

**SPECIAL PROVISIONS APPENDIX  
FOR AMENDMENT TO THE 2016 STANDARD SPECIFICATIONS  
FOR HIGHWAY CONSTRUCTION  
Updated: December 7, 2018**

The Amendments to the 2016 Standard Specifications for Highway Construction are as follows and take precedence. New amendments within this Update are flagged as **NEW**. Others have been previously released on the indicated “Issued Date” heading each provision. *Italicized* text is instructions; normal font is new text. Where so marked, underlined text is inserted; ~~strikeout~~ text is deleted.

**NEW SECTION 101 – QUALITY MANAGEMENT**

*Issued Date: December 7, 2018*

**SS 101.02.02** is amended by adding the following new provisions immediately before the bulleted list lead-in “Without limitation, the Contractor’s Quality Manager shall:”

The QC Plan must include a commitment to have every submission to the Ministry seeking review or approval to be accompanied by a QC Checksheet, showing that:

- a) the contents of the submission have been reviewed by QC staff and signed off by the QC Manager; and
- b) the submission, including any associated information, is
  - i) fully compliant with all requirements of the Contract, or
  - ii) identifies any non-conformances and requests a variance from the Contract provisions including any proposed revised standards to be applicable to the Work and any compensation offered to the Ministry should the variance be approved.

**SS 101.05.02** is amended by adding the following as a final sentence in the first paragraph (“Should the Ministry’s ... a response time.”):

Where appropriate, the Ministry may issue two NCR’s related to a single issue – one for the product itself, and the other for the Contractor’s failure to perform Quality Management.

**NEW SECTION 125 – VALUE ENGINEERING – PROPOSAL GUIDELINES**

*Issued Date: December 7, 2018*

**SS 125.05.01 a) and c)** are amended by deleting the web addresses in the respective provisions and replacing them as follows.

**125.05 Associated Technical Circulars**

**125.05.01**

- a) <https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/technical-circulars/2009/t06-09.pdf>
- c) <https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/technical-circulars/2009/t07-09b.pdf>

**SECTION 201 – ROADWAY AND DRAINAGE EXCAVATION**

*Issued Date: November 2, 2016*

**Section 201** is deleted in its entirety and replaced with the version attached.

**NEW SECTION 312 – STEEL TRAFFIC BARRIERS AND WOOD POSTS**

Issued Date: December 7, 2018

*SS 312.04.04, third paragraph, final sentence, is amended as follows*

All field cuts or holes shall be deburred and treated with two heavy coats of zinc rich paint selected from the Ministry’s [Recognized Products List](#) under the category of “Additional Paint Coatings – Zinc-Rich Touch-up Paints and Primers” ~~two coats of cold galvanizing or zinc-rich coating to CAN/CGSB Standard 1.181-99.~~

**SECTION 320 – CORRUGATED STEEL PIPE**

Issued Date: February 6, 2017

*SS 320.02.02, first paragraph (“As of January 1, 2017 ... Special Provisions.”) is deleted and replaced with the following*

As of August 1, 2017, all CSP and SPCSP shall be supplied from a manufacturing plant certified to CSA G401 or as amended by Special Provisions.

**NEW SECTION 321 – TRAFFIC MARKING PAINT and SPECIAL MARKINGS**

Issued Date: December 7, 2018

*SS 321.03, fourth paragraph (“Traffic Marking Paint...Special Provisions) is deleted and replaced with the following:*

Traffic Marking Paint shall be supplied from traffic paint products listed on the BC Ministry of Transportation and Infrastructure [Recognized Products List](#), or as identified in the Special Provisions.

*SS 321.04(i), second paragraph and bulleted list (“Glass beads for pavement marking shall be: ... greater than 60%”) are deleted and replaced with the following:*

Glass Beads shall be supplied from glass beads products listed on the BC Ministry of Transportation and Infrastructure [Recognized Products List](#).

**NEW SECTION 407 – FOUNDATION EXCAVATION**

Issued Date: December 7, 2018

*SS 407.03, first paragraph (“Solid Rock” shall include ... must be excavated.”) is deleted and replaced with the following:*

Material types will be as defined in SS 201.11 – Description of Materials Types.

*SS 407.06, the table is deleted and replaced with the following*

Work	Type A	Type D
Excavation	80%	60%
Backfilling or Disposal	20%	40%

**NEW SECTION 412 – CONCRETE REINFORCEMENT**

Issued Date: December 7, 2018

**SS 412.33.03 and Table 412-E Concrete Cover for Reinforcing Steel** are deleted and replaced with the following:

**412.33.03 Concrete Cover** – Concrete cover for reinforcing steel shall be in accordance with the [“Bridge Standards and Procedure Manual – Supplement to CHBDC S6”](#), unless shown otherwise on the Drawings.

**NEW SECTION 502 – ASPHALT PAVEMENT CONSTRUCTION (EPS)**

Issued Date: February 22, 2017 – All SS 502-related amendments issued on this date are cancelled, as they have all been incorporated in the December 7, 2018 issue below.

Issued Date: December 7, 2018

**Section 502** is deleted in its entirety and replaced with the attached revised version.

**NEW SECTION 515 HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT (EPS)**

Issued Date: December 7, 2018

**515.02 General Description of the Work:** *The first and second bullets of the bulleted list with lead-in “All equipment and instruments...with this Section:” are amended to read as follows:*

- Equipment shall have the capability to process the existing pavement to a minimum depth of 50 mm through a double-pass operation, at a nominal 25 mm per pass, yielding an average of 120 kg/m<sup>2</sup> of the existing pavement being processed.
- Heating shall be regulated so no overheating of the existing asphalt cement will occur. This will generally require the existing surface to be radiantly heated and no open flame directed at the existing pavement will be permitted.

**515.03.11 a) Denisty:** *Correct the spelling by replacing “Denisty” with “Density”.*

**515.04.06 b) Finished Cross Fall Drainage:** *The clause is amended to read as follows:*

Contractor shall ensure that the appropriate cross slopes for safety and positive drainage are maintained or achieved improved after the recycling process.

**515.04.06 o) Minimum Temperature:** *The clause is amended to read as follows:*

Minimum temperature behind the paver screed of the recycled material shall be not less than 110°C, unless the Ministry Representative accepts that circumstances limit the reasonably achievable temperature to a lower value.

**515.05.02** *The fifth paragraph (lead-in line) is amended to read as follows:*

Paving aggregate shall meet the requirements of Table 502-C-1 for medium mix asphalt aggregates as well as the following requirements:

**Table 515-D: Lot Assessment and Payment Adjustments for Smoothness** *In the second line of the Table The “≥” symbol is deleted and replaced by “≤”, making it read as follows:*

Lot IRI (m/km)	Payment Adjustment
≤1.00	+\$2,500

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

Issued Date: December 7, 2018

**SS 582.31** first paragraph is amended to read as follows:

**582.31 Portland Cement Concrete Curb and Gutter** – Combined Portland cement concrete curb and gutter shall meet the requirements of SS 211 and 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.

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

Issued Date: December 7, 2018

**SS 586.11** is amended as follows.

**586.11 Cement** – – Portland cement to be supplied for the work will comply with the requirements of SS 211 and tests of the Canadian Standards Association CAN A3000 Cementitious Materials Compendium.<sup>11</sup> and subsequent revisions thereof.

**NEW SECTION 604 STEEL TRAFFIC BARRIER CONSTRUCTION**

Issued Date: December 7, 2018

**SS 604.03** third paragraph is amended as follows.

Touch-up treatment for damaged galvanized metal surfaces shall be two heavy coats of zinc rich paint selected from the Ministry's Recognized Products List under the category of "Additional Paint Coatings – Zinc-Rich Touch-up Paints and Primers". ~~a heavy application of zinc rich paint to CGSB Standard 1-GP-181M.~~

**SS 604.06(c)** is amended to read:

c) End assemblies to be ~~"NCHRP"~~ "Manual for Assessing Safety Hardware (MASH)" certified.

**SECTION 635 – ELECTRICAL AND SIGNING**

Issued Date: January 20, 2017

**Drawings Nos. SP635 – 2.1.14 and SP635 – 2.1.15** are missing (should be reinstated on pages 107 & 108).

**Drawings Nos. SP635 – 2.3.14 and SP635 – 2.4.15** (pages 107 & 108) appear in the 2.1xx series where 2.1.14 and 2.1.15 should be. 2.3.14 should follow 2.3.13, and 2.4.15 should follow 2.4.14.

**Drawing No. SP635 – 2.4.8** is duplicated (pages 140 & 141). Delete page 141.

**Drawing No. SP635 – 2.4.16** There is a Drawing No. SP635 – 2.4.16 (page 154) after Drawing No. SP635 – 2.4.20 (page 153), this drawing should be omitted. Just to be clear, there is already a Drawing No. SP635 – 2.4.16 located between .15 and .17 in the 2.4xx series; this drawing should remain where it is.

**NEW SECTION 741 FENCE CONSTRUCTION**

Issued Date: December 7, 2018

**SS 741.12 Standard Wire Type A, B & C Fences and Gates**, third paragraph, is amended as follows:

Touch-up treatment for damaged galvanizing of steel posts and braces shall be with two heavy coats of zinc rich paint selected from the Ministry's Recognized Products List under the category of "Additional Paint Coatings – Zinc-Rich Touch-up Paints and Primers". ~~a heavy application of zinc~~

~~rich paint to CGSB Standard 1-GP-181M Specification for Ready Mixed Zinc Rich Coating.~~

**SS 741.35.02 Post and Brace Installation** – is amended as follows:

Fence posts shall be driven in place with equipment acceptable to the Quality Manager and set out in general accordance with the recommendations of the B.C. Ministry of Agriculture “BC Agricultural Fencing Handbook” B.C. Ministry of Agriculture and Food (BCMAF) Publication #ISBN-07719-9824-4, good local trade practice, and to the Ministry Representative’s direction.

**NEW SECTION 751 TOPSOIL AND LANDSCAPE GRADING**

Issued Date: December 7, 2018

**SS 751.01 Scope**, paragraph c) is amended as follows:

- c) Manufactured topsoil (Growing Medium), including Biosolids Growing Medium (BGM) or Biotic Soil Matrix (BSM) products where specified in the Contract.

**SS 751.03 References** is amended as follows:

**751.03 References** – Canadian System of Soil Classification, Canada Fertilizer Act, Canadian National Master Specification, and BC Weed Control Act & Regulation, Environmental Management Act - Organic Matter Recycling Regulation.

**SS 751.04 Topsoil Supplied by the Contractor**, second paragraph is amended to read as follows

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. All soil tests shall follow the British Columbia Field Sampling and Environmental Lab Manual. Results of the soil test are to be shared with the Ministry Representative prior to installation.

**SS 751.15 Manufactured Topsoil** is deleted and replaced with the following:

**SS 751.15 Manufactured Topsoil** – Manufactured topsoil is any soil or growing medium mixture with chemical and physical properties that fall within ranges required by this Section for a particular application.

Manufactured topsoil shall meet the requirements in the Organic Matter Recycling Regulation and conform to DBSS 751.16 or as specified in the Contract.

**Biotic Soil Media (BSM)** - Where specified in the Contract, the BSM shall be designed as an alternative to topsoil and/or compost to accelerate development of depleted soils/substrates with low organic matter, low nutrient levels and limited biological activity. BSM products used must be non-toxic with fibers that have been phytosanitized to eliminate potential weed seeds and pathogens - prior to the introduction of soil building components. BSM products shall not be used for erosion control and shall be applied to enhance vegetation establishment and growth only. Where erosion control is required, the BSM shall be installed in a two phase process with the BSM hydraulically applied first with the seed, then covered with an erosion control product. BSM products may also be applied dry with broadcast seeding methods. Refer to DBSS 757.

**SS 751.16 Requirements for Topsoil**, first paragraph, is amended as follows:

**751.16 Requirements for Topsoil** – Acceptance of commercially processed and mixed topsoil components shall only be from a facility operating under a valid permit under the Environmental Management Act be done thoroughly by a mechanical mixing process. No hand mixing shall occur. The resulting product shall be a homogenous mixture having the required properties throughout.

**751.31.01 Stripping of Topsoil**, first paragraph is amended to read:

Existing top soil material shall be stripped and removed to stockpile(s) within the project area at least 10m from water unless otherwise approved by the Ministry Representative, 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. Sites chosen for storage of topsoil shall be free of noxious weeds and invasive plants. If invasive plants or noxious weeds are present at a storage site, propagules shall be removed prior to stockpiling topsoil at the site. If topsoil shall be stockpiled for more than one month, all stockpiles must be covered or seeded to prevent erosion and invasive plant or noxious weed establishment. Stockpiled topsoil shall be inspected for the presence of invasive plants or noxious weeds prior to spreading onto prepared rough graded areas, and any topsoil containing noxious weeds shall either be treated prior to use to remove all propagules, or disposed of appropriately at the Contractor's expense, unless the Ministry Representative authorizes its use as fill elsewhere on the project.

**NEW SECTION 757 REVEGETATION SEEDING**

*Issued Date: December 7, 2018*

**SS 757.12.02 Seed Type and Grade**, first paragraph, last sentence is amended as follows:

Seed shall be free of propagules of plant species designated as noxious under the [BC Weed Control Act & Regulation](#), any BC Proposed Prohibited Species, any sweet clover and any other undesirable contaminants indicated in the Contract.

**757.12.03 Seed Analysis Report** first paragraph, last sentence is amended as follows

The Certificates of Seed Analysis shall set out details of the seed as specified in the [Canada Seeds Act](#) and shall be completely free of any noxious weeds listed on the [BC Weed Control Regulation](#), any BC proposed prohibited species , any sweet clover and any other undesirable contaminants indicated in the Contract.

**Table 757-A Standard Grass Seed Mixes and Material Application Rates for Revegetation of British Columbia Highway Roadsides** is amended by adding the following text immediately before the table:

Average annual precipitation values may be found on-line, including from Environment Canada at:  
[http://climate.weather.gc.ca/climate\\_normals/index\\_e.html](http://climate.weather.gc.ca/climate_normals/index_e.html)  
[http://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](http://climate.weather.gc.ca/historical_data/search_historic_data_e.html)

**SS 757 Mean Annual Precipitation Map** (page 9 of 9) is deleted.

**NEW SECTION 905 - TIMBER GLUED LAMINATED**

*Issued Date: May 11, 2017 (Revised December 7, 2018)*

**Section 905** was missing in the 2016 Standard Specifications for Highway Construction and was issued on May 11, 2017. That version is deleted and replaced with the attached revised version.

**NEW SECTION 906 - ROUND TIMBER PILES**

*Issued Date: May 11, 2017 (Revised December 7, 2018)*

**Section 906** was missing in the 2016 Standard Specifications for Highway Construction and was issued on May 11, 2017. That version is deleted and replaced with the attached revised version.

**NEW SECTION 952 CONTRACTOR SUPPLY ASPHALT AND PAVING MATERIALS FOR HIGHWAY USE**

Issued Date: December 7

**952.05 c) Asphalt Cement** *The clause is amended to read as follows:*

- c) Conform to either the Pen Grade requirements specified in Table 952-C-1 and Table 952-D-1 or the Performance Grade (PG) per the requirements specified in Table 952-C-2, Table 952-C-3 (for Polymer Modified Asphalt only), and Table 952-D-2.

*Insert new Table 952-C-3, attached herewith, after Table 952-C-2.*

**Table 952-C-3 POLYMER MODIFIED ASPHALT  
VISCOELASTIC PROPERTIES**

Polymer Modified Asphalt PG Grade	Minimum R <sub>3.2@58°C</sub> per AASHTO T350*
58-24 64-28	25%
58-37, 58-40 64-34 70-28	40%
64-37 76-28	55%

\* AASHTO T350: Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

**Drawings SP952-01 and SP 952-03** *The graphics for these SP Drawings did not reproduce on pages 952 (12 of 16) and (14 of 16). These two pages are deleted and replaced with the pages attached.*

**ATTACHMENTS:**

#	Issued	Title	#of Pages
1)	2016-11-02	Section 201 Roadway and Drainage Excavation .....	8
2)	2017-02-06	Section 320 Corrugated Steel Pipe.....	1
3)	<b>2018-12-07</b>	<b>NEW</b> Section 502 Asphalt Pavement Construction End Product Specification (EPS) [REVISED SECTION].....	32
4)	2017-01-20	Section 635 Drawing SP635-2.1.14 .....	1
5)	2017-01-20	Section 635 Drawing SP635-2.1.15 .....	1
6)	<b>2018-12-07</b>	<b>NEW</b> Section 905 Timber – Glued Laminated [REVISED SECTION] .....	4
7)	<b>2018-12-07</b>	<b>NEW</b> Section 906 Round Timber Piles [REVISED SECTION] .....	6
8)	<b>2018-12-07</b>	<b>NEW</b> Section 952 Drawing SP952–01 .....	1
9)	<b>2018-12-07</b>	<b>NEW</b> Section 952 Drawing SP952–03 .....	1



## 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, pullouts, 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 Ministry provided borrow pit or any available 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, only to Ministry provided sources 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. All Works shall be confined to the right-of-way except where agreements for access rights are in place for other lands, public or private.

