at 25°C, 100 g, 5 s, 0.1 mm	120	250	120	250
Ductility at 25°C, cm	100	---	100	---
Solubility in Trichloroethylene	99.0	---	99.0	---
Water, %	---	0.2	---	0.2



brown resinous and viscous material insoluble in water but miscible with asphalt. TOP is typically used by the Ministry as an asphalt extender, recycling, and anti-stripping agent. Where required, TOP will be added to asphalt cement in a ratio defined by the mix design, usually between 5 - 10%. The composition and properties of TOP depends on the origin and type of trees from which it is derived and the extraction technology. Only TOP approved by the Ministry's New Product Standing Committee shall be permitted for use on Ministry paving projects.

The TOP shall conform to the requirements listed in Tables 951-L and 951-M.

of emulsified Tall Oil Pitch and proprietary asphalt based emulsions. The emulsified products are typically used by the Ministry, in paving operations, as prime coats and tack coats and replace organic solvent based cutback asphalts for environmental reasons. Only products approved by the Ministry's New Product Standing Committee shall be permitted for use on the Ministry paving projects. Each batch of the product delivered to the job site shall be accompanied by the written statement from the manufacturer or supplier confirming that the product formulation complies with the original, previously approved formulation. Emulsified Tall Oil Pitch and asphalt based emulsified products shall conform to the requirements listed in Tables 951-N and 951-O.

**951.21 Emulsified Products** - Emulsified products consist

**TABLE 951-G RAPID CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE					
	RC - 30		RC - 70		RC - 250	
	Min	Max	Min	Max	Min	Max
Flash Point °C	---	---	---	---	27	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	30	60	70	140	250	500
Distillation Test, % of Total Distillate to 360°C: to 190°C	15	---	10	---	---	---
Distillation Test, % of Total Distillate to 360°C: to 225°C	55	---	50	---	35	---
Distillation Test, % of Total Distillate to 360°C: to 260°C	75	---	70	---	60	---
Distillation Test, % of Total Distillate to 360°C: to 315°C	90	---	85	---	80	---
Residue from Distillation to 360°C, volume % by difference	50	---	55	---	65	---
<b>TEST ON RESIDUE FROM DISTILLATION:</b>						
Penetration at 25°C, 100 g, 5 s, 0.1 mm	80	120	80	120	80	120
Ductility at 25°C, cm	100	---	100	---	100	---
Solubility in Trichloroethylene, % by mass	99.0	---	99.0	---	99.0	---
Water, %	---	0.2	---	0.2	---	0.2

**Note:** The material shall not foam when heated to the spraying and mixing temperature range recommended by the Canadian General Standards Board



TABLE 951-H CUTBACK ASPHALT PRIMER RM20

REQUIREMENTS	Min.	Max.
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	20	35
Distillation Test, % of Total Distillate to 360°C: to 190°C	---	60
Distillation Test, % of Total Distillate to 360°C: to 225°C	40	---
Distillation Test, % of Total Distillate to 360°C: to 260°C	70	---
Distillation Test, % of Total Distillate to 360°C: to 315°C	85	---
Residue from Distillation to 360°C, volume % by difference	50	---
<b>TEST ON RESIDUE FROM DISTILLATION:</b>		
Penetration at 25°C, 100 g, 5 s, 0.1 mm	80	200
Ductility at 25°C, cm	100	---
Solubility in Trichloroethylene	99.0	---
Water, %	---	0.2

TABLE 951-I REQUIREMENTS FOR ANIONIC TYPE EMULSIONS

REQUIREMENT	TYPE OF EMULSION									
	RS - 1		RS - 2		MS - 2		SS - 1		CRACK FILLER	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol: at 25°C	20	100	---	---	100	---	20	100	50	200
Viscosity, Saybolt Furol: at 50°C	---	---	75	300	---	---	---	---	---	---
Residue by Distillation, %	57	---	62	---	62	---	57	---	65	75
Settlement, 1 Day, %	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5
Demulsibility: 50 mL of 0.1 N CaCl <sub>2</sub> %	---	---	---	---	---	30	---	---	---	---
Demulsibility: 35 mL of 0.02 N CaCl <sub>2</sub> %	60	---	60	---	---	---	---	---	30	---
Sieve Test, % Retained on 1 mm	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10
Cement Mixing Test, %	---	---	---	---	---	---	---	2.0	---	---
<b>TESTS ON RESIDUE:</b>										
Penetration at 25°C, 100 g, 5 s	100	200	100	200	100	200	100	200	60	100
Solubility in Trichloroethylene %	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---
Ductility at 25°C, cm	60	---	60	---	60	---	60	---	60	---



TABLE 951-J REQUIREMENTS FOR CATIONIC TYPE EMULSIONS

REQUIREMENT	TYPE OF EMULSION			
	CRS - 1K		CRS - 2K	
	Min	Max	Min	Max
Saybolt Furol Viscosity at 50°C	30	125	174	400
% Residue by Distillation	62	---	68	---
Settlement 1 Day, %	---	1.5	---	1.5
Sieve Test, % Retained on 1 mm Mesh	---	0.1	---	0.1
Oil Portion of Distillate, % of Total Volume	0	3	0	3
Particle Charge	POSITIVE		POSITIVE	
TESTS ON RESIDUE				
Penetration at 25°C, 100 g, 5 s	100	250	100	150
Solubility in Trichloroethylene %	97.5	---	97.5	---
Ductility at 25°C, cm	60	---	65	---

TABLE 951-K REQUIREMENTS FOR HIGH FLOAT EMULSIFIED ASPHALTS

REQUIREMENT	GRADE:											
	HF-100S		HF-150S		HF-250S		HF-350S		HF-500M		HF-1000M	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Residue by Distillation, % By Mass	62	---	62	---	62	---	65	---	65	---	65	---
Oil Distillate % By Volume	1	4	0.5	4	1	6	1.5	6	1	6	1	7
Saybolt Viscosity, Furol Seconds at 50°C	35	150	35	150	35	150	75	400	50	---	50	---
Sieve Test, % Retained on 1 mm Sieve	---	0.1	---	0.1	---	0.1	---	0.1	---	0.1	---	0.1
Coating Test %	90	---	90	---	90	---	---	---	---	---	---	---
Settlement 1 Day, % By Mass	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5
Demulsibility: 50 mL 5.55 g/L CaCl <sub>2</sub> , % By Mass	75	---	75	---	---	---	---	---	---	---	---	---
Workability @ 10°C	---	---	---	---	---	---	---	---	---	---	Pass	---
TEST ON RESIDUE												
Penetration at 25°C, 100 g, 5 s	*		**		**		**		---	---	---	---
Viscosity at 60°C, Pa·s	*		**		**		**		8	20	2	8
Float Test at 60°C, s	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---
Solubility in Trichloroethylene, %	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---

\* See Drawing [SP951-02](#)\*\* See Drawing [SP951-03](#)



TABLE 951-L TALL OIL PITCH VISCOSITY AND PENETRATION DATA

REQUIREMENTS	Min.	Max.
<b>Results on original sample</b>		
Absolute Viscosity, 60°C, PaCs	1	2
Kinematic Viscosity, 135°C, mm <sup>2</sup> /s	25	35
Penetration, 4°C/100g, 5 sec, 0.1 mm	150	250
<b>Results after Thin Film Oven</b>		
Loss in weight, %	---	0.65
Absolute Viscosity, 60°C, PaCs	---	3
Kinematic Viscosity, 135°C, mm <sup>2</sup> /s	---	60
Penetration, 4°C, 100 g, 5 sec, 0.1 mm	75	---

TABLE 951-M TALL OIL PITCH DATA

REQUIREMENTS	Min.	Max.
Softening Point, °C (ASTM D 36)	---	35
Flash Point, Cleveland Open Cup, °C (ASTM D 92)	250	---
Fire Point, Cleveland Open Cup, °C (ASTM D 92)	275	---
Boiling Point, °C	320	---
Specific Gravity	0.94	0.98
Vapour Pressure, mm Hg	---	1
pH	3.75	4.25
Wood Extractive, %	98	---
Ash, % (ASTM D 803)	---	0.8
Moisture, % (ASTM D 803)	---	0.1
Fatty Acids, %	7	9
Resin Acids, %	5	7
Unsaponifiables, %	39	44
Neutrals, %	42	46
Acid Number	20	30



TABLE 951-N EMULSIFIED TALL OIL PITCH

REQUIREMENTS	Min.	Max.
Viscosity, SF, 25°C, s	10	30
Residue by Distillation, % by weight	40	---
Oil Distillate, % by volume	---	0.1
Settlement 24hrs, %	---	1.5
pH	6	8
Particle Charge	Negative	
Miscibility with Water	Pass	
Specific Gravity, 20°C	Approx. 1.0	
Boiling Point, °C	100	
Freezing Point, °C	0	
Vapour Pressure, mm Hg	20	
Odour and Appearance - distinctive resinous Odour, light yellow colour		
TEST ON RESIDUE - Shall conform to the requirements for Tall Oil Pitch listed in Table 951-L		

