

STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

Prepared by:
Professional Services Section
Alberta Transportation
Edmonton, Alberta

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Alberta Transportation

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2.1 CLEARING**2.1.1 GENERAL****2.1.1.1 Description**

Clearing shall consist of cutting, piling, removing and disposing of trees, brush, stumps, logs and roots from areas shown on the Drawings or as designated by the Consultant.

2.1.1.2 Clearing in Forest Protection Areas

Clearing in Forest Protection Areas shall be carried out in accordance with the regulations and requirements of the Alberta Forest and Prairie Protection Act.

2.1.2 CLEARING**2.1.2.1 General**

The Contractor shall cut trees and brush within the areas designated for clearing work; and dispose of the resulting debris. Debris from the Contractor's clearing operations shall not be deposited on adjacent lands. Burying of material will not be permitted.

Branches from standing trees extending into the right-of-way which hang within 6.0 m of the ground shall be cut-off close to the trunk in a neat and workmanlike manner. Underbrush and downed trees protruding into the right-of-way shall be removed and disposed of.

At the completion of clearing operations, the limits of the right-of-way shall be left in a condition suitable for fencing.

2.1.2.2 Clearing and Timber Salvage

Areas requiring timber salvage will be identified by the Consultant. Generally, timber salvage will be required where trees have a stump diameter of 125 mm or greater.

The Contractor shall fell, top, limb and deck salvageable timber to the satisfaction of the Consultant. The salvaged timber shall be neatly piled in areas designated by the Consultant.

2.1.2.3 Preservation of Trees

The Consultant may require the Contractor to preserve certain trees within the right-of-way. Underbrush, downed timber, snags and roots shall be removed from the vicinity of trees designated for preservation and the materials disposed of.

2.1.2.4 Hazardous Trees

Trees located outside areas to be cleared which, in the opinion of the Consultant, may present a hazard shall be removed and disposed of.

2.1.3 DISPOSAL OF CLEARING DEBRIS

2.1.3.1 **Disposal of Clearing Debris by Burning**

2.1.3.1.1 General

Generally, debris resulting from the Contractor's clearing operations shall be disposed of by burning. Unless otherwise approved by the Consultant, burning of clearing debris shall take place within the right-of-way.

The Contractor shall obtain authorization from the applicable local authorities prior to burning of clearing debris within Municipal Districts and Counties.

The Contractor is advised that during periods of extreme fire hazard in Forest Protection Areas, fire permits may be refused. In the event the Contractor is unable to burn the debris, through no fault of his own, the Consultant may direct the Contractor to mulch the clearing debris and dispose of it on-site or remove the debris from the right-of-way to his own disposal site.

2.1.3.1.2 Fire Control

The Contractor shall be solely responsible for ensuring all fires are carefully controlled and are fully extinguished at the completion of clearing operations. The Contractor may be held responsible for damages resulting from improperly extinguished fires.

2.1.3.2 **Disposal of Clearing Debris by Mulching**

2.1.3.2.1 General

When specified in the Special Provisions or when directed by the Consultant, the Contractor shall dispose of clearing debris by mulching and spreading the resulting material over the cleared area or other area designated by the Consultant.

2.1.3.2.2 Mulching

Mulching shall consist of the breaking down of all non-salvageable timber or snags, brush, shrubs, slash, waste wood and wood debris left after clearing and/or clearing and timber salvage operations have been completed.

Acceptable mulching methods include flailing, rotary cutting and grinding, pulverizing, or chipping. Alternative methods may be used subject to approval by the Consultant.

Mulching shall be in accordance with the following requirements:

- All mulched materials shall lay flat to the soil. In cases of convoluted or mixed materials, the height protruding above the soil level shall not exceed 0.3 m and shall not exceed a single stem protrusion.
- No single piece of mulched material shall be longer than 0.5 m and shall not exceed 0.07 m in diameter. Exceptions to this requirement may be considered by the Consultant for large diameter woody materials which, upon mechanical manipulation, show evidence of debarking but resist break-up into a size of less than 0.07 m in diameter.

- Woody material mulched in-place shall have no residual height requirement. Material mulched and stockpiled and then spread over the cleared areas at a later time shall have a maximum residual height of 0.07 m.
- The Contractor shall undertake fringe clean-up operations to remove displaced materials in adjacent timber; including tangled or hung-up material, leaning or broken material, or any material displaced by the mulching process. This also includes any material damaged by the mulching process within proximity to the cleared area deemed by the Consultant to be a safety hazard.
- Roadways and adjacent lands shall be inspected for a minimum of 20.0 m from the edge of the property or border of the area cleared. Materials deposited on adjacent lands by the Contractor's clearing or mulching operations shall be returned to the right-of-way.
- All stumps shall be reduced to ground level using methods acceptable to the Consultant.
- Mulching operations shall not incorporate or mix mulched materials into the subsoil. In cases where topsoil is limited, surface mulching operations shall not be allowed to mix topsoil and subsoil horizons.

2.1.4 MEASUREMENT AND PAYMENT

Clearing; clearing and mulching; clearing and timber salvage; and clearing, timber salvage and mulching will be measured in hectares based on horizontal measurements. No allowance will be made for uneven or sloping ground.

Payment for this work will be made at the unit prices bid for "Clearing", "Clearing and Mulching", "Clearing and Timber Salvage" and/or "Clearing, Timber Salvage and Mulching", as applicable, and will be full compensation for all clearing and/or clearing and timber salvage operations; disposal of debris by burning, mulching or other methods specified by the Consultant; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Cutting and removing grain, grass, weeds, brush and shrubs from within areas to be cleared will be considered incidental to the Work, and no separate or additional payment will be made.

If, through no fault of his own, the Contractor is unable to obtain a burning permit and the Consultant directs the Contractor to mulch and spread the clearing debris on-site or dispose of these materials off-site, payment for this Work will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General. However, if, in the opinion of the Consultant, the Contractor did not make use of opportunities to burn debris when available, these costs will be considered incidental to the Work and no separate or additional payment will be made.

Clearing of areas required for Contractor access to the Work and for Contractor campsites shall be carried out by the Contractor at his expense. Payment will not be made for this Work.

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2.3 GRADING**2.3.1 GENERAL****2.3.1.1 Description**

Grading consists of the excavation of soil materials, the salvage of select soil materials, the operation of borrow areas and the construction of embankment. This work includes the removal and/or satisfactory placement of all materials necessary for the construction and preparation of embankments, slopes, drainage works and connections to the required alignment, grade and cross-sections. It also includes the excavation for culverts, underdrains, and foundation pits for bridges, trestles, buildings and other structures.

2.3.1.2 Dimensions of Excavations and Embankments

Generally, the dimensions of the excavations and embankments shall be as shown on the Drawings, however, the dimensions of any or all excavations and embankments may be increased or decreased at any time by the Consultant as conditions and circumstances dictate.

2.3.2 MATERIALS**2.3.2.1 General Description of Suitable and Unsuitable Materials**

The following provides a general description of the materials typically encountered during grading construction and how such materials shall be handled in the course of carrying out the Work. Specific requirements concerning the use of these materials are detailed elsewhere in this Specification.

Materials considered as "suitable" shall be used for backfilling and constructing embankments. Materials considered as "unsuitable" shall either be disposed of or salvaged depending on the nature of the material.

Vegetation, roots, stumps and refuse are considered unsuitable materials. Such materials shall be disposed of in a manner satisfactory to the Consultant.

Topsoil excavated from inside and outside the right-of-way is considered an unsuitable material. Topsoil shall be salvaged and subsequently handled as specified elsewhere in this Specification.

Subsoil excavated from inside the right-of-way is considered a suitable material. Subsoil excavated from outside the right-of-way or from a roadway which is to be obliterated is considered an unsuitable material and shall be salvaged and subsequently handled as specified elsewhere in this Specification.

Excess subsoil excavated from dugout borrow sources may be designated as a suitable material by the Consultant. Such material will be classified and paid for as borrow excavation.

All other excavated material obtained from inside or outside the right-of-way will be considered suitable materials, regardless of the moisture content of the material.

During the performance of the Work, the Consultant will be the final authority in determining suitable and unsuitable materials.

2.3.2.2 Reservation of Special Materials

The Contractor shall notify the Department immediately whenever gravel, stone or other material which has the potential of being suitable for special use by the Department is found.

When required by the Department, such materials shall be reserved and deposited in suitable locations identified by the Department.

2.3.2.3 Description of Topsoil and Subsoil

In this Specification, the terms "topsoil" and "subsoil" are used to describe separate select soils requiring specific handling during construction. The following general descriptions are provided to assist the Contractor in distinguishing these select soils in the course of carrying out the Work. The specific handling requirements for topsoil and subsoil are specified elsewhere in this Specification.

The uppermost layers of soil both inside and outside the right-of-way may consist of any or all of the following.

- Topsoil is the uppermost layer of soil that:
 - (i) Contains the majority of plant roots.
 - (ii) Is normally referred to as the plough layer in agriculture soils.
 - (iii) Is typically darker in colour than the subsoil layer.

- Subsoil is the layer of soil directly below the topsoil layer that:
 - (i) Contains the lower portion of the root zone.
 - (ii) Is typically lighter in colour than the topsoil layer.

2.3.3 CLASSES OF EXCAVATION

All excavation, for whatever purpose, will be classified as specified herein. The classifications for solid rock, channel excavation, common excavation and borrow excavation stipulate excavating and placing the material. In the event the excavated material is unsuitable, the term "excavating and placing" shall be taken to mean "excavating and stockpiling" or "excavating and disposing", as applicable.

2.3.3.1 Rock Excavation

2.3.3.1.1 General

Rock excavation consists of the removal and placement, from its original position, of rock in solid beds or masses, and boulders or detached rock having a volume of 0.5 m³ or greater.

2.3.3.1.2 Rippable Rock

When identified in the Special Provisions, any rock that can be ripped by a Group 12 dozer equipped with a ripper, as defined in the ARHCA Equipment Rental Rate Guide, and excavated using conventional earthmoving equipment will be classified as rippable rock. Excavation of this material will be paid for in accordance with Subsection 2.3.6.5, Rippable Rock Excavation.

2.3.3.1.3 Solid Rock

Rock that cannot be ripped by a Group 12 dozer equipped with a single ripper will be classified as solid rock. Excavation of this material will be paid for in accordance with Subsection 2.3.6.6, Solid Rock Excavation.

2.3.3.2 **Channel Excavation**

Channel excavation includes the excavation and placing of material excavated for the following purposes:

- Improvement of existing watercourses.
- Watercourse channel realignments.
- Off-set muskeg drainage ditches located parallel to the roadway but not forming the normal contiguous roadway ditch. Excavation for ditch sections adjoining the roadway embankment will not be classed as "Channel Excavation".
- Trenches excavated for the installation of perforated pipe sub-drains.
- Trenches excavated for the installation of culverts down to the culvert invert elevation, including sub-excavation for culvert base construction. In cut sections, this is defined as the material excavated for culvert installation subsequent to undercut excavation as shown on the Drawings only. In fill sections, this is defined as the material excavated below original ground only.

Material excavated during channel excavation operations which meets the specifications for solid rock or rippable rock, as described in Subsection 2.3.3.1, Rock Excavation, shall be so classified.

2.3.3.3 **Common Excavation**

Common excavation consists of the excavation and placement of material obtained from within the right-of-way which does not meet the classification definitions for either "Channel Excavation" or "Common and/or Borrow Excavation Loaded to Trucks".

Material excavated from stockpiles within the right-of-way and redistributed over disturbed areas will also be classified as "Common Excavation".

2.3.3.4 **Borrow Topsoil Excavation**

Borrow Topsoil Excavation shall consist of the excavation and salvage of topsoil, and subsoil separately from borrow areas and borrow area haul roads. Such materials excavated from a stockpile and redistributed on borrow areas and borrow area haul roads shall also be classified as "Borrow Topsoil Excavation".

2.3.3.5 **Borrow Excavation**

Borrow Excavation shall consist of the excavation and placing of material obtained from locations outside the right-of-way with the following exceptions:

- (i) The excavation of roadways which are being obliterated will be classified as Common Excavation.
- (ii) With the exception of topsoil and subsoil excavated from outside the right-of-way as described in 2.3.3.5 (i), all other topsoil and subsoil excavated from outside the right-of-way will be classified as Borrow Topsoil Excavation.

2.3.3.6 Common and/or Borrow Excavation Loaded to Trucks

Common and/or Borrow Excavation Loaded to Trucks consists of the excavation, loading to trucks and placing of material obtained from locations inside the right-of-way or borrow areas as shown on the Drawings or as designated in the Special Provisions. Any material not designated to be loaded to trucks will not be so classified.

2.3.4 CONSTRUCTION**2.3.4.1 General Requirements****2.3.4.1.1 Restraining of Livestock**

The Contractor shall erect and maintain such temporary fences as may be required to prevent livestock or other animals from straying upon the right-of-way or adjoining property or upon borrow area perimeters. The Contractor shall at all times provide against the escape of livestock or other animals through openings made by him in right-of-way or other fences.

2.3.4.1.2 Towing Traffic

Where necessary during grading operations, the Contractor shall, upon orders in writing from the Consultant, provide sufficient men and equipment to hookup and tow vehicular traffic through the Work. The amount and type of equipment to be used in towing traffic will be stipulated and approved in the orders by the Consultant. The Contractor shall be responsible for the hookup of towed vehicles, and shall be responsible for any damage caused by such hook-up and towing.

2.3.4.1.3 Equipment Operation on Paved Surfaces

Where the location of excavation material necessitates the hauling across or on an existing paved roadway the operation shall be carried out as follows:

- (i) Haul across an existing roadway shall be limited to a single equipment crossing point for each borrow site approved by the Consultant.
- (ii) Where haul across a road is by conventional earth moving equipment, an earth pad or steel plates of sufficient dimensions shall be placed on the existing road surface so that no damage to the highway surface or roadbed is incurred. Steel plates may remain in place throughout the use of the crossings.

Unless otherwise permitted by the Consultant, earth pads shall be placed no sooner than daybreak and removed no later than sunset each day that haul operations are in progress. In all cases, the use of earth pads on existing roads must be addressed by the Contractor in his Traffic Accommodation Strategy.

- (iii) Where haul along or across a road is undertaken by trucks, the prevalent load limit restrictions for haul along roadways or over bridges shall apply. Haul of excavation material on the existing roadway will only be permitted until completion of sufficient new grade.
- (iv) Under no circumstances shall regular grading equipment be allowed to operate on the existing highway surface or use the highway surface as a haul road.
- (v) Dust abatement material shall be applied when necessary.

Repair of any damage incurred in the pavement or subgrade structure, as a result of the haul operations, shall be the sole responsibility of the Contractor. The damage shall be repaired and the surface restored to a condition equivalent to that which existed prior to the commencement of haul operations.

2.3.4.1.4 Preservation of Survey Monuments

The Contractor shall preserve all survey monuments and property marks along and adjacent to the roadway. The Contractor shall use suitable precautions to protect from damage or disturbance such survey monuments and property marks until their location has been witnessed, or otherwise referenced, and he shall not remove them until directed by the Consultant.

2.3.4.1.5 Slides

All material in slips, slides and subsidences shall be removed by the Contractor and either properly disposed of or used in the Work.

2.3.4.1.6 Construction, Surfacing, Maintenance And Removal Of Staged Construction

Sections of new highway which are used for traffic operation prior to the application of base course shall conform to the permanent grade section, with temporary connections constructed at the end points as required. Immediately upon completion of the grading (or in the case of an alignment revision, immediately prior to instituting traffic thereon), the roadway shall be gravel surfaced and sprayed with asphalt or other dust abatement material. The Contractor shall be responsible for continuously maintaining the surface in a satisfactory bladed and dust-free condition until the application of the base course.

As practical and where required by the Consultant, the material removed from the temporary connections shall be utilized for grade construction.

2.3.4.2 **Solid Rock Excavation**

2.3.4.2.1 Rock Cuts

All rock cuts shall be excavated to below grade, to a depth determined by the Consultant and then backfilled to grade with suitable material.

In solid rock cuts, where pockets which will not drain are formed below the design roadway elevation by blasting, the Contractor shall, at his own expense, provide drainage by ditching to a free outlet as determined by the Consultant, and backfilling both the pockets and the trench to an elevation 0.30 m below profile grade with broken rock or coarse gravel.

2.3.4.2.2 Overbreak

Overbreak will be considered as that portion of rock which is excavated, displaced or loosened outside and beyond the slopes or grade as established by the Consultant, regardless of whether any such overbreak is due to blasting, to the inherent character of any formation encountered, or to any other cause.

If any rock slide occurs as a result of overbreak, all slide debris will be considered as overbreak.

Overbreak material may, as determined by the Consultant, be used to replace material which would otherwise have to be obtained from other sources, or shall be disposed of to the satisfaction of the Consultant.

2.3.4.2.3 Pre-Shearing

Where required by the Consultant, the Contractor shall pre-shear rock faces to minimize overbreak and produce a stable slope.

2.3.4.2.4 Trimming Rock Slopes

Slopes undercut at the base, or destroyed in any manner by act of the Contractor, shall be resloped by the Contractor at his own expense to the slope as staked by the Consultant.

The slopes shall be carefully scaled down, and all rocks and fragments likely to slide or roll down the slopes removed to the satisfaction of the Consultant.

2.3.4.3 **Catch Water Ditches**

Catch water ditches shall be constructed in accordance with the Typical Plans, where shown on the Profile Drawings and/or where designated by the Consultant. In the case of a catch water ditch along the top of an excavation, the Consultant may require that the catch water ditch be constructed prior to commencement of excavation.

2.3.4.4 **Common Excavation**

All topsoil in disturbed areas or to the limits shown on the Drawings or in the Special Provisions or where designated by the Consultant, shall be salvaged for reuse. Any required stockpiling of topsoil material shall be performed to minimize topsoil losses and contamination of the topsoil and surrounding materials.

Following the excavation and salvage of topsoil, all other material shall be excavated to the extent specified in Subsection 2.3.4.7 and as shown on the Drawings, or as determined by the Consultant. Suitable material shall be used for constructing embankments. Any unsuitable material encountered shall be disposed of in a manner satisfactory to the Consultant.

2.3.4.5 **Borrow Topsoil Excavation**

All topsoil, and subsoil materials from borrow and borrow haul road areas shall be separately excavated, salvaged, stockpiled and reused in accordance with the requirements for development and reclamation of borrow areas specified in Subsection 2.3.4.6, Borrow Excavation.

2.3.4.6 **Borrow Excavation**

2.3.4.6.1 General

The use of Borrow Excavation for constructing embankments will be allowed only after all common excavations have been completed and the resulting suitable material hauled into the embankment, or after all the economic possibilities of obtaining further material by the widening of roadway excavations or ditches have been exhausted.

Borrow areas shall be regular in width and, if required, shall be connected with ditches and drained to the nearest watercourse. Particular care shall be taken to work the area so as to cause a minimum of damage and inconvenience to the land owner. On completion of the Work, borrow areas shall be trimmed and left in a neat and uniform condition. The Contractor shall not operate or park equipment in the borrow locations outside of the limits of the actual borrow area, haul roads or stockpile sites. Any areas disturbed, compacted or otherwise affected by the Contractor's operations shall be reclaimed to their original condition.

Borrow areas will be staked out and cross-sectioned by the Consultant before the Contractor begins work therein. Any material excavated from borrow areas previous to measurement will not be paid for. When a borrow area is provided by the Contractor, the Contractor shall provide proof of landowner consent and the right-to-enter for Department employees and the Consultant.

Borrow areas provided by the Department may be entered only with the permission of the Consultant. Such areas may be subject to revisions, additions or deletions at the discretion of the Consultant. The Contractor shall be prepared to accept such borrow location arrangements as will ultimately be made by the Consultant and shall have no claim against the Department on this account. Changes in borrow locations could result in the required use of soil material of undetermined characteristics, and may also affect the equipment fleet required to undertake the Work, as well as the quantities associated with the Work.

The Contractor shall not change the location of a borrow area provided by the Department, without prior approval of the Consultant.

When the construction of access or haul roads for borrow areas are required, the location and dimensions of the access roads shall be subject to the approval of the Consultant.

2.3.4.6.2 Notification Requirements

The Contractor shall notify the Consultant a minimum ten days prior to commencing:

- (i) annual activities at the borrow site;
- (ii) any salvage of topsoil, subsoil materials;
- (iii) any replacement of topsoil, subsoil materials.

If the borrow area is provided by the Contractor, the Contractor shall also inform the local Reclamation Inspector of the appropriate regulatory agency within this same time frame.

2.3.4.6.3 Pre-Disturbance Assessment of Borrow Areas

2.3.4.6.3.1 General

A pre-disturbance assessment shall be completed for each borrow area in accordance with the procedures detailed in the document "Alberta Transportation Pre-Disturbance Assessment Procedures For Borrow Excavations For Road Construction, May 2002". The pre-disturbance assessment must be completed in advance of any construction related activity at the site.

When a borrow area is provided by the Department, the pre-disturbance assessment of the site will be completed by the Consultant. The Contractor shall provide the Consultant with adequate notice of his intention to commence construction activities at the borrow site such that the Consultant has sufficient time to complete the pre-disturbance assessment. The Consultant will provide the Contractor with a copy of the completed pre-disturbance assessment.

When a borrow area is provided by the Contractor, the Contractor shall complete the pre-disturbance assessment of the site, prepared by a Soil Specialist. The Contractor shall not employ the Consultant to complete the assessment. The Contractor shall provide the Consultant with a copy of the completed pre-disturbance assessment at least 3 days prior to the commencement of construction operations in the borrow area.

2.3.4.6.3.2 Soil Specialist

A soil specialist is an individual who is proficient in soil classification, land management and soil conservation practices and has considerable experience in soil and vegetation impact assessment and problem diagnosis.

Individuals with demonstrated field experience with soil conservation and road building practices, but no formal education related to soil management and conservation may carry out the pre and post assessments under the supervision of a soil specialist.

2.3.4.6.4 Conservation of Topsoil, Subsoil on Borrow Areas and Stockpile Sites

The Contractor shall excavate, salvage and stockpile the topsoil, and subsoil in a manner which prevents contamination of one material with another. A minimum distance of 3 m is required between stockpiles of different materials. The materials shall be stockpiled separately in a safe, stable and accessible location.

If topsoil is to be stockpiled for periods exceeding 2 months or when required by the Consultant, the Contractor shall protect the stockpile from erosion by applying an approved seed mixture or other approved biodegradable soil stabilizer.

The Contractor shall suspend the excavation, salvage and stockpiling of topsoil and subsoil materials when wet or frozen, or when other adverse conditions are encountered.

The Contractor shall not construct stockpiles at locations where they are subject to erosion. The Contractor shall maintain erosion and drainage control in the vicinity of all borrow areas and stockpiles to the satisfaction of the Consultant and shall ensure that surface drainage does not adversely affect adjacent lands, watercourses or future reclamation operations.

2.3.4.6.5 Buffer Zones

The Contractor shall ensure an undisturbed buffer zone exists between the disturbed borrow areas and adjacent land and permanent structures. For property boundaries, road allowances and permanent structures, normal buffer zones shall be 4 m or equal to the depth of excavation, whichever is greater.

Dugout borrows shall be a minimum of 40 m from the right-of-way or 70 m from the highway centreline; whichever is greater. For watercourses or water bodies a minimum 30 m wide buffer shall be maintained.

Stockpiles shall not be situated within 30 m of a watercourse or permanent structure or within 4 m of adjacent property boundary.

Extended buffers shall be implemented where local conditions dictate.

2.3.4.6.6 Reclamation**2.3.4.6.6.1 General**

The Contractor shall reclaim borrow areas and borrow area haul road in accordance with the applicable legislation and the requirements of the Specifications.

Borrow reclamation shall be performed as soon as possible after completion of excavation operations in any borrow area. Notwithstanding the requirement for expeditious reclamation of borrows, reclamation may not be permitted to proceed, if in the opinion of the Consultant, there is insufficient time left in the season to allow vegetation to root and minimize soil erosion of the reclaimed areas.

2.3.4.6.6.2 General Reclamation Conditions For Landscape Borrows or Disturbed Areas Around Dugouts, Borrow Haul Roads and Stockpile Sites

No work of any kind shall take place on frozen or wet surface areas, or using frozen or wet material.

Upon completion of the excavation operations, the Contractor shall contour the site to match the surrounding lands and to ensure positive drainage. The entire area shall be scarified to a minimum depth of 0.5 m or to the depth of compaction, whichever is greater. Where large clay clumps or ridges are prevalent, discing shall be performed following scarification. All rocks larger than 70 mm maximum dimension shall be removed. Subsoil material shall only be used for contouring the site with the approval of the Consultant and the local Reclamation Inspector from the appropriate regulatory agency. Topsoil material shall not be used to contour the site.

The Contractor shall replace all soil levels uniformly in lifts in the reverse order that they were removed. The Contractor shall disc each replaced soil layer.

Topsoil shall be evenly redistributed over the entire area and rocks, roots and stumps removed in accordance with Specification 2.6, Topsoil Placement. Redistribution of topsoil shall only be carried out under suitable weather conditions. The Contractor shall not perform such work when wind conditions are such that material is being carried beyond the designated work areas or that the material is not being uniformly applied.

In areas where dry soils are encountered, discing and harrowing may destroy soil structure and lead to loss through wind erosion. When these types of areas are encountered, the Contractor shall contact the local Reclamation Inspector from the appropriate regulatory agency to explore alternative procedures for site reclamation.

Rock picking shall be performed to ensure rock content of the reclaimed land does not exceed the rock content prior to disturbance. If rock content prior to disturbance is not known, the Consultant will use adjoining land to determine the extent of rock picking required.

Material salvaged from dugout borrow excavations shall generally not be replaced inside the dugout.

2.3.4.6.6.3 Seeding of Reclaimed Areas

The Contractor shall seed reclaimed sites in accordance with Specification 2.20, Seeding. The appropriate grass mixture and if applicable, the fertilizer type and application rates will be specified in the Special Provisions.

All disturbed areas resulting in exposed soils within borrow areas and haul roads shall be seeded unless otherwise determined by the Consultant.

2.3.4.6.7 Post-Disturbance Assessment of Borrow Areas

The Contractor shall immediately notify the Consultant when reclamation at a borrow site is complete.

A post-disturbance assessment shall be completed for each reclaimed borrow site in accordance with the procedures detailed in the document "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction, May 2002", with the exception that the vegetation component of the assessment will not be required.

The post-disturbance assessment shall be completed within 15 days following the completion of the reclamation work at the site.

When a borrow site is provided by the Department, the post-disturbance assessment of the site will be completed by the Consultant. The Consultant will provide a copy of the assessment to the Contractor within 15 days following the completion of the assessment.

A reclaimed borrow site which does not comply with the requirements of the Specifications and the reclamation criteria shall be rectified by the Contractor at his expense. In such cases, the site will be re-assessed for compliance with the Specifications and the reclamation criteria. The Contractor will be invoiced \$1,500.00 each time an additional post-disturbance assessment is required.

When the borrow site is provided by the Contractor, the Contractor shall complete the post-disturbance assessment of the site, prepared by a Soil Specialist as defined in Subsection 2.3.4.6.3, Pre-Disturbance Assessment of Borrow Areas. The Contractor shall not employ the Consultant to complete the assessment. The Contractor shall provide the Consultant with a copy of the completed post-disturbance assessment within 15 days following the completion of the assessment.

2.3.4.6.8 Acceptance of Reclaimed Borrow Sites

Each reclaimed borrow site will be assessed for compliance with the requirements of the Specifications and the reclamation criteria specified in "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction, May 2002", with the exception that the vegetation criteria component will not apply.

Notwithstanding the foregoing and further to Section 2.3.7, Construction Completion, the completion of an acceptable Post-Disturbance Assessment will not release the Contractor from his responsibilities with regard to the borrow site until the issuance of the Construction Completion Certificate.

2.3.4.7 **Constructing Roadways**

2.3.4.7.1 Embankments

Embankment shall be constructed by placing, shaping, adjusting the moisture content where necessary and compacting excavation materials. Only suitable materials shall be used for constructing the embankment except as otherwise approved by the Consultant under the specific conditions described herein.

The embankments shall be constructed in conformity with the lines, grades, and cross-sections shown on the Drawings, or designated by the Consultant.

2.3.4.7.2 Constructing New Roadways

2.3.4.7.2.1 Fill Sections

All topsoil shall be salvaged unless otherwise shown on the Drawings or in the Special Provisions.

If the exposed surface is 0.6 m or greater below the design subgrade surface, it shall be bladed, compacted and backfilled using suitable materials placed in successive layers to the required lines and grades.

If the exposed surface is less than 0.6 m below the design subgrade surface, excavation shall be carried out to 0.6 m below the design subgrade surface or to the elevation as determined by the Consultant; and the suitable excavated material used to construct embankments. The exposed surface shall then be bladed, compacted and backfilled using suitable materials placed in successive layers to the required lines and grades.

2.3.4.7.2.2 Cut Sections

Where the design subgrade surface is in cut, and following the excavation and salvage of topsoil and subsoil, excavation shall be carried out to a depth of 0.6 m below the design subgrade surface; and the suitable excavated material shall be used to construct embankments. The exposed surface shall be bladed and compacted, and the excavated area backfilled using suitable materials and in successive layers to the required lines and grades.

At the transition point from a cut section to a fill section, excavation shall be done to 1.0 m below design subgrade surface or to the elevation as determined by the Consultant, for a distance of 60 m in both directions from the transition point; and the suitable excavated material shall be used to construct embankments. The exposed surface shall then be bladed and compacted, and then backfilled using suitable materials placed in successive layers to the required lines and grades.

2.3.4.7.2.3 Hillside Benching

When embankments are to be made on a hillside of a nature that will, in the opinion of the Consultant, preclude a proper bond between the existing and the newly placed materials, the existing ground on which the embankment is to be placed shall be benched before embankment construction is commenced. The extent of the benching required including the height of the vertical bench cuts will be determined by the Consultant. Otherwise, before any embankment is placed on a smooth, firm surface, the existing ground shall be scarified to obtain a bonding of the new material with the existing ground. .

2.3.4.7.3 Reconstructing Existing Roadways

2.3.4.7.3.1 Grade Widening

Where existing roadbeds are being widened or the existing embankments and roadway ditches extended, the sideslopes, the affected ditch bottoms and backslopes shall be denuded of all vegetation. Any topsoil from these disturbed areas shall be excavated and salvaged. Sideslopes shall be benched one level at a time (starting at the ditch bottom) in order to obtain bonding between the existing grade and the new embankment for all cuts greater than 2 m in

depth. Attempts to obtain bonding by the use of vertical cuts for the full depth of the embankment will not be permitted. In all cases, cuts shall not be steeper than 0.5 horizontal to 1 vertical.

Suitable material excavated from the benching operation and any reconstruction of the ditches and back-slopes shall be used for constructing embankments.

Where required by the Consultant, any unsuitable material in the existing grade shall be excavated, disposed of and replaced with suitable material. Generally, the unsuitable material shall be disposed of to the satisfaction of the Consultant. However, the Consultant may require that the unsuitable material be used in the new sideslopes, provided that, in the opinion of the Consultant, it will not adversely affect the structural integrity of the roadway.

When it is necessary to cut the roadway surface for construction of the last bench, the Contractor shall control traffic such that it is not permitted to travel within 0.5 m of the edge of the surface cut.

The length of surface cut shall not exceed 2 km or a length established by the Consultant. In addition, the Work shall be restricted to one side of the roadway in any work area. The Contractor shall promptly backfill sections of exposed vertical cut to provide safe accommodation of traffic.

For any location where surface cutting is required, the Contractor shall erect orange coloured, reflectorized traffic delineators along the pavement edge at 20 m intervals, all in a manner acceptable to the Consultant.

When base course construction does not immediately follow grade widening, or when the surface cut is longer than 1 km, the Contractor shall promptly place and compact a wedge of suitable material in the cut area adjacent to the roadway surface. This wedge of material shall be tapered to a slope no steeper than 3 horizontal to 1 vertical.

2.3.4.7.3.2 Embankment Placed on Existing Road

Prior to the placement of embankment on an existing roadbed, material within the roadbed designated by the Consultant as unsuitable, shall be excavated and replaced with material approved by the Consultant. Generally, the unsuitable material shall be disposed of to the satisfaction of the Consultant. However, the Consultant may require that the unsuitable material be used in the new sideslopes, provided that, in the opinion of the Consultant, it will not adversely affect the structural integrity of the roadway.

To obtain bonding between the existing and new embankment materials on sideslopes, the existing roadbed sideslopes shall be denuded of vegetation, any topsoil excavated and salvaged and where required by the Consultant, benched as described in Subsection 2.3.4.7.3.1, Grade widening.

Where a new embankment of 0.3 m or less is placed on an existing road which is not surfaced with asphalt material, the existing surface shall be scarified to a depth of 0.15 m unless otherwise directed by the Consultant. The moisture content in this scarified material shall be adjusted as required, and the material shall be compacted to the density requirements in accordance with the Specifications.

2.3.4.7.4 Placing Material

2.3.4.7.4.1 Use of Rock Material

Where rock is being used in the embankment, the material shall be carefully distributed and the interstices filled with finer material approved by the Consultant, to form a dense compact mass. Any large rocks encountered during the construction of the embankment in the final finishing operations which the Consultant determines to constitute a hazard to traffic due to size or protrusion from the finished embankment surface, shall be removed and disposed of to the satisfaction of the Consultant.

2.3.4.7.4.2 Snow, Ice or Frozen Material

Embankment material shall not be placed on frozen earth, snow or ice, nor shall frozen soils, ice or snow be placed in any embankment. Any frozen material in the embankment shall be removed and disposed of at the Contractor's expense before proceeding with further embankment construction.

2.3.4.7.4.3 Grade Settlement

Embankment shall be constructed so that after settlement is complete the required grade and cross-section is attained at all points. If at any time before the time of construction completion the embankment settles below the required grade, it shall be brought back to the required grade by the Contractor. This work will be paid for at the applicable unit price bid for the class of material used.

2.3.4.7.5 Moisture Adjustment and Compaction

2.3.4.7.5.1 Layer and Density Requirements

Unless otherwise specifically permitted by the Consultant, all material placed in embankments shall be spread and bladed smooth in successive layers, not to exceed 0.15 m in depth when compacted and to the full width of the cross-section. Each layer shall be compacted by means suitable to the Consultant to a minimum of 95 percent of the maximum dry density established by the Moisture-Density Relation tests using standard compaction, with the exception of the upper 0.30 m which shall be compacted in 0.15 m layers to a minimum of 100 percent. The material in each layer shall be compacted at the optimum moisture content, unless otherwise directed by the Consultant. In case of controversy, the degree of compaction and/or moisture content will be determined by a moisture-density test before the succeeding layer is placed.

When working with soils that have moderate or greater swelling potential, as determined by the Consultant, the moisture content for compaction shall be within a range of optimum to 3 percent above optimum, or as designated by the Consultant. High plastic clay soils are considered to have moderate to very high swelling potential unless proven otherwise. When working with predominately silt materials, as determined by the Consultant, the moisture content shall be within a range of 3 percent below optimum to optimum.

2.3.4.7.5.2 Test Methods

Quality assurance testing for acceptance of the Work is the responsibility of the Consultant. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall be responsible for all quality control testing and for all costs associated with quality control testing.

The Consultant will, from time to time, take samples and carry out testing and inspection of the materials incorporated or being incorporated into the Work. The Contractor shall cooperate with the Consultant for such sampling, testing and inspection. Such inspection and testing will not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

Various alternative test methods may be used by the Consultant to confirm that specification requirements are being met.

In cases of dispute regarding the degree of compaction and/or moisture contents, all testing to confirm compliance with the Specifications will be carried out by the Consultant using the most recent edition of the following standard test methods.

Test Descriptions		Method No.
1.	Classification of Soils for Engineering Purposes	ASTM Designation D2487 ⁽¹⁾
	a) Determining the Liquid Limit of Soils	AASHTO Designation T 89
	b) Determining the Plastic limit and Plasticity Index of Soils	AASHTO Designation T 90
	c) Particle Size Analysis of Soils	AASHTO Designation T 88
2.	Soils Identification, Hand Method	ATT-29
3.	Moisture-Density Relation	
	a) Standard Compaction, - 5 000 µm Material	ATT-23
	b) Standard Compaction, + 5 000 µm Material	ATT-19
	c) One-Point	ATT-20
4.	Density	
	a) In-Place, Sand Method	ATT-9
	b) In-Place, Balloon Method	ATT-8
	c) In-Place, Nuclear Method	ATT-11
5.	Moisture Content	
	a) Oven Method, Soil and Gravel	ATT-15, Part I
	b) Microwave Oven Method	ATT-15, Part IV
	c) Speedy Moisture Teller	ATT-44
	d) In-Place, Nuclear Method	ATT-11
6.	Correction Factors, Nuclear Moisture-Density Measurements	ATT-48

NOTES:

- (1) As modified by the Prairie Farm Rehabilitation Administration (PFRA) to include medium plastic clay with the symbol Cl.
- (2) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specifications 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.
- (3) In all cases the latest amendment or revision current at the closing date of the tender is implied when reference is made to one of the above standards in the Specification.

2.3.4.7.5.3 Compaction Operations

Compaction over the entire surface area of each layer shall be obtained by the use of tamping rollers, or other equipment to meet the specified density requirements. Hauling equipment will not be accepted in lieu of compaction equipment. Compaction to the specified density shall be obtained uniformly throughout each layer.

2.3.4.7.5.4 Construction on Muskeg or Yielding Ground

Where the embankment to be placed traverses muskeg or yielding ground and it is not possible to place the initial embankment lift in a 0.15 m compacted depth, the Contractor may, upon approval of the Consultant, construct the first embankment lift to a depth sufficient to support the construction equipment. All embankment to be constructed above this support will be constructed in 0.15 m compacted depths, as hereinbefore specified.

2.3.4.7.5.5 Moisture Content Adjustments For Compaction

2.3.4.7.5.5.1 Drying

Where moisture content tests indicate that material being used for embankment is above optimum moisture, the material shall be thoroughly disced and worked until a uniform optimum moisture content is achieved.

The use of lime or any other material to assist in drying wet material shall be entirely at the Contractor's discretion.

2.3.4.7.5.5.1.1 Contractor's use of Lime

The type of lime used shall be pulverized quicklime.

2.3.4.7.5.5.1.1.1 Supply, Delivery and Handling of Quicklime

Where using quicklime, the Contractor shall order the quicklime at his own expense and:

- (a) Make all arrangements for the delivery of pulverized quicklime in suitable tanker trucks equipped with distribution equipment appropriate for the direct application of the quicklime onto the wet soils.
- (b) So organize his Work that all personnel are able to avoid contact with the quicklime.
- (c) Take special precautions during windy conditions at the site to avoid damage to personnel, livestock and property during the quicklime application.
- (d) Shall be responsible for any trucking costs related to standby.
- (e) Pay all transportation charges on quicklime returned to the supplier as surplus to requirements, for any cause whatsoever.

2.3.4.7.5.5.1.1.2 Construction

Prior to treatment with the quicklime the soil shall be loosened with suitable equipment. The Contractor shall thoroughly mix the quicklime with the soil until a uniform colour and texture is achieved.

2.3.4.7.5.2 Water for Compaction

Where moisture content tests indicate the material for embankment is below optimum moisture, water shall be added. The material shall be thoroughly disced and broken down, water added in amounts as required, and the material thoroughly worked to mix the water uniformly throughout the soil prior to commencing compaction operations.

2.3.4.7.6 Obliteration of Existing Roadway

When sections of the existing roadway, accesses and crossings, are obliterated upon completion of the new roads or when approved alternative roads are operational, any topsoil and subsoil from the area to be obliterated shall be excavated and salvaged separately. The material excavated from the obliteration operation shall be utilized for embankment construction or disposed of as determined by the Consultant.

Obliterated areas shall be graded to provide positive drainage, and shall be reclaimed to a neat and tidy condition comparable to that of the adjacent ground. The Work shall be carried out in accordance with Subsection 2.3.4.6.6, Reclamation, and Specification 2.20, Seeding; and to the satisfaction of the Consultant.

2.3.4.8 Approach Fills for Bridge Structures (Other Than Bridge Culverts)

2.3.4.8.1 Preparation of Existing Ground

Prior to the placement of embankment on the existing ground where bridge approach fills are to be located, and in order to allow unrestricted pile penetration, all areas where piles are to be driven shall be cleared of obstructions such as pavement, granular and soil cement materials, compacted subgrade, topsoil and subsoil, boulders or rock of any nature, trees, stumps and any other undesirable debris. Where the subsurface of the area is known to contain boulders, they shall be removed to a minimum depth of two metres below the existing ground surface. All the materials removed shall be utilized or disposed of as determined by the Consultant.

The locations where bridge piling is to be located shall be as shown on the Drawings or as determined by the Consultant.

2.3.4.8.2 Placing Material in Bridge Approach Fills

Construction of approach fill embankments shall be undertaken in accordance with Subsections 2.3.4.7.4, Placing Material, and 2.3.4.7.5, Moisture Adjustment and Compaction, excepting that the embankment material shall be free of stones, rocks or other solid material greater than 150 mm.

2.3.4.8.3 Finishing Bridge Headslopes

Bridge headslopes shall be accurately trimmed, particularly at the intersection of the toe of the headslope with the underpassing roadway or with the bank of a stream, to the lines, grades and cross-sections as shown on the Drawings or as determined by the Consultant.

Drainage requirements shall be constructed to the lines and grades as shown on the Drawings or as determined by the Consultant.

2.3.4.9 Overhaul

Overhaul will occur when excavated material is hauled (other than by trucks), more than 300 m and placed in embankments or disposed of as specified herein.

Overhaul will apply to suitable material under the classifications of Common, Solid Rock, Channel and Borrow Excavations when such material is deposited at locations as provided by the Drawings, or as designated by the Consultant. Overhaul will not apply to unsuitable material under these classifications unless the Consultant specifically requires that such material be hauled more than 300 m.

Overhaul will not apply to topsoil and subsoil or other unsuitable materials from borrow and borrow haul road areas unless the Consultant specifically requires that such material be moved outside the disturbed borrow area and the haul to move the material to such locations outside the disturbed borrow area is greater than 300 m.. Overhaul will not apply in situations where such materials are hauled more than 300 m within the limits of the disturbed borrow area.

2.3.4.10 **Finishing Previous Clearing**

The Contractor shall remove and dispose of any stumps, debris and new tree growth within the limits of the previously cleared areas.

2.3.5 FINISHING, INTERIM ACCEPTANCE OF ROADWAY SURFACES AND MAINTENANCE

2.3.5.1 **Finishing**

The Contractor shall, as soon as practicable, bring the excavations and embankments to the correct widths, lines and grades.

Backslopes that are 2 m and greater in height and with a slope steeper than 3 m horizontal to 1 m vertical shall be scarified to reduce the potential for erosion. A typical method for scarifying such backslopes shall be "walking a dozer" over the entire slope, operating the equipment in a direction perpendicular to the roadway. All other backslopes shall be finished in the normal manner.

A maximum of 2 km of grade shall be in the rough at any one time. However, where no traffic accommodation is required through the Work, up to 5 km of grade may be in the rough. In these situations, having more than 2 km of grade in the rough at any one time will be subject to the prior approval of the Consultant.

As soon as the excavations and embankments are completed to the correct widths, lines and grades, the Contractor shall maintain the roadway with a blade machine.

2.3.5.2 **Interim Acceptance of Roadway Surfaces**

Roadway surfaces which have been entirely completed (constructed and finished) in accordance with the Drawings and Specifications will be eligible for inspection and interim acceptance by the Consultant under the following conditions:

- (i) The roadway surface is not being covered with granular base course under this Contract.
- (ii) The section of roadway surface being considered for interim acceptance is not less than 1 km in length and is contiguous to a section of roadway surface previously accepted.

Interim acceptance shall apply to the roadway surface only, and shall not relieve the Contractor of his responsibility to complete other portions of the roadway such as the sideslopes, ditches and backslopes in accordance with the Drawings and Specifications.