**201.02 Extent of Work** – The dimensions of the excavations and embankments shall be as shown on the Contract Drawings but the Ministry Representative may increase or decrease roadbed dimensions and slope angles. 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 subbase or base material is laid.

#### MATERIALS

**201.11 Description of Material Types** – Excavation shall be classified by the Ministry Representative, under the following material types:

- a) Type A
- b) Type D

The material encountered in any project excavation shall be classified as one of the two types listed above.

In no case shall a material be classified using percentages of two or more types.

**201.11.01 Type A - Solid Rock** – Type A shall, without limitation, include all forms of “solid rock in place” including solid formations, masses, ledges, seams or layers of dense sedimentary, igneous or metamorphic material of

sufficient hardness generally requiring drilling and blasting methods, very heavy ripping, or equivalent methods, before excavation and removal.

Type A shall also include detached masses of rock or boulders individually containing a volume of 2.0m<sup>3</sup> or more.

The breaking and removal of frozen materials or manmade materials (such as asphalt pavement or concrete) as determined by the Ministry Representative shall not be considered Type A excavation.

**201.11.02 Type D – Common** – Common material is all other excavation materials of a nature not included in the foregoing description of Type A, regardless of the nature or condition of the material, or the method used to excavate or remove.

**201.12 Material Classification Changes** – It is possible that the material in a cut may change at some level in the excavation, and may change more than once in a single cut.

Where such a change occurs, the Contractor shall immediately, and in any event within 24 hours of attempting to excavate the changed material, notify the Ministry Representative and clean off any material falling within the currently approved material classification of the cut, in order to expose the horizon where the material change is thought to occur.

The Ministry Representative will review the exposed material, determine whether a classification change is warranted, and notify the Contractor if a classification change is warranted or not.

If a classification change is approved, sufficient field measurements will be taken to establish boundaries and the material horizon for volume calculations.

If the Contractor disagrees with the Ministry’s assessment of the material classification, the Contractor may appeal only in accordance with SS 201.13.

#### **201.13 Material Classification Appeal**

**201.13.01 Type A and Type D Material Classification** – The Contractor may appeal the material classification determined by the Ministry Representative.

**201.13.02 Notice and Time Limit of Appeal** – The Contractor shall serve written Notice of appeal to the Ministry Representative within:



## SECTION 201

- i. twenty-four (24) hours of the Contractor attempting to excavate any potentially changed classification material; or
- ii. three (3) working days of the material classification designation by the Ministry Representative; or
- iii. in no event less than two (2) working days prior to the completion of the excavation.

**201.13.03 Ripping Test** – Where the Contractor appeals the material classification, a ripping test will be conducted under the direction and control of the Ministry Representative, including the determination of the location, time, and suitability of weather, ground, equipment and other conditions for the ripping test to occur.

The ripping test will be conducted using a Class 7 or more powerful bulldozer (as identified in the “Equipment Rental Rate Guide” published by the BC Road Builders and Heavy Equipment Association), that will develop sufficient traction and effectively deliver a minimum force of 700kN per lineal metre of ripper shank embedded in the material by a single shank static ripper as determined by the manufacturer’s Drawbar Pull versus Ground Speed Charts.

If, under the above specified ripping force, the material can be broken or loosened into pieces with an individual volume of 2.0 m<sup>3</sup> or smaller, the material will be classified as Type D. If the material cannot be broken or loosened within the time limit as directed by the Ministry Representative, the material will be classified Type A.

The test will be conducted at the Contractor’s expense unless the test determines, in the sole determination of the Ministry Representative, that a material classification change is warranted. In that case, the cost of the equipment (including mobilization and demobilization if the equipment is brought in solely for the purpose of the ripping test) and the operator will be paid as Extra Work.

**201.14 Unsuitable Material** – Only material acceptable to the Ministry Representative shall be used in the construction of embankments.

Material deemed unsuitable for the construction may be wasted between the toe of the embankment and the right-of-way boundary or in other areas as designated by the Ministry Representative. If no on-site waste areas are designated then the unsuitable material shall be removed and disposed offsite at the Contractor’s expense. 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.

## ROADWAY AND DRAINAGE EXCAVATION

Where required in the contract all topsoil and organic material shall be stripped over the entire excavation and fill areas and placed in the area between the toe of the embankment and the right-of-way boundary, or on any other area as designated by the Ministry Representative. Topsoil shall meet the requirements of SS 751.16. Organics shall be considered unsuitable material and managed in accordance with SS 201.14. Topsoil shall be stockpiled for later use or disposed of as designated by the Ministry Representative.

All material above or below subgrade in an excavation or in the foundation of an embankment, which in the opinion of the Ministry Representative is unsuitable, shall be removed and paid for as excavation, as classified by the Ministry Representative. Soft clays and peats are typical examples of unsuitable materials.

Where removal of unsuitable material requires backfilling this work shall be carried out with approved fill materials, as directed by the Ministry Representative. Payment for such backfilling and haul will be made at the Unit Price bid for "Roadway and Drainage Excavation".

Upon completion of the road grade, all topsoil and material suitable for growth of ground cover shall be spread to a nominal depth of 150mm 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 material shall be placed, compacted and trimmed to a neat appearance in a manner to facilitate growth of revegetation. 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 SS 201.45, SS 201.83 and SS 201.93.

**201.15 Surplus Material** – All suitable excavation material shall, if required, be taken or hauled into the nearest embankment and to any embankment on the project to be constructed 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 by widening embankments uniformly within the limits of right of way,
- hauled to form or widen any embankment on the road to be constructed,
- stockpiled on-site or in Ministry pits, or
- lastly removed from Site for disposal by the Contractor.

All subject to the approval by the Ministry Representative, where hauling and placing shall be performed in the most efficient manner.

## SECTION 201

No material shall be wasted without the approval of the Ministry Representative, all surplus material shall be used as much as possible.

### CONSTRUCTION

**201.31 Rock Cuts** – See SS 204.

**201.32 Overhanging Rock and Boulders** – The Contractor shall remove overhanging rock or boulders within the excavation limits, as ordered by the Ministry Representative, and shall backfill and compact all resulting cavities to allow the safe passage of construction and support vehicles generally in accordance with the requirements of SS 135. Such work will be paid at the Unit Price bid for "Roadway and Drainage Excavation."

**201.33 Overbreak in Solid Rock** - Overbreak in solid rock excavation encountered in the 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 SS 201.42).

Any overbreak that occurs due to the inherent character of any formation encountered, as determined by the Ministry Representative in consultation with the Qualified Professional will be classified as allowable overbreak as described in subsection 201.33.01.

All other 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.

The Qualified Professional is defined as the Ministry's Geotechnical Engineer, Rockwork Engineer, or consultant engineer working for the Ministry whose discipline is in geotechnical engineering.

**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 be lack of the following: the sequence of operations, lack of a blast design, lack of preblast survey, lack of as-built blast design as described in 204.04.06, 204.04.07, and 204.04.08 and 204.04.09. Also, definition of negligence will be deemed to mean lack of cut-off drill holes on the backslope, excessive

## ROADWAY AND DRAINAGE EXCAVATION

spacing of drill holes and overloading of the same.

### 201.34 (Not used)

**201.35 Enlargement of Excavation** – In cases where the quantity of material taken from a regular excavation will not be sufficient to form the required embankment, the deficiency shall be supplied by taking material from the 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 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 and attain a degree of compaction no less than attained for layers less than 0.7m in thickness.

Regardless of layer thickness and material particle size all material shall be well compacted to achieve the design density and stability of the embankment and to the satisfaction of the Ministry Representative.

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 supplemented with additional compaction equipment, as necessary to ensure compaction is uniform, a stable embankment is achieved and to the satisfaction of the Ministry Representative.

When a rock embankment is overlain by an earth embankment or by subbase 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

## SECTION 201

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 according to these standards.

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 bid for the class of excavation involved.

When the foundation of the embankment consists of sensitive soils the Contractor shall, with the Ministry Representative's approval, place the initial lift of embankment to a minimum depth required as stated in the design to carry the Contractor's hauling equipment. Static compaction shall be used in areas of sensitive soil.

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 Standard Proctor Density obtained by the current ASTM D 698, except in the top 300 mm of the embankment, which shall be compacted to minimum 100% of the Standard Proctor Density.

The above maximum lift thickness requirements may be waived by the Ministry Representative, where the Contractor can demonstrate

- That the proposed compaction equipment can uniformly compact a thicker layer;
- Attain the required degree of compaction at all levels within the lift;
- Supply compaction testing equipment and services for Quality Control and Quality Assurance that will

## ROADWAY AND DRAINAGE EXCAVATION

reliably test to the full depth of the proposed lift thickness. The supply of all testing equipment for Quality Control and Quality Assurance shall be the Contractor's responsibility.

No organic soils shall be placed in the embankment. Soils with high moisture content that cannot be compacted to the required density 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.

If suitable, 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 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, with Ministry Representative approval, 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 re-handling of this material.

No material is to be placed on a frozen surface unless approved by the Ministry Representative.

**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 SS 202.04 and SS 202.05. Construction of bridge end fill shall be in accordance with

## SECTION 201

SS 202.23.

**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 Drawings 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 Drawings, 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 bid 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 refinishing 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 rut resistant material, with less than 20% passing the 0.075 mm sieve and free of organics, high plasticity clays and other unsuitable materials, obtained from an approved source of supply (e.g. pit or quarry) outside the highway right-of-way, developed and used in accordance with SS 202 Parts C and D.

## ROADWAY AND DRAINAGE EXCAVATION

The Special Provisions may identify potential sources, additional or different material qualities, or require representative sampling and testing of the material.

**201.45 Haul and Overhaul**– "Haul" includes all work necessary to move excavation materials from their in-situ source to any destination with a freehaul distance of 300 m.

"Overhaul" includes all work necessary to move excavation materials for that portion of the move that is beyond the limits of the 300 m freehaul zone. The volume diagrams when provided within the Contract Drawings are theoretical and do not reflect any constraints imposed due to construction staging.

Haul and overhaul shall be incidental to the Work unless specifically identified as an Item of Work in Schedule 7 of the Contract Special Provision – Approximate Quantities and Unit Prices.

**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 and applying 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 Drawings, 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

## SECTION 201

and Drainage Excavation," and no extra payment will be made.

**201.48 Surcharging** – 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 place the initial lift of embankment to a minimum depth required to carry the Contractor's hauling equipment with the approval of the Ministry Representative. Static compaction shall be used in areas of sensitive soils. 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 for a period of time as outlined in the Contract Special Provisions, or as may be indicated by the instrumentation, or as determined and adjusted by the Ministry Representative.

All instrumentation shall be kept in working, continuous, and operable order according to manufacturer's requirements.

Should any of the instrumentation become damaged or rendered unusable by the construction operations, the same will be replaced by the Ministry at the Contractor's expense.

**201.49 Backslope Stabilization** – Drain holes, 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 drain holes, rock bolts, 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 quantities will be measured from  
201 (6 of 8)

## ROADWAY AND DRAINAGE EXCAVATION

the source and computed in accordance with SS 145.21.01. The volume of boulders and unsuitable material removed from borrow pits that is not used in embankments shall be deducted.

**201.82 Excavation** – All "Roadway and Drainage Excavation" will be measured after Clearing and Grubbing operations have been completed, as specified in SS 200.01 through SS 200.03, and volumes computed in accordance with SS 145.21.01.

Pay quantities will be computed, in accordance with SS 145.21.01, in CUBIC METRE to the neat lines staked. 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, for that portion of the movement that is beyond a 300 m freehaul distance from the source, on the completion of the project by the 1000 STATION METRES where a station metre (Sta. m) is 1 m<sup>3</sup> 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."

### PAYMENT

**201.91 Borrow** – Payment for BORROW materials shall be at the Unit Price per cubic metre bid for "Roadway and Drainage Excavation" classified as provided for in SS 201.11. All specifications in this Section relating to excavation shall apply to borrow. Payment shall be full compensation for everything furnished and done, including without limitation costs for acquisition, development, and payment of royalties for private pits or quarries, purchase price of borrow material, access road construction and maintenance, screening, crushing, stockpiling, loading, hauling, spreading, compaction and moisture adjustment (watering or drying) in place as specified.

**201.92 Excavation** – Payment for EXCAVATION shall be at the Unit Price bid per cubic metre for the various types of materials excavated. The Unit Price for such excavation shall 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

## SECTION 201

prescribed in SS 201.93.

**201.93 Overhaul** – OVERHAUL is incidental to the Work and will not be paid separately unless explicitly included as an Item of Work in Schedule 7.

Where such an Item is used, payment for OVERHAUL will be at the Unit Price bid per 1000 station metres (Sta. m).

### **201.94 (not used)**

**201.95 Allowable Overbreak** – Allowable overbreak will be paid at 75% of the Unit Price bid for TYPE A MATERIAL. The quantity at the Unit Price for overbreak in any one cut shall not exceed 10% of the original theoretical cut, as shown on the Drawings 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

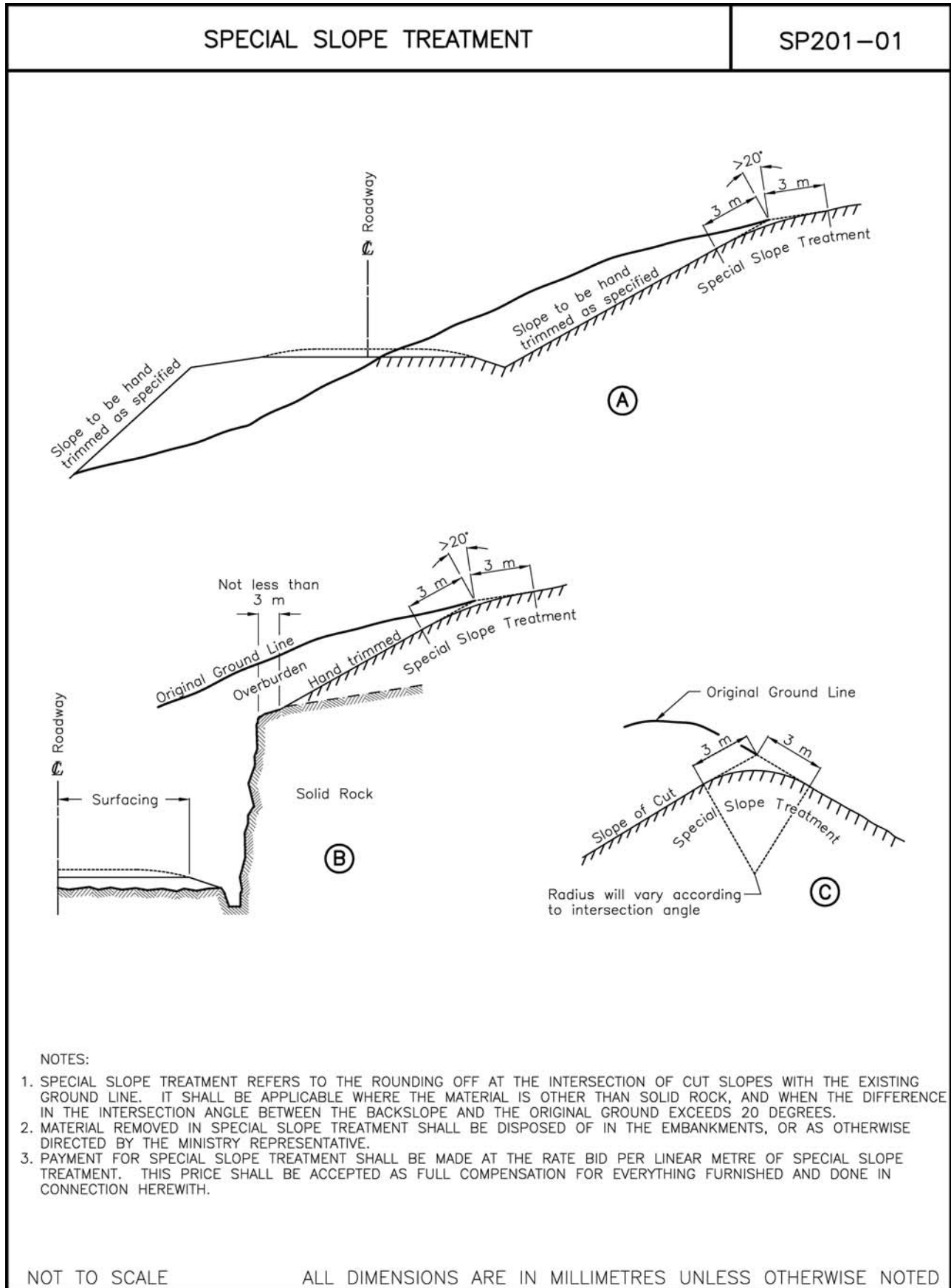
## ROADWAY AND DRAINAGE EXCAVATION

of the Ministry Representative, will be paid at the Unit Price bid 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 (not used)**

**201.98 Surcharge Removal** – Payment for surcharge removal shall be at the Unit Prices bid for EXCAVATION and OVERHAUL.