TABLE 951-O EMULSIFIED PRODUCTS

REQUIREMENTS	Min.	Max.
Viscosity, SF, 25°C, s	10	60
Residue by Distillation, % by weight	40	---
Oil Distillate, % by Volume	---	5
Settlement 24hrs, %	Pass	
Miscibility with Water	Pass	
<b>TEST ON RESIDUE</b>		
Penetration, 25°C, 100 g, 5 sec, 0.1 mm	40	200



**SECTION 951 - APPENDIX A**

The following data is required with the supplier's Quotation:

**ASPHALT CEMENTS**

**Grade and Type (when required)**

**A.Original Asphalt**

- Density @ 15°C, kg/L
- Viscosity @ 135°C
- Viscosity @ 60°C
- Penetration @ 25°C, 100 g/5 s
- Solubility in Trichloroethylene
- Ductility @ 25°C
- Flash Point C.O.C.
- % Retained Penetration after T.F.O.T.  
@ 25°C

**B.Residue After T.F.O.T.**

(when Type A required)

- Penetration @ 25°C
- Penetration @ 10°C
- Penetration @ 4°C

**NOTE:** Viscosity - Temperature chart also required for each batch.

**CUTBACK ASPHALTS**

**A.Cutback Asphalts as Supplied**

- Flash Point, T.O.C. (C.O.C. above 79°C)
- Density @ 15°C, g/cm<sup>3</sup>
- Viscosity @ 60°C, mm<sup>2</sup>/s
- Distillate, % by volume of Total
  - Distillate to 360°C
  - Distillate to 190°C
  - Distillate to 225°C
  - Distillate to 260°C
  - Distillate to 315°C
- Residue from Distillation to 360°C
- Volume % by Difference

**B.Properties of Residue**

- Penetration @ 25°C
- Ductility @ 25°C
- Solubility in Trichloroethylene, %

**C.Residue of 100 Penetration by Mass**

- Ductility of 100 Penetration at 25°C, cm

**EMULSIONS**

**A.Original Emulsion**

- Saybolt Furol Viscosity @ 25°C
- Saybolt Furol Viscosity @ 50°C
- % Residue by Distillation
- Settlement in 5 Days, %
- Oil Portion of Distillate
- % to Total Volume

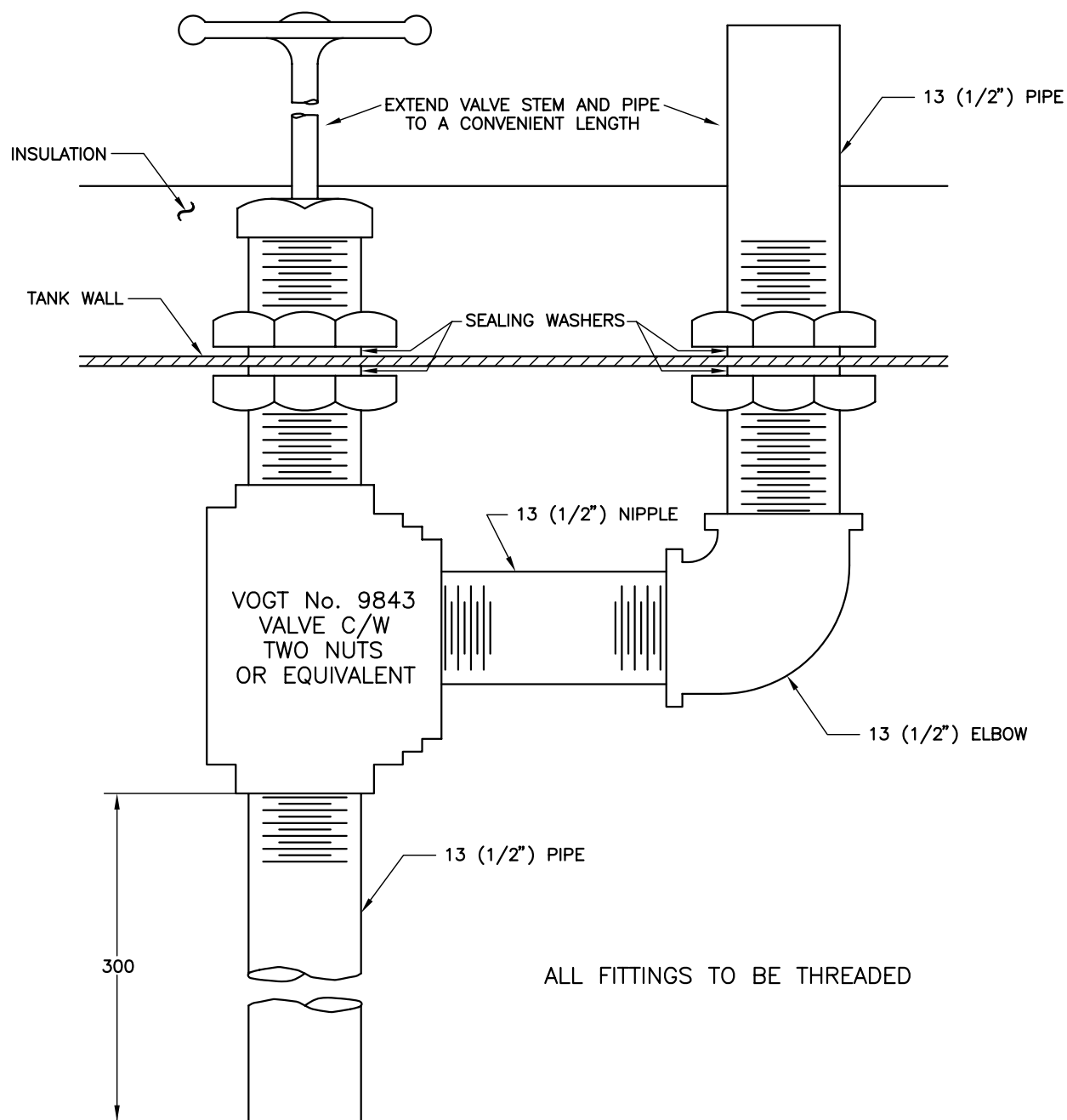
**B.Tests on Residue**

- Float Test @ 60°C, s
- Penetration @ 25°C, 100 g/5 s
- Ductility @ 25°C



# TRUCK TANK SAMPLING VALVE

SP951-01



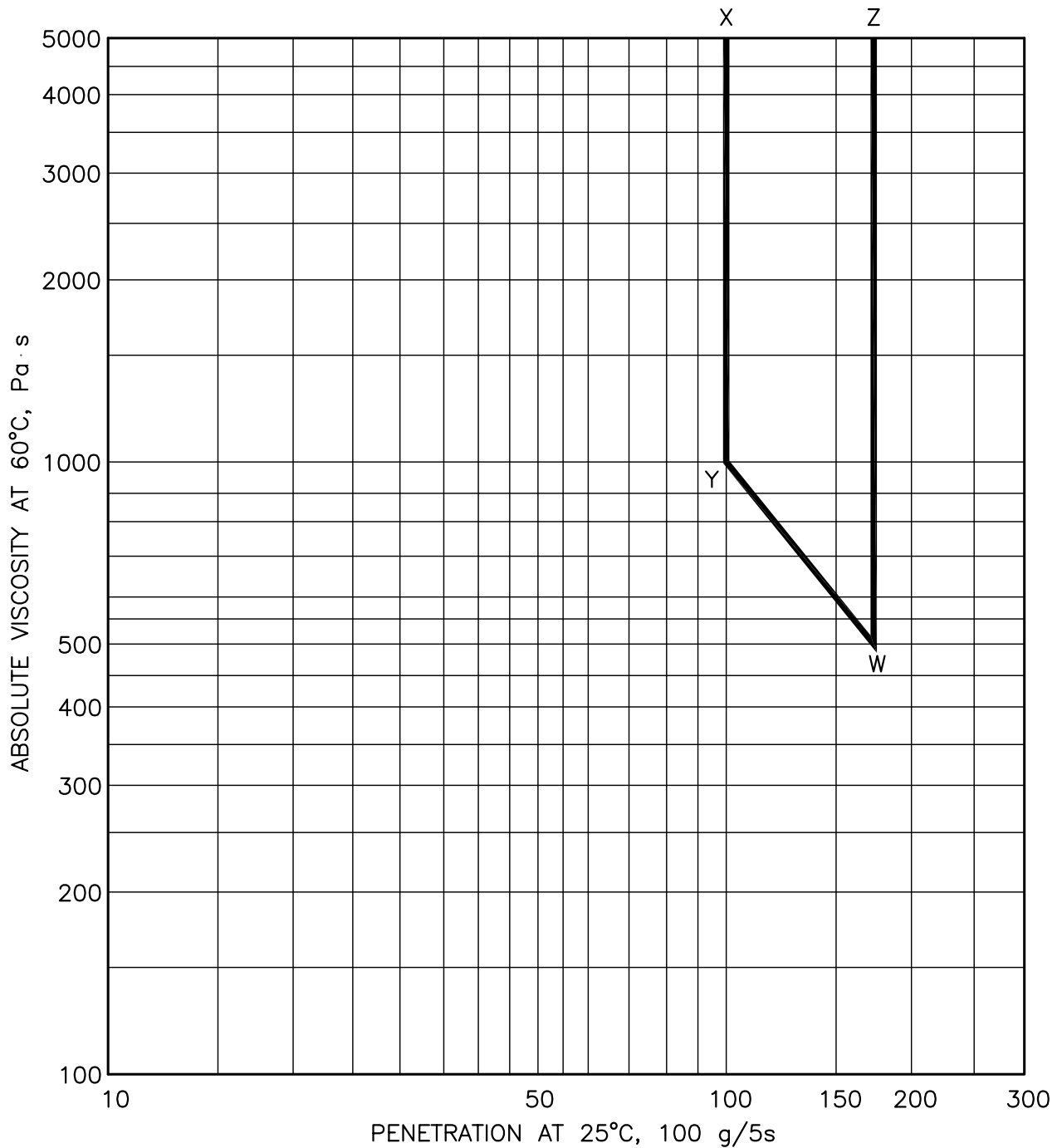
NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