Acceptance of the other portions of the roadway will not be made on an "interim" basis and will only be considered once the entire project is completed and ready for the Construction Completion Inspection as detailed in Specification 1.2, General.

In addition, interim acceptance of a roadway surface shall not relieve the Contractor of his responsibility to repair any failures occurring in the roadway surface prior to the Construction Completion Inspection which, in the opinion of the Consultant, are workmanship related.

2.3.5.3 Maintenance Requirements and Responsibilities

2.3.5.3.1 Uncompleted Roadway Surface

Maintenance shall be at the Contractor's own expense and shall continue daily, or at frequent intervals, depending on the effects of traffic and weather upon the uncompleted portion of the roadway. Ditches and culverts shall be kept free from obstructions so that water will flow freely at all times.

For the purposes of determining maintenance responsibilities and requirements, a roadway surface which is being covered by granular base course under this Contract will be considered to be an uncompleted roadway surface.

2.3.5.3.2 Roadway Surface Accepted on an Interim Basis

Maintenance of roadway surface, which has been accepted on an interim basis, shall be performed by the Contractor at intervals as determined by the Consultant. Payment for maintenance of a roadway surface, which has been accepted on an interim basis, will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

2.3.6 MEASUREMENT AND PAYMENT

2.3.6.1 General

The unit of measure of all classes of excavation will be the cubic metre, and the quantity paid for will be the actual number of cubic metres of material excavated, as measured in its original position and as accepted and recorded by the Consultant.

No payment will be made for material excavated or placed outside the limits indicated by the construction stakes, unless such work has been authorized by the Consultant. Material placed outside the limits indicated by the construction stakes shall be removed as directed by the Consultant, and this work will not be paid for.

The construction and removal of temporary equipment crossings and haul crossings and the restoration of the surrounding area and the repair of any damage to the pavement or subgrade structure as a result of hauling operations will not be paid for separately but shall be at the Contractor's own expense.

No separate payment will be made for the supply, installation and removal of temporary fences other than those associated with borrow areas. These costs will be considered incidental to the Work.

2.3.6.2 Towing Traffic

The cost of towing through the Work, except through those portions of the Work which require towing of traffic due to the Contractor's failure to diligently prosecute the Work to completion, will be paid for as "Extra Work", in accordance with the following conditions:

- (i) Equipment used will be paid for at the approved hourly rate times the actual hours used for towing, as approved by the Consultant.
- (ii) Attachments to the equipment such as scarifiers, dozer blades and winches, will not be paid for unless actually used and previously authorized by the Consultant.
- (iii) Payment for approved standby time will be made only for the equipment operator; no payment will be made for the standby towing equipment.
- (iv) With prior authorization of the Consultant, payment will be made for a vehicle used by the equipment operator when the operator is on standby.

2.3.6.3 Slides

There will be no separate payment made for material from slips, slides and subsidences which is removed and disposed of or used in the Work, unless such occurrences were beyond the control of the Contractor and not preventable by the use of due care and diligence.

Payment for the removal of slides beyond the control of the Contractor will be made at the applicable unit price for the class of excavation involved.

2.3.6.4 Maintenance and Traffic Accommodation

Gravel surfacing on the sections of graded highway, staged construction, detours and temporary connections utilized for traffic accommodation shall be performed and paid for in accordance with Specification 3.3, Gravel Surfacing.

The cost of maintenance including the supply and application of asphalt or other dust abatement material will not be paid for separately but shall be incidental to the Work.

The construction and removal of temporary wedges at surface cut areas will not be paid for separately but will be considered incidental to the Work.

Removal of temporary connections will be paid for as "Common Excavation".

2.3.6.5 Rippable Rock Excavation

Where rippable rock is encountered, rippable rock excavation will be paid at the unit prices bid for "Common Excavation", "Borrow Excavation", "Channel Excavation", or "Common and/or Borrow Excavation Loaded to Trucks", as applicable, plus an additional payment at the unit price bid per cubic metre for "Rippable Rock Excavation - Premium".

The rippable rock excavation premium will be full compensation for all additional equipment and specialized construction techniques required; including any additional labour, materials, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.3.6.6 Solid Rock Excavation

Where solid rock is encountered, solid rock excavation will be paid for at the unit prices bid for "Common Excavation", "Borrow Excavation", "Channel Excavation", or "Common and/or Borrow Excavation Loaded to Trucks", as applicable, plus an additional payment at the unit price bid per cubic metre for "Solid Rock Excavation - Premium".

The solid rock excavation premium will be full compensation for all additional equipment and specialized construction techniques required including, but not limited to: pre-shearing, pre-splitting, line drilling, cushion blasting, perimeter blasting and buffer blasting; and all additional labour, materials, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Overbreak which, with the approval of the Consultant, is used to replace material that would otherwise have to be obtained from other sources, will be paid for on the basis of classification of the replaced material. Any overbreak which is not used to replace other material shall be removed by the Contractor at his expense. Any additional restoration work required due to overbreak shall be carried out by the Contractor at his expense.

2.3.6.7 Channel Excavation

Channel Excavation will be paid for at the unit price bid for "Channel Excavation", and will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.3.6.8 Common Excavation

Common Excavation will be paid for at the unit price bid for "Common Excavation", and This payment will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

The excavation and utilization or disposal of existing surfacing and subgrade materials resulting from obliteration operations will be classified and paid for as "Common Excavation". Conditioning of the material required for its satisfactory incorporation into embankment construction, and work required to complete the restoration of the obliterated areas, except for the placement of subsoil and topsoil, will be considered incidental to the Work, and no separate or additional payment will be made. The placement of subsoil and topsoil will be paid for in accordance with Specification 2.6, Topsoil Placement.

2.3.6.9 Borrow Topsoil Excavation

2.3.6.9.1 Department Supplied Borrow

Topsoil excavation from borrow areas within Department borrow sources will be paid for at the unit price bid for "Borrow Topsoil Excavation", and will be full compensation for the excavation and separate stockpiling of the topsoil and subsoil materials from the borrow areas, including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant..

Payment will also be made at the unit price bid for "Borrow Topsoil Excavation", for the excavation from the separate subsoil and topsoil stockpiles and the proper redistribution of such materials over the borrow areas. This payment will be full compensation for rock removal, scarifying, redistribution, deplaning and discing and any other operations necessary to complete the Work in accordance with the requirements of this Specification and the reclamation criteria in the "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction, May 2002", with the exception that the vegetation component of the assessment will not be required.

If all of the materials from a borrow area are placed in stockpile and subsequently all redistributed over the borrow area, the measurement for the second operation will be taken as equal to the quantity originally measured in its original position. If all of the materials are not

redistributed over the borrow area, the measurement for the second operation will be based on measurements of the stockpiles before and after redistribution.

No additional payment will be made for handling material in layers.

2.3.6.9.2 Contractor Supplied Borrow

Borrow topsoil excavation within Contractor supplied borrow sources will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.10 **Borrow Excavation**

2.3.6.10.1 Department Supplied Borrow

Borrow excavation will be paid for at the unit price bid for "Borrow Excavation", and will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant. Scarifying and trimming of borrow surfaces and removal of rocks larger than a 70 mm maximum dimension prior to and after the redistribution of topsoil, and the smoothing, trimming and maintenance of borrow haul roads, will be considered incidental to the Work, and no separate or additional payment will be made.

Borrow Excavation used in the construction of haul roads to borrow areas, as directed by the Consultant, will be paid for at the unit price bid for "Borrow Excavation". Upon completion of haul, where the material in the haul road is excavated and deposited as directed by the Consultant, the excavation of this material will be paid for at the unit price bid for "Borrow Excavation".

Restoration of the borrow haul road areas and disposal areas, excluding topsoil placement and re-seeding disturbed areas will be considered incidental to the Work, and no separate or additional payment will be made. Topsoil placement and seeding will be measured and paid for at the applicable unit prices bid.

When the Contractor has been directed by the Consultant to excavate unsuitable borrow material, including stones or rocks, and not place this material in the embankment, this excavation will be paid for at the unit price bid for "Borrow Excavation". Subsequent disposal of this unsuitable material, including stones or rocks, will not be paid for directly, but will be considered as incidental to borrow excavation.

The cost of erecting and removing temporary fences associated with Department supplied borrow areas will be paid for as "Extra Work", in accordance with Specification 1.2, General.

2.3.6.10.2 Contractor Supplied Borrow

Borrow excavation will be paid for at the unit price bid for "Borrow Excavation – Contractor Supplied", and will be full compensation for the supply of borrow material; the reclamation of the borrow area and haul roads; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Borrow excavation used in the construction of haul roads to Contractor supplied borrow areas will be considered incidental to the Work, and no separate or additional payment will be made.

When the Consultant directs the Contractor to excavate and dispose of unsuitable borrow material, including stones or rocks, and not place this material in the embankment, the excavation and the subsequent disposal of unsuitable materials will be considered incidental to the Work and no separate or additional payment will be made.

The cost of erecting and removing temporary fences associated with Contractor supplied borrow areas will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.11 **Common and/or Borrow Excavation Loaded to Trucks**

2.3.6.11.1 Excavation and Loading to Trucks

The unit of measure of common and/or borrow excavation loaded to trucks will be the cubic metre, as measured in its original position.

Common and/or borrow excavation loaded to trucks and construction of embankment will be paid for at the unit price bid for "Common and/or Borrow Excavation Loaded to Trucks", and will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.3.6.11.2 Truck Haul of Common and/or Borrow Excavation

When the Contract contains a bid item for the payment of haul of common and/or borrow excavation loaded to trucks on a per cubic metre.kilometre basis, truck haul will be measured and determined in the following manner:

The number of cubic metre kilometres of truck haul of common and/or borrow excavation to be paid for will be the product of the number of cubic metres of truck haul material, as measured in its original position, and the actual haul distance in kilometres, or fractions thereof.

The haul distance will be the actual distance between the centres of mass of the truck haul material in its original position and after placing. No free haul distance will be applied.

The haul distance for roadway excavation will be measured along the centreline of the highway. The haul distance for material obtained from borrow pits will be measured along the shortest practical route, as designated by the Consultant.

The quantities of truck haul, determined as provided herein, will be paid for at the unit price bid for "Truck Haul of Common and/or Borrow Excavation", and will be full compensation for all labour, equipment, tools, and incidentals necessary to complete the Work to the satisfaction of the Consultant.

When the Contract does not include a bid item for "Truck Haul of Common and/or Borrow Excavation", the cost of hauling material will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.12 **Catch Water Ditches**

Catch water ditches constructed in accordance with the typical plans will be measured for payment by length in metres.

Catch water ditches will be paid for at the unit price bid for "Catch Water Ditches", and will be full compensation for all equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.3.6.13 Constructing Embankment

The cost of placing, compacting, moisture adjustment and finishing of materials in embankments shall be included in the unit prices bid for the various classes of excavation used to construct the embankment. No separate or additional payments will be made.

2.3.6.13.1 Preparation of Existing Ground

The cost of preparing the ground following the excavation of any material, scarifying and compacting the exposed surface, denuding and benching of the existing highway embankment slopes, scarifying and benching hillsides, scarifying and compacting existing road embankment to obtain bond, will be considered incidental to the Work, and no separate or additional payment will be made.

Where the subgrade is excavated below design subgrade surface, reconstructed in 0.15 m layers and compacted, the excavation will be paid for at the applicable unit price bid for the class of material excavated.

The required excavation and disposal of unsuitable material encountered in existing roadbeds or encountered in the preparation of the existing ground surface will be paid for at the unit price bid for "Common Excavation".

2.3.6.13.2 Rock Materials Used in Embankment

Relatively finer material used for filling the interstices in embankments constructed of rock, concrete or other solid material will be paid for at the applicable unit price bid for the class of material used.

Removal and disposal of rock, concrete or other solid material from the finished embankment surface will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.13.3 Compaction

Costs associated with compaction of materials shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

2.3.6.13.4 Water for Compaction

Costs associated with supplying, applying and incorporating water required for moisture content adjustment of embankment materials shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

2.3.6.13.5 Drying Wet Material**2.3.6.13.5.1 General**

Costs associated with work necessary to dry wet material shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

2.3.6.13.5.2 Lime for Drying

When the Contractor elects to use lime for drying wet materials, the cost of mixing, storage, transportation within the project limits, loading, unloading, and spreading will be considered incidental to the Work, and no separate or additional payment will be made.

Payment for lime will be made on a cost share basis. The Contractor shall order and pay for the purchase and transportation of the pulverized quicklime directly from the Supplier, and shall provide the Supplier's invoices to the Consultant within 24 hours of the delivery. The Department will reimburse the Contractor for 50% of the approved invoice cost F.O.B. the jobsite.

2.3.6.14 **Approach Fills for Bridge Structures (Other Than Bridge Culverts)**

2.3.6.14.1 Preparation of Existing Ground

The material excavated for the preparation of existing ground for bridge approach fill construction will be classified in accordance with Section 2.3.3, Classes of Excavation. The material excavated will be paid for at the applicable unit prices bid for the class of material excavated.

2.3.6.14.2 Placing Material

The cost of placing, compacting, moisture adjustment and finishing of materials in bridge approach fills shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

2.3.6.14.3 Water for Compaction

Costs associated with supplying, applying and incorporating water required for moisture content adjustment of embankment materials shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

2.3.6.14.4 Drying Wet Material

Costs associated with work necessary to dry wet material shall be included in the unit prices bid for the various classes of excavation. No separate or additional payment will be made.

Payment for the supply and use of lime will be in accordance with Subsection 2.3.6.13.5.2, Lime for Drying.

2.3.6.15 **Overhaul**

When the Contract contains a bid item for the payment of overhaul on a per cubic metre kilometre basis, overhaul will be measured and determined in the following manner:

The number of cubic metre kilometres of overhaul to be paid for will be the product of the number of cubic metres of overhauled material, as measured in its original position, and the overhaul distance in kilometres.

The overhaul distance will be the distance between the centres of mass of the overhauled material in its original position and after placing, less 300 m free haul.

The haul distance for roadway excavation will be measured along the centreline of the roadway. The haul distance for material obtained from borrow pits or for material hauled to disposal sites will be measured along the shortest practical route, as designated by the Consultant.

The quantities of overhaul, determined as provided above, will be paid for at the unit price bid for "Overhaul", and will be full compensation for all labour, equipment, tools, and incidentals necessary to complete the Work to the satisfaction of the Consultant.

When the Contract does not include a bid item for the payment of overhaul, the cost of overhauling material will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.16 **Finishing Previous Clearing**

Finishing previous clearing will be considered incidental to the Work, and no separate or additional payment will be made.

2.3.6.17 **Seeding**

Seeding of reclaimed areas will be measured and paid for in accordance with Specification 2.20, Seeding.

2.3.6.18 **Reservation of Special Materials**

Material excavated during the progress of the Work which is reserved for future use by the Department and stockpiled in locations designated by the Department, will be paid for at the applicable unit prices bid for the various classes of material excavated.

2.3.7 CONSTRUCTION COMPLETION

In addition to the specific requirements included in this Specification, the conditions requisite for suitable and completed work will be a roadway which is smooth and compact over the entire width, with firm sideslopes and regular shoulder lines, clean side ditches, satisfactory approaches, intersections and entrances, and smooth and/or scarified backslopes as applicable.

All loose stones, clods, weeds, trash, etc., shall be removed from the roadway or other work areas, sideslopes, ditches and backslopes. All improperly compacted material in the roadway or other work shall be excavated, brought to optimum moisture content if required, and recompacted by the Contractor at his expense.

On the sideslopes and backslopes, and in the bottom of ditches, all projecting boulders shall be removed or broken off at least flush with the lines and grades, and the resultant cavities, if any, backfilled.

All borrow sites shall be reclaimed in accordance with the requirements of the Specifications and the reclamation criteria specified in "Alberta Transportation Post-Disturbance Reclamation Criteria and Assessment Procedures for Borrow Excavations for Road Construction, May 2002". Any remedial work necessary to achieve these requirements shall be at the Contractor's expense until the issuance of the Construction Completion Certificate.

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2.4 CULVERTS**2.4.1 GENERAL****2.4.1.1 Description**

This specification covers the installation of pipe culverts less than 1 500 mm equivalent diameter.

Abbreviations for the various types of culverts when indicated on the Drawings or used in the Specifications are as follows:

C.S.P.	Corrugated Steel Pipe
C.S.P. Arch	Corrugated Steel Pipe Arch
R.C.P.	Reinforced Concrete Pipe
R.G.R.C.P.	Rubber Gasket Reinforced Concrete Pipe
P.P.	Polyethylene Pipe
C.A.P.	Corrugated Aluminum Pipe
C.A.P. Arch	Corrugated Aluminum Pipe Arch
C.M.P.	Corrugated Metal Pipe (General Term for Corrugated Steel and Aluminum Pipe)
R.C.B.	Reinforced Concrete Box

2.4.2 MATERIALS**2.4.2.1 Culvert Material**

The Contractor shall supply culvert material in accordance with Specification 5.23, Supply of Corrugated Metal Pipe and Pipe Arches, Specification 5.24, Supply of Polyethylene Pipe and Specification 5.16, Supply of Reinforced Concrete Culvert.

2.4.2.2 Gravel Material for Culverts

When the Contract stipulates, the Contractor shall produce gravel material for culvert backfill in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of materials specified. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate.

2.4.3 CONSTRUCTION**2.4.3.1 Excavation and Preparation of Base**

Excavation for the culvert base shall be to a depth of not less than 0.3 m below the invert grade, and shall be of sufficient width to permit assembly of the pipe and the operation of compaction equipment on either side of the pipe. All soft, yielding or unsuitable material at this level shall be removed to a depth satisfactory to the Consultant. Excavated material shall be replaced with gravel or other acceptable material to provide a firm foundation of uniform density throughout the entire length of the pipe.

On completion of excavation for the culvert base and the removal and replacement of any soft, yielding or unsuitable material the Contractor shall compact the exposed surface to uniform density. The Contractor shall then construct the culvert bed to the established elevation using gravel material or other material acceptable to the Consultant. The culvert bed shall be

compacted in accordance with Specification 2.3, Grading. The width of the culvert bed shall be 3 times the culvert diameter or span.

When the culvert installation is in rock, excavation for the culvert base shall be carried out to a depth of not less than 0.2 m below the invert grade. The width of the culvert bed shall be a minimum of 1.5 times the diameter or span of the culvert.

Where gravel bedding or backfill is used, impervious, compacted clay cut-offs shall be constructed at both ends of the culvert as shown on Drawing CB6-2.4M1.

2.4.3.2 Installation

2.4.3.2.1 General

The culvert shall be installed on the prepared base, true to the designed lines and grades unless otherwise established by the Consultant. Separate sections shall be securely joined together in accordance with the Manufacturer's instructions. Coupler bands shall be used for metal and polyethylene pipe and unless otherwise specified, rubber gasket type joints shall be prepared and made between sections of reinforced concrete culvert. At all coupling and joint areas and at areas of concrete pipe that have external bells, depressions shall be constructed in the culvert bed so that the pipe is uniformly supported along its entire length.

The Contractor shall use due care when installing the culvert to avoid damaging the material. Damaged culvert materials shall be removed and replaced by the Contractor at his own expense.

2.4.3.2.2 Installation of Corrugated Metal Pipe and Pipe Arches

When required, elbows shall be installed to accommodate sharp changes in gradient or direction of the pipe.

Pipe shall be carefully handled to prevent damage to the protective coating. Any damage to coatings shall be repaired by the Contractor at his own expense in accordance with CAN 3-G401.

2.4.3.2.3 Installation of Reinforced Concrete Culvert

Reinforced concrete culvert shall be placed beginning at the downstream or lower end of the culvert. The pipes shall be placed with the bell or grooved ends facing upstream. The interior sections of the culverts shall conform to the grade and alignment as shown on the Drawings, or as established by the Consultant.

Culvert sections shall be joined using either a wedge and block, or mechanical pipe pullers to bring the pipe to the homed position. Joints shall not be deflected beyond the Manufacturer's recommended maximum.

Culvert sections shall be anchored to adjacent sections by tie bars, where provided. Lifting holes and holes for engaging bars shall be filled with mortar, and finished flush with the pipe surface.

2.4.3.2.4 Installation of Polyethylene Pipe

The culvert bed shall be shaped to the curvature of the pipe to a depth of 75 mm using a template.

Blocking shall not be used to bring the pipe to grade. The pipe shall be placed on the prepared base to the lines and grades as established by the Consultant, with the separate sections securely joined with the applicable welds and gasket joints as specified in Specification 5.24, Supply of Polyethylene Pipe. Temporary hold downs shall be used to maintain the position of the pipe during installation.

Sections of pipe with a minimum length of 6.0 m shall be used on each end of each culvert.

2.4.3.2.5 Installation of Downdrains

When required, downdrain pipes shall be installed as shown on the Drawings, at the locations as shown on the Drawings or designated by the Consultant. A trench shall be excavated to the established depth and grade required for the installation of the downdrain pipe and connecting elbows, and its bottom surface shall provide a uniform, firm foundation throughout the length of the installation, with sufficient width to permit satisfactory jointing and thorough compaction of the backfill material around the pipe.

2.4.3.2.6 Extension of Existing Culverts

Extensions to existing culverts will be considered as new installations. Where an existing culvert is to be extended, the removal, salvage and reinstallation of the existing sloped end sections may be required as shown on the Drawings or as directed by the Consultant.

Where the existing pipe was manufactured to imperial dimensions and the new pipe is manufactured to metric dimensions and a mismatch occurs at the joint, the Contractor shall caulk the joint with oakum to obtain a water resistant joint.

2.4.3.3 **Backfilling**

2.4.3.3.1 General

Backfill under the haunches and immediately adjacent to the culvert extending from the culvert base up to an elevation of 30 percent of the vertical height of the culvert shall be comprised of select gravel or soil material, as directed by the Consultant. Backfill immediately adjacent to the culvert above this level shall be comprised of select soil material. All backfill material shall be free from frozen lumps and organic material. Backfill within 300 mm of the culvert wall shall be free from stones of diameter larger than 80 mm.

All backfill material shall be placed in layers not exceeding 0.15 m in depth. Each layer shall be thoroughly compacted at optimum moisture content by means of pneumatic or other mechanical tamping equipment. Backfill and compaction layers shall be brought up simultaneously and evenly on both sides of the culvert filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe. This compaction procedure shall be continued until the backfill reaches a minimum elevation of 0.3 m above the top of the pipe, or greater, as determined by the Consultant if necessary to carry the weight of construction equipment without damage to the culvert.

Backfilling of the remainder of the culvert excavation, beyond the immediate region of the culvert, shall be carried out in accordance with Specification 2.3, Grading. Compacting equipment shall be operated parallel to the longitudinal axis of the culvert, until sufficient fill has been placed to proceed with construction of the embankment in the normal manner.

The remaining construction of the grade embankment over the installation may then proceed in accordance with Specification 2.3, Grading.

2.4.3.3.2 Backfilling Polyethylene Pipe

The minimum height of fill above the top of the pipe shall be 0.6 m or as directed by the Consultant.

Immediately after backfill is completed, the Contractor shall saw cut the sloped ends at a ratio of 4:1 as shown on Drawing CB6-2.4M9.

2.4.3.4 **Hand-Laid Riprap**

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Specification 2.5, Riprap.

2.4.3.5 **Removal**

2.4.3.5.1 Removal, Salvage and Reinstallation of Existing Culverts

Where removal and salvage of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall carefully excavate, remove and store the material at locations suitable to the Consultant. Salvaged materials shall be reinstalled in accordance with these specifications.

2.4.3.5.2 Removal and Disposal of Existing Culverts

Where removal and disposal of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall remove and dispose of the material at locations acceptable to the Consultant.

2.4.3.5.3 Culvert Installation and Removal on Roadways in Service

Where culvert installation or removal must take place on roadways that must remain in service during construction, the Contractor shall carry out his installation or removal by either building and maintaining a detour or by working on one half of the roadway while maintaining flagperson controlled and adequately signed traffic flow on the other half. Details of all proposed traffic accommodation methodologies shall be provided in the Contractor's Traffic Accommodation Strategy.

2.4.3.5.4 Grouting Abandoned Culverts

When directed by the Consultant or at the locations shown on the Drawings, the Contractor shall completely fill existing culverts, starting at the upstream end, with a permanent cementitious fill material with a minimum compressive strength of 0.5 MPa to prevent future collapse of the culverts.

The filling of the culverts shall be carried out using methods and materials acceptable to the Consultant. The Contractor shall take precautions during filling operations to ensure that no blow outs or disruptions of the existing roadway occur.

When a replacement culvert is being installed, the replacement culvert shall be in operation before grouting of the abandoned culvert begins.

2.4.4 MEASUREMENT AND PAYMENT

2.4.4.1 **Excavation for Removal of Existing Culverts**

Measurement and payment for excavation for the removal of existing culverts, including the excavation of existing base or surfacing courses, will be in accordance with Specification 2.3, Grading.

2.4.4.2 **Removal, Salvage and Reinstallation of Existing Culverts**

Measurement for the removal, salvage and reinstallation of existing culverts and drainage structures including sloped ends, will be made in metres based on the total invert length of pipe removed and reinstalled.

Payment will be made at the unit price bid per metre for "Culverts - Remove, Salvage and Reinstall" for the various types and sizes of culvert specified. This payment will be full compensation for removing and salvaging the pipe, preparing the culvert bed, reinstalling the pipe, backfilling and the supply and placement of hand-laid riprap, and all materials, labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

When a culvert is identified by the Consultant to be salvaged and the culvert is damaged by the Contractor during the removal operations due to his negligence, the Contractor shall replace the damaged culvert at his own expense.

2.4.4.3 **Removal and Disposal of Existing Culverts**

Measurement for the removal and disposal of existing culverts and drainage structures will be made in metres based on total invert length of pipe removed.

Payment will be made at the unit price bid per metre for "Culverts - Remove and Dispose" for the various types and sizes of culvert specified. This payment will be full compensation for removing and disposing of all the culvert pipe material, and all materials, labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.4.4.4 **Excavation for Culvert Installation**

Measurement and payment for excavation for culvert installation will be in accordance with Specification 2.3, Grading. Where the Contractor chooses to construct embankments before installing culverts, there will be no payment for subsequent excavation of these embankment materials.

2.4.4.5 **Supply and Installation of Culverts**

Measurement for the supply and installation of culverts, and downdrains will be made in metres based on the total invert length of pipe installed, including elbows and sloped end sections.

Payment will be made at the unit price bid per metre for "Culverts - Supply and Install" for the various types and sizes of culvert specified. This payment will be full compensation for supplying all culvert pipe materials including couplers and appurtenances, preparing the culvert bed, installing the pipe, backfilling, the supply and placement of hand-laid riprap, and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

No separate payment will be made for the installation of oakum in joints. Payment for this work will be included in the unit price bid for supplying and installing the culverts.

2.4.4.6 Gravel Material For Culverts

Measurement of gravel material for culverts will be made in cubic metres. Payment will be made at the unit price bid per cubic metre for "Granular Backfill - Culverts." This payment will be full compensation for processing, hauling and placing the gravel material, and all materials, labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for the supply of aggregate used for gravel material for culverts will be made in accordance with Specification 5.2, Supply of Aggregate.

Acceptable material obtained from within the highway right-of-way or from borrow locations will not be classified and paid for as "Granular Backfill - Culverts", but will be classified and paid for as "Common Excavation" or "Borrow Excavation" and "Overhaul" in accordance with Specification 2.3, Grading.

2.4.4.7 Culvert Installation and Removal on Roadways in Service

Where culverts are installed using staged construction, all costs associated with staging the work will be considered incidental and no separate or additional payment will be made.

Where the construction of detours is required, work associated with the construction and subsequent removal of detours will be measured and paid for at the applicable unit prices bid for the type of work incorporated. All costs associated with maintenance of detours will be considered incidental to the Work, and no separate or additional payment will be made.

2.4.4.8 Grouting of Abandoned Culverts

Measurement of grout will be by the cubic metre of grout material acceptably placed, measured to the nearest tenth of a cubic metre. The Contractor shall provide a suitable means of measuring the quantity of grout placed.

Payment will be made at the unit price bid for "Grouting of Abandoned Culverts", and will be full compensation for the supply and placement of grout; including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

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2.5 RIPRAP**2.5.1 GENERAL**

This specification covers the supply and placement of riprap. Riprap is a protective covering consisting of hand-laid or randomly deposited rock, sacked concrete or sacked cement stabilized material which is placed around culvert inlets and outlets and along slopes, embankments and ditches.

2.5.2 MATERIALS**2.5.2.1 General**

All materials necessary for riprap installations shall be supplied by the Contractor. Materials shall be resistant to weathering and water action. Sandstone or shale materials shall not be used.

Upon approval by the Consultant, sources of rock riprap material existing within the right-of-way limits, in gravel pits, or at other locations under the jurisdiction of the Department may be used, free of cost, by the Contractor.

2.5.2.2 Random Rock Riprap

Random rock riprap shall consist of a graded mixture of sound, durable stone or pit-run gravel.

The gradation of the mixture shall be such that 50 percent of the riprap consists of material having a least minimum dimension of 250 mm.

2.5.2.3 Hand-Laid Riprap**2.5.2.3.1 General**

Where hand-laid riprap is specified, the Contractor will have the option of supplying hand-laid rock riprap, sacked concrete riprap or sacked cement stabilized riprap. Materials supplied by the Contractor shall meet the following requirements.

2.5.2.3.2**2.5.2.3.3 Rock Riprap**

Hand-laid rock riprap material shall consist of sound, durable stones that meet the following Class 1M gradation requirements:

(Nominal Diameter of 175 mm)	Equivalent Diameter (mm)	Percentage (by weight) of Riprap Greater than Equivalent Diameter
	300	0%
	200	20% to 50%
	175	50% to 80%
	125	100%
Note: Sizes are equivalent spherical diameter, and are for guidance only. The minimum dimensions of any single rock shall not be less than one third of its maximum dimension		

2.5.2.3.4 Sacked Riprap

2.5.2.3.4.1 Burlap Sacks

Sacks for sacked riprap shall be 370 mm x 685 mm, 285 g burlap, with an approximate capacity of 0.03 m³. The bags shall be of sufficient strength to permit them to be lifted by the top corners of the bag when filled with the applicable materials.

2.5.2.3.4.2 Sacked Concrete Riprap

Concrete shall be manufactured in accordance with Specification 5.5, Supply of Portland Cement Concrete, for Class "S" Concrete.

Upon approval of the Consultant, clean, well graded pit-run gravel, in lieu of separated sand and gravel, may be used in the manufacture of concrete.

2.5.2.3.4.3 Sacked Cement Stabilized Riprap

Cement stabilized material shall be manufactured in accordance with Specification 3.9, Cement Stabilized Base Course, unless otherwise approved by the Consultant.

2.5.3 CONSTRUCTION

2.5.3.1 **Placing Random Rock Riprap**

Random riprap gravel shall be dumped over the area to be treated, until the required depth is attained. Manual handling of the material may be required.

2.5.3.2 **Placing Hand-Laid Riprap**

2.5.3.2.1 General

Hand-laid riprap shall be placed at culvert inlets and outlets, and at other locations as directed by the Consultant. Riprap aprons as shown on Drawing CB6-2.5M1 will only be required when specified in the Special Provisions or shown on the Drawings.

2.5.3.2.2 Rock Riprap

Stones shall be placed with their beds at right angles to the slope, the larger stones being placed first in the bottom courses and graduating to the smaller stones at the top. Stones shall be laid in close contact so as to break joints, and in such manner that the weight is carried by the earth and not by the adjacent stones. The spaces between the larger stones shall be filled with spalls, securely rammed into place. The finished work shall present an even, tight surface as shown on the Drawings and satisfactory to the Consultant.

2.5.3.2.3 Sacked Riprap

2.5.3.2.3.1 Preparation of Base

The base shall be formed by excavating, filling and shaping to the required depth below and parallel to the finished surface of the riprap. The entire base shall be thoroughly compacted to provide a smooth and firm foundation of uniform density.

2.5.3.2.4 Placement

Each burlap sack shall be filled to 70 percent of its capacity with concrete or cement stabilized material; securely sewn or stapled to form a straight edge closure; and immediately placed in its final position on the prepared base. The filled sack shall be placed to conform to the prepared base and adjacent sacks already in position; and to form a closely molded, smooth surface of uniform average depth of not less than 125 mm.

All joints between rows shall be staggered to pattern, and all dirt and debris shall be removed from the tops of the sacks before successive courses are placed.

Not more than five courses of sacks shall be placed in any tier before such time as initial set has taken place in the first course of any such tier.

Following placement, the sacked riprap shall be kept moist for a period of twenty-four hours by sprinkling with water, placement of a moist earth covering, or other means satisfactory to the Consultant.

2.5.4 MEASUREMENT AND PAYMENT

2.5.4.1 **Random Rock Riprap**

Measurement of random rock riprap will be by the cubic metre of material acceptably incorporated into the Work.

Payment will be made at the unit price bid for "Random Riprap - Supply and Place", and will be full compensation for supplying, processing, hauling and placing the material; including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.5.4.2 **Hand-Laid Riprap**

All costs associated with the supply and placement of hand-laid riprap at culvert installation locations, including any required riprap aprons, shall be included in the unit prices bid for the various types and sizes of culvert installations and no separate or additional payment will be made.

Measurement of hand-Laid riprap placed at locations other than for culvert installation, will be measured by the square metre.

Payment will be made at the unit price bid for "Hand-Laid Riprap - Other Locations - Supply and Place", and will be full compensation for bed preparation as required; the supply, processing hauling and placement of rock or sacked riprap material; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

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2.6 TOPSOIL PLACEMENT**2.6.1 GENERAL**

Topsoil placement consists of the placing and finishing of select topsoil material on the areas designated on the Drawings or as directed by the Consultant, for the purpose of establishing vegetation for erosion control.

Generally, those areas containing highly erodible soils such as sand; those areas containing sterile soils such as gravel; and those areas containing exposed subsoil which is subjected to highly erosive action such as in the case of flow channels, will be considered for a covering of topsoil.

2.6.2 MATERIALS**2.6.2.1 Topsoil**

Topsoil shall consist of a natural, friable surface soil of organic character suitable for agricultural purposes. Topsoil shall be free of objectionable quantities of sub-soil, roots, stones and other deleterious substances.

Topsoil shall be obtained from within the highway right-of-way unless otherwise described in the Special Provisions or directed by the Consultant.

The excavation and removal of topsoil from any source shall be under the direction of the Consultant, insofar as the selection of material and/or the exact location of excavation is involved.

2.6.3 CONSTRUCTION**2.6.3.1 General**

The excavation of the topsoil shall be carried out to the lines and depths as established by the Consultant. Topsoil shall be selected as to quality during excavation. Excavated material, which in the opinion of the Consultant, is not suitable for use as topsoil shall be disposed of as directed by the Consultant.

Topsoil placement shall be undertaken as either a single or two phase operation.

When topsoil placement is done in a single operation, the excavated topsoil shall be moved directly to its final position without intermediate stockpiling.

When done in two phases, the first phase of the work shall consist of excavating select topsoil from the designated sources and hauling to stockpile sites. Generally, stockpile sites shall be located within the highway right-of-way. The location of all sites shall be subject to the approval of the Consultant.

The second phase shall be undertaken when the highway grade is near completion. In this operation, the topsoil shall be excavated from the stockpiles, hauled and placed in its final position.

Upon completion of excavation, stockpile sites shall be trimmed to present a neat and tidy appearance, fences removed for purposes of entry shall be replaced, and debris resulting from the operation shall be removed and disposed of, all in a manner satisfactory to the Consultant.

2.6.3.2 Preparation of Placement Areas

Before placing the topsoil, the areas to be covered with topsoil shall be shaped to the uniform lines prescribed. The surface shall then be loosened to a minimum depth of 50 mm, by means of discs, spike-tooth harrows, or other means satisfactory to the Consultant.

2.6.3.3 Placing Topsoil

Topsoil shall be uniformly spread on the prepared areas, to the minimum required depth of 70 mm, or a greater depth as directed by the Consultant. If there is insufficient topsoil to attain a 70 mm depth throughout the Work, the Consultant may direct spreading topsoil to a lesser depth or over a lesser area. After spreading, all hard lumps shall be broken down and all rocks larger than 70 mm in dimension, roots, stumps, and other foreign matter shall be removed and disposed of in a manner satisfactory to the Consultant. After the topsoil has been spread, it shall be satisfactorily compacted. The area covered with topsoil shall be left in a condition suitable for seeding or planting, without additional preparation of any nature.

At the completion of topsoil placement, the adjacent roadway surface shall be cleaned of all debris resulting from the operation, and the completed work left in a neat and tidy condition.

2.6.4 MEASUREMENT AND PAYMENT

2.6.4.1 Excavation

Measurement and payment for excavation from the original source will be in accordance with Specification 2.3, Grading, for the classification of soil as described.

Excavation from intermediate stockpiles, where applicable, will be paid for at the unit price bid per cubic metre for "Common Excavation", in accordance with Specification 2.3, Grading. The quantity will be determined by cross-section measurement of the intermediate stockpiles.

2.6.4.2 Overhaul

Measurement and payment for overhaul will be made in accordance with Specification 2.3, Grading, except that for measurement of overhaul, distribution of topsoil will be considered to be of uniform depth over the area of topsoil placement. When intermediate stockpiling of topsoil is done, overhaul of topsoil material will be paid for from the source to the stockpile and from the stockpile to the final placement position, with 300 m of freehaul in each operation.

2.6.4.3 Topsoil Placement

Topsoil placement will be measured by the square metre of surface topsoiled based on horizontal measurements. No allowances will be made for uneven or sloping ground.

Payment will be made at the unit price bid per square metre, regardless of depth, for "Topsoil Placement". This payment will be full compensation for preparing the surface and placing the topsoil material.

Work on areas which were not specifically designated for topsoil placement, but were disposal areas or embankments constructed of surplus topsoil material, will not be classified or paid for as "Topsoil Placement", but will be paid for in accordance with Specification 2.3, Grading.

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2.7 UNDERGROUND ELECTRICAL CONDUITS**2.7.1 GENERAL****2.7.1.1 Description**

This specification covers the supply and installation of underground electrical conduit and appurtenances.

2.7.2 MATERIALS

All materials shall be supplied by the Contractor in accordance with Drawings CB6-2.7M1 and CB6-2.7M2 and the following:

2.7.2.1 Conduit

The Contractor shall supply the conduit with all necessary couplings, fittings and cement. Flexible conduit for underground electrical installation shall be heavy duty 75 psi medium density polyethylene made to quality assurance Z299.3.

Rigid conduit for underground electrical installation shall be either Polyvinyl Chloride (PVC), type DB2 or Reinforced Thermosetting Resin Conduit (RTRC) conforming to CSA Standards C22.2 No.211.1 and C22.2 No. 211.3 respectively.

2.7.2.2 Fish Wire

Fish wire (brace wire) shall be 3.66 mm soft galvanized wire with a minimum weight of 2.5 kg per 30.5 m of wire.

2.7.2.3 Conduit Locating Pins

Conduit locating pins shall be 450 mm X 12 mm bent steel, deformed bars, or 300 mm X 10 mm spikes, as required.

2.7.2.4 Select Backfill Material

Select backfill material may be the previously excavated material free of lumps and stones larger than 25 mm in diameter, sand, uncrushed rock not exceeding 25 mm in diameter, or crushed rock not exceeding 16 mm in diameter.

2.7.3 CONSTRUCTION**2.7.3.1 General**

The conduit shall be installed by either the trench excavation or pushed conduit method in accordance with Drawings CB6-2.7M1 and CB6-2.7M2. Underground conduit shall normally be trench excavated except where underground conduit is designated to be placed under existing pavement or surfacing structure, in which case the conduit shall be installed by the pushed conduit method.

The fish wire shall be placed in the conduit and wound around the conduit locating pins for future assistance in locating the ends of the conduit.

Conduit required to be installed concurrently with a grading operation shall be installed upon completion of the subgrade construction.

2.7.3.2 Saw-Cutting

Saw-cutting shall be in accordance with Specification 3.40, Cutting of Pavement.

2.7.3.3 Trench Excavation

A trench shall be excavated to the depth and grade required, and a base shall be formed to provide a firm foundation of uniform density throughout the length of the trench. The trench shall be no wider than necessary to permit satisfactory installation of the conduit and thorough compaction of the backfill material around the conduit. The excavation shall be carried out in such a manner as to cause the least possible damage to the adjacent embankment surface and other improvements.

Excavation through roadways open for use by public traffic shall be carried out in such a manner that not more than one traffic lane is restricted at any time.

2.7.3.4 Pushed Conduit

Installation by means of augering, drilling, or pushing shall be classified as pushed conduit. Pushed conduit shall be installed at a minimum depth of 0.8 m below the existing surface. The Contractor shall not be allowed to cut the existing surface without permission from the Consultant. Permission to cut the existing surface will not be considered unless the Contractor has made a minimum of three workmanlike attempts at each crossing and has been unable to successfully install the conduit by pushing.

The diameter of the auger or drill bit shall not exceed the diameter of the conduit by more than 50 mm.

2.7.3.5 Placing Conduit and Backfill

The conduit shall be placed in the prepared trench. Select backfill material shall be used in the first 0.15 m layer of backfill and shall be left untamped. The remaining backfill comprised of the previously excavated material or select backfill material shall be placed in layers not exceeding 0.15 m in depth and shall be thoroughly compacted for the full limits of the trench. Excess excavated material shall be deposited in embankment or uniformly distributed, as directed by the Consultant, and any disturbed areas shall be shaped and left in a neat and tidy condition.

When excavation of trenches for installation of conduit requires the removal of concrete, asphalt pavement, asphalt bases and/or base materials, the Contractor shall replace and reconstruct the disturbed portion of the surface with materials of equal quality. The Work shall be left in a condition satisfactory to the Consultant and shall conform with the adjacent surface.

Flexible conduit shall be placed in continuous lengths with no joints between junction or pole bases.

Rigid conduits may be jointed with approved couplings cemented in accordance with the Manufacturer's instructions.

2.7.4 MEASUREMENT AND PAYMENT**2.7.4.1 Underground Electrical Conduit - Trench Excavation**

Conduit installed by the trench excavation method will be measured by the length in metres of conduit pipe complete in place.

Conduit installed by the trench excavation method will be paid for at the unit price bid per metre for "Underground Electrical Conduit - Supply and Install - Trench Excavation". This payment will be full compensation for excavating and preparing the base, supplying, hauling and placing select backfill material, supplying and installing all conduit materials, backfilling, compacting, site restoration, traffic accommodation, and all labour, equipment, tools and incidentals necessary to complete the Work in accordance with the Drawings and Specifications herein.

Replacement and reconstruction of disturbed portions of the subgrade will not be measured or paid for separately, but shall be considered incidental to the Work.

2.7.4.2 Underground Electrical Conduit - Pushed Conduit

Pushed conduit installation will be measured by the length in metres of the augered hole. Any remaining conduit extending beyond the augered hole will be measured as "Underground Electrical Conduit - Trench Excavation".

Pushed conduit installation will be paid for at the unit price bid per metre for "Underground Electrical Conduit - Supply and Install - Pushed Conduit". This payment will be full compensation for traffic accommodation, excavating, preparing and backfilling of the pit excavations, supplying and installing all conduit materials, compacting, site restoration, and all labour, equipment, tools and incidentals necessary to complete the Work in accordance with the Drawings and Specifications herein.

2.7.4.3 Saw-Cutting

Payment for Saw-Cutting shall be in accordance with Specification 3.40, Cutting of Pavement.

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2.8 PERFORATED PIPE SUBDRAINS**2.8.1 GENERAL**

This work shall consist of trenching, supplying and installing perforated pipe wrapped in filter fabric and backfilling with select filter material at locations and to the depth and grade as established by the Consultant.

2.8.2 MATERIALS**2.8.2.1 Perforated Pipe**

The Contractor shall supply perforated pipe in accordance with Specification 5.23, Supply of Corrugated Metal Pipe and Pipe Arches, or Specification 5.24, Supply of Polyethylene Pipe.