## SECTION 320

### CORRUGATED STEEL PIPE

#### DESCRIPTION

**320.01 General** - This Section covers the material and fabrication requirements for corrugated steel pipe, spiral rib pipe, and structural plate corrugated steel pipe products for applications such as culverts, storm sewers, sanitary sewers, subdrains, ground recharge systems, well casings, underpasses, stream enclosures, shelters, and tunnels.

Abbreviations for the various types of steel pipe are as follows:

CSP - Corrugated Steel Pipe means Galvanized, Aluminized Type II and Polymer Laminated corrugated steel pipe with helical corrugations, fabricated from coiled steel sheet, with continuous helical seam.

SPCSP - Structural Plate Corrugated Steel Pipe means hot-rolled sheets or plates that are corrugated, curved to radius, custom hot-dip galvanized or has a thermoplastic copolymer coating, assembled, and bolted together to form pipes, pipe-arches, and other shapes. This includes deep corrugated structural plate (type I, II, III).

#### 320.02 Supply and Fabrication

**320.02.01 Standards** - The supply and fabrication of Corrugated Steel Pipe (CSP) and Structural Plate Corrugated Steel Pipe (SPCSP) including couplers and appurtenances shall be in accordance with CSA Standard G401-14.

#### 320.02.02 Plant Certification:

As of August 1, 2017, all CSP and SPCSP shall be supplied from a manufacturing plant certified to CSA G401 or as amended by Special Provisions.

The certification shall be performed by a 3<sup>rd</sup> party agency accredited by the Standards Council of Canada. Certified CSP and SPCSP shall be marked according to CSA G401 markings, along with the logo of the 3<sup>rd</sup> party certification body.

The manufacturer's plant certificate documentation shall be made available to the Ministry upon request. This specification is available from CSA.

#### 320.06 Quality of Work

**320.06.01 Inspection** – Products shall be made available for inspection and acceptance by the Ministry at the point and time of incorporation into the Work.

**320.06.02 Quality Management** - The manufacturer shall establish the quality control plan and demonstrate its implementation. The purchaser's Quality Management Plan shall incorporate measures to assure the quality of the materials supplied by the manufacturer meet this Specification.

**320.06.03 Quality Assurance Testing** – Minimum Quality Assurance (QA) tests and inspection, to be performed by the Contractor, shall be per Table 320-A.

## SECTION 502

### ASPHALT PAVEMENT CONSTRUCTION

#### END PRODUCT SPECIFICATION (EPS)

#### GENERAL

**502.01 Preliminary and General** – This Section describes the materials, equipment, professional standards, and end product requirements for the construction of hot mix asphalt pavement and related shouldering operations.

End Product Specifications (EPS) 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 contingent on the product meeting the Quality Control (QC) Plan, professional standards and quality requirements of this Section and is subject to payment adjustments upward and downward in accordance to the provisions provided in this Section.

When used in this Section and subject to the General Conditions:

- “Acceptance” means agreement with past actions or decisions made, within the scope of the Contract.
- “Authorization” means formal approval for future actions, frequently changing the Contract requirements.

**502.02 General Description of the Work** – Generally, the work associated with the construction of asphalt pavement and shouldering by EPS consists of the following:

- Preparing a QC Plan for review 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 SS 952;
- Preparing mix designs which, once reviewed and accepted 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; and
- Supplying, hauling, placing and compacting shoulder gravels.

The Contractor shall provide a paving end product conforming in professional standard, quality and accuracy of detail to the QC Plan and 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 the provisions of this Section. Payment is subject to upward or downward 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**

**502.03.01 Actual Asphalt Content** – The amount of asphalt cement in the mix as determined by the Ministry’s Quality Assurance Program.

**502.03.02 Additives** – Solid or liquid materials to enhance the properties of the liquid asphalt cement or mix.

**502.03.03 Aggregate** – The crushed or screened gravel.

**502.03.04 Asphalt Cement (AC)** – A bitumen-based liquid binder used in asphalt pavement.

**502.03.05 Asphalt Content** – The percentage of asphalt cement in the mix expressed as percentage by weight of the total dry aggregate in the mix determined by the Oven Test procedure.

**502.03.06 Asphalt Mix (AM)** – Hot plant mixture of asphalt cement and aggregate.

**502.03.07 Asphalt Mix Aggregate (AMA)** – The processed crushed aggregate just prior to the addition of asphalt cement.

**502.03.08 Asphalt Mix Design (AMD)** – The asphalt mix design that is developed through the initial trials and

## SECTION 502

testing to determine and optimize the Job Mix Formula for the end product of the asphalt mix.

**502.03.09 Asphalt Pavement (AP)** – Compacted asphalt mix.

**502.03.10 Cutback Asphalt** – Asphalt cement which has been blended with light petroleum distillates.

**502.03.11 Design Asphalt Content** – The asphalt content upon which the Job Mix Formula is initially established.

**502.03.12 Driving Lane** – A single lane in any area of the pavement other than a shoulder or a barrier flare.

**502.03.13 Emulsified Asphalt** – Asphalt cement that has been blended with water and emulsifying agents to form aqueous emulsions, including anionic type, cationic type and high float type.

**502.03.14 End Product Specification (EPS)** – A specification whereby the Contractor is responsible for the workmanship and quality control of the construction processes, and whereby the Ministry reviews the workmanship and may perform the specified quality assurance sampling and testing of the end product for the purpose of determining acceptance/rejection and payment.

**502.03.15 Job Mix Formula (JMF)** – The asphalt mix “recipe”, proposed by the Contractor in accordance with SS 502.08.04 or an accepted variation in accordance with SS 502.08.10 and accepted by the Ministry, establishing the aggregate proportions, gradation, and the asphalt content to be used for production of asphalt mix.

**502.03.16 Levelling Course (LC)** – Asphalt mix used to improve crossfall, level, and strengthen existing pavements.

**502.03.17 Lift** – A layer of asphalt mix laid in a single application then compacted.

**Top Lift** – The uppermost Lift, forming the final running surface.

**Lower Lift** – Any Lift below Top Lift.

**Bottom Lift** – The lowest Lift (excluding Level Course),

**502.03.18 Lot and Sub-Lot** – A Lot is a portion of the work being considered for acceptance and for the determination of payment adjustments. For density, AC content, gradation and smoothness, each Lot is comprised of a number of Sub-Lots, each of which is

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

sampled, and then aggregated to determine the acceptability of the Lot. Lot and Sub-Lot sizes are defined in the appropriate payment adjustment provisions of this Section.

**502.03.19 Reclaimed Asphalt Pavement (RAP)** – Asphalt Pavement that has been removed and processed, for the purpose of recycling.

**502.03.20 Recycled Asphalt Mix (RAM)** – A carefully controlled hot plant mix of asphalt cement, graded high quality aggregate, and reclaimed asphalt pavement.

**502.03.21 Reject Mix** – Asphalt mix that is deemed unacceptable for use in the project.

**502.03.22 Sample Mean** – The arithmetic mean of a set of test results constituting the sample.

**502.03.23 Smoothness** – A measure of the longitudinal profile of the pavement surface, measured as International Roughness Index (IRI).

**502.03.24 Surplus Aggregate** – Aggregate surplus to the works, in split or un-split stockpiles which singly or combined will meet the asphalt mix aggregate gradation.

**502.03.25 Random Sample** – A set of test measurements taken, one each from a number of separate areas or Sub-Lots within a Lot, in an unbiased way.

**502.03.26 Voids in Mineral Aggregate (VMA)** – The space available to accommodate the effective volume of asphalt (asphalt not absorbed into the aggregate) and the volume of air voids necessary in the mixture.

### 502.04 Quality Control

**502.04.01 General** – Quality Control shall be performed by the Contractor in accordance with SS 101 and the requirements of this Section.

**502.04.02 Quality Control (QC) Plan** – The paving component of the Contractor’s Quality Control Plan shall fulfill or exceed the requirements of Appendix 1 and function integrally with any other Quality Management provisions of the Contract.

The QC Plan shall be submitted in accordance with the timelines established in SS 101.02.03(iii).

The QC Plan must include a detailed description of the means by which the Contractor shall use the quality control test results to ensure that the workmanship, asphalt materials, aggregate, mix production, paving and pavement compaction processes will be controlled to keep the product within the specified limits. The QC

## SECTION 502

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 affect 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 QC Plan as most recently submitted and accepted.

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** – Quality Control inspections shall be recorded on check sheets and/or diaries at the time of inspection.

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) or Contractor-supplied forms acceptable to the Ministry Representative.

For the purposes of confirming delivery of asphalt mix and shouldering aggregate 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 placement operation at the end of each shift. The Road Checker's Summary shall include, but not be limited to, the following information:

- Truck Number;
- Weigh Ticket Number and Net Weight of load;
- Date, time and location by station of delivery;
- Material Application Rate Dimensions and Calculations. Calculation frequency minimally shall be for every 10 loads; and

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

- Notes pertaining to the paving of any appurtenances (letdowns, intersections, tapers, etc.).

In addition to the equipment calibration requirements of SS 101, 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 prior to mix production.

**502.04.05 Final Quality Control Testing Reports** – Prior to the issuance of a Completion Certificate, 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.

## MATERIALS

### 502.05 Materials Testing

**502.05.01 Test Procedures** – Where a test is specified to conform to an ASTM procedure, the listed corresponding AASHTO test may be used, or vice versa. See Table 502-A Standard Sampling and Testing Procedures.

**502.05.02 Sieve Sizes** – All aggregate gradation tests shall use the following sieve sizes: 37.5 mm, 25 mm, 19 mm, 16 mm, 12.5 mm, 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 0.600 mm, 0.300 mm, 0.150 mm, and 0.075 mm.

### 502.06 Aggregates

**502.06.01 Aggregates** – The Contractor shall supply all aggregates for the Work from sources acceptable to the Ministry Representative.

**502.06.02 Work in Ministry Pits or Quarries** – Ministry pits offered in the Special Provisions as available sources may be used without charge provided they are developed and worked in accordance with SS 145.26, SS 202 Part C, and the pit development plan. Deviation from the pit development plan will require the authorization of the Ministry Representative. No guarantee is given or implied that aggregate from a Ministry pit(s) will meet the specification requirements or provide requisite quantities.

## SECTION 502

Without limitation and unless otherwise specified in the Special Provisions, the following items shall not be left in a Ministry pit:

- Surplus milled or rubblized asphalt pavements;
- Reject mix;
- Fuel contaminated materials; or
- Other waste products.

**502.06.03 Supply of Aggregates, Aggregate Production and Characteristics** – The Contractor shall not produce aggregate until the Contractor has received written notification from the Ministry Representative that their QC Plan is in accordance with SS 502.04.02, and has in place testing facilities for aggregate production that are in accordance with the QC Plan.

For the production of aggregate within Ministry pits, the Contractor shall follow the Ministry's pit development plan, and 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 safely at a location in the pit 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 directed by the Ministry Representative.

Where the Ministry has any available test result information on the properties shown in Table 502-B-1, 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 aggregate with the requirements of this Section shall be the responsibility of the Contractor.

**502.06.04 Shouldering Aggregate** – Shouldering aggregate shall meet the following:

- All requirements of SS 202.04 and SS 202.05; and
- Aggregate properties and gradation for 25 mm WGB, per SS 202 Table 202-B and Table 202-C, or as otherwise specified in the Special Provisions

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

or with the agreement of the Ministry Representative.

**02.06.05 Paving Aggregates** – 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.
- iv) Shall meet the requirements listed in Table 502-B-1.

### b) Fine Aggregate

- i) Shall be all mineral matter passing the sieve designated in the test procedure(s) 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 sand equivalent of not less than 40 (not less than 45 for Superpave mixes) when tested in accordance with ASTM D 2419.
- iv) For Class 1 and Superpave mixes, 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) 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) Shall be free from organic matter.
- iii) Mineral filler shall be non-plastic when tested in accordance with ASTM D 4318.

TABLE 502-A: STANDARD SAMPLING AND TESTING PROCEDURES

Test Ref. No.		Standard Test Method/Practice (ASTM test title, unless otherwise noted)
AASHTO	ASTM	
<b>Aggregates:</b>		
T 11	C 117	Materials Finer than 75 $\mu\text{m}$ (No. 200) Sieve in Mineral Aggregates by Washing
T 85	C 127	Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
T 84	C 128	Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
T 27	C 136	Sieve Analysis of Fine and Coarse Aggregates
T 112	C 142	Clay Lumps and Friable Particles in Aggregates
T 255	C 566	Total Evaporable Moisture Content of Aggregate by Drying
T 2	D 75	Standard Practice for Sampling Aggregates
T 304	C1252	Method "A" Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
	D 421	Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants [aka Atterberg Limit]
T 176	D 2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
	D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
	D 5821	Determining the Percentages of Fractured Particles in Coarse Aggregate
T 327	D 6928	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
<b>Asphalt Cement:</b>		
T 49	D 5	Penetration of Bituminous Materials
T 202	D 2171	Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer
<b>Asphalt Mix and Pavement:</b>		
T 245		AASHTO Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
	D 979	Standard Practice for Sampling Bituminous Paving Mixtures
T 283	D 1075	Standard Test Method for Effect of Water on Compressive Strength of Compacted Bituminous Mixtures
	D 1188	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin Coated Specimens
	D 2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
	D 2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
T 269	D 3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
	D 4469	Standard Test Method for Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture
T-308	D 6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
<b>Shouldering:</b>		
	D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> )) [aka Standard Proctor]
	D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (shallow depth)
	D 5220	Standard Test Method for Water Content of Soil and Rock in Place by Neutron Depth Probe Method

**TABLE 502-B-1: REQUIREMENTS FOR COARSE AGGREGATES**

Test Ref. #		Procedures	Superpave	Class 1	Class 2
AASHTO	ASTM				
T 85	C 127	Maximum Water Absorption, % by mass	2	2	2
T 112	C 142	Maximum % by mass of clay balls and friable particles	1.0	1.0	1.5
	D 5821	2 Fractured Faces, Minimum % by Mass retained on the 4.75 mm sieve	90	85	70
T327	D 6928	Maximum Micro-Deval abrasion loss factor, %	18	18	20

**d) Superpave Aggregates** – Aggregates for Superpave mixes shall have properties and the gradation limits as specified below and in accordance with the latest version of the Asphalt Institute's *Superpave Series Publication – Superpave Mix Design (current version)*. Changes and/or variations from these limits shall be outlined within the Special Provisions.

- i) 90% fractured aggregate with a 12.5 mm nominal maximum size, including sufficient manufactured fines to provide fine aggregate angularity.
- ii) The aggregates must meet all the requirements for angularity, toughness deleterious materials, clay content, and flat and elongated particles.
- iii) Design ESALs will be 10 – 30 million.

**502.07 Supply of Asphalt Cement and Primer** – The Contractor shall supply the types and grades of asphalt cement and primers as specified in the Special Provisions and in accordance with SS 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.

**502.07.01 Asphalt Binder Testing** – The Contractor shall provide supplier's Asphalt Binder testing and grade information upon request.

**502.07.02 Polymer Modified Asphalt Testing for Viscoelastic Properties** – The Ministry may test a Polymer Modified Asphalt (PMA) to determine the viscoelastic properties of the Asphalt Binder (Asphalt Cement – AC).

The selected grades of PGAC may be tested at a temperature of 58°C to determine the average percent recover at 3.2 kPa (R3.2) according to the requirements of AASHTO T350 Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder using a Dynamic Shear Rheometer.

The minimum R3.2@58°C value for selected asphalt binder grades shall be determined as outlined in Table 502-B-2 MSCR.

**TABLE 502-B-2: MSCR – Elastic Recovery Requirements**

PGAC	Minimum R3.2@58°C
58-34 64-28	25%
58-37 58-40 64-34 70-28	40%
64-37 76-28	55%

### 502.08 Asphalt Mix

**502.08.01 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 utilise a CCIL certified testing laboratory for

- meeting the requirements of SS 101;
- assessing the aggregate material proposed for use; and
- preparing Asphalt Mix Designs as required in SS 502.

### 502.08.02 Requirements for Asphalt Mix Design

- a) **ALL MIXES** – Asphalt mix designs shall be performed using the asphalt cement grade specified in the Special Provisions and which is



## SECTION 502

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.