VISCOSITY REQUIREMENTS FOR DISTILLATION RESIDUES  
FROM HIGH FLOAT EMULSIFIED ASPHALT, HF-100S

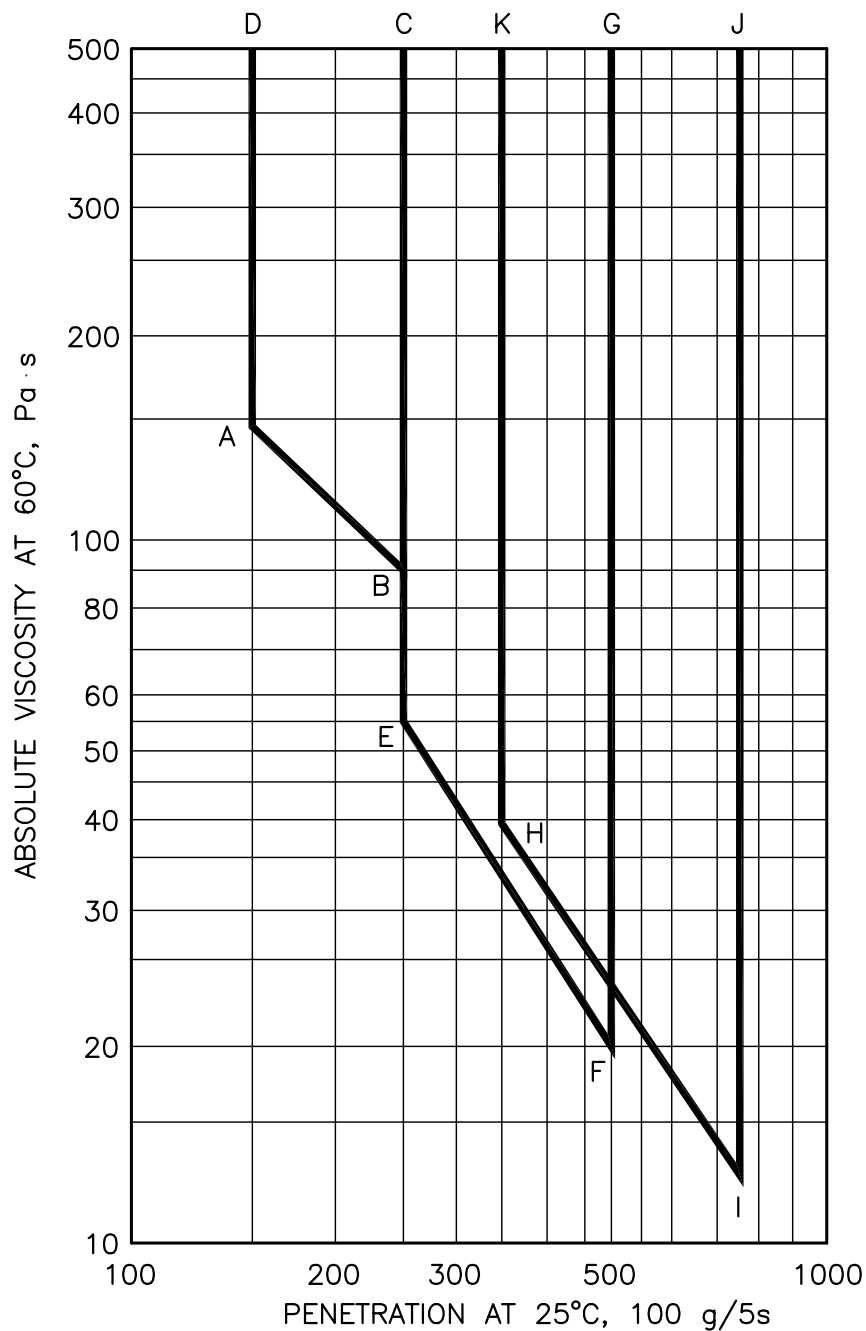
SP951-02





# GRADATION OF HIGH FLOAT EMULSIFIED ASPHALT

SP951-03



## GRADATION OF HIGH FLOAT EMULSIFIED ASPHALT

HF - 150S

HF - 250S

HF - 350S

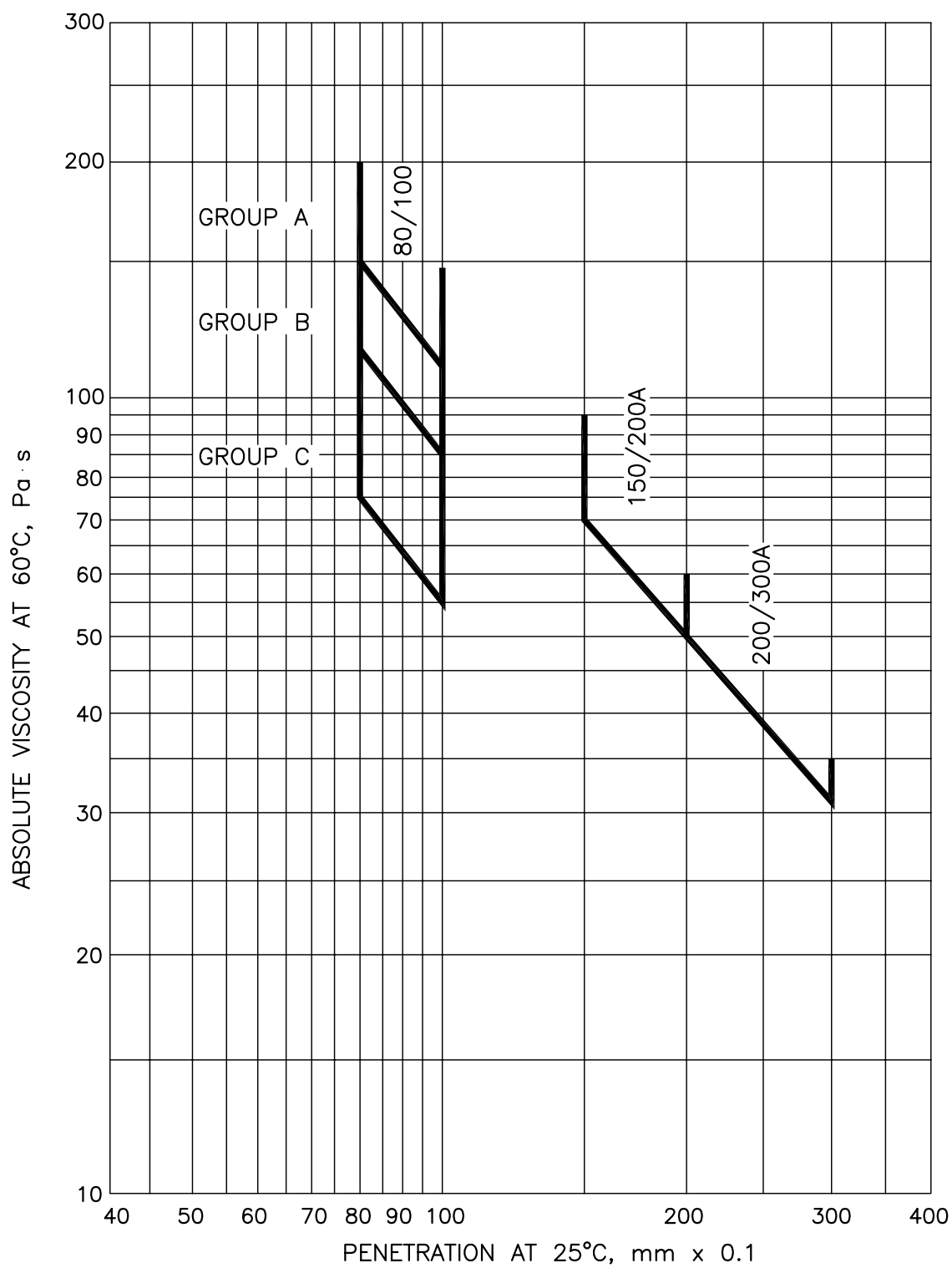
VISCOSITY AND PENETRATION  
SHALL BE WITHIN GRAPHIC  
REGIONS DESCRIBED BY THE  
LETTER CO-ORDINATES

A, B, C, D

E, F, G, C

H, I, J, K







**THIS PAGE IS LEFT INTENTIONALLY BLANK**



## SECTION 952

### CONTRACTOR SUPPLY ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE

#### 952.01 Scope

- a) This Appendix describes the requirements for the different types and grades of asphalt and paving materials to be supplied by the Contractor for highway use as set out in the Special Provisions of the Contract.
- b) The materials so described are generally classified as follows:
- Asphalt Cements
  - Cutback Asphalts
  - Asphalt Emulsions
  - Tall Oil Pitch
  - Emulsified Products
- c) The term "Supplier" referred to in this section shall mean the party or parties supplying the Contractor with materials covered under this specification.