2.8.2.2 Filter Fabric

The filter sock or filter fabric material for wrapping the perforated pipe shall meet the requirements of Type "A" Non-Woven in accordance with Specification 5.31, Geotextile.

2.8.2.3 Filter Material

The Contractor shall supply filter material composed of hard, durable mineral particles free from organic matter, clay balls, soft particles and other deleterious materials and meeting the gradation requirements specified in Specification 3.2, Aggregate Production and Stockpiling, for Designation 8 Class 25 material. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

2.8.3 CONSTRUCTION**2.8.3.1 Trench Excavation**

Trenches shall be excavated to depths and grades as established by the Consultant. The trench shall be kept as narrow as practicable and still permit jointing to be done. The minimum width of the trench shall be the inside diameter of the pipe plus 0.25 m. The bottom of the trench shall be stable to afford a firm and uniform bearing throughout the entire length of the culvert. Where the bottom of the trench is in an impervious layer which has become wet and puddled, gravel material shall be added to stabilize the bottom. However, the depth of gravel material shall be kept to a minimum to prevent possibilities of water flow under the subdrain pipe.

2.8.3.2 Pipe Installation

Perforated pipe shall be installed to the depth and grade established by the Consultant. Perforations shall be oriented in directions as indicated by the Consultant, in accordance with the requirements for either collecting or carrying of water.

2.8.3.3 Filter Fabric Installation

The perforated pipe shall be wrapped with filter fabric or fitted with a filter fabric sock prior to installation.

2.8.3.4 Trench Backfill

The subdrain trench shall be backfilled with pervious filter material conforming to Subsection 2.8.2.3. Filter material shall be placed in 0.15 m layers, shall be thoroughly tamped and carried to a minimum of 0.15 m above the seepage zone, or to height as directed by the Consultant. The remainder of the trench shall be backfilled with impervious material and thoroughly compacted.

2.8.4 MEASUREMENT AND PAYMENT**2.8.4.1 Trench Excavation**

Measurement and payment for excavation for the subdrain trench will be made in accordance with Specification 2.3, Grading, for the various classes of material excavated.

2.8.4.2 Supply and Install Perforated Pipe Subdrain

Measurement for the supply and installation of perforated pipe subdrains will be in metres, measured along the pipe invert. Payment will be made at the unit price bid per metre for "Perforated Pipe". This payment will be full compensation for preparation of the bottom of the trench, supplying and installing the pipe and filter fabric and backfilling of the trench.

2.8.4.3 Filter Material

Payment for filter material for backfilling will be made at the unit bid per cubic metre for "Filter Material". This payment will be full compensation for processing, hauling and placing the material as specified.

2.8.4.4 Supply of Aggregate

Payment for the supply of aggregate will be made in accordance with Specification 5.2, Supply of Aggregate.

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2.9 SALVAGE OF BASE COURSE AND PAVEMENT MATERIAL**2.9.1 GENERAL****2.9.1.1 Description**

This work shall consist of the salvaging and stockpiling of existing surface and/or base course materials, in accordance with these specifications and in conformity with the Drawings and locations provided, or as directed by the Consultant

2.9.2 CONSTRUCTION**2.9.2.1 Salvaging and Stockpiling**

Where directed by the Consultant, the existing surface and/or base course material shall be carefully salvaged and stockpiled. Salvaged surface course material shall be pulverized and blended with the salvaged base course gravel.

Stockpiles shall be placed at locations designated by the Consultant, and shall be uniform in dimension and accessible for loading. Where directed by the Consultant, the salvaged material shall be loaded, hauled, spread and compacted on the finished roadbed.

2.9.2.2 Use of Salvaged Material

When directed by the Consultant, salvaged material shall be excavated from the stockpiles, hauled, spread and compacted on sections of completed subgrade as indicated.

2.9.2.3 Excavation and Recompaction of Subgrade

Where directed by the Consultant, subgrade exposed by the salvage of surface and base materials shall be excavated and/or recompacted to the depth and grade established.

2.9.3 MEASUREMENT AND PAYMENT**2.9.3.1 Excavation of Base Course or Pavement Material**

Base course or pavement material excavated and stockpiled or used on the roadway will be measured in cubic metres in its original position. The quantity as measured will be paid for at the applicable unit price bid per cubic metre for "Salvage Base Course and Pavement Materials (Haul by Trucks)" or "Salvage Base Course and Pavement Materials (Haul Using Grading Equipment)". These payments will be compensation in full for excavating, pulverizing, blending, stockpiling where required, or spreading and compacting directly on the finished roadway, and all labour, equipment, tools and incidentals necessary to complete the Work. When hauling is by trucks, the payment includes the costs of loading and truck hauling. When the material is hauled using grading equipment, separate payment will normally be made for overhaul. If the Contract does not contain a bid item for Overhaul, haul will be considered incidental to the Work.

2.9.3.2 Use of Salvaged Material from Stockpile Using Trucks

Stockpiled material truck-hauled and used as shown in the Contract or determined by the Consultant will be measured by the cubic metre as determined in the original stockpile position.

Payment will be made at the unit price bid per cubic metre for "Salvage Base Course and Pavement Materials (Haul by Trucks)". This payment will be full compensation for the excavation or loading from stockpile, hauling to the road, spreading and compacting on the roadway and for all labour, equipment, tools and incidentals necessary to complete the Work.

2.9.3.3 Use of Salvaged Material from Stockpile Using Grading Equipment

Stockpiled material used as shown in the Contract or determined by the Consultant and hauled using grading equipment will be measured by the cubic metre as determined in the original stockpile position.

Payment will be made at the unit price bid per cubic metre for "Salvage Base Course and Pavement Materials (Haul Using Grading Equipment)". This payment will be full compensation for the excavation or loading from stockpile, spreading and compacting on the roadway and for all labour, equipment, tools and incidentals necessary to complete the Work.

2.9.3.4 Overhaul

When salvaged material is hauled, using grading equipment, a distance of more than 300 m from a source (road or stockpile) to a stockpile or to the completed subgrade, overhaul will be calculated and paid for on the cubic metre kilometre basis, in accordance with Specification 2.3, Grading.

2.9.3.5 Excavation and/or Reworking Subgrade

- (i) Where subgrade preparation is required on subgrade exposed by salvage operations, it will be measured and paid for in accordance with the provisions of Specification 3.1, Subgrade Preparation.
- (ii) When unit prices for excavation under Specification 2.3, Grading, are contained in the Contract, excavation and/or embankment required on subgrade exposed by salvage operations will be measured and paid for in accordance with Specification 2.3, Grading.
- (iii) When no unit prices for excavation under Specification 2.3, Grading, are contained in the contract, excavation and/or embankment required on subgrade exposed by salvage operations will be measured and paid for in accordance with the applicable provisions of Specification 3.1, Subgrade Preparation.

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2.10 MANHOLES, INLETS AND CATCH BASINS**2.10.1 GENERAL****2.10.1.1 Description**

This work shall consist of supplying materials and constructing manholes, inlets and catch basins of concrete, with or without steel reinforcement as specified, and of precast reinforced concrete units, complete with necessary frames, castings and fittings in accordance with these specifications; and at the locations and in accordance with the dimensions, lines, elevations and design shown on the Drawings.

All references to "Standards" or "Specifications" refer to the latest edition at the time of tender.

2.10.2 MATERIALS

The Contractor shall supply all materials required in accordance with the applicable Specifications.

2.10.2.1 Aggregate

The Contractor shall produce aggregate materials for backfill in accordance with Specification 3.2, Aggregate Production and Stockpiling. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

2.10.2.2 Concrete

All materials for the manufacture of concrete shall be supplied by the Contractor and shall comply with requirements specified in Specification 5.5, Supply of Portland Cement Concrete. Class "B" air-entrained Portland Cement Concrete shall be used, unless otherwise specified or shown on the Drawings.

2.10.2.3 Reinforcing Bars and Wires

Steel reinforcing bars shall be deformed bars in accordance with the most recent edition of CSA G30.12 - M "Billet Steel Bars for Concrete Reinforcement".

Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements of the latest edition of CSA G30.5.

2.10.2.4 Precast Reinforced Concrete

Precast reinforced concrete units shall be as specified in the Contract and shall be supplied by the Contractor.

2.10.2.5 Concrete Block Units

Concrete block for the construction of concrete block units shall be supplied by the Contractor. Concrete masonry blocks used for construction of manholes, inlets, and catch basins shall conform to the requirements of A.S.T.M. Designation C139.

2.10.2.6 Mortar

Mortar shall be composed of one part Portland cement and two parts fine aggregate by volume. Materials for the manufacture of mortar shall be supplied by the Contractor.

2.10.2.7 Frames, Castings and Fittings

All required metal frames, castings and fittings shall be supplied by the Contractor.

2.10.3 SAMPLING AND TESTING

Sampling and testing of cast-in-place concrete shall meet the requirements of Specification 5.5, Supply of Portland Cement Concrete.

2.10.4 CONSTRUCTION**2.10.4.1 Preparation of Base**

Foundation pits for manholes, inlets and catch basins shall be excavated to elevations established by the Consultant, and shall be of sufficient size to accommodate the entire dimensions of the structure and foundation slab. All soft and yielding, or other unsuitable material, when encountered at foundation elevation, shall be removed to depth as required and replaced with acceptable gravel backfill. The backfill shall be placed in uniform layers not exceeding 0.15 m in depth and thoroughly compacted. The base shall be finished to provide a smooth and firm surface.

2.10.4.2 Forms

Forms for poured-in-place structures shall be of wood or metal, straight and free from distortion and of sufficient strength to resist springing during the process of depositing and tamping the concrete. All forms shall be thoroughly cleaned and oiled before the concrete is placed therein.

2.10.4.3 Reinforcing Steel

Reinforcing steel shall be accurately placed, and during placing of concrete firmly held in the position shown on the Drawings by means of stays, blocks, ties, hangers or other approved devices.

2.10.4.4 Mixing and Placing Concrete

Concrete for poured-in-place manholes, inlets, catch basins and foundation slabs shall be proportioned and mixed in accordance with requirements specified in Specification 5.5, Supply of Portland Cement Concrete.

Concrete shall be placed in such manner as to avoid segregation, spread in horizontal layers when practicable and consolidated sufficiently to eliminate all voids.

Exposed surfaces shall be thoroughly floated with a moist wooden float to produce a uniform even surface, and edges rounded with an approved finishing tool having a radius of 5 mm.

2.10.4.5 Precast Reinforced Concrete Units

Precast reinforced concrete units shall be constructed on poured-in-place foundations, in accordance with the details shown on the Drawings. All structures shall have the lower section

from the foundation to the top of the inlet and outlet pipes built up with poured-in-place concrete. Precast units shall be used for the structure above the top of the pipe inlets or outlets. All joints of the precast unit shall be sealed with mortar.

Inlet or outlet pipe entering precast units of the structure shall be accommodated in precast holes, having a diameter 75 mm larger than the outside diameter of the pipe. No holes for inlet or outlet pipes shall be made in precast units at the site of the work, unless otherwise directed by the Consultant.

Pipes placed in foundation slabs or precast units shall extend through the walls and beyond the outside surface a sufficient distance to allow for connections. Joints around pipes entering precast units shall be carefully sealed with mortar to prevent leakage.

2.10.4.6 Concrete Block Units

Concrete block units shall be constructed on poured-in-place foundations in accordance with the details shown on the Drawings. All joints of the concrete block units shall be sealed with mortar.

Pipes placed in foundation slabs or concrete block units shall extend through the walls and beyond the outside surface a sufficient distance to allow for connections. Joints around pipes entering precast units shall be carefully sealed with mortar to prevent leakage.

2.10.4.7 Ladder Rungs

Galvanized metal ladder rungs shall be installed in all poured-in-place structures having a depth greater than 1 m. When ladder rungs are required in structures constructed of precast units, the units shall be supplied with ladder rungs installed.

2.10.4.8 Frames, Castings and Fittings

Metal frames and fittings shall be set in the concrete true to line and elevation, as established and as required to fit the adjacent surfaces.

Castings shall be set in full mortar beds, or otherwise secured, as shown on the Drawings.

2.10.4.9 Cleaning

Upon completion, each manhole, inlet, and catch basin shall be thoroughly cleaned of any accumulations of silt, debris, or other foreign matter, and shall be maintained free of such accumulations until final acceptance of the Work.

2.10.4.10 Backfill

After the concrete or mortar has set sufficiently, approved granular backfill material shall be placed and thoroughly compacted in layers not exceeding 0.15 m in depth. The backfill shall be neatly graded off flush with the top of the structure, or to depth as directed by the Consultant, and the completed work left in a neat and tidy condition.

2.10.4.11 Adjusting Existing Manholes, Catch Basins and Water Valves

Where specified, the height of existing manhole, catch basin and water valve frames and covers shall be adjusted to match the elevation of a new surface by means of bricks and mortar or precast risers and mortar or cast iron extension rings as directed by the Consultant. The maximum amount of adjustment allowed using bricks, risers or extension rings is 300 mm.

Adjustments in excess of 300 mm will require alterations of the manhole, catch basin or water valve barrel in conjunction with adjustment of the frame and cover as described above.

2.10.5 MEASUREMENT AND PAYMENT

2.10.5.1 **Preparation of Base**

Excavation of foundation pits and preparation of the base will not be measured and paid for separately, but shall be included in the prices bid for manholes, inlets and catch basins.

2.10.5.2 **Manholes, Inlets and Catch Basins**

Manholes, inlets and catch basins, of dimensions and standard depths as shown on the Drawings, will be measured by the unit complete in place. Structures which exceed the standard depth shown on the Drawings will be measured by the unit of standard depth complete in place, plus the vertical length in excess of the standard depth as measured by the metre.

The depth of the structures will be measured from the top of the foundation slab to the top of the manhole cover, or to the flow line of the inlet grating of catch basin or inlets.

Payment will be made at the unit price bid each for "Manholes, Inlets and Catch Basins", of standard depth and type as specified and at the unit price bid per metre for corresponding vertical length in excess of standard depths. These payments will be full compensation for excavating and preparing the base; supplying all required materials for manufacture of concrete and mortar; supplying all specified precast units, placing all materials; placing backfill; and all labour, equipment, tools and incidentals necessary to complete the Work in accordance with the Drawings and Specifications.

2.10.5.3 **Placing Reinforcing Steel**

Payment for reinforcing steel incorporated into the Work will be either on a lump sum basis or will be measured by the kilogram as identified in the Contract. When measurement is by the kilogram the total weight will be determined using the theoretical weight of bars as shown in the following table:

BAR NUMBER	10	15	20	25	30	35	45	55
WEIGHT kg/m	0.785	1.570	2.355	3.925	5.495	7.850	11.775	19.625

Payment for placing reinforcing steel will be made either at the lump sum price bid or the unit price bid per kilogram for "Reinforcing Steel", as applicable.

2.10.5.4 **Backfill**

Backfilling will not be measured or paid for separately, but shall be included in the price bid for manholes, inlets and catch basins.

2.10.5.5 Adjusting Existing Manholes, Catch Basins and Water Valves

Payment for adjusting the elevation of manholes, catch basins and water valves will be made at the unit price bid per unit for "Adjust Manhole", "Adjust Catch Basin" and "Adjust Water Valve" and will be considered full compensation for all materials, equipment, labour, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for adjustment of the barrels for manholes, catch basins and water valves will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General..

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2.12 FENCING**2.12.1 GENERAL**

Fencing consists of the supply and installation of fence, gates and related appurtenances of the class or classes specified, in accordance with these specifications; as shown on the Drawings; or as directed by the Consultant.

Where specified, existing fence shall be removed and disposed of, or removed and re-installed to the satisfaction of the Consultant.

2.12.2 FENCE CLASSIFICATIONS

Fencing will be classified according to type as follows:

- Class A: 3 barbed wires with wooden posts at 5.0 m maximum spacing (Dwg. CB6-2.12M1)
- Class B: 4 barbed wires with wooden posts at 3.75 m maximum spacing (Dwg. CB6-2.12M2)
- Class C: 2 barbed wires and 813 mm paige wire with wooden posts (Dwg. CB6-2.12M3)
- Class D: 2 barbed wires and 914 mm paige wire with wooden posts (Dwg. CB6-2.12M4)
- Class E: 2 barbed wires and 1 066 mm paige wire with wooden posts (Dwg. CB6-2.12M5)
- Class F: 2 134 mm paige wire with wooden posts (Dwg. CB6-2.12M7)
- Class G: 4 barbed wires with wooden posts at 5.0 m maximum spacing (Dwg. CB6-2.12M8)
- Class H: Chain link Fence

Details of each classification are shown on the Drawings. The use of alternative Class B fencing as shown on Drawings CB6-2.12M2A and CB6-2.12M11 will be permitted only when specified or otherwise approved by the Consultant.

2.12.3 MATERIALS

The Contractor shall supply all materials necessary for the installation of new fencing and the re-installation of existing fencing. Materials shall be supplied in accordance with the requirements of Specification 5.14, Supply of Fence Material.

2.12.4 CONSTRUCTION**2.12.4.1 General**

Fencing shall be installed at the locations shown on the Drawings or as designated by the Consultant.

Fence installation shall be carried out as shown on the Drawings; in accordance with these specifications; and as directed by the Consultant.

2.12.4.2 Clearing for Fence Installation

All trees, brush, or other obstacles which may interfere with fence construction shall be removed prior to commencing fence installation. The resulting debris shall be disposed of to the satisfaction of the Consultant.

2.12.4.3 Wood Posts

The posts shall be set in holes to the required depth; and tamped in a plumb and firm position to the lines and spacings shown on the Drawings or as directed by the Consultant. Post holes shall be large enough to allow for proper tamping. Posts shall be set with the large end down. Backfill shall be placed in layers not exceeding 0.15 m, and compacted by hand tampers, machine tampers, or other suitable equipment. Completed backfill shall be crowned slightly to permit drainage away from the posts.

Driving of posts, including methods employing drilled pilot holes, will only be permitted if the results of these methods produces a satisfactory, uniform, undamaged, plumb installation with the post firmly implanted into the soil to the specified depth. If, in the opinion of the Consultant, the results obtained from the driving of posts unsatisfactory, then this method shall be discontinued.

Sharpening of posts will not be permitted.

Intermediate brace posts shall be erected in conformance with the maximum spacing requirement shown on the Drawings and at any additional locations that may be designated by the Consultant.

2.12.4.4 Metal Stays and Reflective Tubing

Where applicable, metal stays shall be installed to the lines and spacings shown on the Drawings, or as directed by the Consultant. Fence wire shall be placed into the pre-punched slots of the metal stay and locked in place with a keeper wire inserted into the back of the metal stay. Reflective tubing shall be installed between the top wire and the second wire at each metal stay as shown on the Drawings.

2.12.4.5 Wire

Fence wire shall be pulled tight with hand stretchers or other approved tensioning apparatus capable of adjustment. The use of tractors or trucks for tightening the fence wire will not be permitted unless the pull is controlled by an adjustable tensioning apparatus.

2.12.4.6 Gates

Openings for gates shall be provided at locations shown on the Drawings, or as designated by the Consultant.

Gates shall be constructed as shown on the Drawings or as directed by the Consultant.

2.12.4.7 Taking Down and Re-erecting Existing Fence

Where specified, existing fences shall be taken down, the materials carefully salvaged, and the fence re-erected to the satisfaction of the Consultant.

Materials which are not suitable for re-installation, as determined by the Consultant, shall be disposed of at an approved location. Replacement materials necessary for the re-installation of

the fence shall be supplied by the Contractor. Payment for the supply of these materials will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

Existing fencing materials damaged as a result of the Contractor's operations shall be replaced by the Contractor at his expense.

2.12.4.8 Removal and Salvage of Existing Fence

Where removal and salvage of existing fencing is specified, the Contractor shall carefully take down the existing fence and salvage the materials. Salvaged materials shall be stockpiled at locations designated by the Consultant.

Materials which are not suitable for salvage, as determined by the Consultant, shall be disposed of at an approved location.

2.12.4.9 Removal and Disposal of Existing Fence

Where removal and disposal of existing fences is specified, the Contractor shall completely remove the fence and dispose of the materials at an approved location.

2.12.4.10 Chain Link Fence Construction

2.12.4.10.1 Site Preparation

The Contractor shall carry out minor leveling or landscaping of the ground, as necessary, to ensure that the fence can be installed with a consistent elevation or slope and follow ground contours smoothly without any sharp changes in grade.

2.12.4.10.2 Post Location

Line posts shall be set a maximum of 3.0 m apart, measured parallel to the ground surface.

Corner posts shall be installed where the alignment change exceeds 20 degrees.

Where end or corner posts are more than 150 m apart over reasonably smooth grade, the Contractor shall set straining posts at equal intervals not exceeding 150 m on a straight continuous stretch of fence. The Contractor shall set additional straining posts at sharp changes in grade and where designated by the Consultant.

2.12.4.10.3 Post Setting

Post holes shall be dug or drilled to the following minimum diameters and depths that will allow at least 150 mm of footing below the bottom of the post:

Fabric Height (m)	1.5	1.8	2.1	2.4
Line post hole diameter (mm)	200	250	250	250
Line post depth (m)	0.9	0.9	0.9	0.9
Terminal Post hole diameter (mm)	300	360	360	360
Terminal Post depth (m)	1.2	1.2	1.2	1.2

Concrete footings shall be constructed by placing concrete in the post holes and embedding the posts to a minimum depth below ground of 0.75 m for line posts and 1.05 m for terminal posts. The concrete shall be extended 50 mm above ground level and crowned to drain away from the post. Posts shall be braced in plumb position and true to alignment and elevation until the

concrete has set. The concrete footings shall be allowed to cure for a minimum of 5 days before proceeding with further work.

2.12.4.10.4 Top Rail

Top rails shall be supported at each line post with a line post cap so that a continuous brace is formed between terminal posts. The rails shall be joined with sleeves to allow for expansion and contraction. Connections to terminal posts shall be made securely using rail ends and brace bands.

2.12.4.10.5 Terminal Post Bracing

Braces shall be installed from end and gate posts to the nearest line post at mid-panel and parallel to the top rail. Braces shall be installed on both sides of corner and straining posts in a similar manner.

2.12.4.10.6 Bottom Tension Wire

A tension wire shall be installed within the bottom 150 mm of fabric. The wire shall be stretched taut and free of sag; and be fastened securely to the end, corner, gate and straining posts with tension bands and turnbuckles.

2.12.4.10.7 Chain Link Fabric

The fabric shall be placed on the outside of the enclosed area unless otherwise directed by the Consultant. The bottom of the fabric shall be 50 mm above the finished ground. The fabric shall be stretched to tension as recommended by the Manufacturer; and fastened to the end, corner, gate and straining posts with tension bands at 300 mm spacing. The fabric shall also be secured to line posts, top rails and the bottom tension wire with tie wire at 450 mm intervals. The tie wire shall have a minimum of 2 twists. Once installed and tensioned, the fabric shall have a smooth uniform appearance satisfactory to the Consultant, and be free of sags, dents and bulges.

2.12.4.10.8 Damaged Surfaces

Damaged surfaces shall be cleaned with a wire brush to remove loose and cracked spelter coatings, followed by the application of two coats of an approved zinc rich paint over the damaged areas.

2.12.5 MEASUREMENT AND PAYMENT

2.12.5.1 **Measurement**

Measurement for the supply and installation of new fencing; and the taking down and re-erecting or disposal of existing fence will be by the metre or kilometre, complete in place; including the length across constructed, installed or re-erected gates.

For fencing installed parallel to the highway, length measurement will be calculated on the basis of through highway centreline chainage. For all other installations, actual length measurements will be made.

2.12.5.2 Payment**2.12.5.2.1 Supply and Installation of New Fence**

Payment will be made at the unit price bid for "New Fence - Supply and Install", for the applicable class; and will be full compensation for the supply and installation of the fence complete in place including gates; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.12.5.2.2 Taking Down and Re-Erecting Existing Fence

Payment will be made at the unit price bid for "Taking Down and Re-erecting Existing Fence", for the applicable class; and will be full compensation for taking down, salvaging and re-erecting the fence; including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Disposal of materials deemed by the Consultant to be unsuitable for re-installation, if required, will be considered incidental to the Work, and no separate or additional payment will be made.

2.12.5.2.3 Removal and Salvage of Existing Fence

Payment will be made at the unit price bid for "Remove and Salvage of Existing Fence". This payment will be full compensation for removing and stockpiling salvaged materials and/or disposing of unsalvageable materials; and for all equipment, tools, labour and incidentals necessary to complete the Work.

Disposal of materials deemed by the Consultant to be non-salvageable, if required, will be considered incidental to the Work, and no separate or additional payment will be made.

2.12.5.2.4 Removal and Disposal of Existing Fence

Payment will be made at the unit price bid for "Remove and Dispose of Existing Fence", and will be full compensation for all labour, equipment, tools, labour and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.12.5.2.5 Clearing Fence Line

All costs associated with the removal and disposal of trees, brush or other obstacles required for fence installation will be paid for in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

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2.13 LIVESTOCK GUARDS**2.13.1 GENERAL****2.13.1.1 Description**

This work shall consist of the installation of livestock guards of the type and to the dimensions, lines, elevations and design shown on the Drawings and in accordance with these specifications, at locations as shown on the Drawings or as directed by the Consultant.

2.13.2 MATERIALS**2.13.2.1 Concrete**

All materials for the manufacture of concrete shall be supplied by the Contractor and shall comply with the requirements of Specification 5.5, Supply of Portland Cement Concrete. Class "B" air-entrained portland cement concrete shall be used unless otherwise specified or shown on the Drawings.

2.13.2.2 Livestock Guards

Livestock guards shall be fabricated and supplied by the Contractor in accordance with Specification 5.21, Supply of Livestock Guards. All materials including anchor bolts, U-bolts, protection angles, rail type or drill stem decking, treated timber and all nuts, washers and incidental hardware shall be supplied by the Contractor.

2.13.3 SAMPLING AND TESTING

Sampling and testing of cast-in-place concrete shall meet the requirements of Specification 5.5, Supply of Portland Cement Concrete.

2.13.4 CONSTRUCTION**2.13.4.1 Preparation of Base**

Foundation pits for livestock guards shall be excavated to elevations established by the Consultant, and shall be of sufficient size to accommodate the entire dimensions of the structure and footing slabs. All soft and yielding or other unsuitable materials, when encountered at foundation elevation, shall be removed to depth as required and replaced with acceptable granular backfill. The backfill shall be placed in layers not exceeding 0.15 m in depth and thoroughly compacted. The base shall be finished to provide a smooth and firm surface.

2.13.4.2 Forms

Forms shall be of wood or metal, straight and free from distortion, and of sufficient strength to resist springing during the process of placing and tamping the concrete. All forms shall be thoroughly cleaned and oiled before placing concrete therein.

2.13.4.3 Reinforcing Steel

Reinforcing steel shall be accurately placed, and during placing of the concrete firmly held in the position shown on the Drawings by means of stays, blocks, ties, hangers, or other approved devices.

2.13.4.4 Mixing and Placing Concrete

Concrete for livestock guards shall be proportioned and mixed in accordance with the requirements of Specification 5.5, Supply of Portland Cement Concrete.

Concrete shall be placed in such a manner as to avoid segregation, shall be spread in horizontal layers when practicable, and shall be consolidated sufficiently to eliminate all voids.

Exposed surfaces shall be thoroughly floated and finished to produce a uniform, even surface, and edges rounded with an approved finishing tool having a radius of 5 mm.

2.13.4.5 Connections

All bolt connections shall be securely tightened.

2.13.4.6 Backfill

After the concrete has attained sufficient strength, forms shall be removed and approved backfill material shall be placed as required, and thoroughly compacted in layers not exceeding 0.15 m in depth. The backfill shall be graded flush with the top of the structure, or to elevation as directed by the Consultant, and the work left in a neat and tidy condition.

2.13.4.7 Cleaning and Maintenance

Upon completion, livestock guards shall be free draining, cleaned of any accumulation of soil, debris, or other foreign matter, and maintained in this condition until final acceptance of the Work.

2.13.4.8 Remove and Dispose of Livestock Guards

Livestock guards, as shown on the Drawings and/or as directed by the Consultant, shall be removed and disposed of in a manner satisfactory to the Consultant. All materials shall become the property of the Contractor and the site shall be left in a neat and tidy condition.

2.13.4.9 Remove and Reinstall Livestock Guards

Where specified, existing livestock guards shall be removed, the materials carefully salvaged, and the livestock guards reinstalled in accordance with the Drawings; Special Provisions; Specifications; and at a location as directed by the Consultant. Materials damaged through the negligence of the Contractor shall be replaced at his own expense.

2.13.4.10 Install and Remove Temporary Livestock Guards

Prior to the commencement of operations in areas as shown on the Drawings or defined in the Special Provisions, the Contractor shall supply, install and maintain temporary livestock guards in accordance with the applicable Drawings. Upon completion of operations in these areas the Contractor shall remove the livestock guards and restore the areas to the satisfaction of the Consultant.

2.13.5 MEASUREMENT AND PAYMENT**2.13.5.1 Supply and Installation of Livestock Guards**

Measurement for the supply and installation of livestock guards will be made by the unit, complete in place, for the type and width specified.

Payment will be made at the applicable price bid per unit for "Standard Livestock Guard - Supply and Install", "Range Type Livestock Guard - Supply and Install" and "Off-Highway Type Livestock Guard - Supply and Install". This payment will be full compensation for supplying the livestock guard; excavating and preparing the base; driving piles and constructing plank sheathing where applicable; backfill; and installing the livestock guard.

2.13.5.2 Remove and Dispose of Livestock Guards

Payment for the removal and disposal of livestock guards will be made at the price bid per unit for "Remove and Dispose of Livestock Guards". This payment will be full compensation for removing, hauling, and disposing of the material at a location suitable to the Consultant and restoring the site.

2.13.5.3 Remove and Reinstall Livestock Guards

Payment for the removal and reinstallation of livestock guards will be made at the price bid per unit for "Remove and Reinstall Livestock Guards". This payment will be full compensation for removing the existing guards, and for loading, hauling, unloading and reinstalling the livestock guards in accordance with the Drawings; Special Provisions and Specifications; and at the location as directed by the Consultant.

2.13.5.4 Install and Remove Temporary Livestock Guards

Payment for this work will be made at the price bid per unit for "Install and Remove Temporary Livestock Guard". This payment will be full compensation for supplying the temporary livestock guard, installing, maintaining and removing the unit, and restoring the site to the satisfaction of the Consultant.

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2.15 METAL BIN RETAINING WALL**2.15.1 GENERAL****2.15.1.1 Description**

This work shall consist of the construction of metal bin-type retaining walls in accordance with these specifications and in conformity with the dimensions and designs shown on the Drawings, at locations as indicated and to lines and grades as established by the Consultant.

2.15.2 MATERIALS**2.15.2.1 Metal**

The Contractor shall supply all materials required for the construction of the retaining wall in accordance with Specification 5.30, Supply of Metal Bin Retaining Wall.

2.15.2.2 Gravel Backfill Material

The Contractor shall produce aggregate for the gravel material for backfill in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Classification of materials specified or as approved by the Consultant. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

2.15.3 CONSTRUCTION**2.15.3.1 Preparation of Base**

Rough excavation for the site of the retaining wall shall be made to the elevation of the finished ground line at the face of the wall. Below this point, trenches 0.45 m in width shall be excavated for the four sides of the bins to depths established by the Consultant. All soft and yielding or other unsuitable material, when encountered at the base elevation, shall be removed and replaced with acceptable backfill. The base shall be thoroughly compacted and finished to a smooth, firm surface, in conformance with the lines and grades shown on the Drawings or as established by the Consultant.

2.15.3.2 Assembly

The base plates of the columns shall be accurately established to the line and grade necessary to provide a 1:6 batter. The retaining wall shall be erected by connecting the members with bolts, to form bins conforming to the dimensions shown on the Drawings. The columns shall be checked for batter during the placing of the members and before the assembly bolts are tightened.

Members shall be carefully handled during erection, and any which are damaged shall be removed and replaced with new members, by the Contractor, at his own expense.

2.15.3.3 Backfill

The backfill for the interior of the bins shall be approved gravel material, free from large boulders, placed in layers not exceeding 0.15 m in depth, and compacted by means of mechanical tampers of a type satisfactory to the Consultant.

The backfill behind the wall shall be material common to the site where the structure is being erected, and shall progress with the filling of the bins at all times.

2.15.4 MEASUREMENT AND PAYMENT**2.15.4.1 Excavation of Site**

Excavation for the site of the retaining wall and backfill behind the wall will be measured and paid for in accordance with Specification 2.3, Grading.

2.15.4.2 Metal Bin Retaining Wall

Metal bin-type retaining walls will be measured by the square metre of face area for each design depth of wall complete in place.

When more than one design of retaining wall is specified, the designs will be shown by letter suffixes following the pay item.

Payment will be made at the unit price bid per square metre for "Metal Retaining Wall" of design as specified. This payment will be full compensation for preparation of the base; supply and construction of the retaining wall; placement of backfill material; and all labour, equipment, tools, and incidentals necessary to complete the Work.

2.15.4.3 Supply of Aggregate

Payment for the supply of aggregate will be made in accordance with Specification 5.2, Supply of Aggregate.

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2.17 REMOVAL OF MISCELLANEOUS STRUCTURES**2.17.1 GENERAL****2.17.1.1 Description**

This work shall consist of removing concrete curbs, concrete curbs and gutters, concrete surfaces such as sidewalks, pavement and medians, manholes, inlets, catch basins, concrete or masonry walls and other structures; salvaging and disposing of the resulting material as directed, and backfilling the resulting trenches, holes and pits in accordance with these Specifications.

2.17.2 MATERIALS**2.17.2.1 Salvage**

All materials having salvage value shall be carefully removed to avoid damage, and shall be stored outside the limits of construction at locations and in a manner satisfactory to the Consultant.

Approved salvage material shall be used in the new work when directed by the Consultant.

2.17.3 CONSTRUCTION**2.17.3.1 Breaking Down and Removing Structures**

The structures designated for removal, complete with all attached parts and connections, shall be removed in their entirety to the limits as shown on the Drawings or as directed by the Consultant.

In removing concrete curbs, concrete curbs and gutters, and concrete surfaces where portions of the existing structures are to be left in the surface of the finished work, the old structures shall be removed to an existing joint or cut to a true vertical face on a line established by the Consultant.

During the removal of manholes, inlets and catch basins, any live sewers connected with them shall be properly reconnected, and a satisfactory bypass shall be maintained during the construction operations.

Concrete or masonry walls, piers, foundations and similar masonry structures shall be removed entirely, or broken down to an elevation of at least 0.60 m below the finished subgrade surface when the structure falls within the area of the roadbed, and to an elevation of at least 0.30 m below the finished ground surface when the structure exists elsewhere.

When a portion of the existing structure is to be retained, care shall be taken not to damage the retained portion during the removal operations.

All operations necessary for the removal of any structures which might endanger the new construction shall be completed prior to the construction of the new work.

2.17.3.2 Disposing of Materials

As far as practicable, all concrete, stone and brick having no salvage value shall be broken into pieces, such that the largest face is not greater than 0.1 m² in area, and placed in embankments in parallel layers. All voids shall be completely filled with suitable common embankment material and thoroughly compacted. No rubble material shall be placed within the top 0.30 m of the subgrade surface.

Material that cannot be used in embankment construction shall be buried in pits outside the limits of the roadway, in a manner satisfactory to the Consultant.

All poles, posts, timbers, stumps and similar debris shall be disposed of by burning.

2.17.3.3 Backfilling

All trenches, holes and pits resulting from the removal of miscellaneous structures shall be filled with approved material, placed in layers not exceeding 0.15 m in depth. Each layer shall be thoroughly compacted, by mechanical tamping or rolling, to one hundred percent proctor density on areas falling within the limits of the subgrade, and to a density of not less than the density of the undisturbed adjacent soil on areas outside the limits of the subgrade.

2.17.4 MEASUREMENT AND PAYMENT**2.17.4.1 General**

If the Contract does not include separate items for the removal of any of the structures listed herein, the removal of such structures will be paid for in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

Where bid items are included for the removal of the structures, measurement will be made of the structure to be removed in its original position.

2.17.4.2 Curb Removal

Removing concrete curb, and concrete curb and gutter, will be measured by length in metres along the base of the curb face, or along the flow line of the gutter.

Concrete curb, and concrete curb and gutter, measured as provided, will be paid for at the unit price bid per metre, respectively, for "Removing Curb" and "Removing Curb and Gutter", which will be full compensation for excavating, breaking down, removing, hauling, salvaging or disposal of material, backfilling, and all labour, tools, and incidentals necessary to complete the Work in accordance with the Specifications.

2.17.4.3 Removing Concrete Surfaces

Removing concrete surfaces will be measured by area in square metres. Where removal of an integral curb and gutter is required in conjunction with the removal of concrete surfaces, these structures will be classed as removing concrete surface and will be measured by area in square metres.

Removing concrete surfaces will be paid for at the unit price bid per square metre for "Removing Concrete Surface", which will be full compensation for excavating, breaking down, removing, hauling, salvaging or disposing of material, backfilling, and all labour, tools, and incidentals necessary to complete the Work in accordance with the Specifications.

2.17.4.4 Removing Miscellaneous Structures

Removing manholes, inlets, catch basins, and similar structures will be measured as units, including all attached parts and connections.

Payment for removal of miscellaneous structures will be made at the unit price bid each for "Removing Manhole" and/or "Removing Inlet" and/or "Removing Catch Basin", which will be full compensation for excavating, breaking down, removing, hauling, salvaging or disposing of material, backfilling, and all labour, tools, and incidentals necessary to complete the Work in accordance with the Specifications.

2.17.4.5 Removing Concrete or Masonry Walls

Removing concrete or masonry walls and similar structures will be measured by volume in cubic metres, and will be paid for at the unit price bid per cubic metre for "Removing Concrete and Masonry", which will be full compensation for excavating, breaking down, removing and hauling the structures complete, salvaging or disposing of the material, backfilling the resulting trenches, holes and pits, and all labour, equipment, tools, and incidentals necessary to complete the Work in accordance with the Specifications.

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2.18 CONCRETE AND/OR CORRUGATED STEEL STORM SEWER**2.18.1 GENERAL**

This work shall consist of trenching, preparation of base, laying of sewer pipe, backfilling, and constructing related items such as manholes, storm drain inlets, catch basins, special fittings, and special inlet and outlet structures.

2.18.2 MATERIALS**2.18.2.1 Storm Sewer Pipe**

The Contractor shall supply pipe material in accordance with Specification 5.23, Supply of Corrugated Metal Pipe and Pipe Arches, or Specification 5.16, Supply of Reinforced Concrete Culvert, as applicable.

Storm sewer material supplied shall include couplings, bands, bolts, hoops, gaskets, tie bars, and any other applicable hardware.

Corrugated steel pipe material may, where specified, be of the asbestos bonded and/or bituminous coated type.

2.18.2.2 Cement Mortar

If concrete pipe is specified, the supply of cement mortar shall be the responsibility of the Contractor. This cement mortar mixture shall be composed of one part Portland Cement and two parts sand by volume. The quantity of water in the mixture shall be sufficient to produce a stiff, workable mortar. The sand shall conform to the requirements of A.A.S.H.T.O. Specification M45-42 and latest revisions thereof, or shall be an equivalent subject to approval by the Consultant. The cement shall conform to the requirements of A.A.S.H.T.O. Specification M85-63, or latest revisions thereof.

2.18.2.3 Granular Materials

The Contractor shall produce aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of materials specified or as specified herein. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul of aggregate shall be in accordance with Specification 4.5, Hauling.

The Contractor shall produce uniformly graded material, containing sufficient fines to act as a binder, which shall be composed of sound, hard, durable particles free from injurious quantities of flaky particles, soft shale, organic matter, frozen lumps and other foreign material. If, due to foundation conditions, pit-run gravel is required for the bedding material, the Contractor shall supply gravel capable of passing a 50 mm screen, and shall be so graded as to provide a stable foundation.

2.18.3 CONSTRUCTION**2.18.3.1 Excavation and Preparation of Base**

In general, the storm sewer shall be placed in a trench, the dimensions of which shall be in accordance with the Drawings. The trench shall be excavated to a depth of not less than 100 mm below the base of the storm sewer.

All soft, yielding, or otherwise unsuitable material encountered at the bottom of the trench shall be removed to a depth as indicated by the Consultant, and replaced with gravel or other acceptable material to afford a firm foundation of uniform density throughout the entire length of the storm sewer. The exposed surface of the excavation shall then be thoroughly compacted, and the excavation backfilled with pit-run gravel material to within the 100 mm grade elevation established for the storm sewer installation.

Where ledge rock, boulders, rocky or gravelly soil, hardpan, or other unyielding material is encountered, the material shall be removed to provide for a minimum bedding thickness of 100 mm. The excavation shall then be backfilled with sand to the elevation established for the storm sewer installation.

The bedding shall be carefully and accurately shaped by means of a template to fit the lower 15 percent of the overall storm sewer height, so as to provide a uniform and firm contact for the bottom of the storm sewer. If concrete pipe is specified, particular care must be taken during shaping of the bedding to ensure that it is shaped to conform to the bell joint for uniform support. There shall be no rocks or other protuberances projecting into the template-formed bed section.

Unless otherwise directed by the Consultant, excavated trench material may be stockpiled alongside the trench, provided the working space is adequate for this purpose, and provided the material does not spill onto private property. All excavated material, other than that required and suitable for backfill, shall be removed to a suitable disposal area as shown on the Drawings, or as directed by the Consultant.

Excavated material piled along the trench shall not be allowed to unduly restrict cross traffic at road intersections. Material shall be cleared from road intersections and provisions made for use of the cross road by traffic, as soon as possible after excavation has taken place. Pedestrian traffic to individual properties shall be maintained at all times, and where required, temporary timber bridges shall be provided where it is necessary to cross open trenches.

Roadways, driveways, and drainage facilities shall not be blocked unnecessarily. Hindrance to local traffic must be kept to a minimum. In order that excavated material may be piled along the trench, roads may be temporarily closed to traffic if so approved by the Consultant, provided adequate detours are available.

Where excavated material cannot be piled along the trench in compliance with the above Provisions, it shall be trucked to locations where backfilling is taking place, or to a temporary stockpile for return to the trench at the time of backfilling, as directed by the Consultant. Temporary stockpile sites or disposal areas will be located as shown on the Drawings, or as directed by the Consultant.

During construction operations, all necessary precautions are to be taken to protect the workers, the public, and both public and private installations and property. All Workers' Compensation Board regulations regarding trench shoring and safety shall be adhered to. The amount of open trench at any one time is to be limited to 100 m, unless otherwise directed by the Consultant.

2.18.3.2 **Assembly**

2.18.3.2.1 General

Placing and assembling the pipe may proceed only after the excavation, foundation and bedding for the pipe have been approved by the Consultant. Where ground or surface water is encountered, the trench is to be de-watered before pipe laying commences.

A system of batter boards, or other such method, shall be used to control the grade of the installation to the elevations as staked by the Consultant.

When the Work is left for any time, the open end of the sewer must be securely closed. When the sewer is completed, it shall be thoroughly cleaned of all earth, stones and any other debris.

2.18.3.2.2 Concrete Storm Sewer

Storm sewer pipe materials shall be handled and lifted by means of the lifting holes or slings. Assembly of the pipe shall start with the placing of the downstream end section, laid with its bell or grooved end facing upstream. Each successive section shall be placed to the true alignment, and shall bear firmly on the shaped bedding throughout its full length. After preparation of each joint, as described following, successive sections shall be drawn tightly together using a cable and winch method, or such other method as may be approved by the Consultant, to provide a positive, uniform and tight fitting joint. The mechanical tightening device shall be anchored a sufficient distance beyond the joint being tightened to avoid disturbance of previously tightened joints. Assembly tightening and joint construction shall be completed to the satisfaction of the Consultant before backfilling may commence.