Asphalt mix designs, Job Mix Formulas, and field adjustments made in accordance with SS 502.08.10 must all be based on an aggregate gradation meeting the requirements of Table 502-C-1 and the criteria specified in Table 502-C-2 or Table 502-C-3, as applicable.

- b) **MARSHALL MIXES** – The asphalt mix design for Class 1 and Class 2 pavements shall be carried out under Marshall design criteria using the designated equipment and procedures as contained in the Asphalt Institute’s “*Mix Design Methods for Asphalt Concrete MS-2*” (current version).
- c) **SUPERPAVE MIXES** – The Superpave asphalt mix design shall be carried out in accordance with the latest edition of the Asphalt Institute’s “*Superpave Mix Design, Superpave Series No. 2*” (current version) and this specification.

The JMF aggregate gradation shall fall under the maximum density gradation line for the 0.300 mm to 2.36 mm sieves, inclusive.

**502.08.03 Asphalt Mix Antistrip Additives** – For Marshall, the Contractor shall determine the Index of Retained Marshall Stability (IRMS) of each asphalt mix in accordance with ASTM D 1075 “Standard Test Method for Effect of Water on Compressive Strength of Compacted Bituminous Mixtures”. For Superpave mix designs, the Contractor shall determine the Tensile Strength Ratio (TSR) of each asphalt mix in accordance with AASHTO T 283.

An antistrip additive shall be added to the asphalt mix when:

- Special Provisions so direct;
- IRMS is less than 85;
- TSR is less than 80; or
- Ministry Representative specifically requests it.

The Contractor shall select the antistrip additive from the Ministry’s “Recognized Products List” and add it to all asphalt mix used in the Work, at an application rate of 0.3% additive by weight of asphalt cement. The

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Recognized Products list is available on-line at: [http://www.th.gov.bc.ca/publications/eng\\_publications/geotech/Recognized\\_Products\\_Book.pdf](http://www.th.gov.bc.ca/publications/eng_publications/geotech/Recognized_Products_Book.pdf)

**502.08.04 Asphalt Mix Design Submittals** – The Contractor shall submit each Asphalt Mix Design to the Ministry Representative for review. The Ministry will review the Asphalt Mix Design to ensure it complies with the requirements of the Contract,

Paving Work shall not proceed until the Contractor receives the results of the review in writing from the Ministry Representative. The Contractor's submissions shall include the following information:

- Gradation of each aggregate to be used in each mixture;
- Percentage by mass of each aggregate to be used in each mixture;
- Design gradation of the combined aggregate for each mixture for each of the sieve sizes applicable to the mix, per the first column of Table 502-C-1;
- Estimated dry sieve gradation corresponding to the JMF gradation;
- All Asphalt Mix Design data used in arriving at the final mix designs;
- Design Asphalt Content expressed as a percentage of the dry weight of the aggregate;
- Design Mix Temperature, which shall be the temperature at which the kinematic viscosity of the asphalt cement is 0.17 Pa•s (170 centistokes) or as per the Asphalt Cement supplier’s recommendations; and
- Recommended compaction temperature.

**502.08.05 Ministry’s Review of Asphalt Mix Design** - The Ministry Representative will require up to five (5) calendar days from the time of receipt of the Asphalt Mix Design for review. The mix design must be reviewed and accepted by the Ministry Representative prior to commencement of pavement construction.

Upon acceptance of the Asphalt Mix Design, the Contractor shall prepare the laboratory equipment calibration samples, submit them to the Ministry Representative, and participate in the calibration and correlation process described in Appendix 3 Blank Aggregate Sample Preparation and Appendix 4 Ignition Oven Correlation Procedure.

## SECTION 502

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

**502.08.06 Ignition Oven Correlation** – After receiving acceptance of the Asphalt Mix Design, the Contractor shall prepare blank aggregate samples (aggregate-only samples prepared to match the mix design) for correlation of the Contractor, Ministry and appeal laboratory ignition ovens. Blanks shall be prepared in accordance with SS 502 Appendix 3 Blank Aggregate Samples.

The Ministry Representative shall randomly select which of the individual blanks will be used.

Within 3 working days, and prior to any mix production, the Contractor and the Ministry shall prepare and test asphalt mix samples in accordance with SS 502 Appendix 4 Ignition Oven Correlation.

**502.08.07 Use of Calibration Factors in Reporting Asphalt Cement Content** – Results from testing of any asphalt mix shall report the measured AC Content and the corrected AC Content after applying the applicable laboratory calibration factor.

**502.08.08 Verification of Job Mix Formula from the Asphalt Mix Design** - Verification of the Asphalt Mix Design will be carried out by the Contractor during the course of production of the first 1,000 tonnes of mix using the Asphalt Mix Design.

During the first 1,000 tonnes of plant production, the Contractor may make any adjustments it chooses to the

Asphalt Mix Design, testing the mix, and refining the Asphalt Mix Design to a state that fully complies with Table 502-C-1 and 502-C-2 (or 502-C-3 as applicable) and the Special Provisions.

All mix of the Asphalt Mix Design laid must be tracked by the Contractor, and reported to the Ministry Representative, as to lay-down location and the Asphalt Mix Design values in effect at the time that mix was produced, to ensure appropriate values are used in comparing design to sampled properties.

After production of the first 1,000 tonnes, the Contractor shall declare their Job Mix Formula (JMF) to the Ministry Representative, and provide volumetric properties/test data on the final mix produced. Any future adjustments to the JMF shall comply with all requirements of SS 502.

Where the JMF varies from the Asphalt Mix Design by a cumulative amount greater than any tolerance specified in Table 502-D, the Contractor shall do a single point confirmatory Asphalt Mix Design and report the results to the Ministry Representative.

**502.08.09 AC Content Bump** – Upon receipt of a Job Mix Formula meeting all Contract requirements, the Ministry may direct the Contractor to increase the asphalt cement content by a “bump” of up to 0.3% by weight of dry aggregate in the mix.

**TABLE 502-C-1: ASPHALT MIX AGGREGATE GRADATION LIMITS**

Sieve Size (mm)	Percentage Passing By Mass						
	Coarse Mix	Medium Mix		Fine Mix	Asphalt Base Course (ABC)	Asphalt Bound Open Graded Base Mix	Superpave <sup>(1)</sup>
	37.5 mm	19 mm	16 mm	12.5 mm	25 mm	25 mm	Nominal 12.5 mm
37.5	100						
25.0	80 – 100				100	100	
19.0	60 – 92	100			80 – 94	75 – 100	100
16.0			100				
12.5	50 – 85	84 – 95	90 – 100	100			90 – 100
9.50	40 – 80	73 – 90	73 – 90	90 – 100	50 – 84	30 – 60	
4.75	30 – 65	50 – 75	50 – 75	55 – 80	25 – 55	5 – 30	
2.36	20 – 50	35 – 57	35 – 57	32 – 64	20 – 45	0 – 10	28 – 58
1.18	15 – 35	26 – 45	26 – 45	24 – 51	15 – 35		
0.600	8 – 30	18 – 34	18 – 34	17 – 40			
0.300	6 – 22	10 – 26	10 – 26	13 – 29	5 – 20	0 – 8	
0.150	3 – 15	6 – 17	6 – 17	8 – 18			
0.075	1 – 7	3 – 7	3 – 7	4 – 10	0 – 5	0 – 4	2 – 10

Note (1): from Appendix B in SuperPave SP-2

TABLE 502-C-2: MARSHALL DESIGN and PRODUCTION CRITERIA

Property of Laboratory Compacted Paving Mixture	Pavement Class	
	1	2
Number of blows each face of test specimens	75	75
Minimum % Voids in Asphalt Mix Aggregate for 19 mm Medium Asphalt Mix	14	14
Minimum % Voids in Asphalt Mix Aggregate for 16 mm Medium Asphalt Mix	14.5	14
Minimum % Voids in Asphalt Mix Aggregate for 12.5 mm Fine Asphalt Mix	15	15
% air voids in laboratory compacted mixture for 19 mm Medium Asphalt Mix	2.5 to 4.5	2.5 to 4.5
% air voids in laboratory compacted mixture for 16 mm Medium Asphalt Mix	2.5 to 4.5	2.5 to 4.5
% air voids in laboratory compacted mixture for 12.5 mm Fine Asphalt Mix	2.5 to 4.5	2.5 to 4.5
Minimum Marshall Load, N @ 60°C for 80 – 100 Pen. and 120 – 150 Pen.	9000	7000
Minimum Marshall Load, N @ 60°C for 150 – 200 Pen. and 200 – 300 Pen.	7000	6000
Flow index, units of 0.25 mm	8 to 14	8 to 16
Minimum Asphalt Film Thickness, $\mu\text{m}$ (microns) (see Appendix 5)	8.0	8.0
Minimum Index of Retained Stability after immersion in water at 60°C for 24 hours	85%	75%

TABLE 502-C-3: SUPERPAVE DESIGN and PRODUCTION CRITERIA

Property of Laboratory Compacted Paving Mixture For Design ESALs = 10 - 30 million, at $N_{\text{Design}} = 100$ gyrations	SuperPave
% voids in the Mineral Aggregate, minimum	14
Required density: % of Theoretical Maximum Specific Gravity in a laboratory compacted mix at $N_{\text{max}} = 160$ gyrations	98
at $N_{\text{Design}} = 100$ gyrations	95 – 97 <sup>2</sup>
at $N_{\text{Initial}} = 8$ gyrations	<89
% voids filled with Asphalt Cement	65 – 75
Dust to Binder ratio <sup>3</sup>	0.6 – 1.2

<sup>2</sup> For design Superpave density shall be 96. <sup>3</sup> Consideration shall be given to increasing the dust to binder ratio to 0.8 – 1.6

**502.08.10 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 SS 502.08.02 through SS 502.08.04 inclusive. The Contractor shall provide all supporting verification data.

After the Job Mix Formula has been established in accordance with SS 502.08.10, no field adjustment to that Job Mix Formula will be permitted without prior written authorization by the Ministry Representative. The Ministry Representative will limit the number of

field adjustments of the Job Mix Formula to two from the originally derived Asphalt Mix Design.

No field adjustment will be acceptable if it results in a change from the Asphalt Mix Design, for any property, in excess of the maximum adjustment for that property permitted in Table 502-D. All production Mix shall meet either Table 502-C-2 or Table 502-C-3.

TABLE 502-D: FIELD ADJUSTMENT OF JOB MIX FORMULA

Job Mix Formula Property	Maximum Cumulative Field Adjustment
Percentage Passing by Sieve Size:	
37.5 mm, 25.0 mm, 19.0 mm, and 16.0 mm	±2.0%
12.5 mm and 9.5 mm	±2.0%
4.75 mm and 2.36 mm	±1.5%
1.18 mm and 0.600 mm	±1.5%
0.300 mm and 0.150 mm	±1.5%
0.075 mm	±0.5%
Asphalt Cement content	±0.3%

## SECTION 502

### EQUIPMENT AND PLANT

**502.15** All equipment and plant shall be in good mechanical condition and be capable of performing the Work in accordance with this section.

### CONSTRUCTION

#### **502.20 Minimum Acceptable Construction Practices**

– Professional standards in accordance with the Contractor's QC Plan and construction industry best practices are a core requirement of the Work. Any construction practice or activity that results in an obvious defect must be corrected by the Contractor. Construction practices shall include but are not limited to the following:

**502.21 Prime Coat and Tack Coat** - Applications of prime coat and tack coat are required and shall be applied unless otherwise directed by the Ministry Representative.

**502.21.01 Surface and Weather Conditions** – The liquid asphalt for prime coat or tack coat shall be applied when surface and weather conditions are favourable. The application of prime coat and tack coat shall meet manufacturer's requirements.

**502.21.02 Spray Temperature** – The liquid asphalt shall be sprayed within the temperature range specified by the supplier.

**502.21.03 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.

**502.21.04 Application** – The spray bars shall produce double coverage at one pass, with uniform spray and even pressure with application rates controlled to within  $\pm 25\%$  of the specified application rate.

Spray bar nozzles shall be of the same type and size, set to produce uniformly fan-shaped sprays without atomization.

**502.21.05 Spraying Faults** – Any spraying faults shall be corrected by the Contractor.

**502.21.06 Excess Liquid Asphalt** – Excess liquid asphalt remaining unabsorbed shall be blinded with sand or fine aggregate at no expense to the Ministry.

**502.21.07 Surface Condition** – The surface to be tack coated shall be cleaned of dirt or other foreign material.

**502.21.08 Application** – Tack coat shall not be applied on sections of roadway longer than will be covered by

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

one day of asphalt plant production.

**502.21.09 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, at no expense to the Ministry, prior to allowing traffic on same.

**502.21.10 Curing** – Prime coats shall be allowed to cure for a minimum of 24 hours or to the satisfaction of the Ministry Representative prior to the placing of asphalt mix and tack coats shall be allowed to cure to a state that minimizes tracking prior to the placing of asphalt mix.

**502.21.11 Maintenance** - The Contractor shall, at the Contractor's expense, maintain the prime coat and/or tack coat.

#### **502.22 Adjacent Mats, Joints, Edges, and Let-downs**

**502.22.01 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 within 150 to 300 mm from joints in the underlying Lift. Joints shall be pinched as soon as practicable, using best compaction practices.

**502.22.02 Longitudinal Edge** – Any longitudinal edge that has been damaged by traffic or equipment shall be trimmed to provide a vertical abutting face. Vertical surfaces of roadway appurtenances shall be tack coated to the top of the new pavement only.

**502.22.03 Contact Edge** – The contact edge of abutting cooled asphalt pavement shall be thoroughly painted with a uniform coat of emulsified asphalt.

**502.22.04 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.

**502.22.05 Disposal of Raking Material** – Any raked material 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 a manner acceptable to the environmental agencies and the Ministry Representative.

**502.22.06 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

## SECTION 502

that matches the required depth being paved. Material removed from the taper shall be disposed of in a manner acceptable to the environmental agencies and the Ministry Representative.

### 502.23 Stockpiling Aggregates

**502.23.01 Stockpile Construction** – Stockpiles shall be constructed as specified in SS 202.21.

**502.23.02 Stockpiles for Different Materials** – 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.

**502.23.03 Stockpile Requirements Prior to Mix Production** – Before plant mixing commences, the Contractor shall have in stockpile a minimum of 20,000 tonnes 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. These requirements may be waived by the Ministry Representative in circumstances where such stockpiles cannot be accommodated, such as where materials are being barged in or are being hauled to the plant from a remote site.

### 502.24 Mix Production

**502.24.01 Mixing Temperature** – The temperature of the asphalt mix measured at the plant discharge chute shall be maintained at  $\pm 15^{\circ}\text{C}$  of the Design Mixing Temperature designated in the accepted Mix Design, with adjustments within that range made at the Contractor's discretion. Where the Contractor plans to adjust the actual mix temperature to  $10^{\circ}\text{C}$  or more above the Design Mixing Temperature, the Contractor shall notify the Ministry Representative prior to making the adjustment. To optimize mix properties during inclement weather or to address other specific circumstances, the Ministry Representative may agree, in advance, to a higher mixing temperature.

Mix produced at a temperature above the upper tolerance limit may be deemed Reject Mix by the Ministry Representative.

**502.24.02 Residual Moisture Content** – The residual moisture content of the asphalt mix prior to compaction shall not exceed 1% by mass. Should foaming or bubbling persist, even below the allowed percentage of moisture, the Contractor shall modify operations accordingly.

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

### 502.25 Placing the Asphalt Mix

**502.25.01 Surface Condition** – Asphalt mix shall only be placed on clean dry surfaces free from all foreign materials, and when weather and conditions are suitable. Normally, asphalt mix is only placed when the ambient air temperature is  $5^{\circ}\text{C}$  and rising and for Top Lift when the average surface temperature is also above  $5^{\circ}\text{C}$ .

**502.25.02 Asphalt Levelling Course Requirements** – Asphalt Levelling Course shall be placed in one or more Lifts, with a maximum thickness of 75 mm per Lift. The amount of Levelling Course placed shall not exceed the quantity listed in Schedule 7 unless otherwise authorized in writing in advance by the Ministry Representative.

All asphalt mix shall be paver laid, unless otherwise authorized by the Ministry Representative.

Any mix laid prior to the establishment of the Job Mix Formula (per SS 502.08.10) shall normally be placed in a location where performance of the mix is of lower concern, typically as level course, on a low volume side road, and/or in Bottom Lift. The location proposed by the Contractor shall be subject to the authorization of the Ministry Representative.

**502.25.03 Lay-Down Operation** – Asphalt mix should be delivered to the paver at a constant rate sufficient to allow continuous placement.

### 502.25.04 (not used)

**502.25.05 Persons in the Vicinity of the Paver** – When in the vicinity of an operating paver and in front of the screed, workers and inspectors shall stand in full view of the paver operator, clear of side arms, wings, and screed, and never directly in front of the machine hopper.