#### 952.02 Quality Control Requirements

##### 952.02.01 Quality Control Plan

- a) The supplier shall develop and maintain a proven quality control plan in accordance with the provisions of this Specification. The plan shall ensure that adequate inspection coverage is maintained throughout the entire process of manufacture and shipping. All supplies processed or manufactured within the supplier's plant or procured from any other source shall receive sufficient inspection to ensure conformance specifications.
- b) Supplies not conforming to contractual requirements shall not be offered for highway use until the deviations have been authorized by the Ministry Representative.
- c) It shall be a responsibility of the Contractor to ensure that all materials supplied satisfy the related Environmental and Health and Safety Regulations.
- d) Product discharged directly into tank cars or tank trucks from "in line blending" facilities will be sampled as required to ensure uniformity and satisfy quality requirements.

**952.02.02 Quality Control Procedure** - The supplier may be required to furnish the Contractor with an outline of the quality control procedures detailing the method of implementing the requirements of this Specification. This outline shall include the following operations:

- sampling and testing
- storage and handling
- shipping
- recording and reporting.

**95.02.03 Technical Requirements** - The Contractor shall ensure that the supplier provides the following:

- a) **Batching and Batch Analysis:** Each batch of product covered by this Specification shall be given a batch number, and sampled and tested in accordance with the applicable Specification.

The batch analysis must show the Specification requirements for the product tested, test method employed, and the pertinent test results, as listed on Appendix A.

Certified batch analysis shall be dispatched to the Contractor with the first load of material delivered. Provided the batch from which shipments are drawn remains the same and provided that the batch number is shown on the Bill of Lading, no further batch analysis will be required for subsequent remaining shipments. If, during the course of delivery, it is necessary to draw material from a different batch or batches of product, the analysis of the replacement batch shall be sent out with the first load of material from each and every replacement batch.

- b) A Viscosity Chart (Absolute) with the initial load and for each subsequent batch. If inline blending is utilized a new viscosity chart shall be issued should any change in viscosity occur.

#### 952.03 Sampling and Testing

- a) The supplier shall retain adequate sampling equipment, employ satisfactory sampling procedures, and maintain sampling program and records. The Contractor shall obtain samples for quality assurance.
- b) Test methods for asphalt and paving materials shall conform to the standard ASTM tests listed in Table 952-A, supplemented by such special tests as may be described elsewhere to cover special or experimental type materials.
- c) On request, the Contractor shall provide samples, from the supplier, of the product in quantities, not less than 4 ℓ, as may be required for independent testing purposes.

#### 952.04 Delivery of Asphalt and Paving Materials

- a) The Contractor must ensure the supplier delivers asphalt and paving materials in good condition and at correct temperature to the specified delivery point



b) Every bill of lading must show:

- Type of product
- Batch number
- Mass
- Relative density at 15°C
- P.G. Specification (for information only)

c) Trucks shall be equipped with a submerged sampling valve system installed generally as shown on Drawing SP952-01 for each compartment in which asphalt material is to be carried out.

d) Delivery temperature of the shipment shall meet the viscosity requirement shown in [Table 952-B](#).

e) Asphalt Emulsions and emulsified products shall be kept at temperatures above 5°C.

**Note:** In no case shall asphalt materials or Tall Oil Pitch be received at a viscosity outside the specified viscosity range.

**TABLE 952-A TEST METHODS**

TITLE OF TEST	TEST DESIGNATION	
	B.C.H.	ASTM
Penetration	III - 1	D 5
Absolute Viscosity of Asphalts	III - 3	D 2171
Kinematic Viscosity of Asphalts	III - 4	D 2170
Effect of Heat and Air on Asphalt	III - 5	D 1754
Distillation of Cutback Asphalt	III - 6	D 402
Residue of 100 Penetration	III - 2	D 243
Relative Density of Asphalt Cement and Cutback Asphalt	III - 7	D 70
Ductility	III - 8	D 113
Float Test	III - 9	D 139
Flash Point by Tag Open Cup	III - 10	D 1310
Flash Point by Cleveland Open Cup	III - 11	D 92
Solubility in Trichloroethylene	III - 12	D 2042
Water in Asphalt	III - 13	D 95
Softening Point in Ethylene Glycol	III - 14	D 2398
Saybolt Furol Viscosity	III - 15	D 88
Testing Emulsified Asphalts	IV - 1	D 244
Testing High Float Asphalts	IV - 2	

**TABLE 952-B VISCOSITY REQUIREMENTS FOR SHIPMENT DELIVERY TEMPERATURE**

CLASS OF MATERIAL	KINEMATIC VISCOSITY, mm <sup>2</sup> /s
Cutback Asphalt for Surface Spraying	100 - 200
Cutback Asphalt and Asphalt Cement for Plant Mixing	100 - 500
Tall Oil Pitch	20 - 40

**952.05 Asphalt Cement** - Asphalt cements shall:

- a) Be products prepared by the refining of petroleum oils.
- b) Be homogeneous, free from water and shall not foam when heated to 175°C.
- c) Conform to the requirements specified in [Table 952-C](#) and [Table 952-D](#).

The Contractor shall forward a 4 ℓ sample of the product to the Pavement Design Centre of the appropriate Regional Highways office.

**NOTE:** Values for penetration and viscosity are point values only. Intermediate values for Group A, B and C grades shall be obtained by interpolation between the tabulated values on a straight line basis. Minimum viscosity at 60°C for other penetrations within each group can be read from the corresponding straight line on Drawing [SP952-02](#).

**952.06 Cutback Asphalts**

- a) Cutback asphalts shall consist essentially of petroleum derivatives and shall be substantially free from water and other impurities.
- b) Cutback asphalts shall be of the type and grade described in [Tables 952-E to 952-H](#).

**952.07 Asphalt Emulsions** - Asphalt materials in the form of aqueous emulsions shall be of:

- Anionic Type
- Cationic Type
- High Float Type

**952.08 Anionic Type Emulsion for Road Purposes** - Anionic type of emulsion requirements are as follows:

- The asphalt emulsion shall be homogeneous.



- It shall show no separation of asphalt after thorough mixing within 30 days (crack filler 20 days) after delivery, provided separation has not been caused by freezing.
- The emulsion shall conform to the requirements listed in [Table 952-I](#).

**952.09 Cationic Type Emulsions for Road Purposes –** Cationic type emulsions shall conform to the requirements listed in Table 952-J and shall be uniform throughout.

**952.10 High Float Emulsified Asphalt -** Storage stability - High float emulsified asphalt shall show no separation of asphalt within 30 days after delivery and shall be homogeneous after thorough mixing.

The emulsion shall conform to the requirements listed in Table 952-K.

**952.11 Tall Oil Pitch (TOP) -** Tall oil pitch, co-product of the pulp and paper industry is a residual fraction from the crude tall oil vacuum distillation process. It shall be a dark brown resinous and viscous material insoluble in water but miscible with asphalt. TOP is typically used by the Ministry as an asphalt extender, recycling, and anti-stripping agent. Where required, TOP will be added to asphalt cement in a ratio defined by the mix design, usually between 5 - 10%. The composition and properties of TOP depends on the origin and type of trees from which it is derived and the extraction technology. Only TOP approved by the Ministry's New Product Standing Committee shall be permitted for use on Ministry paving projects.

The TOP shall conform to the requirements listed in [Tables 952-L](#) and [952-M](#).

**TABLE 952-C GRADES OF ASPHALT CEMENT**

PENETRATION GRADE ASPHALT CEMENT	80 - 100		150 - 200		200 - 300		TEST METHOD ASTM
Requirements	Min	Max	Min	Max	Min	Ma	D 5
Penetration at 25°C 100 g and 5 s, 0.1 mm	80	100	150	200	200	300	
Group A Group B Group C	Minimum viscosity values defining boundaries for groups A, B, & C are listed in <a href="#">Table 952-D</a> and illustrated in Drawing <a href="#">SP952-04</a>						
Flash Point, °C Cleveland Open Cup	230	---	220	---	175	---	D 92
Thin Film Oven Test % Loss in Mass	---	0.85	---	1.3	---	1.5	D 1754
Penetration of Residue at 25°C 100 g, 5 s, 0.1 mm, % of Original Penetration	55	---	50	---	45	---	After T.F.O.T.
Solubility in Trichloroethylene % by Mass	99.5	---	99.5	---	99.5	---	D 2042
Ductility, 25°C 5 cm/min, cm	100	---	100	---	---	---	D 113
Ductility, 15°C 5 cm/min, cm	---	---	---	---	100	---	

**TABLE 952-D VISCOSITY AND PENETRATION VALUES DEFINING GROUP BOUNDARIES**

Penetration 25°C	80	100	150	200	300	TEST METHOD - ASTM
						D 5
	Minimum Viscosity at 60°C					D 2171
Group A	150	115	70	50	31	
Group B	110	85	---	---	---	
Group C	75	55	---	---	---	



**952.12 Emulsified Products** - Emulsified products consist of emulsified Tall Oil Pitch and proprietary asphalt based emulsions. The emulsified products are typically used by the Ministry, in paving operations, as prime coats and tack coats and replace organic solvent based cutback asphalts for environmental reasons. Only products approved by the Ministry's New Product Standing Committee shall be permitted for use on the Ministry paving projects. Each

batch of the product delivered to the job site shall be accompanied by the written statement from the manufacturer or supplier confirming that the product formulation complies with the original, previously approved formulation. Emulsified Tall Oil Pitch and asphalt based emulsified products shall conform to the requirements listed in [Tables 952-N](#) and [952-O](#).