Field cast wye connections shall be free of any cracks, and shall be fabricated to provide a field strength equivalent to the adjoining pipes.

Unless otherwise specified on the Drawings, a minimum of three end sections shall be anchored to adjacent sections by means of approved anchoring devices. All lift holes shall be filled with an approved mortar, finished off flush with the surface of the pipe.

2.18.3.2.2.1 Mortar Joints

Unless otherwise specified, all joints shall be filled with mortar. The mortar used shall conform to the mixture outlined in Subsection 2.18.2.2 of these specifications.

The pipe ends shall be thoroughly cleaned and wetted with water immediately before the joint is made. Stiff mortar shall then be applied to the lower half of the groove section of the pipe already laid and, simultaneously, to the upper half of the tongue of the sections being placed, and the joint shall then be drawn up tightly. Sufficient mortar shall be used to fill the joint completely and form a bead on the outside of the pipe. The inside of the pipe shall have the joint pointed all the way around. The outside of the pipe shall have the joint mudded all the way around.

The mortar shall be protected from the elements with a proper covering until satisfactorily cured. No water shall be allowed to drain through the newly laid pipe until the joints have satisfactorily cured. No backfilling around the joint shall be undertaken until the joints have been approved by the Consultant.

2.18.3.2.2.2 Rubber Gasket Joints

Where specified, rubber gaskets shall be fitted between the bevelled surfaces of the tongue and groove ends of the connecting concrete pipe sections, to form a flexible, watertight seal.

Gaskets and jointing materials shall be placed in accordance with the recommendation of the particular manufacturer in regard to the use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements and adhesives shall be dry and thoroughly cleaned of all foreign matter. The rubber gasket shall be placed on the tongue end of the pipe section being laid, and the gasket checked for proper positioning.

Gaskets and jointing shall be inspected before installation of the pipe, and loose or improperly affixed gaskets and jointing materials shall be removed and replaced to the satisfaction of the Consultant. Both joint surfaces shall be thoroughly coated with the lubricant supplied, and the tongue of the pipe section being laid shall be lined up true with the groove of the preceding section, and the two sections united together to the tightest position by means of cable and winch, or other approved methods. If, while making the joint, the gasket becomes loose and can be seen through the exterior joint recess when the joint is pulled up to within 25 mm of closure, the pipe shall be removed and the joint remade to the satisfaction of the Consultant.

2.18.3.2.2.3 Corrugated Steel Storm Sewer

Corrugated steel pipe shall be laid on the prepared base, with the separate sections securely joined together by means of the coupling bands provided. Corrugated steel pipe of the round or elongated type, and pipe arch culvert constructed from individual steel plates, shall have the outside laps of circumferential joints in each pipe section on the upstream end, and the longitudinal lap seams at the sides of the pipe.

The pipe shall be laid true to the lines and grades as established by the Consultant. When designated, elbows shall be installed at locations as established by the sharp changes in gradient or direction of the pipe.

All pipe shall be carefully handled to prevent damage to the protective coating. Unavoidable damage to coatings shall be repaired by the Contractor by painting with two coats of zinc oxide or asphaltic type cement paint prior to backfilling.

2.18.3.3 Backfill

2.18.3.3.1 General

After assembly of the pipe has been approved, the backfill shall commence, utilizing sand material to be compacted by means of pneumatic or other mechanical tamping equipment. As the backfill between the sides of the pipe and the sides of the trench must carry a part of the total vertical load on the horizontal plane at the top of the pipe, it is essential that it be good material, carefully placed and compacted.

2.18.3.3.2 Sand Backfill

Backfill under the haunches and up to the quarter points shall be carefully compacted and rammed into place in thin layers, to fill all voids and ensure firm contact with the entire bottom surface. Backfill alongside and above the pipe for a minimum of 0.30 m, unless otherwise shown on Drawings shall also be sand material. Backfilling shall be laid down and compacted in layers not exceeding 0.15 m, and shall proceed simultaneously to the same level on each side of the pipe. Sand backfill shall be compacted to 100 percent of Standard Proctor density at the optimum moisture content. Puddling of the backfill will not be permitted.

In all backfilling operations, care shall be exercised, and it shall be the Contractor's responsibility to ensure that the pipe is not damaged by vertical or lateral forces imposed during installation and by compaction of the backfill. Circular pipe with elliptical reinforcement, and

elliptical pipe with circular reinforcement are particularly vulnerable to damage by careless compaction of backfill, and it may be necessary to install horizontal or vertical strutting until the fill over the pipe has been completed. Strutting, so required, shall be undertaken in an approved manner and at the Contractor's own expense.

Sand backfill will be considered as Class B Bedding, as shown on the Drawings.

2.18.3.3.3 Earth Backfill

Unless otherwise directed by the Consultant, native earth backfill as excavated from the trench shall be used where shown on the Drawings, provided it is an approved, frost-free, fine grained soil. Such soil backfill shall be compacted to a density as specified in the Specifications.

2.18.3.3.4 Extra Sand Backfill

Where, in the opinion of the Consultant, the excavated trench material is unsuitable to be used as backfill, the area shown on the Drawings as earth backfill shall be constructed with sand. The extra sand backfill material shall be placed and compacted to the density specified in the Specifications.

2.18.3.3.5 Granular Backfill Bedding

In areas where the Consultant directs excavation to be done below the normal 100 mm beneath the pipe grade as shown on the Drawings, granular backfill of the Designation and Class specified shall be used as bedding material for that portion of the pipe bed below the 100 mm grade line. The granular backfill shall be placed and compacted to 100 percent of Standard Proctor Density.

2.18.3.4 **Workmanship and Final Acceptance**

In addition to compliance with the details of construction, the completed structure shall show careful finished workmanship in all particulars.

If, in the opinion of the Consultant, any of the following defects are present in the structure, they shall be considered sufficient cause for rejection:

- (a) variation from the designed centerline or grade;
- (b) concrete pipe tongue or grooved edge which has been chipped such that 10 percent of the bevelled surface area is destroyed, or chipped at any point to such a degree that in the opinion of the Consultant a proper joint will not be achieved;
- (c) concrete pipe joined by the construction of improperly formed or cracked joints;
- (d) concrete pipe which shows as a result of negligent handling the exposure of reinforcing steel, or any permanent cracks in the concrete of 0.25 mm or greater width, or deformation induced through improper bedding, backfilling or construction procedures; or
- (e) steel pipe connected with improperly installed couplers and/or gaskets.

Structures exhibiting defects will be rejected, and the Contractor shall be held responsible for replacing and reinstalling the unacceptable section(s). Any material damaged or destroyed by the Contractor shall be replaced at the Contractor's own expense.

Conditions requisite to the final acceptance of the Work shall include, in addition to the terms and conditions of the Contract, a sewer thoroughly cleaned of any accumulations of silt, debris, or other foreign matter, any loose material or waste resulting from the operations disposed of, and the working areas restored to the satisfaction of the Consultant.

2.18.4 MEASUREMENT AND PAYMENT

2.18.4.1 **Excavation for Sewer Installation**

Excavation to the required depth and width as detailed on the Drawings will not be paid for directly, but shall be included in the applicable unit price bid for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads", which price shall include the necessary haul and disposition of the material.

There will be no separate payment for any shoring, dewatering, or any safety precautions necessary. Such payment will be considered to be included in the unit price bid for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads".

Payment for any necessary trucking to another area of the project, or to and from temporary stockpile or disposal areas, will not be made directly, but shall be included in the unit prices bid for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads".

2.18.4.2 **Supply and Install Storm Sewer**

Measurement for the supply and installation of storm sewers will be in metres along the invert centreline length of the sewer. The measurement will be continuous through manholes.

The measurement of laterals and leads shall be taken along the invert centreline of the branch line to the invert centreline of the main sewer. The measurement will be continuous through manholes or storm drains. In cases where the branch line originates at a manhole or storm drain, the measurement will be taken from the mid point of the facility.

Payment will be made at the applicable unit price bid per metre for the various sizes of "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads". This payment will be full compensation for supplying and installing the sewer pipe, precast elbow connections, and all other precast appurtenances; excavation and preparation of the trench to the required depth; supplying and placing sand bedding; shoring; tunnelling under existing utilities; construction of concrete cradles; field casting of wye branches, supplying and backfilling with either native or imported material; compacting where necessary; and the use of all equipment, tools, labour and incidentals necessary to complete the Work.

2.18.4.3 **Bedding and Backfill**2.18.4.3.1 Placing

Payment for supplying and placing of bedding and backfill for storm sewer trenches up to the original ground level will not be made directly, but shall be included in the unit price bid for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads".

For the purposes of this Specification, the original ground line shall be the surface elevation existing at the time of commencement of excavation of the storm sewer trench.

In order to provide reduced load on the storm sewer pipe, it may be specified in the Contract that embankment shall be constructed over a storm sewer alignment prior to the excavation of the trench. In these cases, the original ground line will be the surface of the constructed embankment.

2.18.4.3.2 Supply of Sand Material

Payment for supplying and placing Class B Bedding Material as shown on the Drawings will not be made directly, but shall be included in the unit price bid for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads".

2.18.4.3.3 Extra Sand Backfill

Payment for "Extra Sand Backfill" will be made by the cubic metre in place. This payment will be full compensation for processing and hauling sand material to the point of the installation. Payment for placing this material shall be included in the applicable unit price for "Concrete Storm Sewer - Supply and Install", and/or "Corrugated Steel Storm Sewer - Supply and Install", and/or "Leads".

2.18.4.3.4 Gravel Backfill Bedding

Payment for gravel backfill used in bedding will be made in accordance with Specification 3.8, Granular Fill.

2.18.4.3.5 Supply of Aggregate

Payment for the supply of aggregate for extra sand backfill and/or gravel backfill bedding will be made in accordance with Specification 5.2, Supply of Aggregate.

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2.19 GUARDRAIL AND GUIDE POSTS**2.19.1 GENERAL**

This work consists of the erection, removal, salvage and reinstallation or disposal of guardrail and guide posts.

2.19.2 MATERIALS

The Contractor shall supply all new materials required for the construction of guardrail, barrier and guide posts in accordance with:

Specification 5.25, Supply of W-Beam Guardrail and Posts;
Specification 5.26, Supply of Box Beam Guardrail and Posts;
Specification 5.27, Supply of Cable Barrier and Metal Posts; and
Specification 5.28, Supply of Flexible Guide Post Traffic Delineators.

When the Contract specifies the removal, salvage and reinstallation of guardrail, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be considered acceptable.

The Contractor has the option of supplying plastic guardrail posts in place of wooden posts except at the following locations:

- The transition area between a roadway guardrail system and a bridgerail system.
- As part of a proprietary end treatment such as a Breakaway Cable Terminal (BCT) or Cable Attenuator Terminal (CAT) which normally use wooden posts.
- In any cable barrier system.
- At any other installation specifically prohibited by the Consultant.

2.19.3 CONSTRUCTION**2.19.3.1 General**

Guardrail and guide posts shall be accurately set to the required depth and alignment, in a manner resulting in a smooth continuous installation, as shown on the Drawings or as directed by the Consultant. Permissible tolerance for plumb and grade of posts shall be 6 mm maximum.

Holes shall be excavated by auger. The diameter of the holes augered for guardrail shall be of sufficient size to allow for pneumatic tamping. Prior to digging any holes, the Contractor shall contact all applicable utility companies to arrange for utility location and marking.

Unsuitable material at the bottom of the holes excavated for guardrail shall be replaced with granular material at the Contractor's expense, as directed by the Consultant. The Contractor shall thoroughly compact the bottom of the hole. The guardrail posts shall rest directly and solidly on the bottom of the hole at the time of installation.

Excavated material which is unsuitable for use as backfill shall be substituted with granular material by the Contractor at his expense. Backfill shall be thoroughly compacted, using pneumatic tampers, in layers not exceeding 150 mm, for the full depth of the excavation.

Guardrail laps shall be in the direction of traffic flow. Bolts shall be tightened to a minimum torque of 100 N.m.

Guardrail reflectors meeting the requirements of Specification 5.25, Supply of W-Beam Guardrail and Posts, shall be fastened to the top of every third guardrail in a weak post installation; and to the top of every sixth guardrail for a strong post installation. Reflectors shall be attached by mechanical means such as nailing or stapling. Fastening by adhesives alone will not be accepted.

The colour of the reflectors shall be either white or fluorescent yellow to match the colour of the nearest painted roadway edge line.

The Contractor shall take all necessary precautions to eliminate damage to galvanizing. Minor abrasions shall be repaired by painting with two coats of zinc rich paint. Major abrasions shall be repaired by re-galvanizing. The method to be used for repair of any damage shall be approved by the Consultant before such work is commenced. The Contractor, at his own cost, shall carry out the repair or replace components to the satisfaction of the Consultant.

Construction for installations at bridge approaches shall start at the bridge; and shall be carried out as shown on the Drawings in Appendix D3 of the Roadside Design Guide or as shown on other Contract Drawings. Surplus excavated material and debris shall be removed from the site and disposed of by the Contractor at his expense at an approved location.

Upon completion of the installation, the work area shall be restored to its original condition.

At the end of the one year warranty period, the permissible tolerance for plumb and grade of all posts shall be 13 mm.

Construction of guardrail and guide posts will include several types of installations in accordance with the plans and specifications and as directed by the Consultant. Drawings referenced as TEB or RDG Drawings are found in the latest edition of the Department's Roadside Design Guide. Installations will include but not be limited to:

2.19.3.1.1 Thrie Beam, Modified Thrie Beam, W-Beam Guardrail

Guardrail installations shall be in accordance with TEB and RDG Drawings located in the following Appendixes of the Roadside Design Guide:

Appendix B1, Alberta Weak Post and Strong Post W-Beam Guardrail

Appendix B5, Thrie Beam Guardrail

2.19.3.1.2 Box Beam Guardrail

Standard and median box beam installations shall be in accordance with the TEB Drawings located in Appendix B3, Weak Post Box Beam, of the Roadway Design Guide.

2.19.3.1.3 Cable Barrier

High tension cable or rope barrier shall be installed as shown on the Contract Drawings; and in accordance with the Special Provisions and the Manufacturer's recommended procedures.

2.19.3.1.4 Installation on Base Course Projects

When installing guardrail on base course projects, installation of guardrail and construction of base course shall be performed in accordance with Drawing TEB 3.56 as directed by the Consultant.

2.19.3.1.5 Guide Posts

The Contractor shall remove and dispose of existing guide posts and/or install new guide posts at locations identified by the Consultant.

Guide posts shall be installed straight and plumbed vertical to a uniform depth in accordance with the applicable Drawings found in the latest edition of the Department's manual entitled "Alberta Highway Pavement Marking Guide". All replaced soil around the delineator shall be firmly compacted. The Contractor shall supply any additional material required to ensure that the delineator has a suitable foundation.

A reflective sheeting strip shall be attached to the top of each guide post as described in Section C7, Delineators of the Highway Pavement Marking Guide (2003), and in accordance with the requirements of Specification 5.28, Supply of Flexible Guide Post Traffic Delineators.

2.19.3.2 Removal and Salvage or Disposal of Existing Guardrail**2.19.3.2.1 General**

The Contractor shall remove the designated sections of guardrail including posts and shall fill and compact all holes left from post removal before nightfall.

The Consultant will designate the material to be reused and the material for disposal. Material damaged by the Contractor during removal shall be replaced with new material by the Contractor at his own expense.

2.19.3.2.2 Remove and Salvage

When salvaged material is being reinstalled, the Contractor shall haul it when necessary, and neatly pile the salvaged material near the site of the proposed installation as directed by the Consultant.

At sites where existing guardrail is to be removed and new or salvaged guardrail is to be installed at the same location, the Contractor shall complete the installation within 5 working days of the site becoming available for re-erection of the guardrail.

When existing posts are not salvageable as determined by the Consultant, the Contractor shall replace the damaged posts with new posts as part of the guardrail reinstallation work. The Contractor shall assume ownership of the damaged posts and shall dispose the materials to the satisfaction of the Consultant.

Until guardrail is erected, the Contractor shall erect barricades as shown on Drawing TCS-B-4.2. Other safety protection shall be provided as directed by the Consultant.

2.19.3.2.3 Remove and Dispose

All materials designated for removal and disposal, those damaged during removal and any materials not required for reinstallation as determined by the Consultant, shall become the property of the Contractor and shall be disposed of in a manner and location satisfactory to the Consultant.

2.19.4 MEASUREMENT AND PAYMENT**2.19.4.1 Supply and Install Guardrail or Barrier**

Measurement for supplying and installing barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of barrier or guardrail installed.

Payment will be made at the applicable unit price bid for "W-Beam Guardrail - Supply and Install", "Strong Post W-Beam Guardrail - Supply and Install", "Box Beam guardrail - Supply and Install", "Thrie Beam Guardrail - Supply and Install" "Modified Thrie Beam Guardrail - Supply and Install" or "Cable Barrier - Supply and Install". These payments will be full compensation for supplying and installing all guardrail and cable barrier materials including end terminals and bridge connections and posts.

2.19.4.2 Removal, Salvage and Reinstallation of Existing Guardrail or Barrier

Measurement for removal, salvage and reinstallation of barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of guardrail or barrier removed and reinstalled.

Replacement posts as determined by the Consultant that are necessary for the completion of guardrail re-installations will be measured on a per post basis.

Payment will be made at the unit price bid per metre for "Remove, Salvage and Reinstall Existing Guardrail" for the type of guardrail removed. This payment will be full compensation for removing, salvaging, and reinstalling the guardrail including end terminals and bridge connections and posts.

The supply of new posts on guardrail reinstallations will be paid at the unit price bid for "Supply of Guardrail Posts". The price bid will be considered full compensation for the supply and delivery of the posts, and all labour, materials, equipment, tools and incidentals necessary to complete the Work. The disposal of damage posts and the installation of the new posts will be considered incidental to the work associated with "Remove, Salvage and Reinstall Existing Guardrail".

2.19.4.3 Removal and Disposal of Existing Guardrail or Barrier

Measurement for removal and disposal of barrier or guardrail sections, including end terminals and bridge connections and posts, will be in metres of the length of each type of barrier or guardrail removed.

Payment will be made at the unit price bid per metre for "Remove and Dispose of Existing Guardrail" for the type of guardrail removed. This payment will be full compensation for removing and disposing of the guardrail material as directed by the Consultant.

2.19.4.4 Haul of Guardrail Materials

No separate payment will be made for hauling existing guardrail designated for salvage or disposal. Haul will be considered incidental to the Work.

2.19.4.5 Supply and Install Guide Posts

Measurement will be made of the number of each type of guide post installed.

Payment will be made at the applicable unit price bid per guide post for "Flexible Guide Post/Delineators - Round - Supply and Install" or "Flexible Guide Post/Delineators -Semi Flat - Supply and Install". This payment will be full compensation for supplying and installing the new posts.

No separate payment will be made for guide post removal. The removal and disposal of existing guide posts is considered incidental to the Work.

2.19.4.6 Supply and Install Plastic Guide Posts

If the Contractor elects to install plastic posts instead of wooden posts, the Department will make a premium payment of \$ 10.00 for each plastic guardrail post supplied and installed. This premium will be paid in addition to the unit price bid for the applicable supply and install guardrail bid item.

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2.20 SEEDING**2.20.1 GENERAL**

This specification covers preparation of the area to be seeded, the supply and application of seed and fertilizer, and the finishing of seeded areas.

Areas to be seeded shall include any disturbed or exposed earth surfaces within the right-of-way, borrow and waste areas, and as determined by the Consultant.

2.20.2 MATERIALS**2.20.2.1 Supply of Materials**

Materials for seeding, including grass seed mix, fertilizer, mulch and water shall be supplied by the Contractor.

Seed and fertilizer materials shall be stored dry and protected from direct sunlight and other detrimental conditions. Materials that have been subjected to detrimental conditions, as determined by the Consultant, will not be accepted for use on the project.

2.20.2.2 Grass Seed

Grass seed shall meet the minimum requirements for Common No. 1 Seed as defined by the Grade Tables under the Canada Seeds Act & Regulations, and shall be of the composition specified in the Special Provisions. The seed shall be mixed by a conditioner and bulk storage facility approved by the Authority responsible for Canada Seeds Act & Regulations. All seed shall be tested by a Registered Seed Lab, and each bag shall be clearly marked with the name of the supplier and the mixture composition.

Prior to the use on the project, the Contractor shall provide the Consultant with a Certificate of Analysis for each lot of seed supplied. Test results from the Certificate of Seed Analysis shall specify the germination, or for native seeds that are not a part of the seed tables the Tetrazolium, and purity for each seed species of the mix as well as the seed mix composition expressed as a percentage of each seed species by dry mass for each seed mix specified.

2.20.2.3 Fertilizer

Fertilizer shall be of the composition specified in the Special Provisions.

Fertilizer shall be stored in standard containers clearly marked with the name of the Manufacturer, weight and specified composition.

2.20.2.4 Hydro-Mulch

Mulch material shall be cellulose fibre unless otherwise specified in the Special Provisions. Mulch shall be clean and free of weeds and other foreign matter. Mulch shall be 100% biodegradable, compatible with the environment, and shall contain no germination-inhibiting components.

2.20.2.5 Tackifier

The binder must be capable of joining together the mulch particles to secure the mulch to the ground. The binder shall not form an impervious seal that will prevent the penetration of moisture to underlying soil.

2.20.2.6 Water

Water supplied by the Contractor shall be free of any impurities that might inhibit germination of the seed.

2.20.3 CONSTRUCTION**2.20.3.1 Traffic Accommodation**

The Contractor shall address the traffic accommodation issues associated with his seeding operations in his Traffic Accommodation Strategy. No seeding operations or associated activities shall be started without an accepted Traffic Accommodation Strategy.

When hydro-seeding operations are remote from the Contractor's main work area or when otherwise directed by the Consultant, the Contractor shall, at his own expense, provide a truck mounted arrowboard in accordance with Section 1.2.49, Traffic Accommodation, of Specification 1.2, General, to assist in the accommodation of traffic during hydro-seeding operations.

2.20.3.2 Notification of Commencement of Work

The Contractor shall notify the Consultant a minimum of 48 hours prior to any seeding work. Seeding operations shall not commence until all areas designated for seeding have been prepared to the satisfaction of the Consultant.

Seeding operations shall not commence until the Consultant has reviewed the Certificate of Seed Analysis and verified the specified seed mixture supplied.

2.20.3.3 Surface Preparation

Grading or topsoil placement shall be completed to the satisfaction of the Consultant prior to any surface preparation.

All eroded areas shall be corrected prior to surface preparation, as determined by the Consultant, using imported material or material adjacent to the area being filled.

Areas to be seeded shall be finished to a smooth and uniform surface, which is loosened to a depth of not less than 25 mm at the time of seeding. Where necessary, the surface shall be scarified and the Contractor shall dispose of stones and other debris as determined by the Consultant.

Seeding will not be permitted on hardened, crusted or rutted soil.

2.20.3.4 Weather Conditions

The Contractor shall not proceed with the Work when, in the opinion of the Consultant, weather conditions are unsuitable. The Consultant will not allow work to proceed when wind conditions are such that material is being carried beyond the designated work areas or that the material is not being uniformly applied.

2.20.3.5 **Classes of Seeding**

All seeding, for whatever purpose, will be classified as specified herein:

2.20.3.5.1 Drill-Seeding

Drill seeding shall include the supply of suitable equipment to perform the Work, the supply and placement of the specified seed mixtures and fertilizer (when specified) at locations specified in the Special Provisions or as directed by the Consultant. In areas that are inaccessible to conventional equipment, the Contractor may utilize broad-cast seeding methods.

Distribution of the seed and fertilizer (if required) shall be at a uniform rate and not less than the minimum specified rate of application. The Contractor's equipment shall be calibrated to distribute seed and fertilizer into the soil at not less than specified minimum rates of application. The equipment shall then cover the seed and fertilizer with a suitable covering of soil.

2.20.3.5.2 Broad-Cast Seeding

Broad-cast seeding shall include the application of the specified seed mixtures and fertilizer (when specified) at locations specified in the Special Provisions, or as determined by the Consultant using an acceptable cyclone seeder or approved hand methods. Any areas seeded using broad-cast methods shall be immediately harrowed to provide an acceptable covering of soil for the seed, and surface textured using track-walking or some other means acceptable to the Consultant.

The Contractor shall provide a means of verifying the quantities of seed and fertilizer applied using cyclone or hand-methods; either by weight or by a system of volume measurement acceptable to the Consultant.

2.20.3.5.3 Hydro-Seeding

Hydro-seeding shall include the supply of suitable equipment and the application of a spray-pumped mixture of water, seed, fertilizer (if required), hydro-mulch and tackifier at locations specified in the Special Provisions or as directed by the Consultant.

Hydro-seeding equipment shall have a storage tank with continuous agitation to maintain seed, fertilizer and hydro-mulch uniformly mixed until pumped from the tank. The pump pressure shall maintain a continuous non-fluctuating stream of solution that is calibrated to distribute seed into the soil at not less than specified minimum rates of application.

Generally, those areas which, in the opinion of the Consultant, are impractical to drill-seed due to the terrain characteristics or access problems will be designated for hydro-seeding.

2.20.3.6 **Slope Texturing**

Slope texturing is the roughening of the surface by some mechanical means acceptable to the Consultant, or by track-walking a dozer or similar tracked vehicle perpendicular to the slope, to provide a serrated texture that will reduce erosion potential. The Work shall be performed in accordance with B.M.P. 34a of the Design Guidelines for Erosion and Sediment Control, except as modified herein.

The Contractor shall slope texture the following conditions:

- All cut and fill slopes with slopes equal to or steeper than 3H:1V with a vertical height greater than 1.5 m, and;
- All cut and fill slopes longer than 8 m regardless of the actual slope, and;

For hydro-seeding, the slope texturing shall be performed prior to the application of seed. For broad-cast seeding, the slope texturing shall be performed after the application of seed. For drill-seeding, slope texturing is not required.

2.20.3.7 Application Rates

The following application rates are the minimum required:

Drill Seeding	7 - 15 kg/hectare
Broad-cast Seeding	30 kg/hectare
Fall Cover Crop	5 kg/hectare
Hydro-Seeding	75 - 100 kg/hectare
Hydro-Mulch	1150 kg/hectare

2.20.3.8 Fertilizer

Fertilizer applications are only permitted when using agronomic/forage mixtures. Fertilizer shall not be used when using native seed mixtures.

Formulation and application rates of fertilizers will be as specified in the Special Provisions.

2.20.3.9 Harrowing

When required, the Contractor shall harrow areas designated for harrowing immediately after seed and fertilizer is applied.

2.20.3.10 Protection

The Contractor shall take reasonable care to prevent the contamination of structures, signs, guardrails, fences, utilities and other installations by his operations. Where such contamination occurs, the Contractor shall remove the offending material using methods acceptable to the Consultant.

The Contractor shall ensure that hydro-seeding does not dislodge soil or cause erosion.

The Contractor shall be responsible for the protection of the Work and shall, at his own expense, repair all areas damaged by any cause, until the Work has been accepted by the Consultant.

2.20.3.11 Reseeding

At locations that fail to show a uniform stand of grass for any reason during the calendar year following the year of initial seeding, the Contractor shall repair the defective locations as determined by the Consultant. A uniform stand of grass will be considered growth that shows no deterioration or bare spots greater than 1 square metre in size, and provides a minimum of 80 percent ground cover as determined by the Consultant.

The initial inspection of seeding will occur during the month of May of the calendar year following the year of initial seeding. The Contractor shall complete any required reseeding work

prior to June 15 of that year. This date will be extended if, in the opinion of the Consultant, the weather conditions prior to June 15 are not suitable for reseeding work.

The requirement to reseed will be considered to be a warranty requirement in accordance with Section 1.2.53, Contractor's Warranty and Final Acceptance, of Specification 1.2, General, and shall meet all the requirements for initial the seeding, including seeding method, seed and fertilizer mixtures, application rates, harrowing, and slope texturing as applicable. The Contractor will not be required to reseed any area more than once during the warranty period.

The Contractor shall supply all materials necessary for reseeding work and complete all reseeding work entirely at his own expense.

2.20.4 MEASUREMENT AND PAYMENT

Seeding, for the methods specified, will be measured in hectares to the nearest 0.01 hectare based on horizontal measurements as determined by the Consultant. No allowance will be made for uneven or sloping ground, overlap.

Payment for "Drill-Seeding", "Broad-Cast Seeding", and "Hydro-Seeding" will be made at the unit price bid per hectare. This payment will be considered full compensation for the supply and placement of seed, fertilizer, hydro-mulch, harrowing, and reseeding as applicable, and includes all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Slope texturing will be measured in horizontal square metres. No allowances will be made for slope.

Payment for "Slope Texturing" will be made at the unit price bid per square metre. This payment will be considered full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

When the Contract contains grading or topsoil placement work, the repair of eroded areas prior to seeding will be considered incidental to the Work and no separate payment will be made. When the Contract does not contain grading or topsoil placement work, payment for the repair of eroded areas will be paid for as "Extra Work" in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

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2.21 CABLE DUCTS**2.21.1 GENERAL****2.21.1.1 Description**

The scope of work shall include the construction of 100 mm cable ducts in accordance with these specifications, the Drawings, and Special Provisions, at locations as provided or as directed by the Consultant.

2.21.2 MATERIALS**2.21.2.1 Ducts**

Ducts shall be 100 mm nominal inside diameter and of rigid non-metallic P.V.C. pipe. Couplings are to suit the pipe.

2.21.2.2 Spacers

Spacers shall be cast concrete or interlocking plastic designed for 100 mm standard duct on 200 mm by 200 mm centres. The use of wooden or metal spacers will not be permitted.

2.21.2.3 Concrete

All materials for the manufacture of concrete shall be supplied by the Contractor and shall comply with requirements specified in Specification 5.5, Supply of Portland Cement Concrete. Concrete shall have a minimum compressive strength of 20 MPa at 28 days. Aggregate shall have a maximum size of 19 mm. Cement shall be Type HS (Sulphate Resistant) Portland Cement. Slump shall not exceed 80 mm. An air-entrainment agent shall be added to result in an air content between 5 and 7 percent.

2.21.2.4 Rope

Pull rope shall be 7 mm diameter nylon cord. The rope shall be continuous through each duct with 3 metres spare at each end.

2.21.2.5 Sealant

Duct seal shall be a non-thermoplastic compound used for electrical applications. Acceptable compounds are shown on the Alberta Transportation Products List.

2.21.3 SAMPLING AND TESTING

Sampling and testing shall meet the requirements of Specification 5.5, Supply of Portland Cement Concrete.

2.21.4 CONSTRUCTION**2.21.4.1 Trenching**

The trench shall be carefully excavated to the required depth to allow the duct run to be set on undisturbed soil. Where soft spots or unsuitable material are encountered the Contractor shall, at no extra cost, undercut a minimum of 150 mm, or as directed by the Consultant, replace with acceptable material and compacted to 95 % Standard Proctor Maximum Dry Density.

2.21.4.2 Duct Installation

The duct shall not be placed until the trench has been checked for line and grade by the Consultant. All ducts shall be placed a minimum of 600 mm below subgrade. Duct runs shall be graded uniformly to their ends.

Duct installation shall be by the tier method using the specified spacers. The duct group shall be securely banded together using metal strapping.

Duct couplings shall be staggered by at least 150 mm along the duct run. The cutting and tapering of duct joints shall be made with tools as specified by the duct Manufacturer. All duct joints shall be made water tight. Where ducts are to be connected to existing conduits a suitable conduit to duct coupling shall be used. All ducts shall terminate with a duct coupling that is set flush with the end of the concrete envelope.

Split duct shall be wrapped with a waterproof, impregnated paper or plastic sheeting and securely taped to prevent entry of any concrete.

The duct assembly shall be securely anchored to the trench bottom to prevent ducts from shifting or floating when concrete is poured.

The concrete shall be carefully placed by chute down on the sides of the duct bank so that the concrete flows under the ducts and rises up around the ducts to fill all spaces. The concrete shall be carefully rodded with a flat bar.

Pull ropes shall be installed in each duct and shall be checked to ensure they are free of kinks, bends or joints. The surplus shall be coiled 3 m at each end on the duct.

Duct locations shall be marked by the Consultant in the field prior to backfilling. A 50 mm by 100 mm marker (painted red) shall extend from the duct entrance to 450 mm above grade.

A spike shall be driven flush in the edge of the pavement over the duct run.

2.21.4.3 Backfilling and Compaction

Backfilling shall not be undertaken until the concrete and ducts have been checked by the Consultant. The backfill of trenching shall be with material similar to that removed except that organic material or stones larger than 150 mm in diameter shall be removed.

The degree of compacting shall be similar to existing or to the degree required for various pavement layers under other sections of these specifications. The ends of each duct system shall be backfilled using an envelope of sand, or other suitable backfill, extending 1 m from the duct for a width of 600 mm and from the bottom of the duct system to 500 mm above the top duct.

2.21.5 MEASUREMENT AND PAYMENT**2.21.5.1 Cable Duct**

Payment will be made at the unit price bid per metre of encasement (including 2-100 mm standard ducts). This price shall include all labour, materials, and equipment necessary to complete the Work to the satisfaction of the Consultant.

2.21.6 FINAL ACCEPTANCE

2.21.6.1 **Acceptance**

After each section of duct run is completed and the concrete thoroughly set, a test mandrel that is 65 mm smaller in diameter than the nominal duct size shall be drawn through each individual duct. This test shall be carried out under the supervision of the Consultant.

The Contractor shall be responsible to clear or replace any ducts that do not pass the mandrel test.

Acceptance of the Work will be given upon certification that all ducts have been tested and proven clear of any obstructions.

2.21.6.2 **Sealing**

At the completion of the acceptance the Contractor shall seal in a tight manner the ends of all ducts by using duct seal.

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2.22 PLASTIC CULVERT EXTENSIONS AND CULVERT LINERS**2.22.1 GENERAL**

This specification covers the installation of plastic pipes as liners inside existing culverts, and extensions of these plastic pipes beyond the ends of the existing culverts.

2.22.2 MATERIALS**2.22.2.1 Plastic Pipe**

The Contractor shall supply plastic pipe complete with all necessary material required to join the plastic pipe sections. Plastic pipe material shall meet the requirements of Specification 5.17, Supply of Polyvinyl Chloride Pipe, or Specification 5.24, Supply of Polyethylene Pipe, as applicable.

2.22.2.2 Grout

The Contractor shall supply grout suitable for low pressure pumping into the void between the plastic pipe used as a liner and the surrounding existing culvert and which has a minimum compressive strength of 500 kPa at 28 days.

Cement shall be sulphate resistant.

2.22.3 CONSTRUCTION**2.22.3.1 Preparation For Installation**

The Contractor shall prepare the designated existing culverts for installation of the culvert liners by flushing and scouring the existing culverts with water under pressure, and by inspecting and correcting any minor protrusions within the existing culvert.

2.22.3.2 Liner Installation

The Contractor shall excavate or clear a trench for assembly of liner pipes at the upstream end of the existing culvert. He shall then push or pull the plastic pipe through the existing culvert with the spigot end first (working down grade) preventing any damage to the liner and connecting sections thereafter securely joined together. Pipes shall be joined together to form a flexible, watertight seal. Joints shall not be deflected beyond the Manufacturer's recommended maximum.

The Contractor will ensure that the liner remains at the existing culvert invert elevation during the grouting operation. Liners shall be installed in accordance with Drawing CB6-2.29M1, Plastic Liner Installation and Grouting within Existing Culverts.

2.22.3.3 Grouting

The Contractor shall place grout using a low pressure pump to fill the void completely. Due care shall be taken when pressure pumping so that excessive pressure does not damage the liner. When extension of the plastic culverts beyond the ends of the existing pipe is required, the Contractor shall complete grouting of the liner pipe before completing the backfill of the extension pipe and allow the Consultant to observe the grouting operation and the completion of the grouting.

2.22.3.4 Plastic Pipe Culvert Extension Installation

Extensions to existing plastic pipes or liners shall be made in accordance with Specification 2.4, Culverts, modified as follows:

- Plastic pipe shall be placed on the prepared base, with the separate sections securely joined with joints as specified in the applicable sections of Specifications 5.17 and 5.24.
- The pipe shall be installed true to the lines and grades as established by the Consultant. When designated, elbows shall be installed at locations as established to accommodate sharp changes in gradient or direction of the pipe.
- Backfilling and sloping the ends of plastic pipe shall be performed in accordance with Subsection 2.4.3.3.2, Backfilling Polyethylene Pipe, of Specification 2.4, Culverts.

2.22.3.5 Hand-Laid Riprap

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Specification 2.5, Riprap.

2.22.4 MEASUREMENT AND PAYMENT**2.22.4.1 Supply and Install Plastic Liner**

Measurement for the supply and installation of plastic culvert liners will be in metres based on the length along the centreline invert of pipe installed as a liner.

Payment will be made at the unit price bid per metre for "Culvert Liner - Supply and Install" for the applicable size of culvert as indicated in the unit price schedule. This payment will be full compensation for supplying all materials, flushing of existing culverts, correcting any protrusions in existing culverts, any excavation required for pipe assembly, installing the liner, end treatment if required, and the use of all equipment, tools, labour and incidentals necessary to complete the plastic culvert liner installation.

When, in the opinion of the Consultant, the installation of a liner must be abandoned before completion through no fault of the Contractor, payment will be made for the quantity of pipe actually installed at the full applicable unit price bid.

2.22.4.2 Supply and Placement of Grout

Measurement of grout will be by the cubic metre of grout material acceptably placed, measured to the nearest tenth of a cubic metre. The Contractor shall provide a suitable means of measuring the quantity of grout placed

Payment for grouting will be made at the unit price bid for "Grouting Liners (Plastic Pipe)", and will be full compensation for the supply and placement of grout; including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.22.4.3 Plastic Culvert Extensions

Measurement and payment for the supply and installation of plastic culvert extensions will be made in accordance with Specification 2.4, Culverts.

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2.23 SMOOTH WALL STEEL PIPE CULVERT EXTENSIONS AND CULVERT LINERS**2.23.1 GENERAL**

This specification covers the installation of smooth wall steel pipes as liners inside existing culverts, and extensions of these smooth wall steel pipes beyond the ends of the existing culverts.

The abbreviation S.W.S.P. will mean smooth wall steel pipe.

2.23.2 MATERIALS**2.23.2.1 Smooth Wall Steel Pipe**

Smooth wall steel pipe materials shall meet the requirements of Specification 5.22, Supply and Install Smooth Wall Steel Pipes.

2.23.2.2 Grout

The Contractor shall supply grout suitable for low pressure pumping into the void between the steel pipe used as a liner and the surrounding existing culvert and which has a minimum compressive strength of 500 kPa at 28 days.

Cement shall be sulphate resistant.

2.23.3 CONSTRUCTION**2.23.3.1 Preparation For Installation**

The Contractor shall prepare the designated existing culverts for installation of the culvert liners by flushing and scouring the existing culverts with water under pressure, and by inspecting and correcting any minor protrusions within the existing culvert.

2.23.3.2 Liner Installation

The Contractor shall excavate or clear a trench for assembly of liner pipes at the upstream end of the existing culvert. The Contractor shall then push or pull the S.W.S.P. pipe through the existing culvert with the spigot end first (working down grade) preventing any damage to the liner and connecting sections thereafter securely joined together. Joints shall be welded and the pipe shall be joined using either a wedge and block or mechanical pipe pullers to bring the pipe to the home position to form a watertight seal. Joints shall not be deflected beyond the Manufacturer's recommended maximum.

The Contractor shall ensure that the liner remains at the existing culvert invert elevation during the grouting operation. Liners shall be installed in accordance with Drawing CB6-2.29M1, Plastic and S.W.S.P. Liner Installation and Grouting within Existing Culverts.

2.23.3.3 Welding

Welding of smooth wall steel pipe shall only be performed by journeyman welders. All Welders' qualifications shall be current and shall be available for examination by the Consultant.

Smooth Wall Steel Pipe Culvert Extensions and Culvert Liners

Smooth wall steel pipe sections shall be joined together with a full strength and continuous butt weld which forms a watertight seal in accordance with CSA standard W59, Welded Steel Construction. Welding procedures shall be prepared and stamped by a Professional Engineer and shall be submitted to the Consultant for review prior to welding.

When the ambient air temperature is between 0°C and 5°C the Contractor shall pre-heat the smooth wall steel pipe to a minimum of 100°C for a distance of 80 mm beyond the weld in each direction, and shall shelter the section being welded from the wind. When the ambient air temperature is below 0°C the Contractor shall provide suitable hoarding and heating of the sections being welded. The Consultant has the right to require the Contractor to modify or cease his welding operation if, in the opinion of the Consultant, adequate shelter and heating is not being provided during cold weather welding.

At the discretion of the Consultant, Non-Destructive Examinations such as Radiography and Ultrasonic testing may be required to verify quality and strength of the welds. Non-destructive examinations shall only be done by qualified technicians and the results shall be provided to the Consultant for review. The Contractor shall arrange and provide non-destructive testing when required by the Consultant. Any defects found by such testing shall be repaired at the Contractor's own expense.

2.23.3.4 Grouting

The Contractor shall place grout using a low pressure pump to fill the void completely. When extension of the S.W.S.P. culverts beyond the ends of the existing pipe is required, the Contractor shall complete grouting of the liner pipe before completing the backfill of the extension pipe and allow the Consultant to observe the grouting operation and the completion of the grouting.

2.23.3.5 Smooth Wall Steel Pipe Culvert Extension Installation

Installation of S.W.S.P. extensions shall be carried out in accordance with Specification 2.4, Culverts, and Specification 5.22, Supply and Install Smooth Wall Steel Pipes, modified as follows:

- The pipe shall be installed true to the lines and grades as established by the Consultant. When designated, elbows shall be installed at locations as established to accommodate sharp changes in gradient or direction of the pipe.

2.23.3.6 Hand-Laid Riprap

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Specification 2.5, Riprap.

2.23.4 MEASUREMENT AND PAYMENT**2.23.4.1 Supply and Install Smooth Wall Steel Pipe Liner**

Measurement for the supply and installation of S.W.S.P. culvert liners will be in metres based on the length along the centreline invert of pipe installed as a liner.

Payment will be made at the unit price bid per metre for "Culvert Liner - Supply and Install (S.W.S.P.)" for the applicable size as indicated in the unit price schedule. This payment will be full compensation for supplying all materials, flushing of existing culverts, correcting any protrusions in existing culverts, any excavation required for pipe assembly, installing the liner,

Smooth Wall Steel Pipe Culvert Extensions and Culvert Liners

end treatment if required, and the use of all equipment, tools, labour and incidentals necessary to complete the S.W.S.P. culvert liner installation.

When, in the opinion of the Consultant, the installation of a liner must be abandoned before completion through no fault of the Contractor, payment will be made for the pipe installed at the applicable unit prices.

2.23.4.2 Supply and Placement of Grout

Measurement of grout will be by the cubic metre of grout material acceptably placed, measured to the nearest tenth of a cubic metre. The Contractor shall provide a suitable means to measure the quantity of grout that has been placed.

Payment for grouting will be made at the unit price bid for "Grouting Liners (S.W.S.P.)", and will be full compensation for the supply and placement of grout; including all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.23.4.3 Smooth Wall Steel Pipe Culvert Extensions

Measurement and payment for the supply and installation of S.W.S.P. culvert extensions will be made in accordance with Specification 5.22, Supply and Install Smooth Wall Steel Pipes.

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2.25 HIGHWAY STREET LIGHTING**2.25.1 GENERAL**

This work shall consist of the supply and installation of highway lighting and all associated electrical work in accordance with these specifications, and in conformity with the dimensions, details and requirements shown on the Drawings, at locations as indicated and as established by the Consultant. The electrical installation shall be in accordance with the current edition of the "Canadian Electrical Code", regulations of the Electrical Inspection Department having jurisdiction and as determined by the Consultant. Any work, even if not shown or specified, which is obviously necessary or reasonably implied to complete the Work, shall be done as if it were both shown and specified.

All electrical installation work shall be performed by qualified tradesmen experienced in such work.