**502.25.06 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 or other suitable methods.

**502.25.07 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 flushing of the surface will occur.

**502.25.08 Release Agents** – Hydrocarbon-based release agents are not permitted. Other release agents may be used in accordance with their manufacturer's recommendations. Application rates of any release agent (including water) shall be limited to the minimum necessary, without any excess, to achieve the desired result.

## SECTION 502

**502.25.09 Ponding** - Areas of ponding will be noted as an obvious defect and remedial works will be required.

**502.26 Shoulder Build-up** – Shoulder build-up is typically required where an existing roadway is being overlaid with wider shoulders. It involves construction of base course aggregate (adjacent to a Lift of pavement) which will be overlaid by one or more Lifts of asphalt. Shoulder build-up shall be constructed:

- a) In accordance with the SS 202.26;
- b) To the lines and grades indicated in the Contract, generally to a finished compacted level that matches level and grade of the adjacent asphalt level; and
- c) With cross-fall that matches that of the finished asphalt surface above the shoulder build-up area.

### 502.27 Shouldering

**502.27.01 Shouldering Aggregate** – Shouldering aggregate shall be 25 mm Well-Graded Base (WGB), in accordance with SS 202, unless otherwise specified in the Special Provisions or authorized by the Ministry Representative.

**502.27.03 Lines and Grades** – The finished surface of the granular shoulder shall be true to grade and cross section, and be free from ruts, segregation or other irregularities.

**502.27.04 Aggregate Segregation** – All granular shoulder materials shall be handled in such a manner that segregation does not occur.

**502.27.05 Moisture Adjustment** – If necessary for compacting, the moisture content of the shoulder aggregate shall be adjusted through either drying or applying water. Addition of water is incidental.

**502.27.06 Compaction** – Shoulders shall be thoroughly compacted to a state that will not rut more than 5 mm under a pick-up truck steering axle wheel load.

Where the base under the shoulder has been constructed as part of the Work, the degree of compaction of the granular shoulder measured in accordance with ASTM D 6938 shall be greater than 98% of the maximum dry density determined in accordance with ASTM D 698.

**502.27.07 Adjacent Pavement Damage** – If the adjacent asphalt pavement is damaged during the shouldering operation, the damage shall be repaired to the satisfaction of the Ministry Representative, at no expense to the Ministry.

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

**502.27.08 Interim Shouldering** – 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.

Should the Work extend past the Completion Date and be carried over to the next paving season suitable interim drainage control measures shall be put in place, all at no cost to the Ministry.

### PAYMENT

**502.30 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, the construction of asphalt pavement including the supply of asphalt cement, and for shouldering shall be full compensation for completing the supply and installation of asphalt pavement and shouldering on prepared surfaces in accordance with the contract requirements. Applicable payment adjustments (Additions or subtractions as applicable) shall be applied in accordance with the Payment Adjustment section of this Section.

Compensation for Quality Control shall be at the price bid for Quality Control or, in the absence of such a bid Item in Schedule 7 – Approximate Quantities and Unit Prices, incidental to the Work.

**502.31 Acceptance at Adjusted Payment** – Acceptance of any Lot at adjusted payment will occur if it complies with the requirements of the QC Plan and the sections on Equipment and Plant; and Construction of this Specification, contains no obvious defects as per SS 502.32, and if:

- Test results for EPS acceptance parameters (density, gradation, asphalt content, smoothness, segregation, and application rate) are such that the Lot meets the requirements for acceptance at a reduced payment;
- Lot is acceptable in respect of all other requirements; and
- 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.

## SECTION 502

**502.32 Rejection For Workmanship Defects** – Work may be rejected if it does not comply with the requirements of the QC Plan and the Construction section of this Section.

Additionally, the finished surface of any Asphalt Pavement Lift shall have a uniform 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, may be cause for automatic rejection of asphalt pavement regardless of the values of any other acceptance parameter:

- 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 or roller pick-ups;
- Excess tracking of prime or tack coat;
- Areas contaminated by fuel oil or other deleterious materials;
- Tire marks; or
- Cracking or tearing.

When asphalt pavement is rejected because 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.

**502.33 Partial Payment for Rejected Work** – In the Ministry Representative’s sole discretion and without setting precedence, where any Work is reject but the Ministry Representative determines that it may be left in place, the Ministry Representative may authorize partial payment to the Contractor as full compensation for any residual value the Work may have. Notwithstanding the foregoing, the Ministry is under no obligation to make any payment for such Work.

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

### 502.34 Primer and Tack Coat

**502.34.01 Supply of Primer and Tack Coat** – Payment to Supply 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.

**502.34.02 Application of 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 authorization 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.

**502.35 Paving Aggregate into Stockpile** – Payment for Paving Aggregate into Stockpile shall be at the Unit Price per tonne for the quantity of paving aggregate placed into stockpile in accordance with the following. 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 7 - Schedule of Approximate Quantities and Unit Prices.

The final payment quantity for paving aggregate quantity will be equal to the corresponding asphalt mix quantity actually laid, without any adjustment for AC or moisture content. As a result, the final quantities and payments may vary from those used in prior progress payments; down if the mix quantity underruns and up if it overruns.

Such payment shall be full compensation for all work including but not limited to the production, supply and stockpiling of all paving aggregates.

**502.36 Asphalt Pavement** – Payment for Asphalt Pavement 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.



## SECTION 502

Where overlays are used as a corrective measure, in accordance with SS 502.58:

- 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.

### 502.37 Asphalt Mix Antistrip Additives

#### 502.37.01 Where Specified in the Special Provisions

– Where the Special Provisions direct the addition of an antistrip additive, all costs associated with supplying, storing, and blending the additive into the asphalt mixes shall be incidental to the prices bid for the varying classes of asphalt mix.

#### 502.37.02 Where Not Specified in the Special Provisions

– Where the Special Provisions do not direct the addition of an antistrip additive but the need was identified in accordance with SS 502.08.03, compensation for supplying, storing and blending the additive into the asphalt mixes shall be made at a negotiated price or on a Force Account Basis and any authorized payments will be made from the Provisional Sum for Site Modifications.

**502.38 Asphalt Cement “Bump”** – The Contractor will be compensated for additional oil ordered by the Ministry Representative in accordance with SS 502.08.09 at the AC cost FOB the asphalt plant, demonstrated by the AC supplier’s invoice, with mark-up on a Force Account Basis for the material only.

Payment will be calculated in accordance with the formula below, on a Lot-by-Lot basis based on the difference in asphalt cement content determined from Ministry Quality Assurance (QA) samples and that in the Contractor’s production Job Mix Formula, to a maximum of the bump and a minimum of the Contractor’s proposed Job Mix Formula AC content. No compensation will be made for additional AC in any rejected mix.

$$S_{Lotn} = 110\% \times Cost_{AC} \times t_{Lotn} \times \left[ \left( \frac{AC_{Burn}}{100 + AC_{Burn}} \right) - \left( \frac{AC_{JMF}}{100 + AC_{JMF}} \right) \right]$$

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Where:

$S_{Lotn}$  = Compensation due for additional AC in Lot “n”

$Cost_{AC}$  = Supplier’s invoiced cost for AC, dollars per tonne

$t_{Lotn}$  = Tonnes of asphalt mix laid and accepted in Lot “n”, including AC

$AC_{Burn}$  = Asphalt cement content (% dry mix) of Lot determined from Ministry QA samples, to a maximum of the bumped AC content and a minimum of  $AC_{JMF}$

$AC_{JMF}$  = Asphalt cement content (% dry mix) of Contractor’s production Job Mix Formula before the bump

Note: 110% includes the percentage markup for materials paid on Force Account

### 502.39 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 SS 502.58.

No payment adjustment 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.

**502.40 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 7 - Schedule of Approximate Quantities and Unit Prices. The price bid shall be full compensation for supplying, hauling, placing, moisture adjustment, and compaction of the aggregate to the required grades and crossfall.

### 502.41 Surplus Aggregate

**502.41.01 Surplus Aggregate in Private Pits** – 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

## SECTION 502

works. All surplus aggregate shall be properly stockpiled.

**502.41.02 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 shouldering, surfacing, base and subbase aggregates will be paid in accordance with SS 202.

If the quantity of Asphalt Pavement actually incorporated into the works is less than the estimated quantity, as stated in the Schedule 7 - Schedule of Approximate Quantities and Unit Prices, the Ministry will purchase aggregate up to 100% of the quantity required by the contract, to be paid under the appropriate Unit Price Item for Aggregate in Stockpile. The surplus aggregate must, when singly or combined, meet the gradation requirements set out in the Job Mix Formula.

The portion of material remaining in a stockpile eligible for compensation as surplus aggregate shall be the lesser of:

- a) The quantity of mix as stated in the Schedule 7 - Schedule of Approximate Quantities and Unit Prices minus the quantity of aggregate actually incorporated in the works, and
- b) The volume of the remaining stockpile as determined under SS 502.41.03

No payment shall be made for any surplus shoulder and paving aggregate remaining at contract completion in excess of the contract requirement. Material remaining in a Ministry pit is the property of the Ministry.

**502.41.03 Measurement of Surplus Aggregate -** The Ministry will determine the volume of aggregate by surveying the stockpile(s) using string-line techniques, and determine volume using prismatic volumes between surfaces. Alternatively, the Ministry Representative may elect to survey using cross-section techniques and/or determine volumes using end-area volumes.

The base of the pile will be determined from a pre-stockpile survey or, where such a survey is not available, from a surface determined by the Ministry Representative as being a reasonable interpolation from the intersection of the pile sides with the adjacent ground level. Where there are two or more stockpiles of aggregate meeting the same gradation classification, the compensation will be based on the cumulative quantity of those stockpiles.

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Where necessary, stockpile volume shall be converted to mass using the conversion factor of 2.0 tonnes per cubic metre.

### PAYMENT ADJUSTMENTS

**502.50 Payment Adjustment –** Payment adjustments resulting from the application of this Section will be effected on each progress payment as follows.

**502.50.01 Density, Asphalt Content, and Gradation –** For each Lot paid for by the tonne (t), the applicable payment adjustment derived from Tables 502-E-1 or Table 502-E-2 (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.

**502.50.02 Application Rate –** Payment Adjustments from Table 502-H (Application Rate) shall be computed for the 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, asphalt content, aggregate gradation, and material application rate for the current progress payment.

**502.50.03 Segregation and Smoothness –** For each Lot with payment adjustments based on kilometre (km), 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.

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 and smoothness for the current progress payment.

**502.50.04 Total Payment Adjustment –** The algebraic sum of the total payment adjustments for density, asphalt content, aggregate gradation, material application rate, segregation and smoothness, derived in accordance with SS 502.50.01 through SS 502.50.03 above, shall be the total payment adjustment, positive or negative, in dollars, for all attributes for the current progress payment.

## SECTION 502

The total payment adjustment will be made by a single entry in computing the current progress payment.

**502.50.05 Progress Payments** – The process set out in SS 502.50.01 through SS 502.50.04 above will be used in computing each progress payment to which it is applicable.

**502.51 Initial 1,000 tonnes of Mix** - For the first 1,000 tonnes of asphalt mix produced under a Contract, the following provisions take precedence over all other payment and payment adjustment provisions of SS 502.52 through SS 502.57 inclusive, but do not take precedence over the rejection criteria.

**502.51.01 Payment Adjustments** – Unless requested otherwise by the Contractor in writing in advance of mix production, the first 1,000 tonnes of asphalt mix production and placement shall not be subject to the bonus/penalty payment adjustments for AC content, density and gradation. Payment adjustments will apply to smoothness, segregation and application rate if the mix is applied in a Top Lift location.

**502.51.02 Acceptance Limits** – Contrary to any other provision of SS 502, any mix produced during the initial 1,000 tonnes will only be considered acceptable if:

- a) Asphalt Mix Design has been accepted by the Ministry Representative in accordance with SS 502.08.05;
- b) Aggregate gradation per SS 502.08.02 is within the gradation limits specified in Table 502-C-1 or the banana formed by applying the Table 502-G column 3 variation limits to the JMF gradation;
- c) All other properties fall inside the allowable limits specified, in SS 502 and the Special Provisions, for the mix, including
  - For Marshall mixes, Table 502-C-2; and
  - For Superpave mixes, Table 502-C-3.
- d) AC content of the sample is within  $\pm 0.5\%$  of the design value for top lift and is within  $\pm 0.55\%$  of the design value for the bottom lift.

All values are measured against the Asphalt Mix Design value at the time the sampled mix was produced.

Any mix with any characteristic outside the above limits is Reject Mix.

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Additionally, rejection limits for smoothness, segregation, density and application rate shall apply in accordance with SS 502 and the Special Provisions.

### 502.52 Density

**502.52.01 Lot** – A Lot for density 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; and
- The required material application rate.

**TABLE 502-D-2: TEST SAMPLE SOURCE LOCATIONS**

Test	Sample Source:
Density	100 mm dia. road cores; 150 mm dia. road cores for Superpave
AC Content	Loose Mix Samples
Smoothness	Centre of the Lane
Aggregate Gradation	Loose Mix Samples
Segregation	Roadway Pavement

A change in any above criteria may require a new Lot designation.

Where one day's production is less than 7 hours, 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.

**502.52.02 Sub-Lot** – For density, a Lot shall be divided into three equal Sub-Lots, defined by lineal metres of production

**502.52.03 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 100 mm diameter cores for these purposes. For projects utilizing a Superpave product, 150 mm 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

## SECTION 502

Ministry Representative, within 24 hours of being provided the locations for the coring, to a designated safe storage location.

The Contractor shall fill all core holes before the roadway is re-opened to traffic. Core holes shall be filled by the following method:

- Empty the hole of water and loose material.
- Remove any excess moisture by wiping the inside with a dry towel.
- Tack coat the inside surfaces and the outside perimeter with an emulsified asphalt.
- Place asphalt mix in loosely, so that the compacted Lifts do not exceed 75 mm.
- With a minimum of 20 blows per Lift, compact the loose material using a minimum 2 kg sledge hammer and tamper.
- For additional Lifts repeat Steps (a) to (e).
- The final Lift shall be a minimum thickness of 25 mm, and finished to a level higher but not exceeding 6 mm, than the elevation of the surrounding pavement.

The Contractor may use an alternative method if acceptable to the Ministry Representative.

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.

**502.52.04 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.

- a) **Marshall Mixes** – For the determination of Marshall Briquette Density, the Contractor shall obtain the samples as outlined in SS 502 Appendix 2 for each Sub-Lot. All costs associated with sampling, 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 and tested, and the

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

ASTM D 2726 test results will be averaged to obtain the test value for that sample.

The Marshall Briquette Density for a Lot is the average of the test results from the three Sub-Lots. The Marshall Briquette Density value for the Lot shall be provided to the Ministry Representative prior to the provision of the coring locations to the Contractor.

$$\text{Marshall Percent Density} = \left( \frac{\text{In-place Density of Sample}}{\text{Marshall Briquette Density}} \right) \times 100$$

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 Marshall Briquette Density which will replace the values achieved under Quality Control Testing.

Should the initial test results in any Sub-Lot be lower than 97.0%, one additional core will be taken and tested, and that result shall be averaged with the initial result to determine the new percent density for the Sub-Lot.

In addition, the Contractor shall determine the individual Maximum Theoretical Densities (MTD) per ASTM D 2041 for each of the Sub-Lot samples and average the results of them to obtain the Lot MTD. The Contractor shall report the Lot MTD to the Ministry Representative prior to the provision of the coring locations to the Contractor.

- b) **Superpave Mixes** – The Contractor shall determine the individual Maximum Theoretical Densities (MTD) per ASTM D 2041 for each of the Sub-Lot samples and average the results of them to obtain the Lot MTD. The Contractor shall report the Lot MTD 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 use the same procedures to obtain the values for Maximum Theoretical Density which will replace the values determined by the Contractor.

The average in-place density will be determined from 150 mm diameter core samples of the completed Lift of pavement.

$$\text{Superpave Percent Density} = \left( \frac{\text{In-place Density of Sample}}{\text{Lot MTD (ASTM D 2041)}} \right) \times 100$$

## SECTION 502

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.

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 be averaged with the initial result to determine the new percent density for the Sub-Lot.

**502.52.05 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.

**502.52.06 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. If any Sub-Lot has a value within the reject zone, 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. The Contractor shall mark out the extents of the area identified using chalk or other temporary marking acceptable to the Ministry Representative. 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 any Marshall Mix core density is less than 96% (91% for Superpave mixes), the Contractor shall either overlay or remove and replace the previously placed area of reject 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 accepted by the Ministry Representative before remedial work proceeds.