**TABLE 952-E SLOW CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE					
	SC - 70		SC - 250		SC - 3000	
	Min	Max	Min	Max	Min	Max
Flash Point °C	65	---	80	---	105	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	70	140	250	500	3 000	6 000
Residue from Distillation to 360°C, volume % by difference	70	90	80	94	95	---
Distillation Residue, Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	400	7 000	800	10 000	4 000	35 000
<b>ASPHALT RESIDUE:</b>						
Residue of 100 Penetration, % by Mass	50	---	60	---	80	---
Ductility of 100 Penetration residue at 25°C, cm	100	---	100	---	100	---
Solubility in Trichloroethylene	99.0	---	99.0	---	99.0	---
Water, % by Mass or Volume	---	0.5	---	0.5	---	0.5

**TABLE 952-F MEDIUM CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE			
	MC - 30		MC - 250	
	Min.	Max.	Min.	Max.
Flash Point °C	38	---	65	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	30	60	250	500
Distillation Test, % of Total Distillate to 360°C: to 225°C	---	25	---	10
Distillation Test, % of Total Distillate to 360°C: to 260°C	40	70	15	55
Distillation Test, % of Total Distillate to 360°C: to 315°C	75	93	60	87
Residue from Distillation to 360°C, volume % by difference	50	---	67	---
<b>PROPERTIES OF RESIDUE FROM DISTILLATION:</b>				
Penetration at 25°C, 100 g, 5 s, 0.1 mm	120	250	120	250
Ductility at 25°C, cm	100	---	100	---
Solubility in Trichloroethylene	99.0	---	99.0	---
Water, %	---	0.2	---	0.2



**TABLE 952-G RAPID CURING CUTBACK ASPHALT**

REQUIREMENTS	GRADE					
	RC - 30		RC - 70		RC - 250	
	Min	Max	Min	Max	Min	Max
Flash Point °C	---	---	---	---	27	---
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	30	60	70	140	250	500
Distillation Test, % of Total Distillate to 360°C: to 190°C	15	---	10	---	---	---
Distillation Test, % of Total Distillate to 360°C: to 225°C	55	---	50	---	35	---
Distillation Test, % of Total Distillate to 360°C: to 260°C	75	---	70	---	60	---
Distillation Test, % of Total Distillate to 360°C: to 315°C	90	---	85	---	80	---
Residue from Distillation to 360°C, volume % by difference	50	---	55	---	65	---
<b>TEST ON RESIDUE FROM DISTILLATION:</b>						
Penetration at 25°C, 100 g, 5 s, 0.1 mm	80	120	80	120	80	120
Ductility at 25°C, cm	100	---	100	---	100	---
Solubility in Trichloroethylene, % by mass	99.0	---	99.0	---	99.0	---
Water, %	---	0.2	---	0.2	---	0.2

**Note:** The material shall not foam when heated to the spraying and mixing temperature range recommended by the Canadian General Standards Board

**TABLE 952-H CUTBACK ASPHALT PRIMER RM20**

REQUIREMENTS	Min.	Max.
Kinematic Viscosity at 60°C, mm <sup>2</sup> /s	20	35
Distillation Test, % of Total Distillate to 360°C: to 190°C	---	60
Distillation Test, % of Total Distillate to 360°C: to 225°C	40	---
Distillation Test, % of Total Distillate to 360°C: to 260°C	70	---
Distillation Test, % of Total Distillate to 360°C: to 315°C	85	---
Residue from Distillation to 360°C, volume % by difference	50	---
<b>TEST ON RESIDUE FROM DISTILLATION:</b>		
Penetration at 25°C, 100 g, 5 s, 0.1 mm	80	200
Ductility at 25°C, cm	100	---
Solubility in Trichloroethylene	99.0	---
Water, %	---	0.2



TABLE 952-I REQUIREMENTS FOR ANIONIC TYPE EMULSIONS

REQUIREMENT	TYPE OF EMULSION									
	RS - 1		RS - 2		MS - 2		SS - 1		CRACK FILLER	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol: at 25°C	20	100	---	---	100	---	20	100	50	200
Viscosity, Saybolt Furol: at 50°C	---	---	75	300	---	---	---	---	---	---
Residue by Distillation, %	57	---	62	---	62	---	57	---	65	75
Settlement, 1 Day, %	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5
Demulsibility: 50 mL of 0.1 N CaCl <sub>2</sub> %	---	---	---	---	---	30	---	---	---	---
Demulsibility: 35 mL of 0.02 N CaCl <sub>2</sub> %	60	---	60	---	---	---	---	---	30	---
Sieve Test, % Retained on 1 mm	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10
Cement Mixing Test, %	---	---	---	---	---	---	---	2.0	---	---
<b>TESTS ON RESIDUE:</b>										
Penetration at 25°C, 100 g, 5 s	100	200	100	200	100	200	100	200	60	100
Solubility in Trichloroethylene %	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---
Ductility at 25°C, cm	60	---	60	---	60	---	60	---	60	---

TABLE 952-J REQUIREMENTS FOR CATIONIC TYPE EMULSIONS

REQUIREMENT	TYPE OF EMULSION			
	CRS - 1K		CRS - 2K	
	Min	Max	Min	Max
Saybolt Furol Viscosity at 50°C	30	125	174	400
% Residue by Distillation	62	---	68	---
Settlement 1 Day, %	---	1.5	---	1.5
Sieve Test, % Retained on 1 mm Mesh	---	0.1	---	0.1
Oil Portion of Distillate, % of Total Volume	0	3	0	3
Particle Charge	POSITIVE		POSITIVE	
TESTS ON RESIDUE				
Penetration at 25°C, 100 g, 5 s	100	250	100	150
Solubility in Trichloroethylene %	97.5	---	97.5	---
Ductility at 25°C, cm	60	---	65	---



**TABLE 952-K REQUIREMENTS FOR HIGH FLOAT EMULSIFIED ASPHALTS**

REQUIREMENT	GRADE:											
	HF-100S		HF-150S		HF-250S		HF-350S		HF-500M		HF-1000M	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Residue by Distillation, % By Mass	62	---	62	---	62	---	65	---	65	---	65	---
Oil Distillate % By Volume	1	4	0.5	4	1	6	1.5	6	1	6	1	7
Saybolt Viscosity, Furol Seconds at 50°C	35	150	35	150	35	150	75	400	50	---	50	---
Sieve Test, % Retained on 1 mm Sieve	---	0.1	---	0.1	---	0.1	---	0.1	---	0.1	---	0.1
Coating Test %	90	---	90	---	90	---	---	---	---	---	---	---
Settlement 1 Day, % By Mass	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5
Demulsibility: 50 mL 5.55 g/L CaCl <sub>2</sub> , % By Mass	75	---	75	---	---	---	---	---	---	---	---	---
Workability @ 10°C	---	---	---	---	---	---	---	---	---	---	Pass	---
<b>TEST ON RESIDUE</b>												
Penetration at 25°C, 100 g, 5 s	*		**		**		**		---	---	---	---
Viscosity at 60°C, Pa·s	*		**		**		**		8	20	2	8
Float Test at 60°C, s	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---
Solubility in Trichloroethylene, %	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---

\* See Drawing [SP952-02](#)

\*\* See Drawing [SP952-03](#)

**TABLE 952-L TALL OIL PITCH VISCOSITY AND PENETRATION DATA**

REQUIREMENTS	Min.	Max.
<b>Results on original sample</b>		
Absolute Viscosity, 60°C, PaCs	1	2
Kinematic Viscosity, 135°C, mm <sup>2</sup> /s	25	35
Penetration, 4°C/100g, 5 sec, 0.1 mm	150	250
<b>Results after Thin Film Oven</b>		
Loss in weight, %	---	0.65
Absolute Viscosity, 60°C, PaCs	---	3
Kinematic Viscosity, 135°C, mm <sup>2</sup> /s	---	60
Penetration, 4°C, 100 g, 5 sec, 0.1 mm	75	---



TABLE 952-M TALL OIL PITCH DATA

REQUIREMENTS	Min.	Max.
Softening Point, °C (ASTM D 36)	---	35
Flash Point, Cleveland Open Cup, °C (ASTM D 92)	250	---
Fire Point, Cleveland Open Cup, °C (ASTM D 92)	275	---
Boiling Point, °C	320	---
Specific Gravity	0.94	0.98
Vapour Pressure, mm Hg	---	1
PH	3.75	4.25
Wood Extractive, %	98	---
Ash, % (ASTM D 803)	---	0.8
Moisture, % (ASTM D 803)	---	0.1
Fatty Acids, %	7	9
Resin Acids, %	5	7
Unsaponifiables, %	39	44
Neutrals, %	42	46
Acid Number	20	30