The Contractor shall obtain all permits and approvals and pay all related fees required for the Work and submit a copy of all permits and associated documents to the Consultant.

At locations where new power supply or power supply modifications are necessary, application to the power company will be carried out by the Consultant. A specific service point for the power supply by others will be as shown on the Drawings. The Contractor shall provide all facilities to the service point. The power company will make the final connection.

2.25.2 ABBREVIATIONS AND DEFINITIONS

Wherever in these specifications the following abbreviations are used, the intent and meaning shall be as follows:

CSA:	Canadian Standards Association
NEMA:	National Electrical Manufacturers Association
EEMAC:	Electrical and Electronic Manufacturer's Association of Canada

Reference to regulations and standards in all cases shall mean the latest amendment or revision current at the closing date of the tender.

2.25.3 MATERIALS

The Contractor shall supply all materials required for the installation of the highway lighting including associated electrical components.

All material supplied shall be new and built in accordance with EEMAC standards and shall be CSA approved unless otherwise approved by the local inspection authority. The Contractor shall obtain approval of the local inspection authority and shall bear all inspection charges levied and any modification costs required for any materials not CSA approved.

Material shall also comply with the Drawings and as required by the "Canadian Electrical Code". Where there is lack of specification in the Drawings, the materials shall comply with the Special Provisions, Standard Specifications, or as specified by the Consultant.

When the Work necessitates the removal, salvage and reinstallation of lighting structures, only materials from existing installations shall be used. Contractor stockpiles of used material from other sources will not be acceptable.

2.25.3.1 Conduit

The Contractor shall supply 50 mm or 100 mm underground electrical conduit, complete with all necessary incidentals, as shown on the Drawings.

Underground electrical conduit shall be either Polyvinyl Chloride (PVC), type DB2 or Reinforced Thermosetting Resin Conduit (RTRC) conforming to CSA Standards C22.2 No.211.1 and C22.2 No. 211.3 respectively.

2.25.3.2 Wiring

All wiring within the poles to the luminaires shall be #12 Cu. RW90 X-Link. All conductors shall be copper.

The Contractor shall supply secondary electrical cable as shown on the Drawings. All teck cables shall be copper and have 1000 V cross link insulation. Teck cable shall be HL rated.

2.25.3.3 Luminaires and Standards (Poles)

The Contractor shall supply new luminaires complete with lamps, davit or high mast standards, and bases as shown on the Drawings.

Only new materials shall be used.

The poles shall be continuously tapered of polygonal cross sections presenting good visual appearance. With the anchor base mounted in a horizontal plane, the upright pole section shall be in a true vertical position. All materials used shall conform to the latest edition of CSA Standard G40.21M 300W, ASTM Standard A570 Grade D or ASTM Standard A36 as a minimum requirement. Silicon content of the steel shall be less than 0.04% for the shafts, whereas for base plates the silicon content shall be either less than 0.04% or between 0.15 to 0.25%.

All standards shall be hot dip galvanized in accordance with CSA standard G164-M. Double dipping will not be permitted. Where two or more galvanized sections will be placed in close proximity; the finished appearance each section shall be similar to the adjacent galvanized section(s). The Consultant will determine the suitability of repair methods.

2.25.3.4 Sand Bedding and Backfill

All bedding sand shall be supplied by the Contractor and shall be free of clay, rocks and organic materials. The sand shall be a Designation 5 Class 10A in accordance with Specification 3.2, Aggregate Production and Stockpiling, or as approved by the Consultant.

When native material excavated from a ditch or trench is unacceptable as backfill, the Contractor shall supply sand or other approved backfill material. At no time shall backfill material containing ice, snow, organic or frozen material be used. All backfill material will be subject to the approval of the Consultant.

2.25.3.5 Concrete Bases

The Contractor shall supply all materials for the construction of pole and cabinet bases and the bases shall be constructed of concrete in accordance with CAN3-A23.1-M90. Concrete shall be Type 50, Class C in accordance with Specification 5.5, Supply of Portland Cement Concrete. Reinforcing shall be Grade 400, deformed bars in accordance with CSA G30.12-M77 complete with 10M ties as shown on the Drawings.

Anchor bolts shall be supplied in accordance with the requirements of the pole or base Manufacturer. Generally the top 300 mm of the anchor bolts shall be hot dipped galvanized unless otherwise specified.

2.25.3.6 Frangible Bases (Breakaway Couplings)

The Contractor shall supply all required frangible bases for light standards in accordance with the Drawings and the Special Provisions.

2.25.3.7 Site Lighting Distribution Enclosure and Components

The Contractor shall supply the required distribution enclosure in accordance with the Drawings and as determined by the Consultant.

The enclosure shall be a weatherproof NEMA 4 design complete with padlockable door, hinged on one side. The enclosure shall be of sufficient size to house panel boards, disconnects, breakers, lighting contactors, control transformers, splitters, controls and an externally mounted power supply meter socket, as shown on the Drawings. The enclosure shall be CSA approved with components installed. The entire system in the enclosure shall be concealed in conduit or other acceptable means. Exposed wiring will not be accepted. The Contractor shall provide all wiring schematics for future reference.

Panel boards shall be commercial or industrial grade complete with breaker. Rating of panel boards and number and type of breakers shall be as shown on the Drawings. Breakers shall be bolt in style only to match panels. Acceptable manufacturers are Westinghouse, Square D, FPE or approved equal.

Main disconnect shall be commercial or industrial grade NEMA 1 breaker enclosure suitable for service entrance. Rating and phases shall be as shown on the Drawings. Acceptable manufacturers shall be Westinghouse, Square D, FPE or approved equal.

Lighting contacts shall have a minimum of 600 volt rated contacts and 120 volt operating coil. The contact shall be mounted in a NEMA 1 enclosure and have a rating and number of phases as shown on the Drawings. Acceptable manufacturers shall be Westinghouse, Allen Bradley, Square D or approved equal.

Control transformer (if required) shall be 2000 VA rated and mounted in NEMA 1 enclosure. The transformer shall have voltage ratings and phases as shown on the Drawings.

Control circuit disconnect (if required) shall be rated at 15 amp and shall be mounted in a NEMA 1 enclosure. Voltage ratings and phases shall be as shown on the Drawings. Acceptable manufacturers shall be Westinghouse, Square D, FPE or approved equal.

Hand-Off-Auto switch shall be a 3-position selector switch with capabilities to override photocell and shall be mounted in a NEMA 1 enclosure.

Photocell shall be rated 1500 watt, 120 volt, drift free minimum "turn on level" of 1.5-foot candles. It shall be integrally wired into distribution enclosure and shall be of vandal proof design.

2.25.4 DRAWINGS

The Contractor shall submit four copies of Shop Drawings of electrical work, including poles, luminaires, distribution enclosures and frangible bases to the Consultant for review, a minimum of 14-days before the scheduled start of the Work. Shop Drawings shall be stamped and signed by a Professional Engineer registered in the Province of Alberta. Work shall not commence until all Shop Drawings have been reviewed and accepted by the Consultant.

The Contractor shall maintain a set of Drawings on the site at all times and record any changes required by the Consultant that may occur and on the set mark "AS BUILT". These Drawings shall be submitted to the Consultant upon completion of the project.

At the completion of the project the Contractor shall provide 6 full copies of an Operating and Maintenance Manual to the Department. This manual shall include the following:

- All accepted Shop Drawings.
- All dimensioned and annotated As-Built Drawings.
- Schematics for lighting control and associated equipment.
- Recommended preventative maintenance task, procedures and servicing frequency for:
 1. Each luminaire type used on the project
 2. Control cabinet components – including procedures for changing components
- Manufacturer's technical data on all cables supplied to the project.
- Complete list of replacement parts, manufacturers and distributors for all equipment supplied.

Included with each manual, the Contractor shall supply a set of keys to cabinets and padlocks, and a set of all specific tools or equipment required for access to, or maintenance of the lighting system.

2.25.5 SAMPLING AND TESTING

Sampling and testing of the cast-in-place concrete shall meet the requirements of Specification 5.5, Supply of Portland Cement Concrete.

2.25.6 CONSTRUCTION

2.25.6.1 **Existing Underground Utilities**

The Contractor shall hand expose all underground utilities in all areas of excavation. Hand exposure shall be as specified by the utility owner. The exposure and backfilling of the utilities shall be undertaken by the Contractor under the direct supervision of the company's representative.

2.25.6.2 **Removal and Salvage of Existing Standards**

Where required as shown on the Drawings, the Contractor shall remove, salvage and store existing light standards. Existing pre-cast bases and all other components shall be removed and disposed of in an acceptable manner. The Contractor shall backfill and compact holes left from pole removal before nightfall. Material damaged by the Contractor during the removal shall be replaced with new material by the Contractor at his own expense.

When standards are salvaged for reuse, the existing galvanizing shall be repaired to the satisfaction of the Consultant prior to installation.

When painted standards are designated to be salvaged and reinstalled, they shall be hauled to a plant equipped to do the Work, stripped of all paint and rust and hot dip galvanized in accordance with CSA Standard G164-M.

2.25.6.3 Removal and Disposal of Existing Lighting Fixtures

Where required as shown on the Drawings, the Contractor shall remove and dispose of existing light fixtures including standards, bases and luminaires in a manner and location as acceptable to the Consultant. All materials shall become the property of the Contractor.

The Contractor shall backfill and compact the disturbed areas prior to nightfall.

2.25.6.4 Cutting of Pavement

When required, saw cutting shall be in carried out accordance with Specification 3.40, Cutting of Pavement.

2.25.6.5 Excavation and Backfill

No trenching or excavation work will be permitted over existing power, communication cable, pipeline or other underground utilities without the supervision of the appropriate authority. The Contractor shall call Alberta First Call and the respective utilities to locate and mark existing underground utilities. Damage to any utilities is the responsibility of the Contractor.

Trench digging machinery will be permitted except where its operation will cause damage to trees, buildings, or existing structures above or below ground. At such locations, alternative methods shall be used subject to the approval of the Consultant.

Excavation and backfill shall be executed where required for electrical installation unless otherwise shown on the Drawings. Trenches shall be a minimum of 150 mm wide along alignments. Trenches shall be a minimum of 0.9 m to a maximum of 1.1 m below finished grade level. The trench bottom shall be free of stones, loose material and sharp objects. In backfilled areas, the trench bottom shall be kept level to facilitate laying-in of the cable. The excavation shall be performed in such a manner as to cause the least possible damage to the adjacent embankment surface and other improvements.

No deviation shall be made from the required line or grade except with written approval of the Consultant.

Trenches shall not be left open unattended or unprotected without written permission from the Consultant. In such cases, the open trench shall be properly marked and barricaded with flashers. In locations where flooding may occur or public hazard is created by open trench, the Consultant at his discretion may require that the excavation be appropriately covered.

Temporary support, adequate protection, and maintenance of all underground and surface utilities structures, drains, sewers, and other obstructions encountered in the progress of the Work shall be provided by the Contractor at his own expense.

Backfill material shall be mechanically compacted in maximum lifts of 150 mm to a minimum of 95% of Standard Proctor Density for the full depth of the excavation. Compaction tests shall be on a minimum of one density test per 150 m of trench for compacted vertical backfill. Additional tests may be required at the discretion of the Consultant. The cost of all testing shall be the responsibility of the Contractor.

All disturbed areas shall be restored to the conditions existing prior to the disturbance or a condition satisfactory to the Consultant.

Disposal of all excess material shall be the responsibility of the Contractor.

2.25.6.6 Sand Bedding

Sand used as bedding or backfill in excavated areas beneath roadway, driveways, and sidewalks shall be compacted to a minimum of 100% of Standard Proctor Density and provide a minimum of 50 mm covering on all sides of the conduit. In all other cases, unless otherwise specified by the Consultant, sand shall be compacted to a minimum of 95% of Standard Proctor Density.

2.25.6.7 Street Light Bases

When the type of street light base is not shown on the Drawings or stated in the Special Provisions, the Contractor shall have the option of supplying and installing either cast-in-place concrete bases, steel screw-in bases, or pre-cast concrete bases. Contractor optional bases shall be designed, fabricated, and installed in accordance with Section E6.2.2 of the Highway Lighting Guide 2003 and shall be acceptable to the Consultant.

Cast-in-place bases shall be constructed a minimum of 21 days prior to installing the poles, unless braces, acceptable to the Consultant, are provided.

The Contractor is advised to assess the nature of the existing soil types and conditions prior to tender. The Contractor shall have no claim against the Department for difficulties in the constructability of the bases and footings due to soil types and conditions.

2.25.6.8 Luminaires and Standards (Poles)

The Contractor shall install all davit and high mast standards (to the height specified), luminaires, lamps and frangible bases in accordance with the Drawings and as determined by the Consultant.

Standards shall be installed plumb and level. Shims may be used for levelling, however any gaps between standards and bases shall be appropriately filled with grout.

Each luminaire shall be aligned and aimed correctly as indicated on the plans or as determined by the Consultant.

The Contractor shall complete all associated wiring, fusing and galvanizing in accordance with CSA standard G164-M for the installation of the unit.

Terminations in the pole base shall be completed using insulated crimping connectors, not wire nuts (amp type or approved equal). All aluminum to aluminum or aluminum to copper connections shall be made using PENETROX, or an approved equivalent, in an approved manner.

The Contractor shall furnish such aerial lift devices, with qualified operators and associated traffic control, as may be required for the Consultant to inspect any and all luminaires on the project throughout construction activities, and prior to the expiration of the Contractor warranty.

2.25.6.9 Underground Electrical Conduit

Conduit shall be installed beneath all roadways, walkways, driveway crossings and other locations as shown on the Drawings. The installation shall be for the entire length of the crossing plus an additional metre on each side. Installation shall be in accordance with the Drawings and as determined by the Consultant.

Pushed or trenched underground electrical conduit shall be installed in accordance with Specification 2.7, Underground Electrical Conduits, and the applicable Drawings.

2.25.6.10 Site Lighting Distribution Enclosure

The Contractor shall install the required distribution enclosure in accordance with the Drawings and as determined by the Consultant. The sand bedding for the enclosure shall be compacted to a minimum of 100% of Standard Proctor Density.

A concrete base shall be constructed to the dimensions shown on the Drawings. All connections to the enclosure shall run through the concrete base.

The Contractor shall situate the base and cabinet to ensure that the photocell operation is not effected by outside light sources.

2.25.6.11 Secondary Electrical Cable

Secondary electrical cable shall be placed in trenches in random separation with great care to ensure no kinking or damage to the sheath (splices are unacceptable). Cable shall be installed with sufficient slack and snaking to ensure cable is not damaged during backfilling operations, or from ground movements due to frost heave.

All cables crossing roadways shall be placed in a 50 or 100 mm conduit as specified, one duct for each cable.

Secondary electrical cable shall be installed as shown on the Drawings or determined by the Consultant.

2.25.7 TESTING

The electrical installation shall be completely tested, including but not limited to megger and ground testing, and certified by a qualified licensed electrician demonstrating to the satisfaction of the Consultant that the equipment and system installed perform in the manner intended. The Consultant shall be notified 24 hours in advance of the certification testing.

2.25.8 MEASUREMENT AND PAYMENT

Payment for the following items will be compensation in full for all equipment, labour, tools and incidentals necessary to complete the Work.

2.25.8.1 Trench and Backfilling

Trenching and backfilling for wiring installation placed outside of conduits will be measured by the lineal metre along the centreline of the trench.

Payment will be made at the unit price bid per lineal metre for "Trenching and Backfilling". This payment will be full compensation for trenching, supply, placement and compaction of any required sand bedding, backfilling, disposal of the spoil as required and replacing original sod with topsoil and grass seed.

2.25.8.2 Cutting of Pavement

Measurement and payment for cutting of existing pavement, if required, will be made in accordance with Specification 3.40, Cutting of Pavement.

2.25.8.3 Hand Expose Existing Underground Utilities

All costs associated with hand exposing and backfilling existing underground utilities, as required, will be considered incidental to the Work, and no separate or additional payment will be made.

2.25.8.4 Underground Electrical Conduit

Measurement and payment for conduit installation will be made in accordance with Subsection 2.7.4.1, Underground Electrical Conduit - Trench Excavation, or Subsection 2.7.4.2, Underground Electrical Conduit - Pushed Conduit, of Specification 2.7, Underground Electrical Conduits, as applicable.

2.25.8.5 Secondary Cable

The quantity of secondary cable considered for payment will be based on the length in metres of trench excavated for the installation of underground wiring as measured along the centreline of the trench. No additional allowance or payment will be made for the requirement for extra connecting cable at run terminations or for cable wiring installed at variance with a straight line.

Payment will be made at the unit price bid per metre for "Secondary Cable - Supply and Install" for the type specified. This payment will be full compensation for the supply and installation of the cable.

2.25.8.6 Electrical Wiring and Materials

Except for the secondary electrical cable, no separate or additional payment will be made for the supply and installation of electrical materials required for the proper installation of the luminaires and electrical operating systems. All wiring, fusing, connectors, insulators and any other materials required by the electrical service provider, or necessary for the proper operation of the system will be considered incidental to the Work and no separate or additional payment will be made.

2.25.8.7 Removal and Salvage of Existing Standards

Payment for the removal and salvage of existing standards will be made at the applicable price bid per unit for "Removal and Salvage of Existing Standards" for the type and size indicated. This payment will be full compensation for the supply of all tools, equipment and labour required to remove, salvage and store the standards; remove and dispose of the remainder of the installation; and backfill, compact and restore the excavated areas to the satisfaction of the Consultant.

2.25.8.8 Removal and Disposal of Existing Light Fixtures

Payment for the removal and disposal of existing light fixtures will be made at the price bid per unit for "Removal and Disposal of Existing Light Fixtures". This payment will be full compensation for the supply of all tools, equipment and labour required to remove and dispose of standards, luminaires, concrete bases and electrical components and backfilling, compacting and restoring the excavated areas to the satisfaction of the Consultant.

2.25.8.9 Street Light Bases

Payment for street light bases will be made at the unit price bid for "Street Light Bases - Supply and Install" for the type specified in the unit price schedule. The payment will be full compensation for supplying pre-cast bases, steel screw-in bases, all excavation for the installation, disposal of spoil, supply, placement and compaction of the sand bedding, supply and placement of concrete, rebar and anchor bolts, supply of concrete forms (if necessary), tamping, leveling, installation, and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

2.25.8.10 Davit and High Mast Standards

Payment for the installation of davit or high mast standards will be made at the applicable price bid per unit for "Street Light Standard - Supply and Install" for the type and height specified. This payment will be full compensation for supplying all materials, labor, equipment, tools and incidentals required to complete the installation, testing and commissioning of the pole, luminaire, lamp, frangible base, wiring and accessories; including the provision of all facilities required by the Consultant for inspections of the street light standard.

When frangible bases are not required, payment for the installation of davit or high mast standards will be made at the applicable price bid per unit for "Street Light Standard (without frangible bases) - Supply and Install" for the type and height specified. This payment will be full compensation for supplying all materials, labor, equipment, tools and incidentals required to complete the installation, testing and commissioning of the pole, luminaire, lamp, wiring and accessories; including the provision of all facilities required by the Consultant for inspections of the street light standard.

2.25.8.11 Reinstallation of Salvaged Standards (Poles)

Payment for reinstalling poles will be made at the applicable unit price bid per pole for "Salvaged Street Light Standard - Install" for the type and height specified. This payment will be full compensation for hauling the poles from the storage location, repairing the galvanizing when necessary, installing the salvaged pole, supplying and installing new luminaire, lamp, frangible base, wiring, fusing and all other materials necessary to complete the installation.

When reinstalling salvaged standards without frangible bases, payment for reinstalling poles will be made at the applicable unit price bid per pole for "Salvaged Street Light Standard (without frangible bases) - Install" for the type and height specified. This payment will be full compensation for hauling the poles from the storage location, repairing the galvanizing when necessary, installing the salvaged pole, supplying and installing new luminaire, lamp, wiring, fusing and all other materials necessary to complete the installation.

2.25.8.12 Site Lighting Distribution Enclosure

Payment for the distribution enclosure will be made at the price bid per unit for "Distribution Enclosure - Supply and Install". This payment will be full compensation for supplying and installing all materials necessary to provide the distribution and control of the street lighting system according to the Drawings and Special Provisions. This shall also include supply and installation of the concrete pad and sand bedding, supply and installation of specified grounding system and the complete system testing and certification.

2.25.8.13 Galvanizing of Existing Standards

Measurement will be made of the number of salvaged standards, properly galvanized and reinstalled on the project.

Payment will be made at the applicable unit price bid per pole for "Galvanizing Salvaged Standards" for the type and size indicated. This payment will be full compensation for hauling the standards to the galvanizing plant, removing all paint and rust, galvanizing and returning the standards to the Work site.

2.25.8.14 Drawings and Manuals

All costs associated with production of Shop Drawings, As-built Drawings and the Operating and Maintenance manual will be considered incidental to the Work, and no separate or additional payment will be made.

2.25.8.15 Site Restoration

All costs associated with the restoration of excavated or disturbed areas to a condition comparable to that which existed prior to construction, or to a condition satisfactory to the Consultant, including any required topsoiling and seeding, will be considered incidental to the Work, and no separate or additional payment will be made.

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2.26 TRAFFIC SIGNALS**2.26.1 GENERAL**

This work shall consist of the supply and installation of traffic signals and all associated electrical work in accordance with these specifications, the Special Provisions and in conformity with the dimensions, details and requirements shown on the Drawings, at locations as indicated and as established by the Consultant. In cases of conflict with existing underground utilities, the Contractor shall contact the Consultant for approval of revisions prior to completing the Work.

The electrical installation shall be in accordance with the current edition of the Canadian Electrical Code, the Electrical Protection Act, the regulations of the Electrical Inspection Department having jurisdiction, and as determined by the Consultant. Any work, even if not shown or specified, which is obviously necessary or reasonably implied to complete the Work, shall be done as if it were both shown and specified.

All electrical installation work shall be performed by qualified tradesmen experienced in such work.

Cabinet bench testing, cabinet wiring, termination of cables, testing of signals, and activation of signals shall only be performed by personnel possessing the following qualifications:

- Journeyman Power Systems Electrician, or a Journeyman Power Lineman, or a Journeyman Electrician certificate;
- Successfully completed Traffic Signals Level I and Level II courses offered by IMSA;
- Five years experience with traffic signal installation, maintenance and troubleshooting.

The Contractor shall obtain all permits and approvals and pay all related fees required for the Work and submit a copy of all permits and associated documents to the Consultant. After completion of the Work, the Contractor shall provide the Consultant a "Certificate of Final Inspection and Approval" from the electrical inspection authority. The Contractor shall be responsible for all costs associated with the testing inspection done by the electrical inspecting authority.

At locations where new power supply or power supply modifications are needed, application to the power company will be carried out by the Consultant. A specific service point for the power requirements will be provided by the power company and will be as shown on the Drawings. The Contractor shall provide all facilities to the service point. The power company shall make the final connection.

2.26.2 ABBREVIATIONS AND DEFINITIONS

Wherever in these specifications the following abbreviations are used, the intent and meaning shall be as follows:

AISC:	American Institute of Steel Construction
ASA:	American Standards Association
ATSSA:	American Traffic Safety Services Association
CEMA:	Canadian Electrical Manufacturers Association
CSA:	The Canadian Standards Association
IMSA:	International Municipal Signal Association
NEMA:	National Electrical Manufacturers Association
EEMAC:	Electrical and Electronic Manufacturer's Association of Canada

Reference to regulations and standards in all cases shall mean the latest amendment or revision current at the closing date of the Tender.

2.26.3 MATERIALS

2.26.3.1 **General**

The Contractor shall supply all materials required for the installation of traffic signals including associated electrical components.

All material supplied shall be new and CSA approved, unless otherwise approved by the local inspection authority. The Contractor shall obtain approval of the local inspection authority and shall bear all inspection charges levied and any modification costs required for any materials not CSA approved.

Material shall also comply with the Drawings and as required by the "Canadian Electrical Code". Where there is lack of specification in the Drawings, the materials shall comply with the Special Provisions, Standard Specifications, or as specified by the Consultant.

When the Work necessitates the removal, salvage and reinstallation of existing structures, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be acceptable.

2.26.3.2 **Wire and Cable**

2.26.3.2.1 General

Wire shall be stranded copper RWU90 cross-link conforming to CSA C22.2 No.38, 'Thermoset Insulated Wires and Cables' or equivalent, unless otherwise specified below or shown on the Drawings. Wire and cable shall meet CSA standards for installation in wet environments.

2.26.3.2.2 Signal Control Cable

Signal control cable shall be 600 volt rated, consisting of #14 AWG solid copper conductors, individually polyethylene insulated, covered with a black polyvinyl chloride outer jacket, conforming to IMSA Spec. No. 19-1. Signal cable for exposed installations shall conform to IMSA Spec. No. 20-1. The Contractor shall follow the Drawings and Standard Drawing TCS-F-101 for selecting the type and quantity of signal control cables (7 or 16 conductor cable) for the Work.

2.26.3.2.3 Loop Detector Wire

Loop detector wire shall be 600 volt rated #14 or #16 XHHW stranded copper conductor or equivalent with cross-linked polyethylene insulation conforming to IMSA Spec. No. 51-3.

2.26.3.2.3.1 Loop Detector Lead-In Cable

Loop detector lead-in cable shall be 600 volt rated, composed of two #16 AWG stranded tinned copper conductors individually insulated with polyethylene material, twisted together, and shielded with aluminum backed mylar. The cable shall conform to IMSA Spec. No. 50-2.

2.26.3.2.3.2 Microwave Detector Lead-In Cable

Microwave detector lead-in cable shall be 600 volt rated, unshielded, and composed of four #16 AWG stranded bare copper conductors. Belden 27338A or an equivalent cable are acceptable.

2.26.3.2.3.3 Communication Cable

Traffic signal communication cable shall consist of 4 twisted pairs of #16 AWG stranded copper polyethylene insulated conductor with electrical shielding and a polyvinyl chloride jacket, and shall conform with IMSA Spec. No. 19-2.

2.26.3.2.3.4 Advance Warning Cable

Advance warning signal cable shall be 600 volt rated, unshielded, composed of three #10 AWG RW90 cross-link conductor, suitable for installation in wet environments.

2.26.3.2.3.5 Streetlight Cable

The cable feeding streetlights on combination traffic poles shall be 600 volt rated, polyvinyl chloride jacketed, comprised of two #10 insulated conductors with a concentric neutral. USEB90 or equivalent cable is acceptable.

2.26.3.2.3.6 Power Supply

Power supply conductor shall be #8 AWG RWU90 cross-link.

2.26.3.3 **Grounding and Bonding**2.26.3.3.1 General

Grounding and bonding materials shall conform to CSA C22.2 No.41, 'Grounding and Bonding Equipment'.

2.26.3.3.2 Ground and Bond Conductors

Ground and bond conductors shall be stranded copper RWU90 cross-link, insulation color green, and shall conform to CSA C22.2 No.38-M, type RWU90 cross-link.

2.26.3.3.3 Ground/Lightning Electrodes

Ground/Lightning Electrodes shall be copperclad steel rods, 21mm diameter by 3.0m in length.

2.26.3.3.4 Ground/Lightning Electrode Connectors

Moulded type connectors shall be used on all wire-to-rod connections. Moulded connectors shall consist of metallic alloys and fusible powder mixtures held in place by a suitable mould and connected using an exothermic type welding process.

2.26.3.4 **Conduits**2.26.3.4.1 General

Supply and Installation of conduits shall be in accordance with Specification 2.7, Underground Electrical Conduits, and as specified herein.

2.26.3.4.2 Fittings for DB2 Conduits

Only factory bends are acceptable for Type DB2 PVC conduits. Field fabrication of couplings, adapters, bends, and fittings for DB2 conduits will not be accepted.

2.26.3.4.3 Trench Marker Tape

Trench marker tape shall be 250 mm wide yellow plastic tape, labeled "CAUTION - ELECTRICAL WIRE BURIED BELOW" at minimum 0.5 m intervals.

2.26.3.5 **Junction Boxes**

Junction boxes shall be precast of non-ferrous metal or approved plastic material and shall be of suitable sizes. The boxes shall have a removable metal cover equipped with cap screws and threaded holes in the cover to facilitate removal of the cover after sealing. The metal cover shall be grounded.

2.26.3.6 **Foundations**

2.26.3.6.1 General

The Contractor shall supply portland cement concrete required for foundations in accordance with Specification 5.5, Supply of Portland Cement Concrete, and as specified herein.

2.26.3.6.2 Precast Cabinet Base

Precast concrete base for Type "M1" signal control cabinet and the power supply cabinet shall be constructed in accordance with Standard Drawing TEB 4.39.

2.26.3.6.3 Precast Pole Base

Concrete for the precast pole bases shall have minimum 28-day strength of 30 MPa concrete in accordance with CAN3-A23.1-M90. Concrete shall be Type 50, Class C. The Contractor shall supply galvanized steel anchor bolts with nuts, washers and nut covers.

Precast pole bases for pedestal poles shall be constructed in accordance with Standard Drawing TCS-F-301.

Precast pole base for traffic poles with an arm span of 9 m or less shall be constructed in accordance with Standard Drawing TCS-F-305.

Concrete bases for advance warning signal poles or traffic poles with an arm span greater than 9 m shall be cast-in-place.

2.26.3.6.4 Cast-In-Place Pole Base

Cast-in-place pole bases shall be constructed of concrete using Type 50 sulphate resistant cement to give minimum compressive cylinder strength of 30 MPa in 28-days for Class C exposure with 20 mm nominal size coarse aggregate, slump at point at time of discharge maximum 100 mm and minimum 50 mm. Air content shall be between 4% and 7%. Maximum water cement ratio shall be 0.45 by mass.

Cast-in-place concrete pole bases for pedestal poles shall be constructed in accordance with Standard Drawing TCS-F-301.1.

Cast-in-place concrete pole bases for advance warning signal poles with an arm span up to 9 m and for traffic poles with an arm span up to 11 m shall be constructed in accordance with Standard Drawing TCS-F-305.1.

Cast-in-place concrete pole bases for advance warning signal poles with an arm span up to 11 m and for traffic poles with an arm span up to 15 m shall be constructed in accordance with Standard Drawing TCS-F-310.

The Contractor shall submit the concrete truck tickets to the Consultant to demonstrate that the correct type of concrete is used.

2.26.3.6.5 Galvanized Steel Helix Pedestal Pole Base

Shop Drawings for the galvanized steel helix pedestal pole bases shall be submitted by the Contractor to the Consultant for approval within 4 weeks after award of the Contract. Steel helix pedestal pole bases shall be fabricated to fit a bolt circle diameter (B.C.D.) of 280 mm and for four 25 mm anchor bolts. The steel helix pole base shall be designed to support a loading which corresponds to a 5 m tall pedestal pole with 2 four-section signal head unit side-mounted at the upper section of the pole. Additional loadings are a 60 cm x 75 cm sign and a 60 cm x 60 cm sign mounted below the four-section signal heads.

2.26.3.6.6 Galvanized Steel Rotatable Base

Rotatable bases for traffic poles and advance warning signal poles shall be hot dip galvanized in accordance with CSA standard G164-M. Shop Drawings for the rotatable pole base shall be submitted by the Contractor to the Consultant for approval within 4 weeks after award of the Contract.

Rotatable pole bases shall be fabricated to fit a B.C.D. of 400 mm and for four 35 mm anchor bolts. The maximum height for the rotatable pole base shall be 800 mm. A centre hole with a minimum diameter of 150 mm shall be provided through the base. The rotatable base shall be designed so that a maximum rotating angle of 90 degrees is allowed. This can be achieved by fabricating a stop-end anchor at the underside of the top plate and on the side of the main rotatable base exterior wall tubing. A 40 mm diameter hole should be provided on both stop-end anchors to allow the top plate to be locked in place after it is rotated.

The rotatable base shall be designed to support the loading outlined in Subsection 2.26.3.7, Signal Supports, based on the following arm mounting heights with the rotatable base attached: traffic sign poles - 6.7 m above top of concrete pole base; traffic signal poles - 6.5 m above top of concrete pole base.

Loading calculation shall be based on a wind speed of 160 km/h and a 12.7 mm layer of ice load on one side of the structure / sign surfaces.

Welding for the rotatable base shall be done by a CWB certified company. All welding shall conform to CSA Standard W59 and shall be performed by welders or welding operators qualified under CSA Standard W47.1. SMAW process shall use E48018 or E48018-1 classification electrode. FMAW process shall use E480XT-X classification electrode. GMAW process shall use E480S-X classification electrode. All welding shall be completed prior to galvanizing. Welding activities shall not be permitted in the field without adequate protection from public viewing.

2.26.3.7 Signal Supports**2.26.3.7.1 General**

The pole support structures shall be continuously tapered of polygonal cross sections presenting good visual appearance. With the anchor base mounted in a horizontal plane, the upright pole section shall be in a true vertical position. All materials used shall conform to the latest edition of C.S.A Standard G40.21M 300W, ASTM Standard A570 Grade D or ASTM Standard A36 as a minimum requirement. Silicon content of the steel shall be less than 0.04% for the shafts, whereas for base plates the silicon content shall be either less than 0.04% or between 0.15 to 0.25%.

Only new materials shall be used in its construction.

2.26.3.7.2 Shop Drawings

The Contractor shall submit 3 copies of the Shop Drawings to the Consultant for review prior to any fabrication. Shop Drawings shall be complete and shall include all information such as material specifications, weld sizes, welding procedures, design criteria, and design loading. Shop Drawings shall be stamped and signed by a Professional Engineer registered in the Province of Alberta.

Review of Shop drawings by the Consultant will be for general arrangement only and in no case will the Contractor be relieved of the responsibility for completeness or adequacy of fabrication materials and procedures for the structures. Any costs resulting from changes made necessary by errors in fabrication, or due to failure to have Shop Drawings so accepted shall be the responsibility of the Contractor. Work shall not commence until all Shop Drawings have been reviewed and accepted by the Consultant.

The Contractor shall maintain a set of the Drawings on the site at all times and record any changes approved by the Consultant that may occur and on the set mark "AS-BUILT". These drawings shall be submitted to the Consultant upon completion of the project.

2.26.3.7.3 Structural Design Criteria**2.26.3.7.3.1 General**

The mast arm mounting height for advance warning signal poles or pedestrian corridor poles shall be 6.7 m above the base plate. The mast arm mounting height for traffic shall be 6.5 m above base plate. The arm reach of signal / overhead sign pole mast arm shall follow the Pole Schedule on the Drawings. In situations where rotatable bases are needed, the signal supports shall be fabricated so that shorter pole shafts will be used to achieve the same mast arm mounting heights as specified above.

2.26.3.7.3.2 Live Loads

The wind drag coefficient of the latest National Building Code of Canada for either octagonal section or round section shafts and where other cross sectional shapes are employed shall be utilized in the design. All safety factors shall be in accordance with A.I.S.C. Steel Construction Manual for wind and seismic stresses, or a minimum of 1.25:1 based on the published yield strength of the material.

The structural design criteria shall be for wind velocities up to and including 160 km/h upon the total effective area of the signal structures and fittings. The loading shall include ice load based on 12.7 mm ice thickness on all faces of structure members and on one face of the sign load.

2.26.3.7.3.3 Dead Loads

For Pedestal Poles

1. Two four-section signal heads mounted back to back on the pole. Each signal head has a weight of 20 kg, and
2. Any combination of signal heads or signs of which the projected area is not to exceed 2.0 square metres.

For Combination Cantilever Signal Poles

1. Three traffic signal heads each with maximum projected area of one square metre and weight of 20 kg each on the mast arm. The three signals on the traffic arm are to be located 0.5 m, 3.8 m, and 7.5 m inward from the end of the arm, and
2. Three 75cm x 75cm aluminum signs mounted at 0.2 m, 3.5 m, and 7.2 m inward from the end of the arm, and
3. Two pedestrian signals with a maximum projected area of one square metre and weight of 20 kg, to be mounted on the pole shaft along with a side mounted traffic signal with weight of 20 kg and projected area of one square metre.
4. A streetlight extension section 5.7 m in height (total structure height of combination pole shall be 12.2 m) and reaching 1.8 m towards the road.
5. Pole shafts for signal poles with arm span of 11 m or less shall be designed to support the loading of an 11 m arm with the above-mentioned loadings.
6. Pole shafts for signal poles with arm span of 15 m or less shall be designed to support the loading of a 15 m arm with the above mentioned loadings.

For Cantilever Sign Poles

1. One sign 1.8 m x 2.4 m in dimensions on 20 mm thick marine plywood c/w high intensity retro-reflective sheeting for the sign face (weight - 65 kg), and
2. Two 20 cm diameter amber beacons (weight - 10 kg), and
3. Angle irons to mount sign (weight - 45 kg).
4. Pole shafts for sign poles with arm span of 9m or less shall be designed to support the loading of a 9 m arm with the above-mentioned loadings.
5. Pole shafts for sign poles with arm span of 11 m or less shall be designed to support the loading of an 11 m arm with the above mentioned loadings.

2.26.3.7.4 Pole Setting Features (Anchorage)

The design may be such that the vertical shaft is inserted into the base plate and attached with two circumferential welds.

The signal / sign pole shall meet the following requirements:

1. Each base plate shall have 4 bolt holes equally spaced around the bolt circle. The rectangular centres of the two bolt holes shall be parallel with the neutral plane of the pole shaft. The bolt holes shall be elongated so that it can be fitted onto pole bases with B.C.D. of either 395 mm (15.5") or 405 mm (16"). Width of bolt hole slot shall be 45 mm (1¾") plus/minus 1.6 mm (1/16")

2. The base plate shall be designed for accommodating a single nut cover. Nut covers shall be attached to the poles by means of brass cap screws or other approved methods.
3. The pedestal pole shall be 120 mm across flats at the top with a 115 mm O.D. x 100 mm long tenon. The pole shall come with an end cap.
4. B.C.D. dimensions and anchor bolt sizes shall meet the requirements outlined on Standard Drawings TCS-F-301, 301.1, 305, 305.1, and 310.

2.26.3.7.5 Mast Arm Attachment Features

The mast arm shall be designed to meet structural design criteria. The steel plates (flange) shall have 8 bolt holes equally spaced. A 100 mm (4") diameter hole in flange and pole shaft shall be provided for electrical cable access, and centered in the flange. The 8 bolt holes in the flange shall be 28.5 mm (1 1/8") in diameter. The 8 bolts supplied shall include washers and nuts sized to meet design criteria.

2.26.3.7.6 Surface Finish

The surface finish for the traffic / sign poles shall be hot dip galvanized and shall meet all the requirements outlined in CSA Standard G164-M. Pole refinishing materials shall be a cold galvanizing compound such as "Galvicon" or an approved equivalent.

Where two or more galvanized sections will be placed in close proximity; the finished appearance each section shall be similar to the adjacent galvanized section(s). The Consultant will determine the suitability of repair methods.

2.26.3.7.7 Workmanship and Fabrication

Fabrication and workmanship shall be in accordance with the latest edition of CSA Specification S16, and all workmanship shall be equal to the best practice in modern construction steel shops. The structure inside and outside shall be clear of any obstructions which will hamper the wiring of the traffic signal after erection.

Welding shall be undertaken only by a fabricator fully approved by the Canadian Welding Bureau to the requirements of C.S.A. Standard W47. Any circumferential welds shall develop 100% penetration of the material thickness. All welds shall be cleared of all slags and spatter. If future welding is done after cleaning, the weld metal and adjacent areas shall be cleaned and all spatter removed.

2.26.3.7.8 Electrical Connections

Each pole shall include provision for electrical constructions in the form of hand holes of adequate size positioned 0.5 m above the base plate and at the mast arm mounting level. The hand holes shall be adequately reinforced with a collar with covers secured in place by a 9.5 mm (3/8") galvanized standard N.C. Hex bolt with anti-tampering cup washer.

Each pole shall be provided with 9.5 mm x 38.1 mm (3/8" x 1 1/2") N.C. galvanized bolt which shall be welded to the inside of the pole directly opposite the bottom hand hole. This stud shall be fitted with grounding lug, two washers, and a brass nut suitable for connecting the ground wire.

Wire access on the pole section: Four (4) only, 25 mm (1") with 1360 kg (3,000 lbs) couplings complete with square recessed head plugs and spaced 90 degrees to each other at 3 m above the base plate shall be provided. Recessed head plugs must have a lubricant on the threads to allow easy removal.

Wire access on the mast arm section: Three or four 25 mm (1") diameter rubber grommets shall be provided at the following locations on the mast arm: 0.5 m from the end, and every 3.7 m, thereafter.

2.26.3.7.9 Inspection and Testing

The Contractor shall obtain an independent testing firm to carry out ultrasonic testing on welds. Weld testing reports for all poles shall be submitted to the Consultant for review before the poles are shipped to the work site. Costs associated with testing shall be the responsibility of the Contractor.

Should such tests show the pole structures are not in accordance with the Specifications, they shall be repaired or replaced by the Contractor at his own expense. The Consultant reserves the right to reject any portion of the shipment of pole structures that does not comply with the Drawings and Specifications,

In particular:

- a) Pole structures which do not comply with the physical dimensions or B.C.D. specified on the Contract Drawings shall be rejected.
- b) Pole structures which do not pass visual inspection at delivery shall be rejected.
- c) Pole structures which have been damaged during delivery shall be rejected. The Contractor shall replace or repair rejected structures at his own expense.

2.26.3.7.10 Pole Identifications

Each structure supplied shall be fully identified by permanent markings on the walls of the structure (arm and trunk). The permanent markings are to be stamped or welded on the structures and shall include the following information:

- Name of manufacturer
- Year of manufacturing
- Type of pole
- Dimension / span / height of pole

2.26.3.8 **Luminaries and Photocells**

Luminaries shall be High Pressure Sodium complete with polycarbonate refractors and have integral 120/240 VAC regulated output constant wattage iso-lead (CWI) high power factor ballasts.

Photocell units shall be cadmium sulphide thermal delay type with built in surge and lightning protection. The photocell shall be load rated at a minimum of 1000 volt-amp.

2.26.3.9 **Pole Mounted Traffic Control Fixtures**

2.26.3.9.1 Traffic and Pedestrian Signal Heads and Accessories

Traffic and pedestrian signal heads optical system shall conform to the Institute of Transportation Engineer specifications, the American Standards Association (ASA) specifications, and the Specifications contained herein. The traffic and pedestrian signal heads shall be polycarbonate in design unless otherwise indicated. The fixture body of the traffic and pedestrian signals shall be traffic yellow. The doors and visors shall be dull black. Refer to

Standard Drawings TCS-F-501, 505, 510, 515, 520 and 525 for mounting hardware requirements for traffic control fixtures on signal poles.

2.26.3.9.1.1 General

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the ITE Vehicle Traffic Signal Heads (VTCSH) standard. Two secured, colour coded, 914 mm (36 in) long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105oC, are to be provided for electrical connection.

2.26.3.9.1.2 Voltage Range

LED signal modules shall operate from a 60 ± 3 cycle AC line power over a voltage range from 80 VAC RMS to 135 VAC RMS. The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in signal controller units the procuring agency has in use.

Nominal operating voltage for all measurements shall be 120 ± 3 volts RMS.

Fluctuations in line voltage over the range of 80VAC to 135VAC shall not affect luminous intensity by more than ± 10 percent.

The LED circuitry shall prevent flicker at less than 100 Hz over the voltage range.

It must be ensured that the product will not show illumination for input voltages below 45 volts.

2.26.3.9.1.3 Transient Voltage Protection

The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in Section 2.1.6, of NEMA Standard TS-2, 1992.

2.26.3.9.1.4 LED Drive Circuitry

The individual LED light sources shall be wired so that a catastrophic failure of one LED light source shall result in the loss of not more than 20 percent of the signal module light output.

2.26.3.9.1.5 Electronic Noise

The LED signal and associated on-board circuitry shall meet Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

2.26.3.9.1.6 Power Factor (PF) and AC Harmonics

LED signal modules shall provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 25oC (77oF).