**502.52.06 Payment Adjustment for Density 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-

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

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**

Marshall % Density Lot Average	Payment Adjustment (\$ per tonne)
≥ 98.5	+\$2.00
≥ 98.0 to < 98.5	+\$1.50
≥ 97.5 to < 98.0	+\$1.00
≥ 97.0 to < 97.5	+\$0.50
≥ 96.5 to < 97.0	-\$1.00
≥ 96.0 to < 96.5	-\$2.00
< 96.0	<b>REJECT</b>

**TABLE 502-E-2: PAYMENT ADJUSTMENTS FOR DENSITY - SUPERPAVE**

Superpave % Density Lot Average	Payment Adjustment (\$ per tonne)
≥ 95.0	+\$2.00
≥ 94.0 to < 95.0	+\$1.50
≥ 93.0 to < 94.0	+\$1.00
≥ 92.0 to < 93.0	+\$0.50
≥ 91.6 to < 92.0	-\$1.00
≥ 91.0 to < 91.6	-\$2.00
< 91.0	<b>REJECT</b>

### 502.53 Asphalt Content

**502.53.01 Lot** – A Lot for AC content 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; and
- The required material application rate.

A change in any above criteria may require a new Lot designation.

Where one day’s production is less than 7 hours 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 has not changed or been met.

## SECTION 502

**502.53.02 Sub-Lot** – For AC content, a Lot shall be divided into three equal Sub-Lots, defined by lineal metres of production.

**502.53.03 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 the ASTM\_D 6307 test procedures listed in Table 502-A.

One random sample will be obtained from each Sub-Lot as per SS 502 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.

The ignition oven calibration factor will be applied to the AC Content measured by the ignition oven, and the corrected AC Content used to determine acceptability of the mix and any payment adjustments.

**502.53.04 Payment Adjustments** – The payment adjustment for asphalt content will be the amount shown in Table 502-F, where deviation in AC Content is determined by the percent difference, based on kg of AC per 100 kg of dry aggregate, between the JMF AC content and the actual AC Content.

**TABLE 502-F: PAYMENT ADJUSTMENTS FOR DEVIATION OF ASPHALT CONTENT (AC)**

<b>Differences of Actual AC Content From Designed AC Content Specified in JMF (AC in %)</b>		
<b>Deviation from Asphalt Mix Design JMF</b>	<b>Payment Adjustment \$ per tonne</b>	
	<b>Top Lift</b>	<b>Lower Lifts</b>
<u>-0.56 or less</u>	<b>REJECT</b>	<b>REJECT</b>
<u>-0.55 to -0.51</u>	<b>REJECT</b>	<u>-9.00</u>
<u>-0.50 to -0.46</u>	<u>-8.00</u>	<u>-8.00</u>
<u>-0.45 to -0.41</u>	<u>-7.00</u>	<u>-7.00</u>
<u>-0.40 to -0.36</u>	<u>-5.00</u>	<u>-5.00</u>
<u>-0.35 to -0.31</u>	<u>-3.00</u>	<u>-3.00</u>
<u>-0.30 to -0.21</u>	<u>-1.00</u>	<u>-1.00</u>
<u>-0.20 to -0.06</u>	<u>0.00</u>	<u>0.00</u>
<u>-0.05 to +0.15</u>	<u>+2.00</u>	<u>+2.00</u>
<u>+0.16 to +0.30</u>	<u>+1.50</u>	<u>+1.50</u>
<u>+0.31 to +0.35</u>	<u>0.00</u>	<u>0.00</u>
<u>+0.36 to +0.40</u>	<u>-2.00</u>	<u>-2.00</u>
<u>+0.41 to +0.45</u>	<u>-3.50</u>	<u>-3.50</u>
<u>+0.46 to +0.50</u>	<u>-5.00</u>	<u>-5.00</u>
<u>+0.51 to +0.55</u>	<b>REJECT</b>	<u>-6.50</u>
<u>+0.56 or greater</u>	<b>REJECT</b>	<b>REJECT</b>

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

**502.53.05 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 within the reject zone, the Lot is rejected automatically regardless of the values of other acceptance parameters.

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.

**502.53.06 Payment Adjustment for Asphalt Cement Content 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.

### 502.54 Aggregate Gradation

**502.54.01 Lot** – A Lot for aggregate gradation shall be one day's scheduled production of at least 7 hours plant production where no changes have occurred to the criteria such as but not limited to:

- Accepted Job Mix Formula;
- The specific Lift that is being placed; and
- The required material application rate.

A change in any above criteria may require a new Lot designation.

Where one day's production is less than 7 hours 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 has not changed or been met.

**502.54.02 Sub-Lot** – For aggregate gradation, a Lot shall be divided into three equal Sub-Lots, defined by lineal metres of production.

## SECTION 502

### 502.54.03 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 SS 502.08.10 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.

Although the JMF design gradation must at all times be maintained within the limits specified in the Aggregate Table 502-C-1, the gradation of the mix may vary outside those limits, subject to SS 502.54.05.

**502.54.04 Payment Adjustments** – Where the Sample Mean for every specified sieve size falls within the limiting values prescribed in a particular column of Table 502-G, the Lot will be accepted with a payment adjustment as indicated at the bottom of that column.

**502.54.05 Rejection Limit** – Where one or more values of the Sample Mean for the specified sieves falls outside the limiting value specified in Table 502-G, Column 3, the Lot is reject and the Contractor shall either overlay or, remove and replace the previously placed mix. The Lot will be assessed to determine whether it may remain in place, with payment made in accordance with SS 502.33.

**TABLE 502-G: PAYMENT ADJUSTMENTS FOR AGGREGATE GRADATION**

Sieve Size mm	Divergence from JMF grading curve Percentage passing by mass (ASTM C 117 and ASTM C 136)		
	Column 1	Column 2	Column 3
12.5	±3.5	±4.5	±7.0
4.75	±3.0	±4.5	±6.0
0.600	±2.0	±3.5	±4.0
0.075	±0.75	±1.0	±1.5
<b>Payment Adjustment \$ per tonne</b>	<b>+\$0.75</b>	<b>\$0.00</b>	<b>-\$1.50</b>

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

### 502.55 Material Application Rate

**502.55.01 Lot** – A Lot for material application rate shall be one day's scheduled production of at least 7 hours plant production where no changes have occurred to the criteria such as but not limited to:

- 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 has not changed or been met.

**502.55.02 Sub-Lot** – Sub-Lots are not used for material application rate.

### 502.55.03 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 Representative at the end of each shift.

**502.55.04 Payment Adjustments** – The payment adjustment for material application rate will be applied as shown in Table 502-H, based on the actual material application rate, expressed as a percentage of the specified material application rate.

**502.55.05 Rejection Limits** – Where actual application rate for the Lot is within the reject zone as shown in Table 502-H, the Lot is reject.

A Lot rejected for application rate may be corrected by mill-and-fill or rejected with no remedial work required, subject to the authorization of the Ministry Representative.

**TABLE 502-H: PAYMENT ADJUSTMENTS FOR MATERIAL APPLICATION RATE**

Actual Application Rate (Percent of specified rate)	Payment Adjustment \$ per tonne of material in the Lot (unless otherwise noted)	
	Bottom Lift or Single Lift	Top Lift of Multiple Lifts
≥ 110	-\$7.00 for all material in the Lot up to 110% and no payment for product in excess of 110.0%	-\$7.00 for all material in the Lot up to 106% and no payment for product in excess of 106.0%
≥ 106.0 to <110.0	-\$5.00	-\$5.00
≥ 105.0 to <106.0		
≥ 104.0 to <105.0	-\$1.00	-\$3.00
≥ 96.0 to <104.0	+\$0.50	+\$0.50
≥ 94.0 to <96.0	-\$2.00	-\$2.00
≥ 92.0 to <94.0	-\$3.00	-\$3.00
≥ 90.0 to <92.0	-\$4.00	-\$4.00
≥ 85.0 to <90.0	-\$7.00	-\$7.00
<85.0	<b>REJECT</b>	<b>REJECT</b>

**502.56 Surface Segregation**

**502.56.01 Lot** – A Lot shall be one kilometre length of Top Lift pavement for each driving lane.

**502.56.02 Sub-Lot** – Sub-Lots are not used for segregation.

**502.56.03 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 using photographs or other mutually agreed upon 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.

**TABLE 502-I-1: SEGREGATION – TOP LIFT ONLY – REMEDIATION METHODOLOGY**

Segregation Severity	Visual Appearance	Repair Procedures
None	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 authorized by Ministry Representative.

**502.56.04 Payment Adjustments** – The payment adjustment for Top Lift segregation will be the applicable amount shown in Table 502-I-2.

**502.56.05 Repair** – On Top Lift all segregation, including any areas outside the driving lanes assessed for the payment adjustment, shall be repaired according to Table 502-I-1.

All segregation patch repairs shall be completed to a rectangular shape.



## SECTION 502

Repair shall be to the neat lines and dimensions of the segregated area using sand cement slurry or other product acceptable to the Ministry Representative.

Acceptable sand cement slurry can be made as follows, with proportions varied as needed for workability:

- 25 litres of SS-1 (or equivalent) emulsion
- 4 – 5 kg (2 shovels) of  $\leq 3$  mm sand
- 2 – 3 kg (1 shovel) Type GU (general use) Portland cement
- Additional water, if needed for workability.
- Or other products approved

After repairs, the Lot will be re-evaluated for acceptance, but not for segregations payment adjustments.

The Contractor shall be responsible for all costs associated with the repair of segregated areas.

**TABLE 502-I-2: SEGREGATION – TOP LIFT ONLY – PAYMENT ADJUSTMENTS**

Payment Adjustment	Number of Segregated Areas, by Category		
	Slight	Moderate	Severe
+\$1,500 per lane km. <i>(Applies only if the criteria in all three adjacent columns are achieved)</i>	0 to 3	0	0
+\$1000 per lane km. <i>(Applies only if the criteria in all three adjacent columns are achieved)</i>	4 to 6	0	0
No payment adjustment	7 to 9	0 to 1	0
-\$500 per lane km. <i>(Applies if the criteria in any one or more of the adjacent columns occurs)</i>	10 to 12	2 to 4	0
-\$1,000 per lane km. <i>(Applies if the criteria in any one or more of the adjacent columns occurs)</i>	13 to 16	5 or 6	0 to 2
-\$3,000 per Lane km <i>(Applies if the criteria in any one or more of the adjacent columns occurs)</i>	17 or more	7 or more	3 or more

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

### 502.57 Smoothness

**502.57.01 Lot** – A Lot for smoothness shall be one kilometre length of Top Lift pavement for each driving lane.

**502.57.02 Sub-Lot** – A Sub-Lot for smoothness shall be a 100 metre section of a Lot, or for the last Sub-Lot within a Lot, a section of up to 100 metres.

**502.57.03 Traffic Control for Pavement Smoothness Testing** – The Contractor shall provide traffic control for smoothness testing.

The Ministry Representative will provide sufficient notice to the Contractor regarding when the Ministry will perform smoothness testing. As directed by the Ministry Representative, the Contractor will be responsible to schedule and provide traffic control for the Ministry's smoothness testing, including a Shadow Vehicle and all signage necessary. The Contractor shall also be responsible for sweeping and any other preparation work required for smoothness testing. No extra payment will be made for sweeping or other preparation work; and the provision of traffic control for smoothness testing will also be considered incidental and no extra payment will be made.

The Contractor may also be required to provide an additional Shadow Vehicle or traffic control for smoothness testing as determined by the Ministry Representative. Payment for the provisions of an additional Shadow Vehicle or traffic control, if required, will be made under the Provisional Sum Item for Site Modifications (Schedule 7).

**502.57.04 Determination of Pavement Smoothness** – The finished pavement surface shall be tested by the Ministry 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 centre of the lane for each Sub-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

## SECTION 502

Representative a chalk guideline in the centre of the lane immediately prior to measurement.

**502.57.05 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:

*For a segment 565 metres long, the payment adjustment factor is*

$$= \text{Length of segment} / \text{Length of standard Lot}$$

$$= 565 \text{ m} / 1000 \text{ m}$$

$$= 0.565$$

Hence the applicable payment adjustment is 0.565 times the payment adjustment for a 1 km Lot as determined from Table 502-J.

**TABLE 502-J: PAYMENT ADJUSTMENTS FOR SMOOTHNESS**

Lot IRI (m/km)	Payment Adjustment Per Lot	
	Standard	Alternate
≤ 0.80	+\$2,000	+\$2,000
> 0.80 to ≤ 0.90	+\$1,000	+\$2,000
> 0.90 to ≤ 1.00	+\$500	+\$2,000
> 1.00 to ≤ 1.10	+\$200	+\$1,000
> 1.10 to ≤ 1.20	0	+\$500
> 1.20 to ≤ 1.30	-\$100	+\$250
> 1.30 to ≤ 1.40	-\$250	0
> 1.40 to ≤ 1.50	-\$600	-\$300
> 1.50 to ≤ 1.60	-\$1,400	-\$300
> 1.60 to ≤ 1.70	-\$2,000	-\$750
> 1.70 to ≤ 1.80	-\$3,000	-\$750
> 1.80 to ≤ 1.90	<b>REJECT</b>	-\$1,500
> 1.90 to ≤ 2.00	<b>REJECT</b>	-\$2,500
>2.00	<b>REJECT</b>	<b>REJECT</b>

**502.57.06 Sub-Lot and Lot Acceptance Limits** – The reject limit and payment adjustments applicable to a road for smoothness are specified in Table 502-J. The default values in the “Standard” column shall apply except where the Special Provisions specify that “Alternate” values apply.

The International Roughness Index (IRI) value, calculated for each Sub-Lot, will be used to determine if

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

the Sub-Lot or Lot will be accepted, and if so whether it will be subject to any payment adjustment.

The Lot IRI is the average of the individual IRI values for the Sub-Lots within the Lot.

A Sub-Lot is rejected if:

- It has an IRI within the applicable reject zone shown in Table 502-J, subject to SS 502.57.08;
- For Top Lift only, there are obvious defects per SS 502.32 or it has unrepaired smoothness deficiencies which require remediation in accordance with SS 502.57.09.

A Lot is rejected for Smoothness if any Sub-Lot is rejected.

**502.57.07 Payment Adjustments** – For Top Lift only, the payment adjustments per the applicable column of Table 502-J shall apply to each Lot.

**502.57.08 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 acceptance of the Ministry Representative, but such acceptance 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 manpower used to improve, or attempt to improve, smoothness.

**502.57.09 Smoothness Deficiencies** – Smoothness deficiencies (bumps and dips) less than 12 mm over 3 m will not have remedial work required. Individual deficiencies between 8 mm and 12 mm over 3 m will result in a \$200.00 penalty for each occurrence. Deficiencies exceeding 12 mm over 3 m will require remedial work.

**502.58 Overlays as a Corrective Measure** – If an overlay is used as a corrective measure on a defective

## SECTION 502

Lot or Sub-Lot, the overlay thickness will be subject to the acceptance of the Ministry Representative, but shall not be less than 40 mm. 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.

### APPEAL TESTING

**502.60 Time Limits For Appeal of Test Results** – To appeal any test results, the Contractor shall serve written notice of appeal to the Ministry Representative, within the following period after receipt of the applicable test results:

- For Density, Gradation and Asphalt Content, within two (2) working days; and
- For Segregation, Smoothness and Application Rate, within three (3) working days.

**502.61 Appeals of 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.

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 appeal testing laboratory shall hold current certification from the Canadian Council of Independent Laboratories (CCIL) (<http://www.ccil.com/>) under both the Asphalt Laboratory and Aggregate Laboratory

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Certification Programs, and at least one technician in the asphalt laboratory shall hold current certification under the Asphalt Technician Certification Program.

**502.61.01 Density Appeals** – For density appeals, 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 the failed sample(s) within the Lot, and there will be no appeal allowed for single tests within a Sub-Lot.

Any attempt to improve density on the appealed Sub-Lot after the Ministry Representative has tested the Sub-Lot for acceptance shall void the appeal and the original test results will apply.

- The Contractor shall, within two (2) working days of filing the appeal and in the presence of the Ministry Representative, take five (5) core samples from random locations from a Sub-Lot;
- The Contractor shall then deliver new core samples to the Ministry Representative;
- The Ministry Representative shall deliver the core samples and the companion loose mix samples from the appealed Sub-Lots to the appeal testing laboratory;
- The appeal agency shall prepare new briquette densities from the previously taken companion samples as per Appendix 2;
- The appeal agency shall determine the Bulk Density (BD) / Maximum Theoretical Density (MTD) from the companion sample and the densities of the cores and report the results to the Ministry Representative and the Contractor;
- The original core test results will be discarded and a new sample mean will be calculated from the five (5) random cores and shall be used for acceptance and payment adjustments for the Sub-Lot.

**502.61.02 Asphalt Content and Gradation Appeals** – For asphalt content and gradation appeals:

- The party who has possession of the companion loose mix samples shall deliver them to the appeal testing laboratory.
- The appeal agency shall prepare three (3) new samples from the companion sample and determine the AC contents and gradations, average

## SECTION 502

the results, and report all results to the Ministry Representative and the Contractor.