TABLE 952-N EMULSIFIED TALL OIL PITCH

REQUIREMENTS	Min.	Max.
Viscosity, SF, 25°C, s	10	30
Residue by Distillation, % by weight	40	---
Oil Distillate, % by volume	---	0.1
Settlement 24hrs, %	---	1.5
pH	6	8
Particle Charge	Negative	
Miscibility with Water	Pass	
Specific Gravity, 20°C	Approx. 1.0	
Boiling Point, °C	100	
Freezing Point, °C	0	
Vapour Pressure, mm Hg	20	
Odour and Appearance - distinctive resinous Odour, light yellow colour		
TEST ON RESIDUE - Shall conform to the requirements for Tall Oil Pitch listed in table 951-L		



**TABLE 952-O EMULSIFIED PRODUCTS**

REQUIREMENTS	Min.	Max.
Viscosity, SF , 25°C, s	10	60
Residue by Distillation, % by weight	40	---
Oil Distillate, % by Volume	---	5
Settlement 24hrs, %	Pass	
Miscibility with Water	Pass	
<b>TEST ON RESIDUE</b>		
Penetration, 25°C, 100 g, 5 sec, 0.1 mm	40	200



## APPENDIX A

The following data is required from the supplier:

## ASPHALT CEMENTS

## Grade and Type (when required)

## A. Original Asphalt

Density @ 15°C, kg/L

- Viscosity @ 135°C
- Viscosity @ 60°C
- Penetration @ 25°C, 100 g/5 s
- Solubility in Trichloroethylene
- Ductility @ 25°C
- Flash Point C.O.C.
- % Retained Penetration after T.F.O.T.  
@ 25°C

**B. Residue After T.F.O.T.**  
(when Type A required)

- Penetration @ 25°C
- Penetration @ 10°C
- Penetration @ 4°C

**NOTE:** Viscosity - Temperature chart also required for each batch.

## CUTBACK ASPHALTS

## A. Cutback Asphalts as Supplied

- Flash Point, T.O.C. (C.O.C. above 79°C)
- Density @ 15°C, g/cm<sup>3</sup>
- Viscosity @ 60°C, mm<sup>2</sup>/s
- Distillate, % by volume of Total
  - Distillate to 360°C
  - Distillate to 190°C
  - Distillate to 225°C
  - Distillate to 260°C
  - Distillate to 315°C
- Residue from Distillation to 360°C
- Volume % by Difference

## B. Properties of Residue

- Penetration @ 25°C
- Ductility @ 25°C
- Solubility in Trichloroethylene, %

## C. Residue of 100 Penetration by Mass

- Ductility of 100 Penetration at 25°C, cm

## EMULSIONS

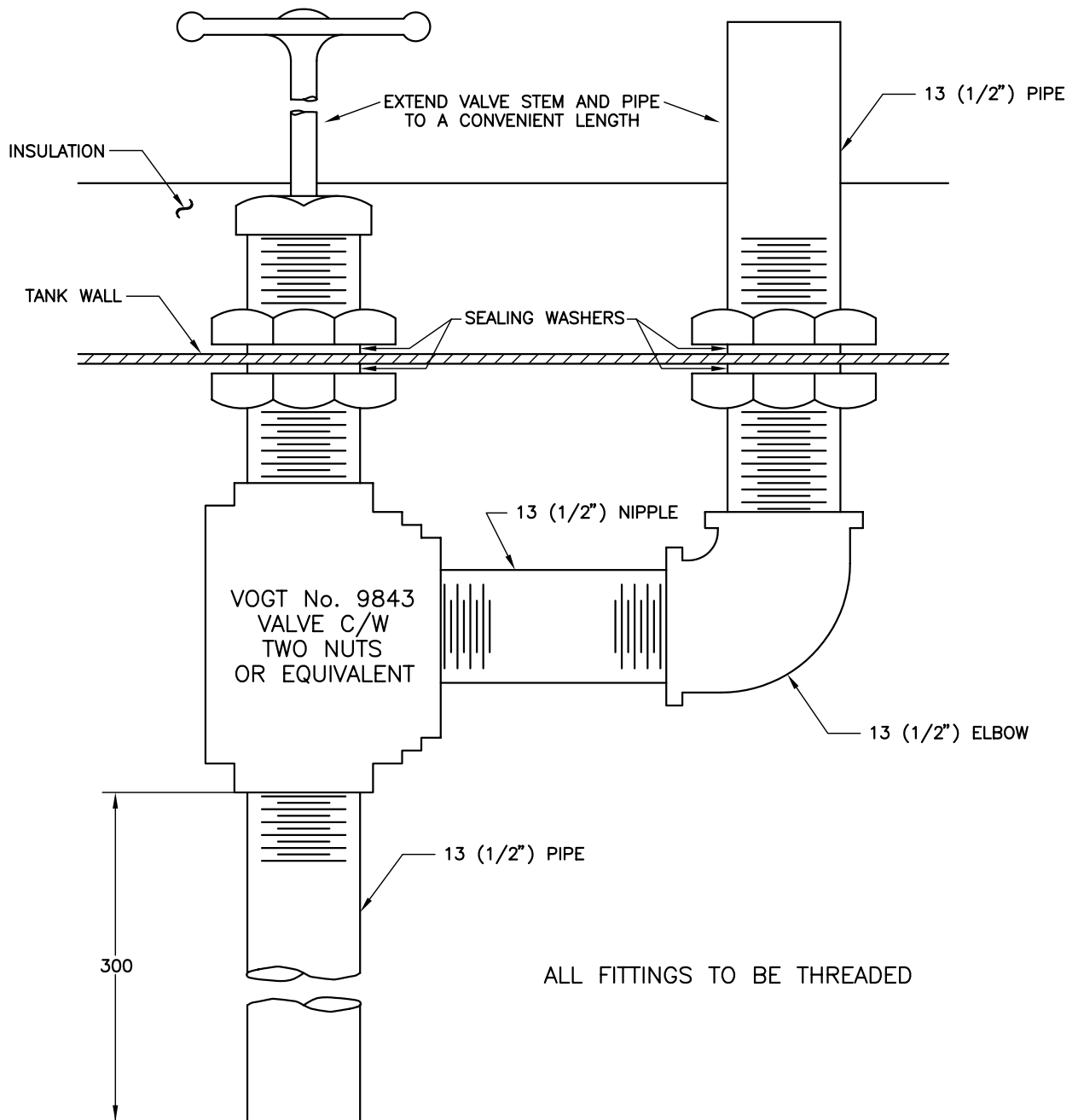
## A. Original Emulsion

- Saybolt Furol Viscosity @ 25°C
- Saybolt Furol Viscosity @ 50°C
- % Residue by Distillation
- Settlement in 5 Days, %
- Oil Portion of Disillate

## B. Tests on Residue

- % to Total Volume
- Float Test @ 60°C, s
- Penetration @ 25°C, 100 g/5 s
- Ductility @ 25°C