Total harmonic distortion induced into an AC power line by an LED signal module, operated at nominal operating voltage, with a power consumption equal to or greater than 15 watts at 25oC (77oF) shall not exceed 20 percent. Total harmonic distortion induced into an AC power line by an LED signal module, operated at nominal operating voltage, with a power consumption less than 15 watts at 25oC (77oF) shall not exceed 40 percent.

2.26.3.9.2 Traffic Signal Head

All traffic signal heads shall be 300 mm in diameter with Standard Full Matte Black Visors (tunnel visors). The signals shall come with 300 mm signal backboards and all mounting hardware. Backboards, doors, and visors shall be flat black. The design of the traffic signal head shall be such that the reflector assembly is hinged separately from the door assembly. The signal head shall be secured by a minimum of 2 latching bolts for the door assembly.

2.26.3.9.3 Pedestrian Signal Head

All pedestrian signal heads shall be of the standardized square head of 300 mm size or as specified, and shall be designed to retain optical efficiency.

The background of all message and indication type lenses shall be an opaque grey ceramic, fired directly on the lens. The lens shall be made of impact resistant polycarbonate.

WALK and DON'T WALK message shall be symbolized to the standards outlined in the Manual of Uniform Traffic Control Devices for Canada.

Standard cowl/cutaway style visors shall be included. The colour shall be flat black.

2.26.3.9.4 Pedestrian Pushbutton and Sign

Pushbutton and pushbutton housing shall be cast using aluminum alloy. The pushbutton shall be controlled by low voltage relay switching, operating from 24 VAC supply from the controller cabinet.

Pushbuttons shall have an isolator / LED latch module to enable a LED indicator light to come on once pressed. Each pushbutton requires a switch circuit module to operate the 3 volt LED. A 4-channel isolator/latch module is needed to operate up to 4 pushbuttons, for a total of 16 pushbuttons per isolator/latch module. Each pedestrian movement at the intersection requires at least one unlatch module. An intersection with 2 pedestrian movements will require 2 unlatch modules.

2.26.3.9.5 Microwave Detectors

Microwave detectors shall be controlled by a microprocessor. They shall be designed to allow a minimum detection range of 50 m and to trigger the operation of a traffic controller.

The microwave detector shall only respond to motion in one direction (approach or depart only - selectable). The detector shall generate a microwave beam aim to cover the same area normally covered by a loop detector system. The microwave detector shall have an operating voltage of 24 VAC.

2.26.3.9.6 Special Crosswalk

Special crosswalk sign shall consist of a 75 cm x 240 cm sign with RA-102 sign message and the following colour scheme - White Background, Black Border, Black Message/Symbol. The sign board material shall comply with the requirements of Specification 5.18, Supply of Permanent Highway Signing. Two 200 mm amber beacons shall be mounted on the sign. Mounting hardware for the special crosswalk sign shall be provided in accordance with Standard Drawing TCS-F-520.

2.26.3.9.7 Advance Warning Signal

Advance warning signal sign shall consist of a 150 cm x 240 cm sign with WB-5 sign message and colour scheme. The sign board material shall comply with the requirements of Specification 5.18, Supply of Permanent Highway Signing. Two 200 mm amber beacons shall be mounted on the sign. Mounting hardware for the advance warning signal sign shall be provided in accordance with Standard Drawing TCS-F-525.

2.26.3.10 **Traffic Signal Controller Unit and Cabinet**

2.26.3.10.1 General

This specification is applicable for TS2 Type 2 Traffic Signal Control Cabinet for application in Alberta. TS2 Type 1 Cabinet is also accepted as an alternative. TS2 Type 1 Cabinets, if used, shall comply with the requirements of NEMA TS2-1998.

The Contractor shall demonstrate to the Consultant, in the Contractor's own signal shop, the ability of the controller cabinet to provide the expected traffic operations as specified on the Drawings.

2.26.3.10.2 Manufacturer's Identification

The Manufacturers' identification shall be on all major equipment supplied with this specification including the cabinet assemblies. The date on which the controller cabinet is manufactured shall also be marked on the inside cabinet door.

2.26.3.10.3 Software Changes and Updates

All applicable software changes and updates shall be supplied and installed in the equipment at no extra cost to the Department for the duration of the warranty period.

2.26.3.10.4 Traffic Signal Cabinet Configurations

Traffic signal controller cabinets shall be configured to provide a minimum of 8-phase signal operations, with the following minimum configuration:

Controller Unit

- TS2 - Type 2 - Type A2 (TS2 Type 1 is an acceptable alternative)

MMU

- Type 12

Terminal and Facilities

- 16 Channel Detector Rack (Rack mounted. Shelf-mounted detector shall not be used)
- 8 veh / 4 Ped Test Switch Panel
- Police Panel on Main Door

Auxiliary Devices

- 12 Load Switches
- 1 - 2 cct Solid State Flasher
- 4 Flash Transfer Relays
- As per Detector Schedule on Contract Drawings

Cabinet

- Type M1 (82 cm x 46 cm x 152 cm) with Corbin No. 2 Key (2 sets of keys)
- Bus Interface Unit
- 1 for Detector Rack, Controller, and MMU SDLC Interface

2.26.3.10.5 NEMA TS 2-1998 Exceptions

2.26.3.10.5.1 Controller Unit (CU)

The controller supplied by the Contractor shall be one of the Controllers listed on the Alberta Transportation Products List. Other controllers configured for Dual Ring operations and conforming to the applicable standards of the National Electrical Manufacturers' Association (NEMA) TS 2-1998 edition for Type 2 configuration Type A2 - Controller Units in all material respects will be allowed with the prior approval of the Consultant.

2.26.3.10.5.2 Malfunction Management Unit (MMU)

The MMU shall be capable of operation in a cabinet designed to TS 1 specification with no loss of TS 1 functionality.

If a TS-1 type controller is used, all electrical connections with the monitor shall be through approved quick disconnect MS type connectors and harnesses such that it is directly pin plug interchangeable with other conflict monitors of like manufacture and NEMA series. If a TS-2 type controller is used, communication with the MMU shall be either as above or via a serial data bus.

MMU shall be provided complete with a "Programming Card".

2.26.3.10.5.3 Terminal and Facilities (TF)

The TF interface shall be as defined for TS 2 - Type 2 Controller Units and the use of a BIU for communication with the MMU and vehicle detectors.

AC Neutral Bus shall have minimum 14 positions. Earth Ground (Bond) Bus shall have minimum 14 positions. Main Breaker shall be 40 amp for the traffic signal equipment. Auxiliary Breaker shall be 15 amp for auxiliary equipment. As an integral part of the power assembly a ground fault equipment receptacle, controller ON/OFF switch and cabinet light switch shall be provided. The power distribution assembly shall be integral to the entire load bay assembly and shall be located in the center of the panel. All components of the power panel shall be protected by a front panel that isolates and protects all parts of the power assembly. This panel shall be clearly marked as to the functions for both the power assembly and output load bay.

Where any harnesses are exposed to damage or handled frequently, the harness shall be covered by a protective nylon cover. Changing flash programming, from red to amber flash, shall be accomplished by easily moving jumpers on a separate terminal block located on the front of the load bay or by means of toggle switches from a control panel. All wires used in the cabinet shall be of the low temperature type and be rated for -40 degrees C to +105 degrees C. A bracket shall be used to support all load switches and flashers and prevent them from vibrating out of position.

A small recessed police panel with a separate access door shall be contained within the front of the cabinet, with the following switches: "Signal AUTO/FLASH", "Signal AUTO/MANUAL".

A maintenance panel located on the inside of the front door, with the following switches: "Signal ON/OFF", "Signal AUTO/FLASH", "Signal AUTO/MANUAL".

2.26.3.10.5.4 Auxiliary Devices

Auxiliary Devices including: Load Switches; Solid State Flashers; Flash Transfer Relays; and Inductive Loop Detector Units.

No Exceptions to be noted.

2.26.3.10.5.5 Cabinet

The cabinet shall be a Canadian Electrical Manufacturer Association (CEMA) Type 3 enclosure, fabricated from sheet aluminum with a thickness of 3.18 mm (0.125 inches), type 5052 - H32 or an approved equivalent. It shall provide weather and dust protection, with adequate strength to withstand reasonable vandalism protection to the control equipment.

The interior and exterior of the cabinet shall be properly cleaned and prepared for coating. The coating shall be a high quality ultra violet ray stable polyester powder paint (ASA 61 Grey), applied with a minimum thickness of 3 mil.

The cabinet shall include two (2) shelves with strong supports for placement of supplied signal controller and auxiliary equipment.

The main door of the cabinet shall include a police door. Both the main door and the police door shall be supported by continuous hinge. Included in the main door shall be ventilation louvers and an air filter (that fits tightly to the door) c/w sheet metal removable winter frost cover.

The cabinet shall be designed for base mounting on a Standard M or M1 signal cabinet concrete foundation.

The cabinet shall be equipped with a separately fused electric exhaust fan assembly for summer operations. The fan shall be thermostatically controlled and manually adjustable to turn on between +20°C and +65°C in increments of 10°C or less. The cabinet shall also be equipped with a separately fused 350 watt finned (Fast Heat RV0200D1 or equal) heater assembly for winter operations. The heater shall be thermostatically controlled and manually adjustable to turn on between -20°C and +10°C in increments of 10°C or less. The thermostats for the heater and exhaust fan shall be calibrated, labeled and installed on an easily accessible separate panel in the cabinet.

The cabinet shall be equipped with a switch and a fused lamp to illuminate the inside of the cabinet. Lamp shall be incandescent type.

2.26.3.10.5.6 Bus Interface Unit (BIU)

No Exceptions to be noted.

2.26.3.10.5.7 Documentation

Two sets of the following documentation shall be supplied:

- operation manual for the controller and MMU
- detailed controller programming chart
- cabinet wiring diagram
- MMU programming schematic
- any logic wiring diagrams that are applicable

One set of the documentation shall be placed in the controller cabinet inside a durable print pouch, which hangs in a convenient location not interfering with other equipment. The other set of the documentation shall be supplied to the Consultant directly.

2.26.3.11 **Pedestrian Actuated Flashing Signal Control Unit**

2.26.3.11.1 Control Unit Cabinet

The units shall be housed in a cast aluminum weatherproof cabinet. The cabinet shall be latched by a standard traffic control lock (2 sets of keys to be supplied). It shall be supplied with mounting brackets capable of being used for mounting the cabinet on any size of conventional type of traffic pole.

2.26.3.11.2 Inspection and Testing

Approval from the electrical inspection authority must be obtained by the Contractor before the unit is installed in the field for full operations.

2.26.3.11.3 Manufacturer's Identification

The Manufacturer's Identification shall be on all major equipment supplied with this specification including the control unit assemblies.

2.26.3.11.4 Instruction and Wiring Diagrams

The Control Unit shall be supplied with complete installation instructions including a complete chart for field connections. Installation hardware and instruction, including limits of operation, along with service manual shall be provided. Two set of the documentation shall be supplied. One set of the documentation shall be placed in the controller cabinet inside a durable print pouch, which hangs in a convenient location not interfering with other equipment. The other set of the documentation shall be supplied to the Consultant directly.

2.26.3.11.5 Functional Specifications

The pedestrian actuated flashing signal control unit shall function as follows:

Upon actuation of the crosswalk sign / signals by a pedestrian pushbutton, the pedestrian indicator lights will come on approximately 5 seconds (adjustable in increments of one second from 0 - 180 seconds) after the crosswalk sign / signals starts operating and will terminate 10 seconds (adjustable in increments of one second from 0 - 180 seconds) before the crosswalk sign / signals stop.

The timer relays shall disengage the flash conditions of the crosswalk signals and indicator lights after all of the preset time periods and rest itself automatically. Successive pushbutton actuation shall not cause extension of the timer relays.

Standard Drawing TCS-F-701 illustrates a typical wiring scheme and a functional scheme for the pedestrian actuated flashing signal control unit. Other design methods and wiring configurations are acceptable as long as the functional requirements are produced by the control unit.

2.26.3.11.5.1 Reset Timers

Rest timers shall be capable of performing a single timed interval for a preset time when initiated by an external signal (pedestrian pushbutton). The reset timers shall function as follows:

- a) Crosswalk Signals Flash Time - sets the length of crosswalk signals flash time
- b) Pedestrian Indicator Lights Start Time - sets the start time for the indicator lights flashing (delay start in relation to crosswalk signals)
- c) Pedestrian Indicator Lights Flash Time - sets the length of indicator flash time.

2.26.3.11.6 Wiring

The units shall be wired in such a manner as to be able to accept #14 awg wires for the signal lamp connections, #8 awg wires for the a.c. feed connections, and #14 awg wires for the pedestrian pushbutton connections. These connections shall be made at a suitable termination strip. All 116 VAC connections shall be fused.

2.26.3.11.7 Flasher

The flasher used to generate alternate power on and off cycles between the two output terminals shall be of the Solid-State type. It shall be a plug in module easily replaceable without any tools. It shall be supplied with a radio interference suppressor and two 116 VAC power outputs. The output alternating rate shall be adjustable from 60 to 120 cycles per minute. The outputs shall be capable of handling at least 10 amps of current draw.

2.26.3.11.8 Timer

The timers used to time the preset time periods shall be adjustable from 0 to 180 seconds in one second intervals.

2.26.3.11.9 Pushbutton Field Circuit

The field circuit to be used for the pedestrian pushbuttons shall not exceed 12 volts A.C. or D.C.

2.26.3.11.10 Service Entrance

The unit supplied shall be approved for service entrance by the electrical inspection authority.

2.26.3.12 **Detector Loops**2.26.3.12.1 Loop Detector Conductor

In-road loop detectors shall be insulated single conductor No. 14 or No.16 RW90 XLPE stranded copper conductors.

2.26.3.12.2 Lead-In Cable

Lead-in cable shall be similar to Beldon 8720 shielded audio broadcast cable, consisting of two continuous unspliced #14 or #16 stranded tinned copper conductors. Exterior insulation shall be polyethylene or other material suitable for direct burial in wet ground conditions.

2.26.3.12.3 Loop Sealant

Loop sealant shall be "3M" detector loop sealant or equivalent.

2.26.3.13 **Power Supply**

The Contractor shall supply and install a power supply cabinet to house a loadcentre and an externally mounted power supply meter socket. The enclosure shall be CSA approved and consist of a CEMA 3 enclosure complete with a vandal resistant padlocked door, with ASA 61 gray enamel finish over rust resistant primer. The loadcenter shall include a 60 ampere main breaker, and an eight position branch circuit panel to service the traffic control cabinet, street lighting on the combination traffic poles, median flashers, etc.

Shop Drawings shall be submitted for the Consultant's review prior to fabricating the cabinet.

2.26.4 CONSTRUCTION2.26.4.1 **Wire, Cable and Grounding/Bonding**2.26.4.1.1 Wire and Cable

All installations of wire and cable shall comply with the Canadian Electric Code and the Alberta Electric and Utility Code.

Cable runs must be separated by function. Traffic signal cables and any other 120V wires and cables shall be grouped together into one or more conduits with a #8 AWG bonding conductor. If spare conduits are available, low voltage detector cables should be grouped together in separate conduit(s). Communication cable shall be run in a conduit and junction box system that is completely separate from the system for 120V wires/cables.

Routing of bonding conductor, signal cable, and streetlight cable shall be carried out in accordance with Standard Drawing TCS-F-105, and as per the Conduit Schedule on the Drawings. Where wires and cable pass through junction boxes, there shall be a minimum 300 mm of slack left in each junction box, and also in pole handholes. Wire and cable shall be run continuous from the controller cabinet to the pole handhole - no splices are permitted underground in conduit or in junction boxes. In the case of detector loop wiring, splices between the loop conductors and the lead-in cable shall be made in the junction box in accordance with the installation procedures and requirements outlined in Section 8.3.7, Detector Loops.

Wires and cables shall be labeled at each junction box and at the traffic cabinet with tags of a permanent nature. Labeling shall identify the purpose/destination of the cable using the following convention:

Cable Labeling Requirements:

Traffic signal cable	Pole ID - TS (e.g. Pole A - TS)
Streetlight cable	Pole ID - SL (e.g. Pole A - SL)
Microwave cable	Pole ID - MWD No. (e.g. Pole A - MWD2)
Loop Lead-In Cable	Loop No. - Traffic Movement (e.g. Loop 3-EBLT) (LT - Left Turn, RT - Right Turn, TH - Through) (Loop No. denotes signal phasing)

2.26.4.1.1.1 Signal Control Cable

Standard colour coding for the IMSA signal control cable is shown on Standard Drawing TCS-F-101. The size and number of signal cables pulled to each traffic pole shall be as per the Conduit Schedule shown on the Drawings.

2.26.4.1.1.2 Traffic Signal Poles

Each traffic signal and pedestrian head shall be separately wired to the base of the pole utilizing a #14 AWG stranded signal cable and a #14 AWG fixture bonding conductor. All common connections shall be made accessible from the handhole at the base of the pole. Cable and wires from the mast arm hanger to cable entrances shall be bundled / taped together.

Where the Contractor is required to drill and tap the steel poles for wire outlets, rubber grommets shall be used to prevent abrasion to the signal cables. If requested by the Consultant, the Contractor shall drill additional cable entrances on the steel poles for future signal head mounting locations. The drilled holes shall be touched up with a cold galvanizing compound and plugged to minimize entrance of moisture.

2.26.4.1.1.3 Traffic Cabinet

Field wiring shall be dressed and routed in corners of the cabinet to the various terminal boards or blocks, secured by plastic locking cable ties, lacing or preformed plastic spiral wrapping harness and fanned out neatly from the harness to each terminal.

Individual leads shall be long enough to permit re-routing to different terminals at a later date should this be required or as specified on the Drawings. All conductors shall be stripped such that the amount of exposed conductor protruding from the terminal block does not exceed 3 mm.

2.26.4.1.1.4 Splices

Splices in both aerial and underground cable must be electrically sound and waterproof. Splices shall be located in pole handholes. Splices are not permitted in conduit runs or within signal fixtures or within a pole base if not readily accessible through a handhole. No splices or joints of cable shall be drawn inside conduit.

2.26.4.1.2 Grounding

2.26.4.1.2.1 Service Ground

The intersection service ground will be connected to the power supply cabinet, and NOT to the traffic cabinet. The service ground shall consist of a minimum three 21 mm diameter x 3.0 m long copperclad ground rods on a #6 AWG bare copper ground conductor. The three ground electrodes shall be spaced 3.0 m apart, forming an equilateral triangle (3 m x 3 m x 3 m), and located at least 5.5 m from either the traffic controller or the power supply cabinets. The service ground shall be bonded to the neutral side of the main power disconnect breaker with one #6 AWG conductor in a single circuit.

2.26.4.1.2.2 Fixture Bond

A #8 AWG insulated bonding conductor shall be installed throughout all conduits containing live 120 AC conductors and shall connect all poles, pole fixtures, luminaries, steel junction box lids, and metal conduit to the grounded or neutral side of the AC power supply.

2.26.4.1.2.3 Lightning Attenuation

The Contractor shall install a 21 mm diameter x 3.0 m long copperclad lightning electrode in the junction box adjacent to all main traffic poles (i.e. cantilever poles, cantilever combination poles, and signal bridges. Pedestal poles, in most cases, can be installed without lightning electrodes located immediately adjacent to them), and connect the lightning electrode to the pole bonding stud with a #6 AWG conductor.

2.26.4.2 Conduits and Junction Boxes

2.26.4.2.1 Conduits

Refer to Specification 2.7, Underground Electrical Conduits, for general requirements related to conduit installations. Additional requirements related to conduit work in a traffic signals project are provided herein.

The Contractor shall install the conduits in accordance with the size, quantity, location, and installation method as specified on the Conduit Schedule and Underground Installations plan shown on the Drawings. If the installation method is not specified on the Drawings, approval from the Consultant shall be obtained prior to conduit installation. Any deviation from the design on the Drawings shall be pre-approved by the Consultant.

For traffic signal work, all underground conduit that runs underneath a roadway surface shall typically be installed at a minimum depth of 1.2 m. Where it is necessary for conduits to cross over other conduits, a minimum separation of 150 mm shall be provided between the crossing conduits. Where it is necessary for conduits to cross over utilities, a minimum separation of 300 mm shall be maintained. Where local authorities have different separation requirements from their underground utilities, the more stringent (i.e. farther apart) requirements will govern unless otherwise authorized by the Consultant, the Owner, or representative of the local authority. Where conduits are installed prior to placing roadbed granular materials, the conduits shall be protected with a minimum cover of 300 mm of compacted materials.

All conduits shall be installed free from dents and bruises and, as soon as installed, shall have the ends plugged to prevent the entrance of dirt or moisture. All conduits shall be thoroughly cleaned out before installation of conductors. All unused conduits shall be capped. Multiple bends in opposing directions are not permitted.

Conduit entrances into junction boxes designated for fibre optic cable installation shall be installed so that conduit designated for communication is capable of accommodating a minimum of 230 mm bend radius and a minimum of 300 mm clearance from the top of the cable bend to the top of the junction box.

The Contractor shall demonstrate to the Consultant the conditions of conduit connections by using an air compressor to blow a suitably sized styrofoam ball through the conduit system.

The Contractor shall use a red pen to record the location, alignment, quantity, size, installed depth, and installation method of all conduits on the Drawings provided by the Consultant. Any deviation from the Drawings shall be clearly marked.

2.26.4.2.2 Junction Boxes

The Contractor shall install junction boxes in accordance with the size and location as specified on the Underground Installations plan shown on the Drawings. Any deviation from the design

on the Drawings shall be pre-approved by the Consultant. Field location of all junction boxes shall be approved by the Consultant.

Junction boxes shall be rested on a 100 mm layer of compacted gravel. The cover of the junction boxes shall be level with the surrounding surface. Ground surface adjacent to a junction box should provide slope to direct surface runoff away from the junction box.

The Contractor shall use a red pen to record the location, quantity, and size of all junction boxes on the Drawings provided by the Consultant. Any deviation from the Drawings shall be clearly marked.

2.26.4.2.3 Backfilling

Conduits installed by trench excavation must be backfilled with a trench marker tape placed 300 mm below ground level, or provide at least 300 mm separation above the installed conduit. The Consultant shall be notified prior to backfilling over any electrical conduits. Trenches shall not be excessively wet and shall not contain pools of water during backfilling.

2.26.4.3 **Foundations**

The locations of the traffic pole bases and cabinet bases shall be as shown on the Drawings, and will be subject to field confirmation by the Consultant. If obstructions or other existing conditions cause problems with the placement of the traffic pole bases or cabinet bases, the Consultant may direct that a different location be used. Any deviation from the design on the Drawings must be pre-approved by the Consultant.

The Contractor shall use a red pen to record the approved as-built location, quantity and size of all pole bases on the Drawings.

2.26.4.3.1 Precast Cabinet Base and Pole Base

Excavation required for the installation of the precast cabinet base and the precast pole bases shall be carried out in such a manner as to avoid any unnecessary damage to streets, sidewalks, landscaping and other improvements. Excavation shall not be performed until immediately before installation of the precast concrete bases. At the end of each working period, all excavations shall be barricaded or covered, or both, to provide safe passage for pedestrian and vehicular traffic.

The precast cabinet bases shall be installed with the top of the base mounted at 600 mm above the surrounding ground surface. The controller cabinet base shall be placed on a minimum 100 mm layer of compacted granular material.

Precast concrete pole bases shall rest directly and solidly on the bottom of the hole. The top of the pole bases shall be up to 25 mm above the existing or new curb and sidewalk, or up to 100 mm above finished grade where there is no curb or sidewalk, except in sloped areas where they shall be up to 300 mm above finished grade or as shown on the Drawings.

A 900 mm diameter hole shall be excavated either by auger or hydrovac for precast concrete pole bases for cantilever or cantilever combination poles. A 600 mm diameter hole shall be excavated for precast pole bases for pedestal poles. The Contractor shall thoroughly compact the bottom of the hole. Unsuitable material at the bottom of the holes shall be replaced with granular material. All surplus excavated materials shall be properly disposed of within 48 hours by the Contractor.

Excavated material from augering the foundation holes shall not be used for backfilling around a precast concrete pole base. Lean mix concrete with a minimum 15 MPa 28 day compressive strength shall be used for backfilling. Alternatively, cold mix asphalt can be used, with compaction, for backfilling.

Allowable tolerances for precast concrete cabinet bases and pole bases are as follows:

Tolerance Limits:

Cabinet Bases:	Horizontal location (base centre)	+/- 100 mm
	Vertical location (top of base)	+/- 50 mm
Pole Bases:	Horizontal location (pole base centre)	+/- 50 mm
	Vertical location (top of pole base)	+/- 25 mm
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25 mm
	Bolt circle diameter (B.C.D.)	+/- 10 mm
	Vertical location (from top of pole base)	+/- 15 mm

Situations where more stringent tolerance limits are required will be indicated in the Special Provisions or on the Drawings. The more stringent tolerance limits shall be adhered to.

2.26.4.3.2 Cast-In-Place Pole Base

The Contractor shall install casing for pole bases as per dimensions specified on the Pole Schedule shown on the Drawings.

Steel cage for the cast-in-place pole base shall be constructed in accordance with the reinforcement quantities, lengths and dimensions shown on Standard Drawings TCS-F-301.1, 305.1, and 310. The anchor rods for the signal supports shall be physically bonded to the steel cage by either spot welds or reinforcements ties. The anchor rod assembly shall be centred on the pole base. The Contractor shall use 50 mm concrete spacer blocks at the perimeter of the steel cage assembly and the sonar tube shall be erected to plumb. If the sonar tube is not positioned to plumb, it shall be extracted and the drill hole or hydrovac hole be enlarged so that the sonar tube can be positioned vertically.

The anchor rod shall be positioned so that the erected mast arm on the signal support shall be perpendicular to the approaching travel lanes, unless otherwise specified on the Drawings. Before the concrete is poured, the steel cage and the sonar tube shall be ready and in position, and the anchor rod assembly shall be secured to the steel cage and wrapped to protect the anchor bolt assembly from the concrete pour.

A 25 mm chamfer shall be provided by using preformed formwork around the inside ring of the sonar tube for the purpose of establishing the top level of the pole base, provide a reference point for finishing the top of pole base, and to form a 25 mm chamfer around the perimeter of the top of the finished pole base. The length of anchor rod protruding from the top of the pole base shall be as shown on Standard Drawings TCS-F-301.1, 305.1, and 310.

The concrete shall be placed in accordance with CAN3-A23.1. Use Hot Weather Concrete protection procedures when air temperature is at or above 25°C. Use Cold Weather Concrete protection procedures when air temperature is at or below 5°C. Concrete shall not be placed on frozen subgrade or subbase. Water shall not be added to the concrete after the concrete truck arrives at the work site.

Obtain approval from the Consultant before placing concrete. Steel cage for pole base shall be checked before concreting for cleanliness, secure connection to anchor bolts, and a minimum 50 mm cover between steel cage and the sonar tube casing or the drilled hole. Copies of the Concrete Tickets shall be submitted to the Consultant after concreting as a record of the type of concrete used and the ambient conditions during concreting.

Ensure pile casing and anchor bolts are not disturbed during concrete placement. The allowable tolerances for the cast-in-place concrete pole bases are as follows:

Tolerance Limits:

Pole Bases:	Horizontal location (pole base centre)	+/- 50 mm
	Vertical location (top of pole base)	+/- 25 mm
	Vertical plumb (side of pole base)	+/- 5 degrees
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25 mm
	Orientation of the anchor bolt	+/- 10 degrees
	Vertical location (from top of pole base)	+/- 15 mm

The above tolerances shall be measured and checked by the Consultant after the concrete is set and the concrete form tube casing is stripped from the pole base.

Situations where more stringent tolerance limits are required will be indicated in the Special Provisions or on the Drawings. The more stringent tolerance limits shall be adhered to.

2.26.4.3.3 Galvanized Steel Helix Pole Base

The allowable tolerances for the helix pole bases are as follows:

Tolerance Limits:

Pole Bases:	Horizontal location (pole base centre)	+/- 50 mm
	Vertical location (top of pole base)	+/- 25 mm
Anchor Bolts:	Horizontal location (relative to centre of pole base)	+/- 25 mm
	Bolt circle diameter (B.C.D.)	+/- 10 mm
	Vertical location (from top of pole base)	+/- 15 mm

Situations where more stringent tolerance limits are required will be indicated in the Special Provisions or on the Drawings. The more stringent tolerance limits shall be adhered to.

2.26.4.3.4 Salvaged Pole Base

Precast pole base to be salvaged shall be cleaned by the Contractor prior to delivery to the destination specified on the Drawings or by the Consultant.

2.26.4.4 **Signal Supports**

2.26.4.4.1 Refinishing Poles

Any spots where the galvanizing of the signal poles is damaged due to drilling, tapping, reaming, welding or surface damage during transportation and erection shall be refinished with an approved cold galvanizing compound. The application of the cold galvanizing compound shall be in accordance with the following:

- a) The surface preparation and application of the compound shall be performed under the supervision or authorization of the Consultant. Any unsupervised or unauthorized application shall be completely removed and redone under proper supervision at the Contractor's own expense.
- b) The surface shall be mechanically cleaned with a wire brush or grinder and chemically cleaned to remove all welding flux, grease, oil, rust, scale and other dirt.
- c) The surface shall be absolutely dry and the ambient temperature shall be over 10°C.
- d) The cold galvanizing compound shall be thoroughly stirred before using until it has a completely uniform appearance. No thinning agent shall be added unless the Contractor is instructed to do so by the Consultant.
- e) A single brush coat shall be applied. This coat shall be as thick as possible without causing runs in the finished surface.
- f) The brush shall be dipped to the bottom of the can each time. Periodic stirring of the can during painting is required.
- g) Complete drying time can be as long as 48 hours so the application shall be timed so that the treated surface is not subject to damage or abrasion to other work within 48 hours of the time of application.

2.26.4.4.2 Signal / Sign Poles

The signal / sign poles shall be plumbed by the Contractor so that they are vertical when viewed from all directions. The plumb will be checked by the Consultant and the Contractor shall make any adjustments which are necessary by installing leveling shims as required around the anchor bolts. If requested by the Consultant, the Contractor shall grout underneath the shimmed pole base plate with a flowable and expansive high-strength grout compound, such as Sika 232, designed for such purposes. The Contractor shall obtain approval from the Consultant prior to using a selected grout compound.

The signal poles shall be oriented so that the mast arms are perpendicular to the approaching travel lanes, unless otherwise specified on the Drawings. Where practical, the signal poles shall be positioned with the handhole in the back of the pole or, if not possible, on the downstream traffic side of the pole.

Flange connections between all signal pole pieces shall be secured by means of bolts, washers and double nuts on each bolt in accordance with the torque recommended on the support structure Shop Drawings.

2.26.4.5 **Pole Mounted Traffic Control Fixtures**

The Contractor shall install traffic signal heads and other traffic control fixtures including signs, microwave detectors, and pushbuttons on the signal support in accordance with the Pole Schedule shown on the Drawings. The Contractor shall be required to drill and tap the steel poles as required. All drill holes shall be further protected by a rubber grommet.

Standard mounting height and location of the pole mounted traffic signals, pedestrian signals, and pushbuttons shall be in accordance with Standard Drawing TCS-F-501.

Standard mounting hardware arrangement for traffic and pedestrian signals on pedestal poles shall be in accordance with Standard Drawing TCS-F-505.

Standard mounting hardware arrangement for traffic and pedestrian signals on the side of the signal pole (such as secondary heads) shall be in accordance with Standard Drawing TCS-F-510.

Standard mounting hardware arrangement for traffic signals, either horizontally or vertically, on the mast arm of a cantilever or combination pole shall be in accordance with Standard Drawing TCS-F-515. A minimum vertical clearance of 5.8 m shall be provided between the bottom of the fixtures on the mast arm and the final pavement surface. This vertical clearance requirement is also applicable to large overhead signs such as special crosswalk sign and advance warning signal sign. The location and position of all pole mounted fixtures including traffic signal heads and pedestrian signal heads, pushbuttons, signs, and microwave detectors shall be checked with the Consultant in the field prior to final mounting.

All conductors from mast hangers to cable entrances shall be taped together.

The Contractor shall completely covered the signal heads, pedestrian signal heads, pushbuttons, and all signs that provide conflicting messages to the current traffic operating arrangements, from the time they are installed until the system is turned on for full operation.

Installation of microwave detectors shall include aiming and positioning of the detector to provide the desirable detection zone as shown on the Drawings or designated by the Consultant.

The following items shall be inspected by the Consultant after all traffic control fixtures are mounted and secured on the support structures:

- Position and quantity of overhead signs, signal heads and other traffic control fixtures shall be checked for compliance with the Above Ground Installation Plan and Pole Schedule shown on the Drawings.
- Alignment of signal head and overhead signs to travel lane shall be checked with reference to the Above Ground Installation Plan shown on the Drawings.
- Type and detailed configuration of signal head mounting hardware shall be checked for compliance with the Above Ground Installation Plan and Pole Schedule shown on the Drawings, and Standard Drawings TCS-F-501, 505, 515, 520, and 525.
- Alignment of pedestrian signal heads shall be checked for visibility from pushbutton location across the street.
- Mark on traffic signal head lens covers shall be checked for signal lenses alignment.
- Type of light bulb used shall be checked for compliance with Section 8.2.5.
- Vertical clearance for traffic control fixtures mounted on the mast arm shall be checked if the 5.8 m minimum value is provided.
- All exposed cables shall be checked for presence of jacket insulation
- All unused signal cable wires shall be checked to ensure that they are taped off or grounded.

2.26.4.6 Traffic Signal Controller Unit and Cabinet

2.26.4.6.1 Controller Timing Programming

The Contractor is responsible for programming the controller, verifying proper/expected operation through testing, and final turn-on verification of the provided timings. The Consultant shall supply the Contractor the signal timing plans, in a generic format, for the traffic controller. The timings shall be provided to the Contractor a minimum of 4 weeks prior to the expected traffic signal start-up date so that the Contractor can arrange for proper bench testing of the controller cabinet.

2.26.4.6.2 Bench Testing

Cabinets shall be pre-wired at the Contractor's shop to simulate all field operations in accordance with the traffic signal design shown on the Drawings. The cabinet shall be configured to operate in accordance with the designs provided, including timing, phasing and any additional control logic. When full compliance with the designs has been confirmed, the cabinet shall be bench tested for a period of 48 hours to verify proper operation. All timing plans and time-of-day plans shall be tested. Prior to and after all bench testing, a full MMU test shall be performed.

At the end of the bench testing process, the Contractor shall arrange for an inspection by the Consultant. The Contractor shall demonstrate to the Consultant during this inspection that the controller cabinet is wired and operating in accordance with the design illustrated on the Drawings, using the preliminary traffic signal timings provided by the Consultant.

The following reports shall be submitted to the Consultant at the time of the inspection at the Contractor's shop:

- A printed report of the conflict monitor test results
- Bench test and flash test reports
- A copy of the controller cabinet wiring drawing

2.26.4.6.3 Delivery to the Field

The Contractor shall be fully responsible for all costs associated with the delivery of the controller cabinet and associated control equipment to the site.

All equipment shall be delivered to the site free from any scratches or dents. Equipment will be rejected if noted that it has signs of any damage at time of "Construction Completion Inspection".

2.26.4.6.4 Field Wiring

Field wiring shall be terminated as shown on the Cabinet Wiring Drawing and shall be dressed and routed in corners of the cabinet to the various terminal boards or blocks, secured by lacing, cable ties, or preformed plastic spiral wrapping harness and fanned out neatly from the harness to each terminal. Individual leads shall be long enough to permit re-routing to different terminals at a later date should this be required or specified on the Drawings.

Wires and cables entering the traffic cabinet shall be labeled with tags of a permanent nature. Labeling shall identify the purpose of the cable (i.e.: Pole A-TS for traffic signal cable to Pole A). Refer to Subsection 2.26.4.1, Wire, Cable and Grounding / Bonding, for cable labeling requirements. Colour coding of the traffic signal cable and conductors shall be in accordance with the requirements outlined in Subsection 2.26.4.1, Wire, Cable and Grounding / Bonding. The load switches and detector racks shall be labeled with a thick, black permanent marker the corresponding signal phasing the component is serving.

Any field modification to the wiring of the cabinet must be documented by marking up the Controller Cabinet Wiring Diagram. A copy of the marked-up Drawing shall be submitted to the Consultant for records as part of the Record Drawing package.

The following items will be tested by the Consultant as part of the Construction Completion Inspection of the controller cabinet installation:

- Check for number of conduits entering the cabinet
- Check ground connection
- Check signal timing values
- Check signal phasing and detector phasing are in accordance with the Phasing Diagram and Above Ground Installations Plan shown on the Drawings, and in accordance with the Wiring Diagram accompanying the controller cabinet.
- Cleanliness
- Labeling of cables and auxiliary components in the controller cabinet such as load switches, and detector amplifiers.

2.26.4.6.5 Cabinet Sealing

The bottom of the controller cabinet contact with the concrete pedestal shall be sealed with a silicon base compound to prevent infiltration of dust and moisture.

2.26.4.7 **Detector Loops**

The Contractor is responsible for roadway cutting and patching for detector loop installation at locations indicated on the Underground Installation plan shown on the Drawings.

2.26.4.7.1 Wire Loop Assembly

Diamond detector loops shall be installed in accordance with the dimensions and methods shown on Standard Drawing TCS-F-801.

Rectangular detector loops shall be installed in accordance with the dimensions and methods shown on Standard Drawing TCS-F-805.

Quad detector loops shall be installed in accordance with the dimensions and methods shown on Standard Drawing TCS-F-810.

For total lead-in length more than 100 m, the number of windings should be increased by one.

When multiple loops are used, they shall be connected in series for maximum efficiency and greater reliability.

Conductor feeder pairs from loop to junction box shall be taped together every 0.3 m and twisted to provide a minimum of 15 turns per metre.

Adjacent loops serving a similar purpose shall be wired to provide current flow in the same direction (all clockwise or counter-clockwise). Adjacent loops serving separate traffic phases shall be wired to provide current flow in different directions (one clockwise and once counter-clockwise).

2.26.4.7.2 Pavement Slot Cutting

The locations of the detector loops shall be marked on the pavement as shown on the Drawings.

To minimize cross-talking between detector loops, the home runs of the detector conductor towards the roadside shall be located a minimum of 300 mm apart. At roadside where the home run enters the loop conduit connecting to the junction box, a minimum of 75 mm separation should be provided between home run slots. Maintain minimum 300 mm separation between loop conduits.

The depth of the saw cut and the saw cut width shall meet the requirements shown on Standard Drawings TCS-F-801, 805, and 810. Saw cuts shall be straight and be overlapped at corners to ensure that the full depth is cut. Diagonal saw cut of 45 degrees shall be used in all 90 degree corners of the detector loop.

2.26.4.7.3 Loop Installation

Remove all jagged edges and protrusions along the slot. The saw cut slots shall be cleaned by flushing with water and dried by blowing with oil free compressed air.

Place a small amount (5 to 10 mm) of loop sealant as a base. Carefully lay loop wire in the slot avoiding any kinking or stretching of the insulation and seat each turn using a blunt tool such as a wooden paint stirrer, but not a screwdriver or other such sharp object. Hold wire in place (minimum 35 mm below the surface of the roadway) with a backer rod. Push backer rod tight against conductors.

One continuous, unbroken length of wire shall be used to form a loop of the number of windings required from the loop to the junction box in accordance with Standard Drawings TCS-F-801, 805, and 810. Conduit connection at the roadside shall be installed in accordance with Standard Drawings TCS-F-815 and 815.1. Seal both ends of the flexible conduit with electrical cable sealant compound to prevent water from entering the conduit.

2.26.4.7.4 Sealing of Pavement Slot Cuts

Install detector loops and seal pavement slot cuts in the same day. Immediately prior to the application of loop sealant, saw cut slots must be thoroughly blown dried by using a high pressure air compressor.

Apply sealant in accordance with the Manufacturer's instructions. Apply the sealant in multiple (minimum 2) passes to prevent loop wire insulation damage and allowed to set prior to allowing vehicles to cross the loop.

Ensure that sealant completely surrounds detector loops and all hold down materials. Air bubbles which will leave voids must be removed and excess material smoothed out. Ensure that the slot is completely filled with sealant to 2 mm below the surface of the pavement. Any excess sealant or spillage shall be removed. The sealant shall be covered with dry cement powder or fine sand.

2.26.4.7.5 Splice between Loop Conductor and Lead-In Cable

Splices into the lead-in cable at the junction box shall be twisted, soldered and sealed using heat shrink connectors in accordance with Standard Drawing TCS-F-820. All pair splices shall be sealed separately. Coil 1 m of the lead-in cable in the junction box. No other splices to the lead-in cable will be permitted. The splicing arrangement shall be completed in accordance with the Detector Schedule shown on the Drawings. Lead-in cable run back to the controller cabinet shall be installed in accordance with the Conduit Schedule shown on the Drawings. Lead-in cable shall be grounded at the controller cabinet only. At the twisted feeder cable end, the ground wire of the lead-in cable shall be cut off flush and not connected to the ground.

2.26.4.7.6 Identification

Shielded cables shall be identified by labeling mechanically using identification tags by loop numbers and signal phases. Labeling shall be carried out using indelible marking pen. Label the shielded cables at the junction box and at the controller cabinet.

2.26.4.7.7 Tests

All splices shall be carefully made to ensure constant low resistance and be insulated in such a manner that, under the prevailing environmental conditions, the installation maintains resistance to ground of not less than 10 megohms. To ensure that the loop installation is correct, a continuity check on the loop wiring and a resistance check on the loop to ground using a "megger" or other suitable insulation tester shall be performed.

All tests shall be performed by the Contractor in the presence of the Consultant. The Contractor shall arrange for a field inspection by the Consultant. A minimum of two (2) business day notice is required to arrange for the inspection. Replace any loop or lead-in cable that fails the tests. Repeat test after completion of detector loop installation.

2.26.4.8 **Power Supply Cabinet**2.26.4.8.1 Power Supply Cabinet

The power supply cabinet shall be pole mounted or concrete base mounted as shown on the Drawings. When mounted on a pole, the power supply cabinet shall be mounted securely using stainless steel straps. Rigid PVC conduit and fittings shall be installed on the pole using PVC conduit straps and galvanized lag screws at 1.5 m maximum centers. When mounted on a concrete base, the bottom of the power supply cabinet that is in contact with the concrete base shall be sealed with proper weatherproof compound to prevent infiltration of dust and moisture.

The power supply cabinet shall be installed at least 11 m away from the traffic controller cabinet.

2.26.4.8.2 Grounding and Bonding

2.26.4.8.2.1 Service Ground

When a power supply cabinet is shown on the Drawings, the intersection service ground will be connected to the power supply cabinet and shall consist of a minimum three 20 mm diameter x 3 m long copperclad ground electrodes, spaced 3 m apart on a #6 AWG bare copper ground conductor, and arranged in a equilateral triangle formation. The service ground shall be bonded to the neutral side of the main power disconnect breaker with one continuous #6 AWG conductor. The intersection service ground electrodes shall be installed at a minimum of 5.5 m from both the traffic control cabinet and the power supply cabinet.

2.26.4.8.2.2 Bonding

A #8 AWG green bonding conductor shall be installed from the power supply service cabinet to the traffic control cabinet and to each traffic signal pole and street light pole supplied by the power supply service cabinet.

Where bonding conductors are spliced in a junction box, a copper split bolt connector shall be used to join the associated conductors together.

From each pole fixture, a bonding conductor shall be installed to the bonding stud at the base of each pole.

Lightning electrodes shall be connected to the bonding stud at the base of each pole.

2.26.5 SIGNALS COMPLETION

A Signals Completion Inspection is required to demonstrate and determine that all parts of the traffic signal system function as per design prior to the signal actually being turned on for public traffic.