- The original test results will be discarded. A new sample mean for the three (3) new test results will be determined using the companion samples and will be used for acceptance and payment adjustments.

**502.62 Smoothness Appeals** – 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.

**502.63 Segregation Appeals** – Appeals of segregation ratings will 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

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

Ministry and B.C. Road Builders, to assess the area(s) in question.

**502.64 Application Rate Appeals** – Appeals of application rate will be handled by a joint review with the Contractor and Ministry Representative. If the issue cannot be resolved, the issue will be resolved through the dispute resolution provisions of the Contract General Conditions.

**502.65 Application of Appeal Testing Results** – The appeal test values, thus determined, in all cases, will be binding on the Contractor and the Ministry.

**502.66 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 would 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.

## SS 502 APPENDIX 1

## QUALITY CONTROL REQUIREMENTS AND GUIDELINES

## 1.01 General

The Contract requirements for preparing, submitting and adhering to the paving components of a Quality Control Plan are specified in SS 502.04. This Appendix titled "Quality Control Requirements and Guidelines" sets out the guidelines for the Contractor's Quality Control Plan, in addition to those set out in SS 502.04 and the Special Provisions.

## 1.02 Quality Control Plan

The Contractor shall prepare and submit a Quality Control Plan for review. A qualified Subcontractor or an independent organization/agency may operate the Plan wholly or in part. 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:

- Purchased Materials (asphalt cement characteristics, additives, purchased aggregates, etc.)
- Aggregate production (including source quality, gradation, fracture, crushing procedures, stockpiling, etc.)
- Calibration and Correlation of Testing Equipment (plant sensors, lab equipment, nuclear moisture/density gauges, etc.)
- Mix Design
- Asphalt Plant Mixing procedures (cold feed sampling, AC flow rate, temperature control, records, weigh scale, etc.)
- Product quality (volumetrics, EPS payment elements, etc.)
- Professional standards (joints, placing temperature, rolling procedures, etc.)

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.

- A Quality Control Manager (QCM) responsible for the development and management of the Quality Control Plan. This person shall be qualified as per the requirements identified in SS 502.04.03. This individual shall also be responsible for signing off Quality Control Testing and Inspection records. This individual shall also be responsible for ensuring the qualifications of 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 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.

## SECTION 502

### 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 during the asphalt mixing operation, should be kept on the form H0295 - 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

## ASPHALT PAVEMENT CONSTRUCTION (EPS)

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 densitometer (or moisture/density gauge) 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

Minimum test frequencies guidelines for Quality Control are described in the following table:

TABLE 502-APPENDIX 1: GUIDELINES FOR MINIMUM TEST FREQUENCIES

	ASTM Test	*Minimum Frequency
Tests During Aggregate Production	C 136, Dry Sieve Analysis of Aggregate	- Split Stockpiles: 1 for each stockpile for every 2 hours of production.
	or	- One main stockpile: for every 300 tonnes.
	C 117 Sieve Analysis of Aggregates by Washing ( <i>Modified for Field Lab with drying done over a hotplate or similar heating element</i> )	- Blend Sand: 1 for every 100 tonnes during stockpiling.
		- Natural filler: 1 for every 50 tonnes during stockpiling.
	D 5821 Determining the Percentage of Fractured Particles in Coarse Aggregate	Every second coarse aggregate sieve test.
	C 117 Sieve Analysis of Aggregates by Washing ( <i>Modified for Field Lab</i> )	One (1) per shift on reduced sample obtained from combined samples from the crusher.
Asphalt Products Tests	Tack and Prime	Contractor's option.
Tests During Asphalt Plant Mixing	C 136, Dry Sieve Analysis of Aggregate	One (1) of combined aggregate (off the belt) every 300 tonnes.
	C 566 & D 2216, Moisture Content	Aggregate: Two (2) tests per Lot Asphalt mix: One (1) on first Sub-Lot and every second day.
	C 117 Sieve Analysis of Aggregates by Washing ( <i>Modified for Field Lab</i> )	One (1) per shift on reduced sample obtained from combined samples from the plant cold feed.
	D 5581 Resistance to Plastic Flow Using Marshall Apparatus.	One set of three briquettes for 1,200 tonnes or Lot, whichever is less.
	D 6307 Asphalt Extraction, Ignition Method	One per Lot.
	D-5 Penetration of Bituminous Materials	One per Manufacturer's Batch. Samples should be taken for every 3000 tonnes of mix production.
	D 2171 Viscosity	Contractor's Option.
	D 2041 Maximum Theoretical Density	One per <u>Sub-Lot</u> .
Test During Asphalt Paving for Density Testing	AASHTO T 245-97 Resistance to Plastic Flow Using Marshall Apparatus	One 15 kg sample for every Sub-Lot or minimum One (1) per 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 Marshall mix cores to be a minimum of 100 mm diameter; Superpave mixes shall require minimum 150 mm diameter cores.

\* These are the 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. QC frequencies may be reduced below this level, subject to the Ministry Representative's authorization, should the Contractor's QC Plan be proven very effective.

## SS 502 APPENDIX 2

## OBTAINING AND PREPARING

## LOOSE MIX SAMPLES

1. Three (3) samples per Sub-Lot shall be obtained by the Contractor (generally from the paver augers), at locations and times chosen by the Ministry Representative. The first sample shall be used by the Contractor for Quality Control, the second sample by the Ministry for Quality Assurance, with the third retained by the Ministry for potential appeal testing.
2. The samples taken shall meet the requirements of ASTM D 979 Sampling of Bituminous Mixtures, Table 1, Size of Sample.
3. 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:
  - a) 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.
  - b) 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.
  - c) This process is to be repeated for each sample to provide the Quality Acceptance and Appeal Samples.
4. 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.
5. The Contractor shall deliver the QA and appeal samples to the Ministry Representative for storing.
6. If a sample is taken from the mat, the areas sampled shall be filled with mix immediately after sampling, and shall receive the same compactive effort as the rest of the mat.



## SS 502 APPENDIX 3

## BLANK AGGREGATE SAMPLE PREPARATION

1. Blank aggregate samples replicate the Job Mix Formula design aggregate gradation, without asphalt cement and are used to correlate the Ministry, Contractor, and appeal lab ignition ovens.
2. Twelve (12) blanks are required, each weighing 1900  $\pm$  1 gram. This size approximates the size of the mix samples, less the asphalt cement, that will be used for the project's daily Quality Assurance testing.
3. The blanks shall be prepared from bulk aggregate samples (i.e. coarse aggregates, fine aggregates, blend sand, etc.) that were produced from the same sources and are the same materials as the aggregates that will be used for the project and have been designated in the Mix Design. The amount of each aggregate material required will be 50 kg to 60 kg.
4. The bulk aggregate samples shall first be dried, and then thoroughly blended at the design proportions. The blended material shall then be sieved into each of the individual sieve sizes designated in the Mix Design down to passing 0.075 mm.
5. The aggregate blanks will then be made up from the sieved material, starting with the pan, and progressively adding proportions from each successive individual sieve to conform to the estimated dry aggregate JMF gradation within the tolerances specified below. Prepare two (2) additional dry blank samples within the tolerances specified in Table 502-Appendix 3. Run washed sieve analysis on both samples and using the average passing on the two samples to arrive at a "Target Adjustment", matching the submitted design JMF for the final blank aggregate preparation. Masses of aggregate added shall be done based on the average washed sieve adjustment as described above.
6. Masses of aggregate added shall be within the tolerances specified in Table 502-Appendix 3.
7. Samples shall be sealed in cans or bagged in moisture-proof heavy gauge plastic bags, and labeled with the project number, blank number, the preparation date, and a JMF identification number.

TABLE 502-APPENDIX 3: SIEVE SIZE

Sieve Size	Cumulative Mass Tolerance (g)
Pan	0.1
0.075	0.1
0.15	0.1
0.30	0.1
0.60	0.1
1.18	0.1
2.36	0.1
4.75	0.1
9.50	0.7
12.5	2.0
16.0	3.0
19.0	6.0
25.0	13.0
37.5	45.0

## SS 502 APPENDIX 4

## IGNITION OVEN CORRELATION PROCEDURE

1. Asphalt Mix samples are prepared and burned to determine the effect each oven has on the mix.
2. The Contractor and the Ministry shall each prepare three (3) Asphalt Mix calibration samples by adding AC (provided by the Contractor from the supplier and batch that will be used on the project) to randomly selected aggregate blanks prepared by the Contractor in accordance with SS 502 Appendix 3.
3. AC shall be added to the blanks at the proportion specified in the accepted JMF, within a tolerance of  $\pm 0.1$  gram.
4. Each party shall burn their mix calibration samples in their ignition oven in accordance with ASTM D 6307 to determine their calibration factor.
5. The calibration factors determined above shall be compared and the inter-laboratory correlation determined.
6. Correlation between the Contractor's lab and the Ministry lab shall be completed, reviewed and mutually acceptable to the Contractor and the Ministry Representative a minimum of one (1) working day prior to placement of any mix.
7. In the event of an appeal on AC Content, the appeal laboratory shall also prepare and burn calibration samples to determine their oven calibration factor.
8. Results from testing of any asphalt mix shall report the measured AC Content and the corrected AC Content after applying the laboratory calibration factor.

**SS 502 APPENDIX 5****ASPHALT FILM THICKNESS IN BITUMINOUS MIXTURES**

1. The following method is to be used to determine the asphalt film thickness on aggregate particles in an asphalt mix. The results of this calculation express the asphalt film thickness in  $\mu\text{m}$  (microns).

- Mix Design percentage of asphalt cement by weight of dry aggregate
- Percentage of Asphalt Absorption
- Specific gravity of aggregate
- Gradation of asphalt mix aggregate
- Specific Gravity of the asphalt cement

2. Data Required:

**Table 502-Appendix 5: Surface Area (SA) Factors**

<u>Total % Passing Sieve No.</u>	<u>Maximum Size</u>	<u>4.75 mm (No. 4)</u>	<u>2.36 mm (No. 8)</u>	<u>1.18 mm (No. 16)</u>	<u>0.600 mm (No. 30)</u>	<u>0.300 mm (No. 50)</u>	<u>0.150 mm (No. 100)</u>	<u>0.075 mm (No. 200)</u>
<u>S.A. (m<sup>2</sup>/kg)</u>	<u>0.41</u>	<u>0.41</u>	<u>0.82</u>	<u>1.64</u>	<u>2.87</u>	<u>6.14</u>	<u>12.29</u>	<u>32.77</u>

Surface Area factors shown are applicable only when all the above listed sieves are used in the sieve analysis.

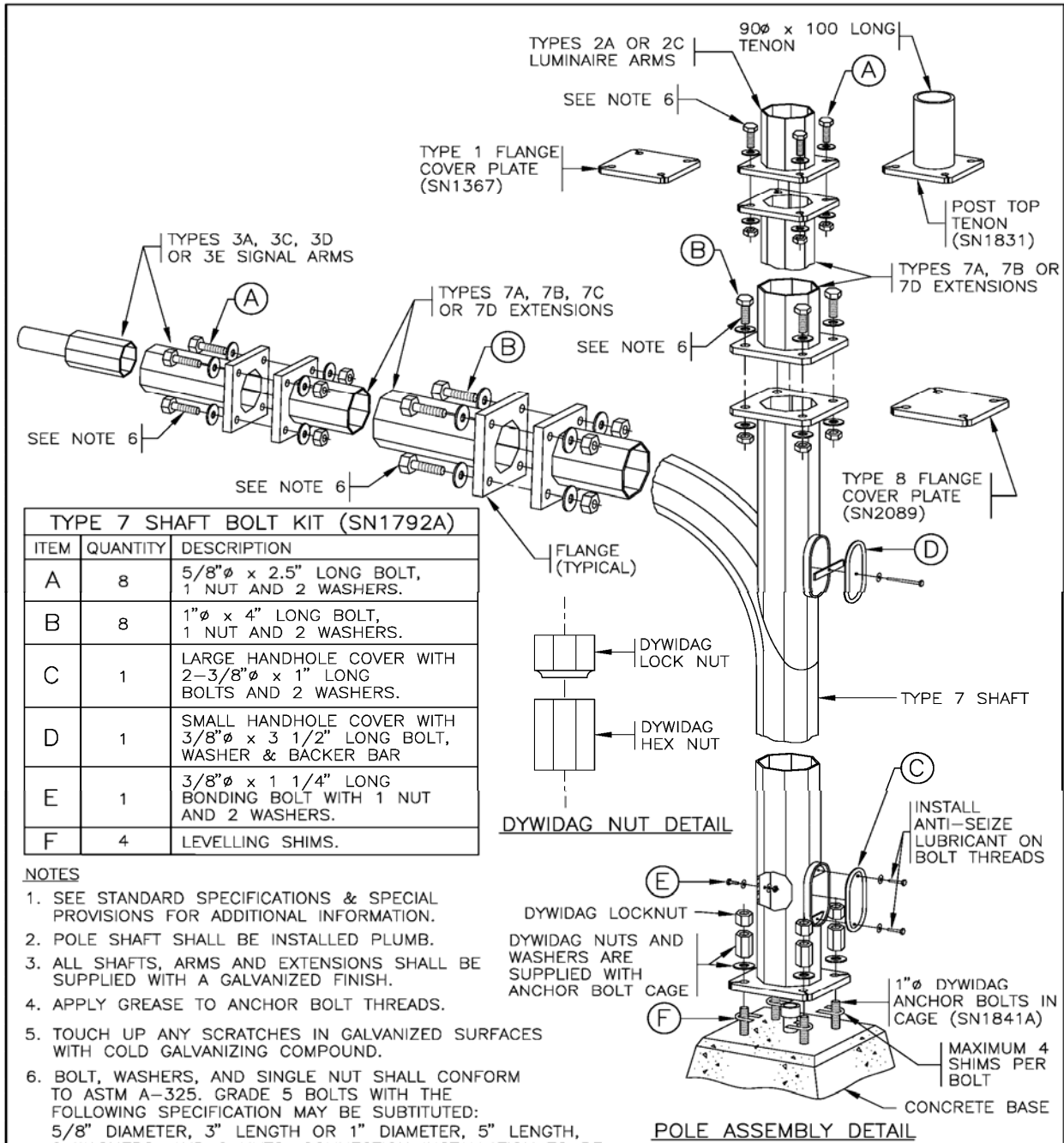
This example tabulation demonstrates the calculation of surface area by this method.