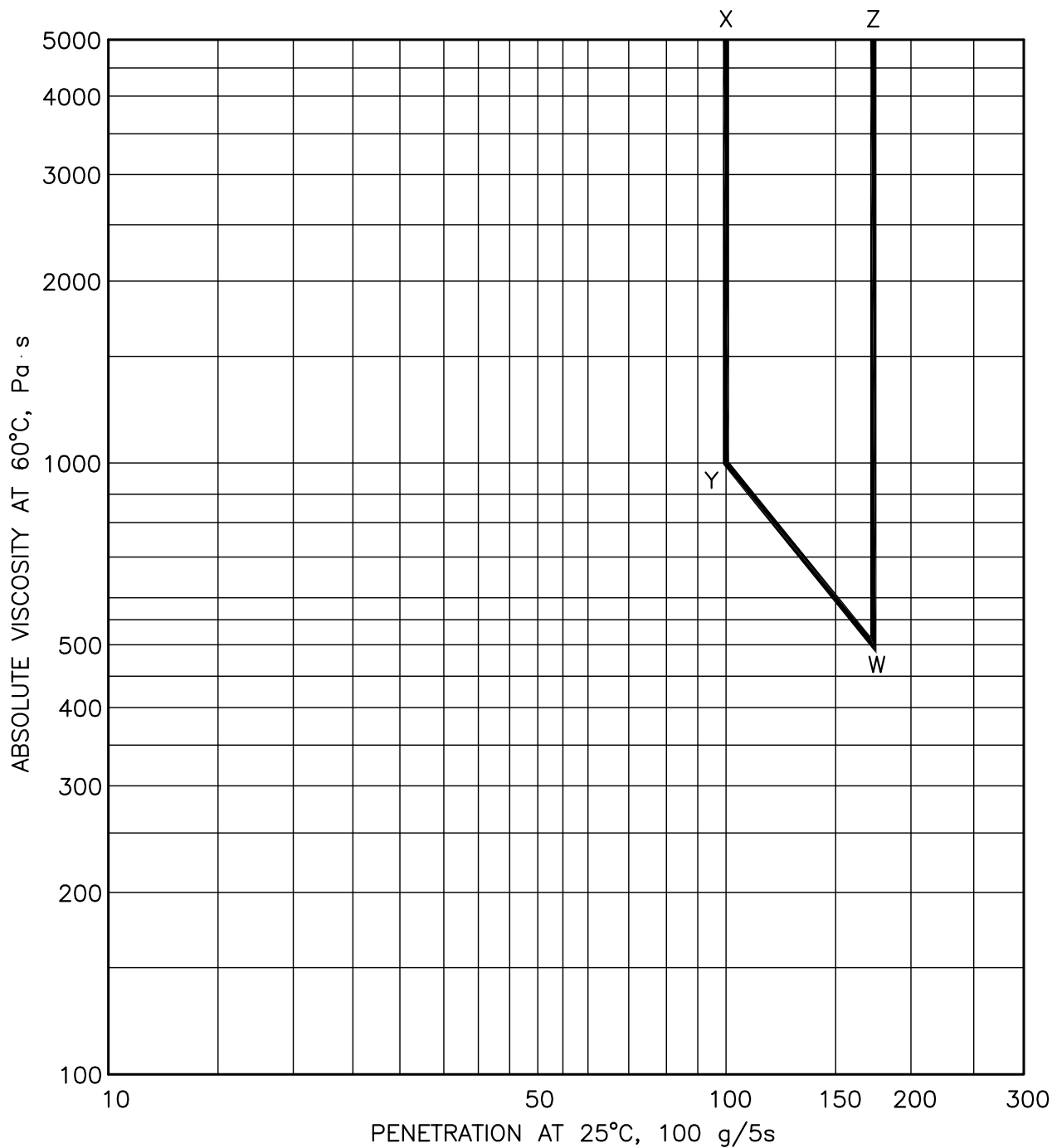




NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



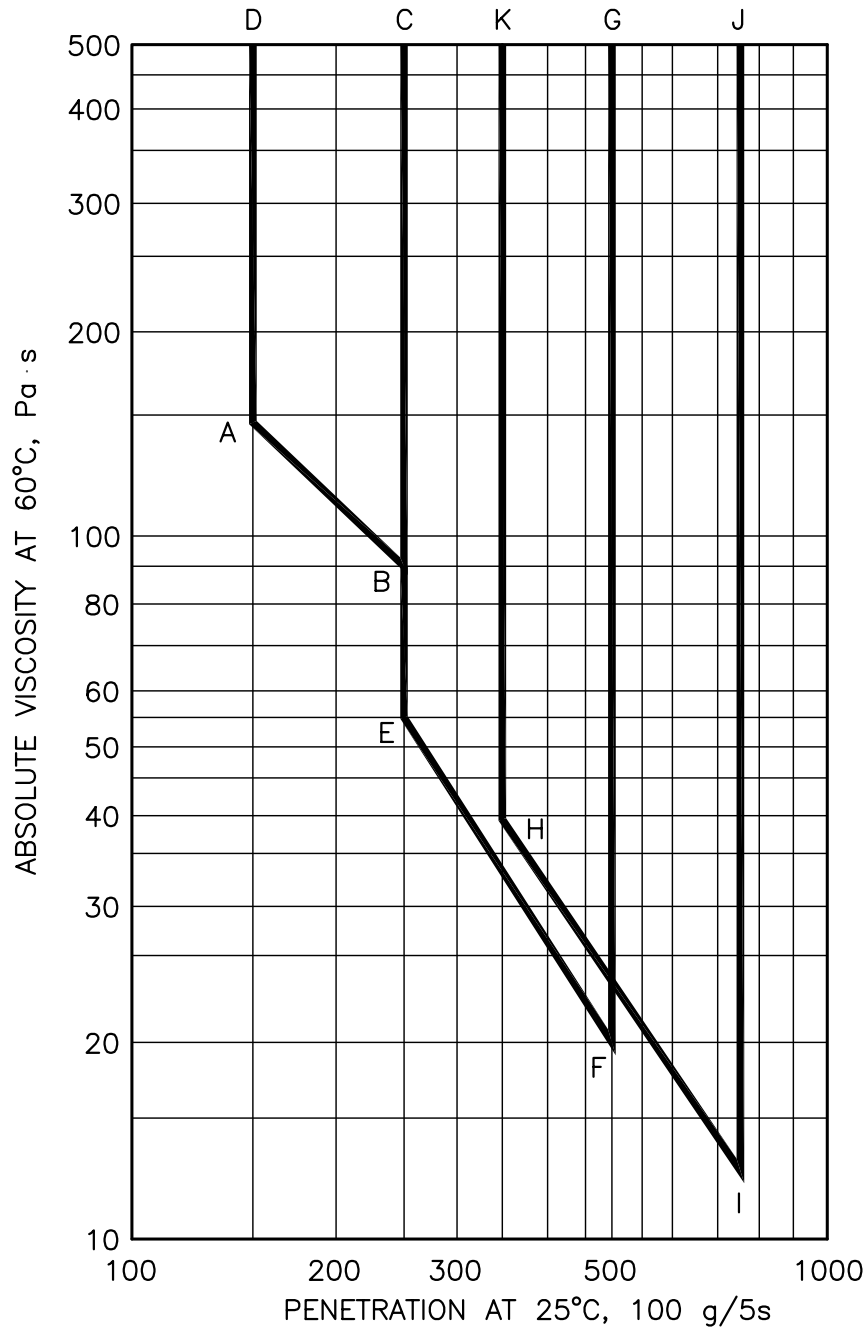


**NOTE:**  
VISCOSITY SHALL BE WITHIN GRAPHIC REGIONS DESCRIBED  
BY THE LETTER CO-ORDINATES X, Y, W, Z.



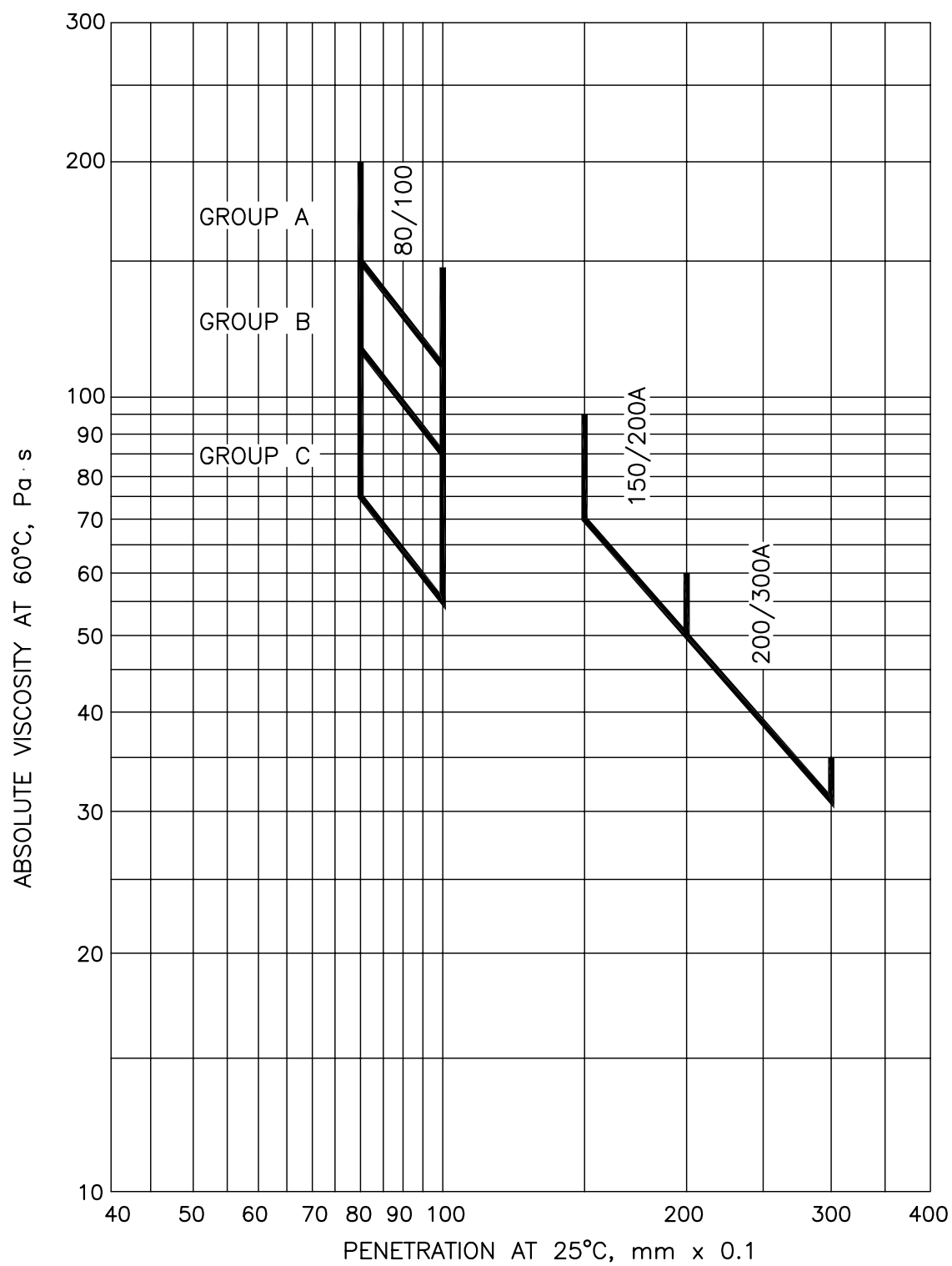
# GRADATION OF HIGH FLOAT EMULSIFIED ASPHALT

SP952-03



GRADATION OF HIGH FLOAT EMULSIFIED ASPHALT	HF - 150S	HF - 250S	HF - 350S
VISCOSITY AND PENETRATION SHALL BE WITHIN GRAPHIC REGIONS DESCRIBED BY THE LETTER CO-ORDINATES	A, B, C, D	E, F, G, C	H, I, J, K







## SECTION 971

### PLASTIC TRAFFIC CONES

**971.01 Scope** - This Section applies to plastic traffic cones used to provide a temporary traffic guidance system for vehicles and pedestrians under daylight conditions. Their use is primarily associated with maintenance and construction or similar roadway operations.