When the Contractor has finished all necessary wiring, obtained approval from the electrical inspection authority, entered into the traffic controller the traffic signal timings provided by the Consultant, and is confident that the signal system will operate satisfactorily; he shall inform the Consultant and request for a Signals Completion Inspection of the signal system. The Contractor shall submit a set of As-built Drawings to the Consultant as part of the Signals Completion Inspection. The As-built Drawings shall indicate (in red) the location and accurate alignments of all junction boxes, conduits, poles, detector loops, and other equipment or fixtures installed, as well as all changes, additions, deletions, or any other modifications made to the original design. A minimum of two (2) business days notice is required for scheduling the inspection.

In preparing for Signals Completion Inspection, the Contractor shall carry his own inspection to verify that all materials and equipment are in place and secure, and the traffic signal equipment and detectors are functioning. The results of such tests shall conform to the requirements of the Canadian Electrical Code and shall be to the satisfaction of the electrical inspection authority and the Consultant.

- (a) If the Consultant decides that the results of the Signals Completion Inspection are unsatisfactory, a subsequent Signals Completion Inspection shall be arranged. The signal heads shall be either bagged or turned down if the traffic signal is not ready to go into a flashing mode.
- (b) If the test results are satisfactory to the Consultant, the signal system will be left in a flashing mode. A date for Signal-Turn-On, usually 3 to 7 days later, will be selected jointly by the Consultant and the Owner for switching the traffic signal from a flashing mode to a fully operational mode. The Consultant may identify a list of deficiencies which must be rectified by the Contractor prior to the Signal-Turn-On Date.
- (c) During both Signals Completion Inspection and Signal-Turn-On, the Contractor shall ensure that a qualified representative of the company, familiar with the equipment installed, is on site until it has been demonstrated that all equipment functions as intended on the Drawings and in the Specifications, and to the satisfaction of the Consultant.

A Signals Completion Certificate will be issued to the Contractor if the traffic signal system has been operating satisfactorily for a pre-specified burn-in period after Signal-Turn-On. For traffic signal installations located near an urban centre or is close to a local Alberta Transportation Maintenance Contract Inspector (MCI) office, a 7-day burn-in period is required. For traffic signal installations located outside an urban centre, or more than 100 km from a local Alberta Transportation MCI office, a 14-day burn-in period is required.

2.26.6 WARRANTY

Notwithstanding General Specification 1.2.53, Construction Completion and Acceptance, the warranty period will commence on the day following the successful completion of the burn-in period, or upon issuance of the Construction Completion Certificate; whichever date is later.

2.26.7 MEASUREMENT AND PAYMENT

Payment for a complete and operating traffic control system and all the Work described herein will be made at the lump sum price bid per intersection for "Traffic Signal System - Supply and Install". The lump sum price will be considered full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for supply and installation of underground conduit will be made in accordance with Specification 2.7, Underground Electrical Conduit.

All costs associated with Signal-Turn-On and the Burn-In Period will be considered incidental to the Work, and no separate or additional payment will be made.

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3.1 SUBGRADE PREPARATION**3.1.1 GENERAL****3.1.1.1 Description**

Subgrade shall be considered as the soil surface on which a subsequent layer or layers of base course, gravel surfacing, surface treatment, pavement or other material is to be placed. Prior to the deposition of any material on the subgrade, the subgrade shall be prepared to the satisfaction of the Consultant in accordance with the provisions hereinafter specified.

3.1.1.2 Test Methods

Unless otherwise specified, the test methods used shall be the same as specified in Subsection 2.3.4.7.5.2, Test Methods of Specification 2.3, Grading.

3.1.2 CONSTRUCTION**3.1.2.1 Subgrade Excavation**

Subgrade soil or previously existing, failed surfacing materials designated as undesirable by the Consultant shall be excavated, removed and disposed.

Existing topsoil that may be disturbed by the excavation work shall be stripped and stockpiled prior to the subgrade excavation work. All disturbed areas shall be covered with the stockpiled topsoil in accordance with Specification 2.6, Topsoil Placement, and seeded in accordance with Specification 2.20, Seeding.

The Contractor shall assume ownership of the excavated material and shall remove it from the roadway to his own storage or disposal site; or otherwise dispose of the material to the satisfaction of the Consultant. Written approval from the Owner of the disposal site, including proof of the disposal site cleanup, shall be submitted to the Consultant before full payment for this work will be made.

3.1.2.2 Granular Fill

Where designated by the Consultant, the Contractor shall place and compact granular fill on the prepared subgrade.

This work shall be carried out in accordance with the provisions of Specification 3.8, Granular Fill, and in general accordance with Subsection 3.50.5.2, Preparation of Existing Surface, of Specification 3.50, Asphalt Concrete Pavement (EPS).

3.1.2.3 Preparing Subgrade Surface

The subgrade shall be scarified to a depth of 150 mm, unless otherwise specified. The loosened material shall be windrowed to the side, and the exposed surface shall be thoroughly compacted. The windrowed material shall then be uniformly mixed, shaped to conform to the dimensions, lines, grades and cross-section as established by the Consultant, and compacted to obtain an average of 100 %, and with no test results being less than 97 % of the maximum dry density at optimum moisture content established by the Moisture-Density Relation tests using Standard Compaction. Approved material shall be added or removed to restore true grade and cross-section as directed by the Consultant.

When material varies from optimum moisture content, it shall be treated in the following manner. When a deficiency in moisture content exists, the material shall be watered and thoroughly mixed until optimum moisture content is attained. When an excess in moisture content exists, the material shall be worked and aerated until optimum moisture content is attained. The use of lime or any other material to assist in drying material shall be entirely at the Contractor's discretion.

When working with soils that have moderate or greater swelling potential, as determined by the Consultant, the moisture content for compaction shall be within a range of optimum to 3% above optimum, or as designated by the Consultant. High plastic clay soils are considered to have moderate to very high swelling potential unless proven otherwise. When working with predominately silt materials, as determined by the Consultant, the moisture content shall be within a range of 3% below optimum to optimum.

Any large rocks encountered during the subgrade preparation process, which constitute a hazard to traffic due to size or protrusion from the finished subgrade, shall be removed and disposed of as directed by the Consultant.

The finished subgrade surface shall be firm and uniform, true to grade and cross-section, and shall be approved by the Consultant before placing subsequent material thereon. Subgrade that does not conform to the requirements as to grade, cross-section, moisture content or density shall be reworked until such requirements are met.

Where required, the subgrade shall be prepared to a depth exceeding 150 mm on sections of the roadway as designated by the Consultant. When such work has been ordered, it shall be carried out in layers, each of which do not exceed 150 mm in depth, and requirements for density and optimum moisture as specified above shall apply for each layer.

Subgrade ramps of whatever nature at approaches to railway crossings, bridge structures, or adjacent to fixed obstructions, shall be removed to the lines and grades as directed by the Consultant. When the surplus material has been removed, the subgrade shall then be prepared in accordance with these specifications.

The Contractor shall, at his own expense, repair any damages to a prepared subgrade surface as well as repair damages done to culverts by his equipment, and shall remove any obstructions he may have placed which will interfere with the normal function of a drainage system.

3.1.2.4 Preparing Subgrade Surface on Combined Grading and Surfacing Projects

Where the Contract specifies grading and subsequent base course and/or paving work on the same project area, subgrade preparation shall be performed as required between the separate phases as determined and directed by the Consultant. Subgrade preparation Work, when so ordered by the Consultant, shall be performed according to the specified requirements of Subsection 3.1.2.3, Preparing Subgrade Surface.

Subgrade preparation bid units included in the Tender for combined projects shall not relieve the Contractor of completing the initial grading construction totally to the specified profile, cross-section, moisture content and compaction standards.

3.1.3 MEASUREMENT AND PAYMENT

3.1.3.1 **Subgrade Excavation**

Subgrade excavation will be measured in cubic metres based on the actual number of cubic metres excavated, as measured in its original position. Payment will be made at the unit price bid for "Subgrade Excavation". This payment will be full compensation for excavating, hauling and disposing of the material at a location acceptable to the Consultant.

Removal of ramps of whatever nature at approaches to railway crossings, bridges, or adjacent to fixed obstructions, will be paid for at the unit price bid for "Subgrade Excavation".

If necessary, topsoil excavation, topsoil placement, and seeding will be considered incidental to the Work and no separate or additional payment will be made.

Payment for backfilling failed areas with gravel fill, and asphalt concrete pavement will be made in accordance with the applicable Specifications for the materials specified.

3.1.3.2 **Granular Fill**

Granular fill, placed where required, will be paid for in accordance with the provisions of Specification 3.8, Granular Fill.

3.1.3.3 **Preparing Subgrade Surface**

Preparing subgrade surface will be paid for at the price or prices bid per square metre for "Preparing Subgrade Surface", for the top surface area and the top surface area of successive layers of 150 mm in depth, prepared in accordance with these specifications, which payment shall be compensation in full for all equipment, labour and tools necessary to complete the Work and shall include scarifying the subgrade, blading, mixing, watering or drying, shaping and compacting.

When the Consultant directs the Contractor to prepare subgrade surface for a layer or successive layers of 150 mm depth below the layer or layers specified in the Contract, preparation of such layers will be paid for at the unit price bid per square metre for "Preparing Subgrade Surface" of the nearest upper layer and shall be compensation in full for all equipment, labour and tools necessary to complete the Work as specified.

When the Contractor elects to use lime for drying wet materials the costs of mixing, storage if required, transportation within the project limits, loading, unloading, and spreading will be considered incidental to the Work and no separate or additional payment will be made.

The Contractor shall order and pay for the purchase and transportation of the pulverized quicklime directly from the supplier and shall provide the supplier's invoices to the Consultant within 24 hours of the delivery. The Department will reimburse the Contractor for 50% of the approved invoice cost F.O.B. the jobsite.

3.1.3.4 **Preparing Subgrade Surface on Combined Grading and Surfacing Projects**

On combined projects, the Contractor shall complete the grading construction to required profile, cross-section, moisture content and compaction standards in accordance with Specification 2.3, Grading, and payment for this will be made in accordance with Specification 2.3, Grading.

On areas where the grading has been approved as acceptable and the condition of the subgrade has subsequently deteriorated, the Consultant may direct that subgrade preparation be performed before the subsequent application of base or surfacing materials. For these areas as designated by the Consultant, the Contractor shall perform the subgrade preparation work in accordance with Subsection 3.1.2.3, and payment for these specified areas will be made at the unit price bid per square metre for "Preparing Subgrade Surface". Payment will be made only once for preparing subgrade on the designated areas and layers.

Payment for subgrade preparation will be made only for those areas and layers specified by the Consultant for preparing subgrade surface and where such is fully completed in accordance with Subsection 3.1.2.3. Separate payment will not be made for minor leveling, removing ruts or blading the subgrade surface required between the time of grading and the base or surfacing work, this being considered incidental to the grading operation.

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3.2 AGGREGATE PRODUCTION AND STOCKPILING**3.2.1 GENERAL**

This specification covers the general requirements for production, gradation, stockpiling, and pit operations for specified aggregate materials.

3.2.2 MATERIALS

The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate.

3.2.3 PRODUCTION**3.2.3.1 General**

Aggregate produced from all sources shall comply fully with the Specifications, and the Contractor shall recognize and satisfy himself as to the type and amount of work that may be necessary to produce the material required. The aggregate shall meet the specified requirements as shown on Table 3.2.3.1 for the material specified. The Contractor shall adjust and modify aggregates as required in order to meet specification requirements.

The crushed aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock, and shall be free from elongated particles, injurious quantities of flaky particles, soft shales, organic matter, clay lumps and other foreign matter.

All material up to and including 300 mm diameter in Designated Sources and Department Sources identified in the Contract shall be crushed.

When producing Designation 7 Class 40, "Cement Stabilized Base Course Aggregate", in the event that clay lumps are encountered, the maximum allowable size of material shall be 25 mm.

Acceptance of processed aggregates shall take place when they are in their final position and have met all the requirements of the Contract. The Consultant may test at any time and reject material that does not meet specifications. Final position for a crushing and stockpiling bid item will be the stockpile.

For Designation 1 aggregates used for wearing surfaces (top lift), the Contractor shall produce aggregates such that material retained on the 5 000 micron sieve shall not contain more than 3% detrimental matter based on the total mass of the combined aggregates in the final product.

Prior to the production of any aggregate for use as a wearing surface, the Contractor shall submit a proposal to the Consultant detailing the action to be taken in the event the specification requirement for detrimental matter cannot be achieved. Production of aggregates for use as a wearing surface shall not proceed until such an action plan has been approved by the Consultant.

TABLE 3.2.3.1, SPECIFICATIONS FOR AGGREGATE

DESIGNATION	1					2					3					4				5		6		7	8	9
	10	12.5	16	25		16(N2)	20	25	40		12.5AW	12.5BW	12.5C	16	20	25	40	10A	10B	80	125	40	25	8		
Class (mm)																										
125 000																										
80 000																										
50 000																										
40 000																										
25 000																										
Percent Passing Metric Sieve																										
20 000																										
16 000																										
12 500																										
10 000																										
(CGSB 8-GP-2M) F _m																										
8 000																										
5 000																										
1 250																										
630																										
315																										
160																										
80																										
% FRACTURE BY WEIGHT (2 FACES)																										
ALL +5000																										
PLASTICITY INDEX (PI)																										
L.A. ABRASION LOSS PERCENT MAX.																										
FLAKINESS INDEX																										
COEFFICIENT OF UNIFORMITY (CU)																										

Designations:

- Designation 1 - Asphalt Concrete Pavement
- Designation 2 - Base Course Aggregate
- Designation 3 - Seal Coat Aggregate
- Designation 4 - Gravel Surfacing Aggregate
- Designation 5 - Sanding Material
- Designation 6 - Gravel Fill
- Designation 7 - Cement Stabilized Base Course Aggregate
- Designation 8 - Granular Filter Aggregate
- Designation 9 - Slurry Seal Aggregate

*** Notes:**

- N1. According to Specification 3.50, Asphalt Concrete Pavement - EPS or 3.53, Asphalt Concrete Pavement - Superpave and Mix Type Specified.
- N2. Designation 2 Class 16 Material is for ASBC
- N3. For crushed aggregates other than all Designation 5 and Designation 9 materials, a tolerance of three percent in the amount passing the maximum size sieve will be permitted provided all oversize material passes the next larger standard sieve size.
- N4. Unless otherwise specified, Pit-Run Aggregate will be defined as unprocessed granular material, with no specified gradation requirement, that is extracted from an aggregate deposit

3.2.3.2 Quality Control

3.2.3.2.1 General

In all sources, quality control testing is the responsibility of the Contractor. Tests performed by the Consultant will not be considered to be quality control tests.

The Contractor shall use Professional Engineering services and a qualified testing laboratory licensed to practice in the Province of Alberta to assess and where necessary, modify the aggregate materials being produced to ensure their end use meets all specification requirements.

3.2.3.2.2 Test Methods

The terms "ATT" and "TLT" refer to Alberta Transportation Test methods.

Unless otherwise specified, the latest edition of the test methods shown in Table 3.2.3.2(A) will be used to determine material characteristics.

TABLE 3.2.3.2(A)
Test Methods Used to Determine Material Characteristics

TESTS	STANDARD
Sampling, Gravel and Sand	ATT-38
Sieve Analysis	ATT-25 or 26
Sieve Analysis, 80 000 Fm Minus, Part II - Pit-Run Contamination, - 5 000 Fm Sieve Analysis	ATT-25, Part II
Determining the Liquid Limit of Soils	AASHTO T 89
Dry Strength, Non-Plastic Aggregates	ATT-54
Determining the Plastic Limit and Plasticity Index of Soils	AASHTO T 90
Percent Fracture	ATT-50
Classification of Soils for Engineering Purposes (for definition of Coefficient of Uniformity, Cu)	ASTM D2487
L.A. Abrasion	AASHTO T 96
Flakiness Index	ATT-49
Detrimental Matter in Coarse Aggregate	TLT-107

Note: In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Table 3.2.3.2 (B).

TABLE 3.2.3.2(B)

SIEVES IN ACCORDANCE WITH: AASHTO DESIGNATION: M 92 ASTM DESIGNATION: E 11			METRIC SIEVES IN ACCORDANCE WITH: CGSB SPEC. 8-GP-2M
(U.S. STANDARD SERIES) (OPENING AND DESIGNATION)			
125.0	mm	5"	125 000
75.0	mm	3"	80 000
63.0	mm	2-1/2"	63 000
50.0	mm	2"	50 000
37.5	mm	1-1/2"	40 000
25.0	mm	1"	25 000
19.0	mm	3/4"	20 000
16.0	mm	5/8"	16 000
12.5	mm	1/2"	12 500
9.5	mm	3/8"	10 000
8.0	mm	5/16"	8 000
4.75	mm	#4	5 000
2.36	mm	#8	2 500
2.00	mm	#10	2 000
1.70	mm	#12	1 600
1.18	mm	#16	1 250
0.850	mm	#20	800
0.600	mm	#30	630
0.425	mm	#40	400
0.300	mm	#50	315
0.150	mm	#100	160
0.075	mm	#200	80
0.045	mm	#325	45

3.2.3.2.3 Quality Control Testing

The Contractor shall provide and maintain equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work.

The Contractor shall provide safe and convenient means for accurately and representatively sampling each aggregate stream being produced during all screening, splitting and crushing processes.

The minimum frequencies of quality control testing are described in Table 3.2.3.2(C) of this specification. Copies of all quality control tests shall be submitted to the Consultant within one working day of the completion of each test.

TABLE 3.2.3.2(C)
Quality Control Testing of Aggregates

TESTS		STANDARD	MINIMUM FREQUENCY
SIEVE ANALYSIS			
Crushed Aggregate			
1	Des. 1 and 2 Des. 3 (Class 12.5 & 16) 4 and 5 and 9	ATT-25 or ATT-26	Minimum Frequency not Specified One per 1000 tonnes production
2	Determining Pit-Run Contamination of Des. 1 (coarse fraction of Mix Types H1 & H2) and Extra Manufactured Fines aggregates.	ATT-25, Part II	One per 12 hours of plant production.
3	Blend Sand	ATT-26	Minimum Frequency not Specified
4	Extra Manufactured Fines	ATT-26	Minimum Frequency not Specified
5	Chips (Des. 3 Class 12.5AW & 12.5BW)	ATT-26	One per 8 hours of wash plant production
Uncrushed Fine Fraction(s)			
6	Contractor Supply of Aggregate	ATT-26	Minimum Frequency not Specified
	Department Controlled Source	ATT-26	One for first 5 000 tonnes plus one for each additional 10 000 tonnes.
DRY STRENGTH		ATT-54	Des. 2-one per 20 000 tonnes
PLASTICITY INDEX		AASHTO T 90	Des. 1-minimum frequency not specified Des. 2-one per Source and one per 20 000 tonnes when ATT-54 indicates a non-plastic high result. Other Des.-when requested by the Consultant
PERCENT FRACTURE		ATT-50	One per 5 000 tonnes.
L.A. ABRASION		AASHTO T 96	When requested by the Consultant
FLAKINESS INDEX (DES. 3 CLASS 12.5AW & 12.5BW)		ATT-49	One per source
DETRIMENTAL MATTER IN COARSE AGGREGATE (Paving Aggregates, Coarse Fraction, +5000 F m material)		TLT-107	Minimum of one for first 5 000 tonnes. ⁽¹⁾
The Consultant may require an increase in the frequency of any quality control test which has a specified minimum frequency. The Contractor shall arrange and pay for any additional tests required by the Consultant.			

⁽¹⁾ Additional tests at rate of one per 10 000 tonnes if first test indicates deleterious material is $\geq 4\%$.
(Reported on line E of Form MAT 5-730/94)

3.2.3.2.4 Quality Assurance Testing

The Consultant may inspect the aggregate production process and test and monitor the quality of the material being produced by the Contractor at any time and as often as he deems necessary. Such inspection or testing shall not in any way relieve the Contractor of the responsibility for producing aggregates that meet the Specifications in all respects.

The Consultant is under no obligation to provide the Contractor with test results.

3.2.3.2.4.1 Aggregate Quality

Testing by the consultant to verify aggregate quality will be undertaken on the following sources:

- i.) Any unproven source in which there is no history as being used on a Department project, or
- ii) any source for which the Consultant has concerns about the aggregate quality, or
- iii.) as identified in the Special Provisions.

The Contractor is to assist the Consultant in obtaining representative samples. Aggregate sampled for quality assurance testing shall be obtained from the stockpile containing crushed aggregate or the coarse fraction for Designation 1 applications. A minimum sample size of 120 kg shall be obtained according to the procedures outlined in ATT-38 except that a front-end loader may be used in place of a back hoe for sampling the stockpile. Sampling should occur shortly after 5 000 t have been stockpiled or at a time mutually agreed upon between the Contractor and Consultant. The Consultant is to be present during sampling. The Consultant will split the sample into three samples of approximately equal weight. One sample will be given to the Contractor, one will be tested by the Consultant and the third will be retained by the Consultant for potential appeal testing.

All quality assurance and appeal testing for aggregate quality will be completed by firms that are pre-qualified by the Department in the category of Mix Design Services - Marshall. Quality assurance testing to verify aggregate quality will include some or all of the following tests: Sieve Analysis, Detrimental Matter in Coarse Aggregate (Coarse Fraction, +5000 μm material) and L.A. Abrasion. The results of this testing will be used by the Consultant to verify specification compliance for the requirements of L.A. abrasion and/or detrimental matter. Aggregate that does not meet specification requirements shall not be incorporated into the Work.

If the Consultant's test results for detrimental matter content exceeds 3% the Contractor will not be allowed to use this material for top lift production unless the proportion of coarse fraction used in the asphalt mix results in a detrimental matter content of 3% or less based upon the total mass of the combined aggregates.

3.2.3.2.4.2 Appeal Testing for Aggregate Quality

The Contractor may appeal the results of the verification testing for aggregate quality if the test value indicates the aggregate material is not acceptable to be incorporated into the Work at the anticipated aggregate proportions to be used. The Contractor shall serve notice of appeal to the Consultant, in writing, within 48 hours of receipt of the test results.

The Department will arrange and pay for an independent testing laboratory to perform the appeal testing. The Consultant will arrange to have the remaining split of aggregate material delivered to the appeal laboratory.

The reported appeal value will be combined with the original verification value and averaged. The mean value will be used to determine whether the aggregate material is suitable to be incorporated into the Work.

If the new mean value indicates that the aggregate material is acceptable then appeal testing costs will be the responsibility of the Department.

If the new mean value indicates that the aggregate material is not acceptable then the Contractor will be invoiced by the Department for the testing costs at the following rates:

L.A. Abrasion - \$300 per appeal,

Detrimental Matter Content - \$500 per appeal.

3.2.3.3 Stockpiling

When aggregate stockpiles are specified or used as part of construction operations, the following shall apply:

- i.) When stockpiling is specified in the Contract, the stockpile sites shall be located as shown on the Drawings or as directed by the Consultant.
- ii.) If, in order to expedite his construction operation, the Contractor constructs temporary stockpiles at sites of his own choosing, he shall arrange for such sites and be responsible for them in all respects, including all costs for clearing, removal and salvage of overburden and other site preparation and reclamation. The Contractor shall also obtain approvals and clearances from Alberta Environmental Protection and the Archaeological Survey of Alberta for these sites prior to commencement of the Work.
- iii.) Stockpiles shall not be constructed at locations or by methods that will interfere with or damage any utilities such as power lines, telephone lines, pipelines, and underground utilities.
- iv.) Sites shall be cleared to the required dimensions. Topsoil and subsoil shall be separately excavated to the full depth or 300 mm, whichever is greater, and stockpiled separately. Stockpile sites shall be shaped to a uniform smooth surface and graded to ensure positive drainage.
- v.) Stockpiles shall be constructed by first distributing material uniformly over the entire base, and building upwards in successive layers not exceeding a thickness of 2 m.
- vi.) Construction operations shall be controlled to prevent segregation of the various particle sizes.
- vii.) Crushed aggregate or gravel fill shall not be pushed or dumped over the edges or down the faces of stockpiles.
- viii.) For blend sand, newly processed material shall be blended into the stockpile.
- ix.) Completed stockpiles shall be neat and regular in form and shall be constructed to occupy the smallest feasible area taking into consideration the bearing capacity of the foundation soils and the requirements of the Occupational Health and Safety Act.
- x.) If different types of material are to be stockpiled, the piles shall be located and constructed so that no intermixing of material will occur.

3.2.3.4 Aggregate Production

3.2.3.4.1 General

The Contractor shall produce aggregates conforming to the Specifications for the Designations and Classes called for in the Contract.

Prior to any aggregate production, the Contractor shall submit a written proposal to the Consultant, detailing aggregate processing procedures intended to be used. These proposed

procedures will require the approval of the Consultant. Aggregates produced prior to this approval will not be accepted.

The Contractor shall notify the Consultant a minimum of two days in advance of the start of aggregate production to allow the visual inspection of the process and testing of the production as deemed necessary by the Consultant.

Any recombining of aggregates or addition of blend materials shall be performed so that a uniform mix of the various sizes is achieved.

Unless otherwise specified, the Contractor shall ensure that manufactured fines are retained in the crushed aggregate stockpile.

There will be no separate payment made for any additional work associated with the Contractor's proposal in achieving the specification requirements for detrimental matter and all related costs shall be included in the unit price bid for "Asphalt Concrete Pavement" for the class of material used.

3.2.3.4.2 Production of Designation 1 Aggregates

The Contractor shall split aggregates for Designation 1 material into coarse and fine fractions prior to crushing of the coarse fraction. The crushed coarse and the fine fractions shall be stockpiled separately.

The Contractor shall select a screen size at which splitting will take place. Splitting of aggregates shall be controlled such that the coarse aggregate fraction, before crushing, shall contain no more than 5% passing the 5000 sieve for all mix types.

In Department sources, all uncrushed fine fraction(s) shall contain no more than 20% of material retained on the 5000 sieve size.

Further splitting of the crushed coarse aggregate into separate stockpiles may be performed at the Contractor's option. No additional payment will be made for this work.

3.2.3.4.3 Production and Addition of Blend Sand

When the aggregate being produced is destined for further processing through a mixing plant, the addition of any required blend sand shall take place at the mixing plant.

Prior to the mix production, blend sand shall be separately stockpiled so that a representative sample can be obtained in order to establish a mix design.

All blend sand shall be screened before being incorporated into the mix, to remove clay lumps, roots and other deleterious materials. All blend sand so screened shall pass the 5 000 sieve.

Blend sand shall be dried if necessary to ensure a uniform feed.

All other aggregates requiring an addition of blend sand to meet the gradation requirements shall be adjusted at the crushing stage by means of a separate conveyor or other approved device capable of metering the blend sand at a specified uniform rate. The blend sand shall be added prior to or onto the crusher screen deck.

3.2.3.4.4 Production of Extra Manufactured Fines

Manufactured fines are defined as that portion of the material passing the 5 000 sieve size which is produced by the crushing process.

In the event the manufactured fines in the total combined aggregate do not meet the requirement for the specified Asphalt Concrete Mix Type, extra manufactured fines shall be produced by screening the pit-run material so that the screened material contains no more than 5% material passing a 5 000 sieve. This material shall be crushed and all material produced by this crushing process shall be placed in a separate stockpile and designated as Extra Manufactured Fines.

3.2.3.5 **Interim Payment for Producing, Hauling and Stockpiling Crushed Aggregates**

3.2.3.5.1 General

Interim payments for producing, hauling, and stockpiling certain designations and classes of crushed aggregates will be made under the following conditions:

- (i) The Contractor submits a written request for interim payment to the Consultant.
- (ii) The producing and stockpiling has been completed in accordance with the Specifications.
- (iii) There are no separate payments specified for crushing and stockpiling aggregates.
- (iv) The Contractor provides the Consultant with written consent of Surety to the interim payment, or with security in the form of an Irrevocable Letter of Credit in the amount of the total interim payment.

Interim payment will not imply acceptance of the crushed aggregate by the Consultant. Interim payment will not be made for reject or surplus material.

3.2.3.6 **Surplus Crushed Aggregates**

3.2.3.6.1 Definitions

For the purposes of this specification only, the following definitions will apply:

3.2.3.6.1.1 Surplus Crushed Aggregates

Aggregates which have been produced from Designated Sources or Department Sources identified in the Contract for use on this Contract, and which remain in stockpile after completion of the Work. These aggregates are the property of the Department.

3.2.3.6.1.2 Quantity Placed

The quantity of any particular material incorporated into the Work and accepted by the Consultant.

3.2.3.6.1.3 Tender Quantity

The quantity shown in the Unit Price Schedule for the particular material.

3.2.3.6.1.4 Modified Tender Quantity

For any particular material, the Modified Tender Quantity will be either:

- (i) the greater of
 - (a) the Tender Quantity, or
 - (b) the increased amount of material to be crushed as ordered by the Consultant, or
 - (c) the Quantity Placed, or
- (ii) in the case where the Consultant orders a reduction in the Quantity to be placed, before the crushing of the material in question was completed, the Modified Tender Quantity will be the greater of
 - (a) the reduced Quantity as ordered, or
 - (b) the Quantity Placed.

3.2.4 MEASUREMENT AND PAYMENT3.2.4.1 **General**

In all sources, the production of aggregates including the processing, hauling and addition of blend sand, the production and addition of extra manufactured fines, and any other aggregate gradation adjustments and modifications will not be paid for separately. The cost of this work will be considered included in the unit price of the Contract item for which the aggregates are being produced.

Payment for the supply of aggregate materials incorporated into the Work will be made in accordance with Specification 5.2, Supply of Aggregate.

If the Contract specifies only crushing and stockpiling aggregates, or stockpiling of pit-run aggregates, then measurement will be made in tonnes or cubic metres measured in the vehicle. Payment will be made at the applicable unit price bid for the quantity produced.

The cost of erecting and removal of temporary fences associated with Sources Controlled by the Department will be paid for as "Extra Work" in accordance with Specification 1.2, General.

The Contractor shall be responsible for the cost of quality control. The Contractor shall be responsible for the cost of all consulting services retained by him.

When stockpiling is specified in the Contract, haul to stockpile will be measured and paid for if applicable, in accordance with the requirements in Specification 4.5, Hauling.

When required, a conversion factor of $1 \text{ m}^3 = 1.632 \text{ tonne}$ will be used.

3.2.4.2 **Interim Crushing, Hauling and Stockpiling**

Measurement for interim payments will be based on the quantity of crushed aggregate in stockpile, the tender quantity for the bid item incorporating the crushed aggregate, or the amount of material to be crushed as ordered by the Consultant, whichever is least.

Interim payments for producing and stockpiling crushed aggregates will be made monthly and in accordance with the following:

- (i) Interim payment is considered a portion of the unit price bid for the material placed on the roadway which incorporates the crushed aggregate. The interim payment will be deducted when payment is made under the applicable bid item or when all work covered by applicable bid item has been completed.
- (ii) Interim payment will be made at the following rates or at the unit price bid for the Work incorporating the crushed aggregate, whichever is least, for the Designation and Class specified:

<u>Designation</u>	<u>Mix Type or Class</u>	<u>Rate</u>
1	H1, H2, S1, S2	\$ 8.00 per tonne
1	M1, L1, S3	\$ 6.75 per tonne
Superpave	All Mix Types	\$ 8.00 per tonne
2	All Classes	\$ 4.25 per tonne
3	12.5AW and BW	\$17.00 per tonne
3	12.5C	\$ 8.00 per tonne
4	All Classes	\$ 3.75 per tonne
6	All Classes	\$ 3.25 per tonne
Haul	All Classes	\$ 0.12 per tonne.kilometre

Extra manufactured fines will be classified as Designation 1 material for interim payment.

Interim payment will be made for the portion of natural fines which will be incorporated into the Work.

Interim payment for premixing asphalt stabilized base course to stockpile will be made at the rate of 35% of the unit price bid for Asphalt Stabilized Base Course in addition to the payment already provided for producing and stockpiling the Des 2 aggregate.

For chip seal coat work with payment made on a square metre basis, the rate of interim payment shall also be on a square metre basis using a conversion factor of 20 kilograms per square metre.

If the Contractor elects to haul the crushed aggregate required under this Contract to an interim stockpile site, the Contractor shall be solely responsible for all costs associated with the interim stockpile site, including but not limited to, leasing, access development, haul roads, site development, pre and post disturbance assessments, final clean-up and site reclamation.

3.2.4.3 Surplus Crushed Aggregates

Surplus Crushed Aggregates for which payment will be made are shown in Table 3.2.4.3. These aggregates will be measured in cubic metres by the Consultant by cross-sectioning the piles.

Payment for Surplus Crushed Aggregates will be made at the applicable rates shown in Table 3.2.4.3 or at the bid price for crushing and placing, whichever is lower, in accordance with the following:

- (i) at Rate No. 1, for the quantity of Surplus Crushed Aggregate which when added to the Quantity Placed will be up to but will not exceed the Modified Tender Quantity; and
- (ii) at Rate No. 2, for the quantity which equals the total measured Surplus Quantity minus the amount determined in (i) above, up to a maximum of 10% of the Modified Tender Quantity.

No payment will be made for the following:

- (i) Quantities of surplus crushed aggregate in excess of those calculated in (i) and (ii) above.
- (ii) Material which was rejected by the Consultant or which does not meet the applicable specifications.
- (iii) The natural fines portion of a split aggregate.
- (iv) Rejected fines.
- (v) Material produced under a "Crush to Stockpile" bid item.
- (vi) Reject oversize aggregate.

TABLE 3.2.4.3
SURPLUS CRUSHED AGGREGATE

Designation	Class	Rate No. 1	Rate No. 2
1	All Classes ⁽²⁾	\$4.50/t	\$3.50/t
Superpave	All Mix Types ⁽²⁾	\$4.50/t	\$3.50/t
2	16, 20 and 25	\$2.75/t	\$2.00/t
2	40 and 50	\$2.75/t	\$2.00/t
2 ⁽¹⁾	16 (mixed with asphalt)	\$18.00/t	\$15.00/t
4	20 and 25	\$2.75/t	\$2.00/t
4	40	\$2.75/t	\$2.00/t
6	80 and 125	\$2.00/t	\$1.50/t
8	25	\$3.50/t	\$2.75/t

⁽¹⁾ These rates are for Surplus Crushed Aggregate which was mixed with asphalt and intended for Asphalt Stabilized Base Course.

⁽²⁾ Includes only the crushed coarse aggregate and extra manufactured fines.

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3.3 GRAVEL SURFACING**3.3.1 GENERAL**

Gravel surfacing shall consist of the shaping of the road surface as required, and the placing of crushed gravel thereon as designated by the Consultant.

3.3.2 MATERIALS

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

3.3.3 CONSTRUCTION**3.3.3.1 General**

Equipment used for shaping or for spreading gravel shall operate in the direction of normal traffic flow at all times.

3.3.3.2 Placing of Gravel Material

The road surface shall be shaped to the proper grade, crown and super elevation as shown on the Drawings or as directed by the Consultant.

The Contractor shall advise the Consultant at least 24 hours prior to commencement of gravel surfacing operations to allow inspection of the prepared road surface. Gravel surfacing may proceed only on sections of road which have been approved by the Consultant.

The gravel shall be placed in one or more layers as designated by the Consultant, and the amount of gravel surfacing material to be placed in each layer will be as shown on the Drawings or as designated by the Consultant.

Gravel shall be promptly and uniformly spread, and in all cases shall be spread before darkness each day. Every precaution shall be taken by the Contractor to provide for the safety of traffic in the area of operations.

After gravel surfacing is complete, the Contractor shall repair all damage to the shoulders or ditches resulting from his operations, leaving the road neatly trimmed and true to cross-section and grade.

The Contractor shall maintain the graveled surface until it is accepted by the Consultant. Maintenance shall be at the Contractor's own expense and shall be carried out daily or at frequent intervals, depending upon the effects of traffic and weather upon the graveled sections of roadway.

The Consultant may accept contiguous one kilometre long sections of graveled roadway or the whole project.

3.3.4 MEASUREMENT AND PAYMENT**3.3.4.1 Gravel Surfacing**

Measurement of gravel surfacing will be in cubic metres or tonnes, whichever is specified.

Volume measurements will be based on truck box measurement. The capacity of the gravel hauling vehicles will be measured by the Consultant. The measurements will be to the nearest 0.1 m³ capacity, and the capacity of the vehicle once measured shall not be changed without the consent of the Consultant.

The gravel shall be leveled, using a strike-off method, by the Contractor before measurement. No heaping or rounding of the load above the top of box level will be allowed. Truck boxes used in the haul of gravel shall be thoroughly cleaned upon unloading.

Payment of gravel surfacing will be made at the unit price bid per tonne or per cubic metre, whichever is specified for "Gravel Surfacing". This payment will be full compensation for shaping the road surface, processing, hauling and placing the gravel material.

There will be no separate or additional payment for placement of gravel surfacing in more than one layer.

Payment for the supply of aggregate will be made in accordance with Specification 5.2, Supply of Aggregate.

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3.5 ASPHALT STABILIZED BASE COURSE**3.5.1 GENERAL**

Asphalt stabilized base course shall consist of an intimate mixture of crushed aggregate and cutback or emulsified asphalt, produced by plant-mixing at elevated temperatures and placed in layers upon a previously prepared surface, compacted and finished as specified herein.

3.5.1.1 Alberta Transportation Test Procedures

Test methods designated in these specifications as "ATT" or "TLT" refer to Alberta Transportation Tests.

3.5.2 MATERIALS**3.5.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of materials specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling. Aggregate shall not contain lime.

3.5.2.2 Asphalt

The Contractor shall supply asphalt material in accordance with Specification 5.7, Supply of Asphalt, by Contractor.

Unless otherwise specified in the Special Provisions, asphalt binder for asphalt stabilized base course shall be MC-250 or MC-800. The Contractor shall make the choice between these two.

3.5.3 MIX DESIGNS AND JOB MIX FORMULA**3.5.3.1 Responsibility for Mix Designs**

Preparation and submission of asphalt stabilized base course mix designs for Consultant approval are the responsibility of the Contractor. All costs incurred in mix design formulation are the responsibility of the Contractor. Shipping costs for samples sent to the Consultant for approval are the responsibility of the Contractor.

The Contractor shall use Professional Engineering services and a qualified testing laboratory licensed to practice in the Province of Alberta to assess the aggregate materials proposed for use on the Work and to carry out the design of the asphalt stabilized base course mixture.

3.5.3.2 Requirements for Mix Design

The asphalt stabilized base course mix design shall follow the Marshall Method of Mix Design as outlined in the latest edition of procedure TLT-302 or TLT-303, as appropriate. A minimum of four specimens shall be prepared at each asphalt content and the grade of asphalt used in the design shall conform to Specification 5.7, Supply of Asphalt, shall be identical to that being supplied to the project and shall be obtained from the same supplier.

Mix designs shall meet the following characteristic requirements at the design asphalt content:

TABLE 3.5.3.2
MIX DESIGN CHARACTERISTICS

	HF-500M	MC-250 OR MC-800
Marshall Stability (N)	3000+	6700+
Air Voids	3% to 6%	3% to 6%

3.5.3.3 Approval of Mix Designs

The Contractor shall submit the mix design to the Consultant for approval. The Contractor's submission shall include the following information:

- (a) The gradation of each aggregate to be used in the mixture;
- (b) The percentage by mass of each aggregate to be used in the mixture;
- (c) The mix design gradation of the combined aggregate;
- (d) Other characteristics of the combined aggregate specified in Specification 3.2, Aggregate Production and Stockpiling;
- (e) All Marshall mix design characteristics, including graphs used in arriving at the final mix design, the bulk specific gravity of the combined aggregates, and the asphalt absorption of the combined aggregate; and
- (f) The recommended design asphalt content expressed as a percentage of dry weight of the aggregate.

The Consultant will require up to five working days from the time of receipt of the mix design to complete the evaluation.

The Consultant may, at any time, require the Contractor to provide representative samples of the individual aggregates in sufficient quantity that, when combined at the design proportions, a 100 kg sample is achieved. The Consultant will require up to five working days from the time of receipt of such samples to verify the mix design. The cost of such mix design verification will be borne by the Department.

Where required by the Consultant because of a change in the nature or source of the aggregates, or where a new mix design is desired by the Contractor, the Contractor shall provide a separate and complete mix design. This new mix design shall be subject to the approval of the Consultant.

The Consultant will not accept any asphalt mix produced prior to the Contractor receiving written approval of the mix design from the Consultant.

The aggregate proportioning and asphalt content for the approved mix design will then be the Job Mix Formula for the production of the asphalt stabilized base course mixture.

The Contractor shall be totally responsible for the production of mixes in conformance with the Contract.

3.5.3.4 Variation from the Approved Job Mix Formula

After the Job Mix Formula gradation and proportioning of the various aggregate sizes have been established and approved, no alteration to the Job Mix Formula will be permitted. The maximum permissible variation between an individual Cold Feed sample gradation and the Job Mix Formula gradation shall be as shown in the following table:

TABLE 3.5.3.4
GRADATION VARIATION

MAXIMUM PERMISSIBLE VARIATION * PERCENT BY WEIGHT PASSING	
Sieve Designation	Individual Cold Feed Sample
5 000	± 6
1 250	± 4
630	± 3
315	± 3
160	± 2
80	± 2
* In any case, the Gradation must meet the gradation requirements of Specification 3.2, Aggregate Production and Stockpiling.	

If any deviation from the approved Job Mix Formula beyond the variations given above, or any alteration of aggregate proportioning, is requested by the Contractor in writing, the Consultant will evaluate the request and determine if a new mix design is required.

Any deviation whatsoever from the approved Job Mix Formula shall require the prior written approval of the Consultant, and the Consultant will not accept any asphalt mix produced prior to this approval.

The Estimated Original Binder content of any individual sample shall not vary by more than 0.5% from the Job Mix Formula and the daily average by more than 0.3% from the Job Mix Formula.

3.5.4 SAMPLING AND TESTING

3.5.4.1 Test Methods

Unless otherwise specified, the latest edition of the following Test Methods shown in Table 3.5.4.1 will be used to determine material characteristics.

TABLE 3.5.4.1
TEST METHODS

TEST	STANDARD
Moisture or Volatile Distillates in Bituminous Paving Mixtures	AASHTO T 110
Extraction	ATT-12
Correction Factor, Extracted Asphalt Content	ATT-12, Part III
Sieve Analysis, 20 000 F m Minus	ATT-26
Density, ASBC Control Strip Method	ATT-66
Sampling, Mixes	ATT-37
Sampling, Asphalt	ATT-42
Sampling, Gravel and Sand	ATT-38
Moisture Content, Oven Method, Part II, Emulsified Asphalt Mixes	ATT-15, Part II
Moisture Content, Oven Method, Part III, Cutback Asphalt Mixes, Calcium Oxide Method	ATT-15, Part III

NOTES:

- (1) In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.
- (2) In all cases the latest amendment or revision current at the closing date of the tender is implied when reference is made to one of the above standards in the specification.

3.5.4.2 Quality Control Testing

Quality control testing is the responsibility of the Contractor throughout every stage of the Work, from the crushing and production of aggregates to the final accepted product. Tests performed by the Consultant will be quality assurance tests and will not be considered as quality control tests. The Contractor shall provide and maintain equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work.

The minimum frequencies of quality control testing are described in Table 3.5.4.2. The Consultant may require an increase in the frequency of any quality control test. The Contractor shall arrange and pay for any additional tests required by the Consultant. Copies of all quality control tests shall be submitted to the Consultant within one working day of the completion of each test.

The Contractor shall bear the cost of all consulting services retained by him.