<u>Sieve Size (mm)</u>	<u>Percent Passing</u>	<u>Surface Area Factor (m<sup>2</sup>/kg)</u>	<u>Surface Area (m<sup>2</sup>/kg)</u>
<u>19.0</u>	<u>100</u>		
<u>12.5</u>	<u>95</u>	<u>0.41</u>	<u>0.41</u>
<u>9.5</u>	<u>80</u>		
<u>4.75</u>	<u>57</u>	<u>0.41</u>	<u>0.23</u>
<u>2.36</u>	<u>39</u>	<u>0.82</u>	<u>0.32</u>
<u>1.18</u>	<u>31</u>	<u>1.64</u>	<u>0.51</u>
<u>0.600</u>	<u>23</u>	<u>2.87</u>	<u>0.66</u>
<u>0.300</u>	<u>17</u>	<u>6.14</u>	<u>1.04</u>
<u>0.150</u>	<u>12</u>	<u>12.29</u>	<u>1.47</u>
<u>0.075</u>	<u>7.5</u>	<u>32.77</u>	<u>2.46</u>
<u>Surface Area of Sample (sum of the above):</u>			<u>7.1</u>

$$\text{Corrected Surface Area} = \frac{2.650}{\text{Specific Gravity of the Aggregate}} * \text{Surface Area of Sample}$$

$$\text{Effective Asphalt Cement} = \text{Mix Design AC} - \text{Asphalt Absorption}$$

$$\text{Film Thickness} = 10 * \frac{\text{effective asphalt content}}{\text{corrected surface area} * \text{specific gravity of asphalt cement}}$$

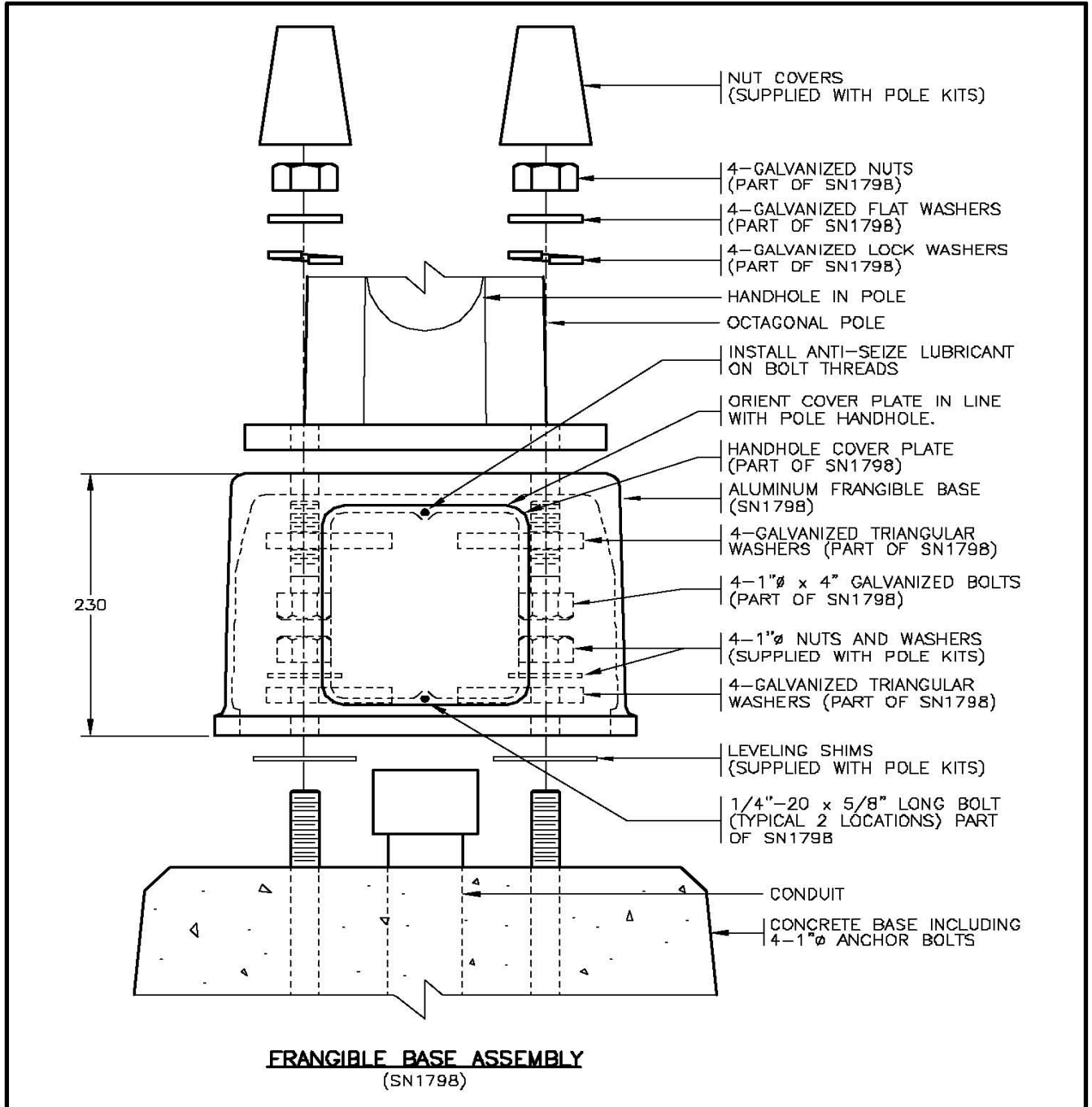


No.	Revision	Date
F	TYPE 1 & 8 FLANGE BOLTS CHANGED TO A325	DEC 10
E	7C LUM EXTENSION CHANGED TO 7B	OCT 03
D	ANTI-SEIZING LUBRICANT NOTED ON HANDHOLE BOLT	NOV 98
C	SMALL HANDHOLE BOLT LENGTH REVISED	AUG 96
B	HANDHOLE BOLT LENGTH REVISED	AUG 95
A	GENERAL REVISIONS	AUG 94

TYPE 7 SHAFT INSTALLATION DETAILS (SIGNAL POLE)

Date: 30/09/93 Approved: E.L. (Signature on File) Chief Highway Engineer

SPECIFICATION DRAWING No. SP635-2.1.14



**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		
B	SPRING LOCK WASHERS REMOVED	AUG 95		
A	GENERAL REVISIONS	AUG 94		
			Date	Approved
			<b>30/09/93</b>	<b>E.L. (Signature on File)</b> Chief Highway Engineer
			SPECIFICATION DRAWING No. <b>SP635-2.1.15</b>	

## SECTION 905

### TIMBER - GLUED LAMINATED

**905.01 General** - The requirements of the current CSA Standard 0122 - Structural Glued Laminated Timber shall apply to all glued laminated members. Wood species shall be as specified, except that if the members are specified to be Douglas Fir - Larch, and to be pressure treated, they may only be of Coast Region Douglas Fir.

Cutting, framing and boring of glulam members to receive preservative treatment shall be done before treatment insofar as possible.

**905.02 Prefabrication Meeting** –The Ministry will at its discretion, convene a prefabrication meeting with the Contractor to confirm the Ministry’s requirements and to review issues such as, but not limited to, schedule, lines of communication, fabricator and sub-fabricator scope of work, location of all work, procedures on quality control, procedures for testing, lumber grading and any other specific requirements as it relates to the Work.

**905.03 Classification** - Unless otherwise specified, 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.

**905.04 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 O122 shall be carried out by the Contractor. Vacuum-pressure cycle tests described in CSA Standard O122 shall be carried out by the Contractor.

The Contractor shall provide test results from the shear and vacuum-pressure tests to the Ministry Representative.

**905.05 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 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.

**905.06 Incising** - All surfaces of members shall be incised prior to pressure treatment.

**905.07 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 done in a manner 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 O80 - Wood Preservation. Timber which, in the opinion of the Ministry Representative, cannot be made good by such methods will be rejected.

**905.08 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 and covered to prevent UV damage.

**905.09 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 from the glue laminating plant prior to inspection or before a release for shipment has been issued by the Ministry Representative.

**905.10 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).

When the Contractor is responsible for the design of items that are detailed on the shop drawings, the shop drawings

## SECTION 905

## TIMBER - GLUED LAMINATED

shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC).

Working drawings shall be in the same system of units as the design drawings.

Lettering for notes and dimensions shall be at least 2.5 mm and 4 mm for headings. Drawings shall be legible when printed on 11" x 17" sheets.

**905.10.01 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, camber diagram, complete geometric information that member dimensions and shapes are based on, connection details, material and product standards, mark numbers and general arrangement of member locations, details of attachments, fastener details, mass of members, special tolerances, special handling instructions, lifting details and lifting locations.

A copy of the shop drawings shall be available at all times at the location where the components shown on the drawings are being fabricated. Changes to the steelwork from what is shown on the reviewed shop drawings, or repairs made during fabrication and/or construction, shall be indicated by the Contractor on a marked-up set of shop drawings and submitted to the Ministry Representative at the completion of the Work.

**905.10.02 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.

**905.10.03 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
- Layout and details of fall protection and their sequence of installation.

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 specified factored demand/capacity ratios or allowable stresses are not exceeded in members, falsework, temporary bracing and temporary supports and that member capacities and final geometry will be correct. These calculations shall be sealed by the professional engineer who sealed the erection drawings.

Falsework, temporary supports and temporary bracing shall meet the requirements of CSA Standard S269.1, "Falsework for Construction Purposes" and shall also meet all the requirements for falsework given in Clauses 20.17 to 20.26 inclusive of the WCB Occupational Health and Safety Regulation.

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 a sealed engineering certificate is issued by a professional engineer registered with APEGBC which:

- Indicates the specific areas inspected and

## SECTION 905

- Certifies that the falsework has been erected in accordance with the latest approved erection drawings and supplementary instructions.

**905.10.04 Submittals** – The Contractor shall submit to the Ministry Representative one set of all working drawings in digital format. Prior to submission to the Ministry Representative, working drawings shall be reviewed and approved by the Contractor. By this review and approval, the Contractor represents that it has determined and verified all field measurements, field construction criteria, materials, and similar data, and that it has checked and coordinated each working drawing with the requirements of the work and the contract documents. The Contractor shall indicate its review and approval by including on each drawing the date and signature of a person designated by the Contractor as being responsible for the Work. Working drawings shall be submitted at least fourteen days prior to the fabrication of the Work and shall be accompanied by a transmittal listing each of the drawings submitted. At the time of submission, the Contractor must notify the Ministry Representative in writing of any deviations in the shop drawings from the requirements of the contract documents. 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 one complete set of the revised drawings in digital format to the Ministry Representative. Any drawing that has changed from the version originally submitted shall be identified as such on a transmittal accompanying the revised drawing set.

If no exceptions are taken to the drawings, the Ministry Representative will return one set of reviewed drawings to the Contractor.

Shop drawings will not be reviewed without the transportation details and erection drawings applicable to the members in question.

Erection will not be allowed to proceed without the Ministry Representative's review of the method proposed.

Review of working drawings shall not relieve the Contractor of responsibility for carrying out the work in accordance with the contract documents.

If so agreed to in advance by the Ministry Representative, working drawings may be submitted in paper format. The reference to shop drawing submittal copies shall be increased to four paper copies in this case.

At least 14 days before fabrication is to commence and when requested by the Ministry, the fabricator shall submit a schedule of fabrication to the Ministry Representative in the form of a Gantt Chart. At the discretion of the Ministry, the schedule shall be updated on no less than a

## TIMBER - GLUED LAMINATED

monthly basis. The schedule shall be made available to the Ministry Representative for reference and planning of inspections and progress reporting. At the request of the Ministry Representative, the Contractor shall report any interim variations to the schedule.

**905.10.05 Working Drawing Format** - The Contractor shall transmit working drawings through attachments to e-mail. Electronic attachments to an email must total no more than 7 MB and must be submitted unzipped. Drawing files shall be submitted in Portable Document Format (PDF) to print out on 11" x 17" size pages. PDF sets shall be created by "distilling" CAD sheets rather than by scanning paper plan sets. Electronic attachments greater than 7.3 MB in size shall be sent in two parts by separate emails, denoting "1 of 2" and "2 of 2" in the subject lines after other required subject-line information.

If agreed to by the Ministry Representative, the Contractor may employ a document and data management service such as Buzzsaw® to transmit working drawings. If this process is used, the limitation on drawing file size is waived. The Contractor shall be responsible for setting up the appropriate folders within the document and data management software and for providing access to these folders to the fabricator, Ministry Representative and the design engineer. The Contractor and the Ministry Representative shall send e-mail notification to each other whenever they post drawings to the document and data management folders.

The resolution of drawings shall be such that the finest detail must be legible at full scale on a 21 inch monitor without zooming in (1-in. width on an 11x17-in. sheet is 1 in. on the monitor).

Drawings shall be black images on a white background.

All PDF sheets shall be assembled within a single file, subject to the maximum file size indicated above, ensuring that all sheets are rotated to a "ready to read" orientation within the PDF file set. Generally 11x17 plan sheets should be in landscape and 8 1/2x11 note sheets in portrait, so that the majority of text is vertical. PDF sheets shall be ready to print out on appropriate sized paper sheets with no additional formatting required by the viewer.

Drawing sets that are not legible or that do not conform to submission requirements will be returned to the Contractor without being reviewed and the Contractor shall submit four paper copies of the drawing set as substitutes. Drawings of large or complicated pieces, where it is not practical to show all details on an 11" x 17" sheet, may be submitted on full size paper drawings, in which case the Contractor shall submit four copies of the drawing set. When revisions to full size paper drawings are required, the Contractor shall supply four complete sets to the Ministry Representative.



## SECTION 905

## TIMBER - GLUED LAMINATED

### 905.11 Payment

**905.11.01 Supply and Fabrication** – Payment for supply and fabrication of glued laminated timber will be made at the lump sum price bid. Payment shall be for quality control, working drawings, the supply and fabrication of all necessary work. Payment shall also cover storage as necessary.

**905.11.02 Shipping and Erection** – Payment for shipping and erection of glued laminated timber will be made at the lump sum price bid. Payment shall be for quality control and the loading, shipping and unloading of glued laminated timber. Payment shall also cover falsework if necessary and the erection of glued laminated timber.

REVISED SECTION

## 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 O56 Round Wood Piles, in particular for term definition (see Appendix A) and the majority of measurement and material requirements.

Preservative treatment of piles shall conform to the requirements of SS 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 in the Contract Documents.

**906.02.02 Pressure Treated Piles** - Species of piles to be pressure treated shall be as specified and restricted to those for which pressure treating specifications are included in CSA Standard O80 Wood Preservation. Pressure treatment of piles shall be according to SS 908.

**906.03 Size** - The size of a pile shall be designated by length, minimum and maximum butt diameter and minimum tip diameter. Sizes of piles normally available are shown in Table 906-A.

**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	-	-	-

Diameters in Table 906-A are minimum, except for the tolerance permitted in SS 906.04(f).

#### 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. Maximum diameter at the butt shall not exceed 550 mm for any pile size
- d) Tip diameters shall be measured at the extreme tip.
- e) The diameter of a pile at a given point along its length shall be determined either by measuring the circumference at that point and dividing the result by 3.14 or by taking the average of the maximum and minimum diameters measured at the point in question.
- 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 within a given substructure element provided there are at least four piles in that element.
- g) If allowances are specified, they shall supersede SS 906.04 (f).

#### 906.05 Length

- a) Pile lengths shall be measured in metres.
- b) A variation of  $\pm 0.15$  m from designated lengths will be permitted, unless allowable over and under lengths are specified.

**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

## SECTION 906

## ROUND TIMBER PILES

- 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 SS 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 Specification O80 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 Site, at the Site or both. The Contractor shall provide the necessary facilities to enable the Ministry Representative to expeditiously examine all parts of each pile. All piles rejected shall be replaced at the Contractors expense, including shipping charges and removal of reject piles from the Site, if applicable. Inspection of the piles before shipment shall not prevent their subsequent rejection at the Site if found to fail any requirements of this Section.

Inspection of any preservative treatment shall be in accordance with SS 908.03.

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 which shall be in accordance with SS 908.03.

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 Contractor's option, such inspection may be carried out at the Site. All piles rejected at the Site shall be removed and replaced.

#### 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.

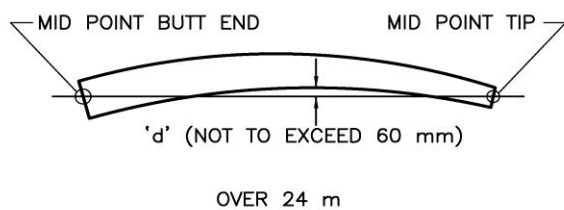
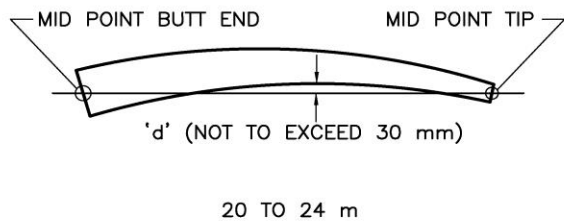
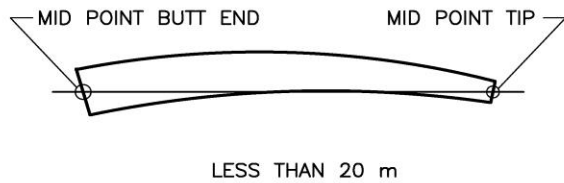
**Hard stain:** a stain, which is not accompanied by softening or other disintegration of the wood.

**Sweep:** the deviation of the pile from straightness (see Drawing SP906-01).

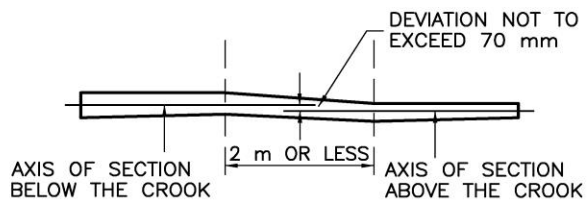
**Reverse sweep:** a deviation from straightness, which changes direction or reverses direction in the length of the pile (see Drawing SP906-02).

MEASUREMENT OF SWEEP AND CROOK IN PILES

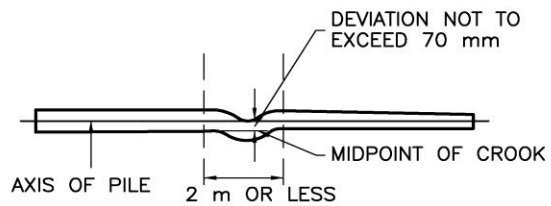
SP906-01



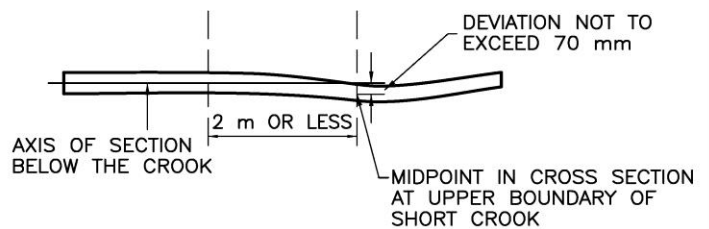
MEASUREMENT OF SWEEP



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

SP906-02



## 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