#### 971.02 Classification

- a) Cones shall be supplied in three nominal sizes: 150 mm, 450 mm, and 700 mm.
- b) Cones shall be supplied in one type only: "High Stability, High Visibility, Fluorescent."
- c) Cones shall be of such quality that when used, stored and handled with reasonable care they shall have a service life of at least two years. At the end of this period the cones shall be substantially undamaged and shall meet the requirements of this specification with respect to visibility and colour.

#### 971.03 General Requirements

- a) Upper portion of the cone shall be made of a suitable thermoplastic with physical properties adequate for the intended service in British Columbia and pigmented to provide a high visibility fluorescent colour. If necessary, to meet the colour and visibility requirements, an inner white liner may be used. The white liner shall be of substantially the same material as the outer section and shall be securely fused to it. The base of the cone shall be made of a high density mineral filled thermoplastic to provide high stability to the cone. The use of separate metal weights in the base is not permitted. The base and upper portion of the cone shall be fused together, this joint shall not constitute an area of weakness and shall be reinforced if necessary.
- b) The cone shall be of uniform taper from top to bottom to permit the cones to be nested efficiently. The surfaces of the cone shall be uniformly smooth so that the cones may be easily separated from the stack.

- c) Voids on the surface or within the plastic material will not be permitted.

**971.04 Dimensions** - Minimum dimensions shall be as shown in Table 971-A.

Wall thickness shall be measured not closer than 25 mm from top or bottom of the cone.

**Note:** 150 mm cones to be used for centrelining operations shall have a maximum outside diameter at the bottom of 105 mm and maximum outside diameter at the top of 55 mm.

**971.05 Mass** - The minimum total mass and the minimum mass of base as a percentage of the total mass shall be as shown in Table 971-B.

**TABLE 971-B MASS**

NOMINAL SIZE	TOTAL MASS (g)	MASS OF BASE AS % OF TOTAL
150	475	75
450	2200	65
700	3200	50

**971.06 Tensile Properties** - The tensile properties of the thermoplastic from the upper portion of the cone shall be as shown in Table 971-C.

**TABLE 971-C TENSILE PROPERTIES**

Minimum Ultimate Tensile Strength	7000 kPa
Minimum % Elongation	200%
Minimum Tensile Stress at 200% Elongation	6000 kPa

(Test Method ASTM D 638)

**TABLE 971-A MINIMUM DIMENSIONS**

NOMINAL SIZE	HEIGHT (mm)	BASE (SQUARE) (mm)	OUTSIDE DIAMETER AT BOTTOM (mm)	OUTSIDE DIAMETER AT TOP (mm)	WALL THICKNESS (mm)
150	150	150	90	50	1.8
450	450	275	180	50	2.0
700	700	360	350	50	2.2



**971.07 Colour** - The colour of the upper portion of the cone shall be fluorescent red and will be accepted on visual matching with CGSB Colour 1-GP-12 Red 609-401. Cones with slight colour mismatch towards Orange 608-401 will be accepted. Cones with colour mismatch towards white (i.e., pink) or towards black (i.e., a darker red) will not be accepted. Fluorescence is defined in this case as the property of emitting visible light as the result of absorption of ultra violet light. (Test Method CGSB 1-GP-71 Method 12.9 using North daylight)

**971.08 Resistance to Colour Change** - The upper cone material shall withstand 80 hours in an Atlas Twin Arc Fadeometer without appreciable change in colour, neither fading nor darkening. The reflectance factor (ASTM E 97) should not vary by more than three units before and after exposure. (CGSB 1-GP-71 Test Method 120.1.)

**971.09 Specular Gloss** - The 60 degree Specular Gloss (ASTM D 523) of the upper cone material shall be not less than 70 units. Gloss readings shall be taken on a cut section of cone approximately 100 mm square firmly bonded to a flat surface. (Test Method ASTM D 523.)

**971.10 Recovery after Bending** - The cone when placed in its normal position on a flat and level surface and folded at a point near the middle of its vertical height so that the upper tip touches the surface on which the base is resting and when held there for 10 seconds shall upon release return to its original shape and vertical position within 15 seconds. This requirement shall be met when the cone and ambient temperatures are  $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

**971.11 High Temperature Requirement** - The cone must be self-supporting with no appreciable slump or sag after four hours exposure at a temperature of  $65^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

**971.12 Resistance to Flexing** - The surface of the cone shall not crack, permanently crease or discolour when the cone is bent sharply at a 180 degree angle and flexed 25 times.

**971.13 Cold Temperature Requirement** - The cone, after cooling for four hours in a freezing chamber set at  $-25^{\circ}\text{C}$ , shall be able to withstand one passage of the test vehicle wheels without evidence of cracking, splitting, breaking or other damage. The cone will be held in a wooden restraining device with the test site ambient air temperature sensibly constant and within the range of  $10^{\circ}\text{C} \pm 3^{\circ}\text{C}$ . The elapsed time between removal of the cone from the freezing chamber and performance of the test shall not exceed

15 seconds. The test vehicle shall have a gross mass of  $1850 \pm 50$  kg, travel at  $10 \pm 1$  km per hour, and be equipped with H78-15 summer tread pattern tire inflated to 220 kPa (32 p.s.i.).

**971.14 Blowover Resistance** - No significant movement of any cone shall occur when a 48 passenger standard bus is driven by three times at a distance of 150 mm (cone base edge to tire edge) from a line of five test cones from one supplier. The bus speed shall be 100 kilometres per hour. There shall be no appreciable ambient wind and the pavement shall be dry.

**971.15 Stacking Qualities** - When cones are nested together the base of each cone shall be substantially in contact with the top of the base of the cone immediately below it in the stack. The maximum separation between the bases of the stacked cones shall not exceed 6 mm.

When cones are stacked together one on top of the other each cone shall be capable of being lifted easily from the stack without binding or jamming on the cone below it.

**971.16 Marking** - Letters reading "B.C. GOVT." 25 mm minimum high shall be indelibly marked on the upper surface of the base of the cone in a colour contrasting to the colour of the base.

**971.17 Bid Samples** - Each bidder shall submit the following number of cones for purposes of defining the quality level of their bid samples:

- 150 mm high cones - 15 units
- 450 mm high cones - 10 units
- 700 mm high cones - 10 units

These bid samples will be requested from the suppliers by the Purchasing Commission.

**971.18 Inspection** - Cones shall be inspected and tested prior to shipment. At least two cones of each type ordered will be sampled from each shipment from the supplier's manufacturing plant if in British Columbia or from the supplier's warehouse in British Columbia if cones are manufactured outside of the Province.

Upon successful completion of inspection and testing, a Release for Shipment will be issued; this, however, shall not be a bar to subsequent rejection of individual cones or the entire shipment should they be found to fail any requirements of this Specification.



## SECTION 991

### CALCIUM CHLORIDE AND SODIUM CHLORIDE

**991.01 Calcium Chloride** - Calcium chloride, for highway purposes, shall conform to CGSB Specification 15-GP-1M Calcium Chloride. It shall be supplied as Type I Regular (77%) bulk (flake) or sacked, or as liquid at 35% solution concentration, as specified.

**991.02 Sodium Chloride** - Sodium chloride, for highway purposes, shall conform to CGSB Specification 15-GP-9M Sodium Chloride, Pavement De-icer but it shall be supplied as shown in [Table 991-A](#).

**TABLE 991-A GRADATION FOR SODIUM CHLORIDE**

SCREEN SIZE	PERCENT PASSING
12.0 mm (1/2")	100
9.00 mm (3/8")	90 - 100
4.75 mm (#4)	35 - 85
2.40 mm (#8)	15 - 55
1.20 mm (#16)	5 - 30
0.600 mm (#30)	0 - 10

---

**991.03 Chemical Contamination of Road Salt** -  
When applied as specified, the de-icing chemicals shall not contain substances that exceed the current

environmental guidelines, Provincial or Federal, and shall not cause harm to flora and fauna.

---

**Note:** CGSB Specifications are obtainable from:

Canadian Government Specification Board,  
Ottawa, ON K1A 0S5



**THIS PAGE IS LEFT INTENTIONALLY BLANK**