TABLE 3.5.4.2
ASPHALT STABILIZED BASE COURSE
QUALITY CONTROL TESTING

TEST	STANDARD	MINIMUM TEST FREQUENCY	
Plant Calibration	ATT-17	Once per project or as required by the Consultant	
Moisture or Volatile Distillates in Bituminous Paving Mixtures	AASHTO T110	<u>PLANT PRODUCTION</u> One per day ⁽¹⁾	<u>FINAL PLACEMENT</u> One per day ⁽²⁾
Asphalt Extraction	ATT-12	Two per day	
Sieve Analysis	ATT-26	Each Extraction	
Asphalt Correction Factor	ATT-12, Part III	One per design	
Moisture Content of: Emulsified Asphalt Mixes Cutback Asphalt Mixes	ATT-15, Part II ATT-15, Part III	<u>PLANT PRODUCTION</u> Two per day	<u>DURING LAYDOWN</u> After a rain, as required by the Consultant
Aggregate Sieve Analysis (Cold Feed)	ATT-26	One per day	
Mix Temperature	ATT-30	Four per day	
Plant Inspection	ATT-16	Four per day	
Sampling Cutback Asphalts and Emulsions	ATT-42	One sample per day	
Sampling Tack, Prime and Fog Materials	ATT-42	One per load	
Emulsion Breaking Point	ATT-65	During laydown as required	

NOTE:

- (1) One test per day for the first 3 days of production if all mix specification criteria are met.
(2) Not required if Plant Production test results for % of the original cutback weight are between 40-70% for MC 250, and more than 75% for MC 800.

3.5.4.3 Acceptance Sampling and Testing

Within this specification certain requirements, limits, and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be measured and accepted based on the Consultant's quality assurance test results.

3.5.5 CONSTRUCTION

3.5.5.1 General

The Contractor shall mix the asphalt stabilized base course through a central mixing plant at elevated temperatures.

The mix shall be produced, placed and compacted in a manner which results in a uniform and non-segregated product. The Contractor shall eliminate the causes of any aggregate segregation or non-uniform asphalt distribution which may occur and shall correct any areas which are segregated or excessively rich, lean or wet.

3.5.5.2 Asphalt Mixing Plant Requirements

3.5.5.2.1 All Plants

The Contractor shall calibrate the plant at each production location and shall provide the Consultant with a calibration certificate and data attesting to the calibration.

The Consultant may, when he deems necessary, verify the calibration of the plant at any time. The Contractor shall provide all equipment, facilities and operating staff required to verify the calibration safely and accurately.

The cold aggregate feed shall contain separate bins for each aggregate to be introduced into the mix. Each cold feed bin shall have an adjustable gate and a variable speed feed belt. The cold feed bins shall be calibrated by diverting and weighing the aggregate flow at various speeds of the feed belt. The Contractor shall provide vibrators or other devices to ensure a uniform flow of material.

Each cold feed unit shall be equipped with a sampling device which will allow a representative sample of the aggregate material being delivered to the mixing plant to be obtained safely and without disrupting the continuous operation of the plant.

3.5.5.2.2 Batch Plants

Batch plants shall be equipped with weigh scales on both the asphalt and the aggregate hoppers.

The asphalt scale accuracy shall be checked with enough test weights to simulate the size of the anticipated asphalt batch.

The aggregate scale accuracy shall be checked with test weights or by diverting a number of pre-weighed batches into a truck and verifying the weight on the platform scale.

Each scale shall be accurate to 1.0%.

3.5.5.2.3 Continuous Mix Plants (Pug-Mill Type)

The hot aggregate hopper shall be equipped with an adjustable gate and may also have a variable speed apron feeder. The hot bin shall be calibrated by diverting and weighing the hot aggregate flow into a truck at various gate settings or apron feeder speeds or both. The asphalt pump shall be of the positive displacement type and shall be mechanically or electronically interlocked with the aggregate flow. The asphalt pump shall be calibrated by diverting asphalt into a suitable container for a time at various settings and weighing the pumped asphalt on the platform scale. The container shall have a volume of at least 3 000 litres.

3.5.5.2.4 Drum Mix Plants

Drum mix plants shall be equipped with electronic controls that automatically and continuously measure the amounts of aggregate and asphalt that are being delivered to the mixing drum. The flow of aggregate shall be weighed by an electronic belt scale.

The calibration shall be performed by diverting the aggregate flow into a truck and the asphalt flow into a container of at least 3 000 litres capacity. The materials shall be weighed on a platform scale and the weight compared to the plant readings.

During the calibration, the asphalt percent delivered shall not vary by more than 0.1% from a particular setting.

The rates of flow of aggregate and asphalt shall be displayed on the control panel.

The belt scale shall be accurate to within 1.0% of the truck weight at the anticipated production rate and also at the lesser of the following rates:

- 100 t/h less than the anticipated production rate, or
- 25% lower than the anticipated production rate.

3.5.5.3 Production

Asphalt binder, of the designated type and grade, shall be uniformly applied to the combined crushed aggregate at the rate approved in the Job Mix Formula. The temperature of any ingredient of the mix shall not exceed 100°C at the time of plant mixing. Mixing shall continue until all the asphalt is uniformly dispersed throughout the mix and all aggregate particles are coated with asphalt. The drying and mixing process shall not reduce the cutback level to such a degree that the mix cannot be properly placed. Up to the time of spreading and placing material that is to be blade laid, the amount of cutback in the mix shall be maintained as shown below for each binder grade:

- MC-250 Between 40% and 70% of the original cutback weight;
- MC-800 More than 75% of the original cutback weight

Mixes containing emulsified asphalt shall not be placed and compacted until the Emulsion Breaking Point Test (ATT-65) indicates the emulsion breaking point has been reached.

The moisture content at the plant discharge of mixes containing cutback asphalt shall be 1.0% or less as measured by any individual test.

3.5.5.4 Stockpiling

When asphalt stabilized base course stockpiles are used as part of construction operations, the general provisions for stockpiling contained in Specification 3.2, Aggregate Production and Stockpiling, shall apply, modified and supplemented as follows:

- (a) Stacking conveyors only shall be used in the construction of the stockpiles.
- (b) The free fall distance from the conveyor to the base of the stockpile at the commencement of stockpiling operations at a given site shall not exceed 3.5 m, and the conveyor shall not be raised until the free fall is less than 2 m. Thereafter, the free fall shall not exceed 2 m.
- (c) No equipment shall be allowed on the stockpile at any time.
- (d) Stockpiles shall be constructed so as to minimize segregation and the taking on of moisture. The height of stockpiles shall not exceed 8 m.

- (e) The Contractor shall not plant-mix or stockpile asphalt stabilized base course mix during periods of rain. Work may resume when the rain ceases.

3.5.5.5 Spreading and Compaction

For blade laid material, up to the time of spreading and placing, the amount of cutback in the mix shall be maintained as shown below for each binder grade:

- MC-250 Between 40% and 70% of the original cutback weight;
- MC-800 More than 75% of the original cutback weight.

Mixes containing emulsified asphalt shall not be placed until the Emulsion Breaking Point Test (ATT-65) indicates the emulsion breaking point has been reached.

The mix shall be uniformly placed on the prepared and approved surface at the rate of application required to yield the nominal compacted thicknesses specified or designated by the Consultant.

The mix shall be spread and compacted only when the ambient temperature is 5°C or greater and its moisture content is 1.0% or less as measured by any individual test.

Vibratory compaction equipment shall not be used over cement stabilized base course unless specifically approved by the Consultant in writing.

The mix shall be spread and compacted to specified grade and cross-section, be stable, uniform in depth, gradation, density and asphalt content at the values specified or designated, and the finished surface shall be smooth, waterproof and free of roller and tire marks.

The Contractor shall, at his own expense and to the satisfaction of the Consultant, repair or restore to specified condition any asphalt stabilized base course which fails, loses specified density or becomes too wet or too dry, or becomes unstable, rutted, distorted, loose or rough prior to placing subsequent layers of material and prior to final acceptance of the Work.

3.5.5.6 Density Control

3.5.5.6.1 General

Control over the density to which asphalt stabilized base course is compacted will be exercised by the construction of a Control Strip.

A "Control Strip" is a layer of asphalt stabilized base course of specified depth constructed on a section of prepared surface. The length of the Control Strip section shall be 200 m long or as directed by the Consultant.

The Control Minimum Number of Passes is the number of passes with the minimum compaction equipment to attain a Control Maximum Wet Density for a Control Strip.

To determine the Control Minimum Number of Passes, the Consultant will take density measurements by means of nuclear equipment during the compaction operation until a maximum wet density is achieved. The wet density so achieved is the Control Maximum Wet Density.

A new Control Strip with its corresponding Control Maximum Wet Density may be required at any time throughout the project as determined by the Consultant.

3.5.5.6.2 Minimum Compaction Equipment

A Control Strip over Granular Base Course shall be compacted using the following equipment as a minimum:

- (i) Two vibratory steel-wheeled rollers, weighing not less than 6 t each and having vibratory capacities of at least 1 500 vibrations per minute with a minimum dynamic or centrifugal force of 8 000 kg, operated in the vibratory mode at a speed not to exceed 8 km/h; or
- (ii) One vibratory steel-wheeled roller, weighing not less than 6 t and having a vibratory capacity of at least 1 500 vibrations per minute with a minimum dynamic or centrifugal force of 8 000 kg, operated in the vibratory mode at a speed not to exceed 8 km/h; and one of the following:
 - (a) Six wobbly-wheel pneumatic-tired rollers with tires inflated to a pressure of from 165 kPa to 235 kPa, ballasted with at least a level load and towed at a speed not to exceed 8 km/h; or
 - (b) Two self-propelled pneumatic-tired rollers, each ballasted to its maximum capacity, weighing not less than 10 t, having a minimum tire pressure of from 365 kPa to 435 kPa, and travelling at a speed not to exceed 8 km/h; or
 - (c) A combination of 4 wobbly-wheel pneumatic-tired rollers and one self-propelled pneumatic-tired roller, all of which meet the appropriate criteria described above.

A Control Strip over cement stabilized base course shall be compacted using the equipment options as described in Subsection 3.5.5.6.2 (ii) above as a minimum, except that the vibratory steel roller is to be operated in static mode.

3.5.5.6.3 Method of Compaction for the Control Strip

A "pass" is one complete coverage of the Control Strip area with at least the minimum compaction equipment specified in Subsection 3.5.5.6.2 of this specification.

As portions of the mix are being spread, the Contractor shall initially compact the mix either with one of the vibratory steel-wheel rollers specified in Subsection 3.5.5.6.2(i) or (ii), or with the equipment specified in Subsection 3.5.5.6.2(ii) (a), (b) or (c), as the case may be, so that when the entire lift has been spread he shall have covered the Control Strip area completely at least twice with this compaction equipment.

Once the Contractor has completely spread the asphalt stabilized base course for the Control Strip, the Consultant will commence measurements of wet density using nuclear equipment. Compaction using all the minimum equipment specified in Subsection 3.5.5.6.2(i) or (ii) shall then proceed, and shall continue until the Control Maximum Wet Density is attained and the Control Minimum Number of Passes is established.

When pneumatic-tired rollers are used for compaction, they shall precede the vibratory steel-wheeled roller.

3.5.5.6.4 General Construction Using the Control Strip

Once the Control Minimum Number of Passes and the Control Maximum Wet Density have been established using a given combination of equipment, the Contractor shall use the same equipment, spreading technique and minimum number of passes for the general construction operation unless otherwise approved by the Consultant.

The Consultant may at any time take measurements using nuclear equipment to determine if the Control Maximum Wet Density has been attained. If the results at ten randomly selected test sites do not average at least 98.0% of the Control Maximum Wet Density, then the Contractor shall carry out more passes until such an average is attained, or he shall construct a new Control Strip to establish a new Control Maximum Wet Density and a new Control Minimum Number of Passes, as directed by the Consultant.

The Contractor shall compact areas such as entrances, where all of the specified equipment cannot work practically, using a vibratory steel-wheeled roller as specified in Subsection 3.5.5.6.2 until 95.0% of the Control Maximum Wet Density has been achieved.

3.5.5.7 **Asphalt Fog Coat**

The Contractor shall apply an asphalt fog coat to the finished asphalt stabilized base course surface as soon as is practical, as the Work progresses, and at locations and to dimensions designated by the Consultant, according to Specification 3.19, Prime, Tack and Fog Coats. Areas of asphalt stabilized base course which have been repaired or restored shall be re-fogged to the satisfaction of the Consultant.

3.5.5.8 **Interim Lane Markings**

The Contractor shall provide interim lane markings on all newly constructed asphalt stabilized base course surfaces, or on tacked surfaces that are to be exposed to traffic overnight. All paint spots shall be 100 mm wide and 300 mm long, shall be applied lengthwise to the road surface, shall be spaced 15 m apart on centre in tangent sections and 7.5 m apart on curves, shall employ the same paint colour as the permanent marking to come and shall be completely covered with glass beads at the time of painting.

3.5.5.9 **Slopes and Ditches**

Slopes shall be neatly trimmed, and loose or waste material shall be either neatly bladed against the edge of the base course or spread neatly over the sideslopes and ditches as directed by the Consultant. All rocks larger than 75 mm in diameter shall be removed from the side slopes and ditches and disposed of in a manner satisfactory to the Consultant.

3.5.5.10 **Asphalt Stabilized Base Course for Others**

The Contractor shall make available, on request, additional asphalt stabilized base course for the use of the Department. The estimated quantity of additional material is shown in the unit price schedule as "Asphalt Stabilized Base Course For Others". This additional material will either be picked up at the mixing plant by other forces at times that are mutually agreeable to the Contractor and the Consultant or stockpiled by the Contractor, as determined by the Consultant.

3.5.6 MEASUREMENT AND PAYMENT**3.5.6.1 Asphalt Stabilized Base Course**

Accepted asphalt stabilized base course material will be measured in tonnes and paid for at the unit price bid per tonne for "Asphalt Stabilized Base Course". This payment will be full compensation for processing, hauling and placing the mix; stockpiling if appropriate, interim lane marking and quality control.

No payment will be made for any material used to repair failures which may occur in the base courses constructed under this Contract. Any expense incurred in the supply, processing, hauling and placing of such material shall be borne by the Contractor.

The removal and disposal of rocks will be considered incidental to the Work and no separate or additional payment will be made

3.5.6.2 Asphalt Stabilized Base Course For Others

Payment will be made at the unit price bid per tonne for "Asphalt Stabilized Base Course For Others." This payment will be full compensation for processing the mix, loading to trucks or stockpiling the material and quality control.

3.5.6.3 Supply of Aggregate

Payment for the supply of aggregate will be made in accordance with Specification 5.2, Supply of Aggregate.

3.5.6.4 Fog Coat

Measurement and payment for fog coat will be in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.5.6.5 Supply of Asphalt

Payment for the supply of asphalt for asphalt stabilized base course will be made at the unit price bid per tonne for "Supply of Asphalt for Asphalt Stabilized Base Course."

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3.6 GRANULAR BASE COURSE**3.6.1 GENERAL****3.6.1.1 Description**

Granular base course shall consist of an intimate mixture of crushed aggregate and water, which is placed in layers upon a prepared surface, compacted and finished, as specified herein.

3.6.1.2 Definitions

A "Control Strip" is defined as a lift of granular base course constructed using the equipment and method of compaction as prescribed herein, normally on a 400 m section of prepared surface selected by the Consultant.

The "Control Density" is defined as the maximum dry density attained on a "Control Strip."

A "Pass" is defined as one complete coverage of the Control Strip area with at least the minimum compaction equipment specified herein.

A "Lot" is normally defined as the quantity of granular base course placed in one day's production. For projects with small quantities of granular base course, generally less than 3000 tonnes, the entire quantity of granular base course will be considered as one Lot. If the Consultant suspects a portion of a Lot is substandard, he may order extra testing to define the area and severity of the deficiency. A new Lot will be designated for this portion if this extra testing indicates the granular base course is subject to unit price adjustment or rejection.

A "Visually Failed Area" is defined as an area of any subgrade or base course which fails, loses specified density, becomes too wet or too dry, or becomes rutted, distorted, loose or rough.

3.6.2 MATERIALS**3.6.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of materials specified. The Contractor shall supply materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

When the Contract specifies the use of Designation 2 Class 25 material, the Contractor shall have the option of supplying either Designation 2 Class 20 material or Designation 2 Class 40 material providing it meets the requirements of the Specifications.

3.6.2.2 Water

The Contractor shall supply and haul all water required for the construction and maintenance of this work.

The water shall be free from substances which render it unfit for use.

3.6.2.3 Asphalt

The Contractor shall supply asphalt material for prime coat in accordance with Specification 5.7, Supply of Asphalt.

3.6.2.4 Interim Lane Markings

The Contractor shall supply interim lane marking paint and glass beads from the list of approved products shown in the Special Provisions or Specification Amendments.

As an alternative to paint and glass beads, the Contractor has the option of supplying reflectorized temporary pavement markers or self-adhesive reflectorized pavement marking tape. Acceptable temporary pavement markers are shown on the Alberta Transportation Products List.

3.6.3 ACCEPTANCE SAMPLING AND TESTING

All testing will be carried out by an approved laboratory.

The Consultant may at any time take samples, carry out testing and inspection of materials incorporated or being incorporated into the Work. The Contractor shall cooperate with the Consultant or his representative for such sampling, testing and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

Sample locations for routine quality testing will be randomly selected as far as it is practical to do so. This will not limit the Consultant from testing at any additional locations deemed necessary.

Results of the tests are available to the Contractor for his information. It is the responsibility of the Contractor to interpret test results and alter his operation if necessary, so that the product meets all required specifications.

3.6.3.1 Test Methods

Unless otherwise specified, the following standard Alberta Transportation test methods (ATT) shown in Table 3.6.3.1 will be used to determine the material characteristics.

**TABLE 3.6.3.1
QUALITY ASSURANCE TEST METHODS**

TEST	STANDARD	FREQUENCY (Minimum)
SAMPLING, Gravel and Sand	ATT- 38	As Required
⁽¹⁾ SIEVE ANALYSIS	ATT-25 or 26	As required in ATT-38
PERCENT FRACTURE	ATT-50	As required in ATT-38
DENSITY, Control Strip Method	ATT-58	⁽²⁾ Control & Test Sections
RANDOM TEST SITE LOCATIONS	ATT-56	Each Test Sections
MOISTURE CONTENT, Oven Method, Soil and Gravel	ATT-15	As required

NOTES: ⁽¹⁾ In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.

⁽²⁾ Control Strips are established as specified herein. Density Test Sections are randomly established every 1000 m on all lifts.

3.6.4 CONSTRUCTION3.6.4.1 **Aggregate Production**

The Contractor shall advise the Consultant which material (2-20, 2-25, 2-40) he will be producing prior to commencing his crushing operations. If the Contractor decides to change materials at any time during his crushing operations, he shall immediately advise the Consultant and stockpile the new material separately from any previously crushed material. In cases where the Contractor elects to use more than one material he shall, prior to hauling, keep the Consultant informed which material is being hauled on a daily basis. No intermixing of materials will be allowed at any time.

3.6.4.2 **Control Strip Construction**

The nominal lift thickness of a granular base course shall be determined by the Contractor but shall not be less than 100 mm, or exceed 200 mm compacted. The total design granular base course thickness may require that more than one lift be constructed, in which case, a new Control Strip is required for each lift; for a change in designation, class or source of aggregate; or when called for by the Consultant.

Control Strips shall not be constructed during freezing ambient temperatures, with frozen aggregate, or on frozen subgrades.

Aggregate for construction of a Control Strip shall be spread by means of a motor grader or paver.

The Control Strip moisture content shall be adjusted as directed by the Consultant during spreading of the aggregate. The surface of the granular base course shall be kept moist until testing is completed.

Once the aggregate for the Control Strip lift has been completely spread, the moisture and density measurements for determining the Control Density will commence, and will continue during repeated passes of the specified compaction equipment until the maximum dry density is attained. These measurements will be taken by the Consultant using nuclear testing equipment.

3.6.4.2.1 Control Strip Minimum Compaction Equipment

The Control Strip lift shall be compacted using at least the following equipment:

Two vibratory steel rollers weighing not less than 10 t each and having a vibratory capacity of at least 1500 VPM with a minimum dynamic or centrifugal force of 8000 kg, operated in the vibratory mode, and at a speed not exceeding 8 km/h; plus one of the following:

- (i) Six wobbly tired rollers with tires inflated to a pressure of 200 kPa plus or minus 35 kPa, ballasted with at least a level load of gravel, and towed at a speed not exceeding 8 km/h; or
- (ii) Two self-propelled pneumatic rollers, each ballasted to its maximum capacity, weighing not less than 10 t each, having a minimum tire pressure of 400 kPa plus or minus 35 kPa, and travelling at a speed not exceeding 8 km/h; or
- (iii) A combination of 4 wobbly tired rollers and 1 self-propelled pneumatic roller each of which meets the appropriate criteria described above.

On projects where Control Strips are being established on small areas such as acceleration and deceleration lanes, and culvert backfills, other minimum equipment proposed by the Contractor may be approved by the Consultant.

3.6.4.2.2 Control Strip Compaction

If portions of the lift are being spread using a motor grader, the aggregate shall be compacted so that when the entire lift has been spread, a minimum of 4 complete passes with the specified compaction equipment shall have been completed over all the Control Strip area.

If the aggregate has been spread by means of a motor grader and vibratory compaction causes a loss of density during base course construction, vibratory compactors shall operate in the static mode supplemented with the specified pneumatic rollers. Whenever a granular base course lift is spread by a paver, a vibratory compactor operating in the vibratory mode shall be utilized.

When pneumatic self-propelled rollers or wobbly type rollers are used for compaction the pneumatic self-propelled rollers or wobbly type rollers shall lead the steel vibratory compactor.

3.6.4.3 **General Construction**

Once the Control Density has been established, the Contractor may choose his own combination of compaction equipment.

The base course shall be uniformly placed at the same lift thickness as the corresponding Control Strip lift thickness.

Each lift of base course shall be constructed true to grade and cross-section and the finished surface shall be smooth and free of loose material.

The Contractor shall compact areas such as entrances, using a vibratory steel-wheeled roller as specified in Subsection 3.6.4.1.2 to the satisfaction of the Consultant or until 95.0% of the Control Density has been achieved.

The Consultant may direct the Contractor not to use the vibratory compaction mode within certain areas located near utilities or other restricted areas as determined by the Consultant.

Water shall not be added in such quantities that it seeps into the underlying subgrade.

Materials shall be handled so that segregation of the coarser and finer fractions does not occur, and the Contractor shall take all necessary precautions to prevent aggregate segregation for each lift of base course.

Base course shall not be spread on frozen subgrade and compaction shall be completed before freezing.

3.6.4.4 **Finishing Work**

Subgrade slopes shall be neatly trimmed, and loose or waste material from the side slopes shall be either neatly bladed against the edge of the base course or spread neatly over the side slope and ditches to the satisfaction of the Consultant.

In addition, the finished base course surfaces shall be in compliance with the tolerances specified in the Specification Amendment referenced in the Contract.

All rocks larger than 75 mm in diameter shall be removed from the side slopes and ditches and disposed of in a manner satisfactory to the Consultant.

Prime coat shall be placed on the finished final lift of granular base course in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.6.4.5 Interim Lane Markings

The Contractor shall provide interim lane markings on all newly primed surfaces that are to be exposed to traffic overnight. The Contractor has the option of using paint and glass beads or reflectorized temporary pavement markers.

When paint is used, all paint spots shall be 100 mm wide and 300 mm long, shall be applied lengthwise to the road surface, shall be spaced 15 m apart on centre in tangent sections and 7.5 m apart on curves, shall employ the same paint colour as the permanent marking to come and shall be completely covered with glass beads at the time of painting.

When reflectorized temporary pavement markers are used, they shall be placed at 25 m intervals on tangent sections and at 15 m intervals on curves and shall be removed immediately prior to being overlaid.

3.6.5 COMPLIANCE REQUIREMENTS

The Contractor shall, at his own expense, repair and/or restore to specified condition, any visually failed areas or areas of aggregate segregation.

Each lift shall be compacted to an average of 98.0% of the applicable Control Density with no single test less than 95% of the applicable Control Density. Frequency of testing is outlined in ATT 58.

As specified for Control Strip construction, the surface of the granular base course shall be kept moist until testing is completed.

3.6.6 END PRODUCT ACCEPTANCE OR REJECTION

For granular base course aggregate material placed in all lifts, acceptance will be subject to all compliance requirements of Section 3.6.5 and the following requirements for the Lot aggregate gradation and fracture count.

Price Adjustments for aggregate gradation for each sieve size will be based on the variation of the Lot Mean Gradation from the limits of the Designation and Class outlined in Table 3.2.3.1. The corresponding adjustment points are shown in Table 3.6A.

When the Lot Mean Gradation is outside the gradation limits of Table 3.2.3.1, the penalty assessment will be \$0.02 per tonne for each Mean Adjustment Point outside those limits. If the maximum deviation shown in Table 3.6 A is exceeded, the lot is rejected.

Price Adjustments for Fractures will be based on the Mean Fracture deviation below the specification minimum shown in Table 3.2.3.1, one adjustment point for each one percent below the specification minimum will occur up to a maximum of ten percent. If the maximum deviation is exceeded, the lot is rejected.

Price Adjustments for Lot Mean Gradation and Fractures will be based on a minimum of three tests each per Lot sampled under a Full Testing Program in accordance with ATT 38, Sampling, Gravel and Sand.

At the discretion of the Consultant a Partial Testing Program in accordance with ATT 38 may be used in determining End Product acceptance subject to other compliance testing. Price adjustments will not apply in cases where the Partial Testing Program is used.

3.6.6.1 Methods of Repair of Rejected Areas

All rejected areas shall be repaired by the Contractor to the satisfaction of the Consultant.

For areas rejected due to Lot Mean Gradation and/or Fractures, the following methods of repair are generally acceptable but are subject to the acceptance of the Consultant:

- Remove and replace entire depth of rejected lift in failed area.
- Place a remedial lift equal to 30 percent of the depth of the rejected lift thickness or 50 mm, whichever is greater. When remedial lifts are used as a repair method, the surrounding areas/lanes also require additional material to create smooth transitions and acceptable elevation changes between the repaired and approved areas. When a lower lift is repaired using a remedial lift, the repair material will not be considered to take the place of any portion of subsequent lifts.(i.e. the completed structure will be the design depth plus the depth of repair lift)
- Correct aggregate requirements by adding, blending and reworking appropriate materials.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Consultant.

Any aggregate segregation shall be corrected by re-blending as necessary.

All repairs shall be carried out by the Contractor at his expense.

3.6.6.1.1 Payment for Work that had been Rejected, but was Made Acceptable

All repaired areas will be retested and the results of the retest will be used for determining pay adjustments.

When the method of repair is a remedial lift, the remedial lift will be tested and any pay adjustment as determined will be applied to the rejected underlying lift and the additional material will not be paid for.

When the method of repair is adding, blending and reworking materials, the added materials will not be paid for. Only the quantity of material originally constructed will be paid for.

Payment for the additional testing will be charged to the Contractor in accordance with the rates as shown in Subsection 3.6.7.2, Payment of Appeal Testing Costs.

3.6.7 APPEAL OF ACCEPTANCE TEST RESULTS AND APPEAL TESTING

3.6.7.1 Gradation and Fractures

Appeal testing will be done using appeal sampling method described in ATT 38. The Contractor may appeal the results of acceptance testing of gradation or fractures for any rejected or penalized Lot only once. The Consultant may request that cause be shown for the appeal. The appeal shall be for all tests within the Lot, and there will be no appeal allowed for single tests within a Lot. Priming or placing of additional lifts on the appealed Lot will void any appeal.

The following procedures will apply for an appeal:

- (i) The Contractor shall serve notice of the appeal for Gradation, Fractures, or both, to the Consultant, in writing, within 24 hours of receipt of the test results;
- (ii) The Department will arrange and pay for an independent testing laboratory certified to operate in the Province of Alberta, 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;
- (iii) The Consultant will sample the compacted base and provide the samples to the independent testing laboratory. The Contractor may observe the sampling process. The number of the new tests for the appeal shall be the same as the number used to determine the Lot Mean; and
- (iv) All test results from the old Lot will be retained and averaged with the new appeal tests. A new mean for all tests will be determined and used for acceptance and unit price adjustment.

The new mean, thus determined, in all cases, will be binding on the Contractor and the Department.

3.6.7.2 Payment of Appeal Testing Costs

If the new results show that a penalty no longer applies, sampling and testing costs incurred during the appeal procedures for that Lot will be borne by the Department.

If the new results verify that any unit price reduction or rejection remains valid for that Lot, the Contractor will be invoiced by the Department for the sampling and testing costs for the appeal procedures, at the following rates:

Gradation:	\$500
Fracture Count:	\$300

3.6.8 MEASUREMENT AND PAYMENT

3.6.8.1 General

Measurement of granular base course will be in tonnes for material acceptably placed..

Payment will be made at the unit price bid for "Granular Base Course" for the applicable Designation and Class of material, subject to the unit price adjustments specified herein. This payment will be full compensation for processing, hauling and placing the material on the roadway, intersections, entrances and approaches; supplying water and adjusting the moisture content; preparing the surface; the supply and application of asphalt material for prime coat; supplying and applying blotting sand when required; maintaining the treated surface; interim lane marking; quality control; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for the supply of aggregate materials incorporated into the Work will be made in accordance with Specification 5.2, Supply of Aggregate.

Section 3

**Specification 3.6
Granular Base Course**

Separate payment will not be made for any material required to repair failures or rejected areas which occur in the granular base course. All costs associated with the repair of failed or rejected areas will be the responsibility of the Contractor.

If the Contractor chooses to supply Designation 2 Class 20 or Designation 2 Class 40 in place of Designation 2 Class 25 material for granular base course material, payment will be made at the unit price bid for Designation 2 Class 25 material.

Payment for the supply of asphalt for prime coat will be in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.6.8.2 Payment Adjustments

Total Lot Adjustment points will be calculated for each Lot. A Lot Gradation and Fracture Price Adjustment per tonne will be applied based on the following formula, providing the Lot Mean does not exceed the requirements in Table 3.6 A or the maximum deviation for fractures is not exceeded.

$$PA_{gf} = (PA_g + PA_f) \times \$ 0.02$$

Where:

- PA_{gf} = Unit Price Adjustment for Gradation and Fractures
- PA_g = Adjustment Points for Gradation
- PA_f = Adjustment Points for Fractures

The Lot Unit Price Bid per tonne will be calculated as follows:

Lot Unit Price Per tonne	=	Contract Unit Price Bid Per tonne	-	PA _{gf}
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**TABLE 3.6 A
MEAN ADJUSTMENT POINTS FOR DEVIATIONS FROM GRADATION LIMITS
AND MAXIMUM DEVIATIONS ALLOWABLE**

LOT MEAN REQUIREMENTS	SIEVE SIZE F _m			
	⁽¹⁾ 25 000 20 000 16 000 10 000	5 000 1 250 630 315	160	80
Mean Adjustment Points for Deviations from limits of Table 3.2.3.1	2 for each 1% Deviation	5 for each 1% Deviation	0.5 for each 0.1% Deviation	5 for each 0.1% Deviation
Maximum Allowable Deviation from limits of Table 3.2.3.1	2	3	3	1.5

Note: ⁽¹⁾ Include all applicable sieves up to one size smaller than top size.

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3.8 GRANULAR FILL**3.8.1 GENERAL**

Granular fill shall consist of pit-run gravel, gravel fill, sand or crushed gravel placed upon the prepared areas and in excavations, at locations and to thicknesses specified.

3.8.2 MATERIALS**3.8.2.1 Aggregate**

The Contractor shall produce processed aggregates in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

3.8.2.2 Water

When required, the Contractor shall supply suitable water.

3.8.3 SAMPLING AND TESTING**3.8.3.1 Test Methods**

Unless otherwise specified, the latest edition of the test methods shown in Table 3.8.3.1 will be used to determine material characteristics.

**TABLE 3.8.3.1
TEST METHODS USED TO DETERMINE MATERIAL CHARACTERISTICS**

Test Description	Method No.
Sampling, Gravel and Sand	ATT-38
Sieve Analysis	ATT-25 or 26
Determining the Liquid Limit of Soils	AASHTO T 89
Dry Strength, Non-Plastic Aggregates	ATT-54
Determining the Plastic Limit and Plasticity Index of Soils	AASHTO T 90
Density, Control Strip Method	ATT-58
Moisture Content, Open Pan Method	ATT-14

NOTES:

- (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.

3.8.4 CONSTRUCTION**3.8.4.1 Granular Fill**

The granular fill shall be deposited on the prepared area or in an excavation in a uniform manner and quantity, which will produce the required compacted thickness and width designated by the Consultant. Any coarse material segregated during dumping operations shall be blended with fines and shaped to the required depth, grade and cross-section.

The granular fill shall be watered or dried and compacted. Compaction shall continue in conjunction with light blading and water spraying where necessary to maintain cross-section and designated moisture content until the required density is reached.

3.8.4.2 Fine Grading Gravel Course

When required, a light application of crushed gravel material of the Designation and Class specified shall be placed in a single layer on the granular fill course for fine grading purposes.

The crushed gravel shall be windrowed uniformly upon the designated area and spread to the required cross-section and depth. The surface shall be compacted to the required density as directed by the Consultant. If necessary, water shall be added to the material during compaction to maintain the required uniform moisture content.

The moisture content of any layer shall not exceed the designated moisture content prior to any subsequent operations.

3.8.5 MEASUREMENT AND PAYMENT

Measurement of granular fill and graded gravel course will be made in tonnes or cubic metres, whichever is specified, and will be based on truck box measurements.

Payment will be made at unit price bid for "Granular Fill" for the applicable Designation and Class of material acceptably placed. This payment will be full compensation for supplying and adding water; processing, hauling and placing the granular fill material; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for the supply of aggregate materials incorporated into the Work will be made in accordance with Specification 5.2, Supply of Aggregate.

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3.9 CEMENT STABILIZED BASE COURSE**3.9.1 GENERAL****3.9.1.1 Description**

Cement stabilized base course shall consist of a uniform mixture of sand or crushed aggregate, portland cement and water, combined as hereinafter specified, placed, compacted, and finished on the prepared surfaces.

Cement stabilized base course material as defined herein shall be mixed through a central mixing plant in accordance with the requirements of the Specifications.

3.9.2 MATERIALS**3.9.2.1 Portland Cement**

The Contractor shall supply portland cement in accordance with Specification 5.11, Supply of Portland Cement. Unless otherwise directed or approved by the Consultant Normal Type 10 portland cement shall be used.

3.9.2.2 Aggregates

The Contractor shall produce aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

3.9.2.3 Water

The Contractor shall supply all water required in the construction of cement stabilized base course.

Water shall conform to the requirements of the latest version of CSA Standard CAN 3-A23.1, Concrete Materials and Methods of Concrete Construction. Water used in portland cement concrete construction shall be subject to the prior approval of the Consultant.

3.9.2.4 Asphalt

The Contractor shall supply all required asphalt materials in accordance with Specification 5.7, Supply of Asphalt.

3.9.2.5 Test Methods

Unless otherwise specified, the following standard test methods will be used to determine material characteristics.

When requested by the Contractor, the most recent edition of the following test methods will be used for verification purposes, the results of which shall govern:

Test Description	Method No.
(i) Sampling Stone, Slag, Gravel, Sand and Stone Block for Use as Highway Materials	AASHTO Designation T 2
(ii) Sieve Analysis of Fine and Coarse Aggregates (1), and (a) Amount of Material Finer than 0.075 mm sieve in Aggregate (1)	AASHTO Designation T 27 AASHTO Designation T 11
(iii) Determining the Liquid Limit of Soils (1)	AASHTO Designation T 89
(iv) Determining the Plastic Limit and Plasticity Index of Soils	AASHTO Designation T 90
(v) Classification of Soils for Engineering Purposes (for definition of Coefficient of Uniformity, Cu)	ASTM Designation D 2487
(vi) Determination of Cement Content in Cement-Treated Aggregate by the Method of Titration (1)	AASHTO Designation T 211
(vii) Cement Content of Soil-Cement Mixture (hardened)	AASHTO Designation T 144
(viii) Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester	AASHTO Designation T 217
(ix) Laboratory Determination of Moisture Content of Soil	ASTM Designation D 2216
(x) Moisture Density Relations of Soil-Cement Mixtures (1) (hereinafter referred to in Section 3.9 as the Standard Proctor Test)	AASHTO Designation T 134
(xi) Compressive Strength of Molded Soil-Cement Cylinders	ASTM Designation D 1633
(xii) Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory	ASTM Designation D 1632
(xiii) Capping Cylindrical Concrete Specimens	AASHTO Designation T 231
(xiv) Density of Soils In-Place by Block, Chunk or Core	AASHTO Designation T 233
(xv) Density of Soil In-Place by the Rubber Balloon Method	AASHTO Designation T 205
(xvi) Density of Soil In-Place by the Sand Cone Method	AASHTO Designation T 191
(xvii) Density of Soil and Soil-Aggregate In-Place by Nuclear Method (shallow depth)	AASHTO Designation T 238
(xviii) Sampling Bituminous Materials	AASHTO Designation T 40

NOTES:

- (1) In all Test Methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.

3.9.3 EQUIPMENT**3.9.3.1 General**

The Contractor shall provide sufficient equipment to produce and place cement stabilized mixture at a rate of not less than 200 t per hour.

3.9.3.2 Mixing Plants - General

Mixing plants shall be of approved batch or continuous mix type, capable of producing a uniform mixture. All mixers shall be equipped with adjustable metering devices of a type which will introduce the cement and water into the mixer in the designated proportions. The cement metering devices and feeder shall be interlocked and synchronized to maintain a constant ratio of cement to the sand or gravel material, and the water metering control shall be adjustable to maintain the designated moisture content.

The mixing unit shall be capable of adjustment, either by reduction in volume of material or other means, to correct occurrence of dead areas in the mixer in which material does not move or is not sufficiently agitated to produce the necessary uniform dispersal of the ingredients of the mixture, as may be required by changes in the mixing properties of the material being mixed.

3.9.3.3 Batch Type Mixers

If a batch type mixer is used, the material shall be proportioned by batch weights.

3.9.3.4 Continuous Type Mixers

If a continuous type of mixer is used, the materials shall be proportioned by volume. The sand or gravel materials shall be drawn from the storage bin or bins by an approved continuous feeder through adjustable calibrated gates, or by an approved fixed gate continuous feeder with adjustable speed control, which will supply the correct amount of sand or gravel materials in proportion to the cement and water. The plant shall be equipped with facilities satisfactory to the Consultant for sampling materials and calibrating gate openings or rate of feed by weighing check samples.

3.9.3.5 Spreading Equipment

Spreading equipment shall be readily adjustable to various depths and widths, and shall be constructed and operated to produce a layer of material of uniform thickness, true to grade and cross-section and of uniform consistency.

3.9.3.6 Compaction Equipment

Compaction equipment shall be capable of producing the specified degree of compaction and surface finish within the time limits specified.

3.9.3.7 Sampling and Sampling Stand

Samples of the various components of the mixture and the mixture itself will be taken as often as considered necessary by the Consultant for the purpose of verifying quality control, adherence to specification, or other test purposes. The Contractor shall cooperate with the Consultant and/or his representatives in obtaining the samples required, including the provision by the Contractor of suitable sampling devices. The Contractor shall provide access to all parts of the plant as required by the Consultant. The Contractor shall at his own expense provide, install and maintain a suitable sampling stand for the purpose of sampling from loaded trucks. The stand shall be of solid construction, safe, firmly anchored, and of a convenient height to enable easy acquisition of samples from haul vehicles. The stand shall have a minimum platform area of 3 m in length and 1 m in width, shall be equipped with stairs, and be completely enclosed with guard and hand rails. The stand shall be placed in an approved location.

3.9.3.8 Plant Calibration

Prior to production of any material, the plant shall be calibrated to produce a mix containing the proper proportion of all components of the mixture. Calibration of the plant shall be performed at each new plant setting and at any other time as directed by the Consultant.

All plants shall contain devices capable of diverting each component of the mixture into separate receptacles or trucks for the purpose of weighing check samples.

3.9.4 CONSTRUCTION**3.9.4.1 Cement Stabilized Base Course - General**

Cement stabilized base course shall not be mixed or placed when the atmospheric temperature is at or below 5°C, or when conditions indicate that the temperature may fall below 5°C within 24 hours, unless adequate means satisfactory to the Consultant are employed for the protection of the Work. In no case shall cement stabilized base course be placed on frozen subgrade.

All cement stabilized base course shall be effectively protected from frost action, and any material which has become damaged by the frost action shall be replaced by the Contractor at his own expense.

3.9.4.2 Cement Addition

The measurement of cement content for addition to the sand or gravel shall be by weight, whether proportioned by batch weight or by volume.

Cement to be mixed with the sand or gravel material shall be uniformly distributed throughout the material during the mixing operation.

3.9.4.3 Mixing Cement Stabilized Base Course

Blending of the sand or gravel material shall be performed prior to the mixing operations to meet the requirements as specified herein.

Sand or gravel, cement and water shall be mixed such that an homogeneous mixture, uniform in gradation, cement content, moisture content and appearance is attained.

The proportions of water and cement to be added to the mixture will be designated by the Consultant, and the rates of addition shall be under strict control at all times.

Cement content of the mixture shall not vary by more than plus or minus 0.3% by weight from the designated cement content. The moisture content shall not vary by more than plus or minus 2% by weight, and shall be such that the designated moisture content is achieved at the compaction stage.

In the event the moisture content of the gravel or sand is above the optimum moisture content designated for the mixture, the material shall be dried by aerating or piling and allowing to drain, or by dewatering with pumps or other such methods prior to plant mixing, such that the optimum moisture of the cement stabilized mixture is realized.

3.9.4.4 Placing Cement Stabilized Mixture

Immediately prior to placing of the cement stabilized mixture, the surface of the prepared subgrade shall be moistened and kept moist until covered by the mixture. Care shall be exercised to prevent softening of the subgrade by the addition of excess amounts of water. Ponding of water will not be permitted.

Materials shall be transported by means of approved vehicles equipped with protective covers if required, and deposited and spread by approved spreading equipment. Dumping of mixture in piles or windrows upon the subgrade and subsequent spreading by motor graders or other equipment will not be permitted unless approved by the Consultant for irregular, restrictive areas.

The mix shall be spread and compacted to conform to grade and cross-section, be uniform in gradation, density, moisture and cement content, at the values designated, and the finished surface shall be smooth and tight.

The spreading operation will not be permitted in widths of less than 3 m, excepting as permitted by the Consultant for irregular, restrictive areas.

Where the final compacted thickness of the cement stabilized base is 225 mm or less, sufficient material is to be placed in one operation to obtain this thickness.

Where the thickness designated is greater than 225 mm, the spreading operation shall be carried out in two layers of equal thickness unless otherwise directed by the Consultant. Unless otherwise permitted, placing and spreading of base course materials shall be performed in contiguous sections.

Unless otherwise directed by the Consultant, the mixed materials shall be spread for part width of the subgrade under construction. Care shall be taken to prevent damage to the exposed edge, or edges, by the compacting equipment where part width construction is undertaken. Care shall also be taken to prevent damage to the exposed edge, or edges, by the compacting equipment and/or traffic and weather.

Where the Consultant directs that the mixed materials shall be spread for the full width of the subgrade under construction, either one spreader or several spreaders may be operated in a staggered position across the subgrade. Where more than one spreader is used to distribute the mixed material in adjacent spreads, or where one spreader is used alternately on two adjacent spreads, joint construction as hereinafter specified will not be required when less than thirty minutes elapses between the time of spreading the mix in adjacent spreads at any location. When more than thirty minutes elapses between the placing of adjacent or successive spreads, joint construction as hereinafter specified will be required.

After a part width section has been completed, the longitudinal joint against which additional mixed material is to be placed shall be trimmed to a neat line parallel to the roadbed alignment and with a vertical edge. Material cut away from the edge or material previously placed to protect the edge shall be spread uniformly over the adjacent subgrade, or otherwise disposed of as directed the Consultant.

Contamination of the cement stabilized mixture with subgrade materials will not be permitted.

The spreading operations shall be performed in a manner to prevent excessive drying or loss of moisture, and shall reserve sufficient time to permit complete compaction within the time limits specified or as required by the Consultant.

3.9.4.5 Compacting the Cement Stabilized Mixture

Immediately upon completion of the spreading of each lift, the material shall be thoroughly compacted in a manner to avoid the formation of irregularities, and the finished base shall be true to the required grade and cross-section and be of uniform thickness.

The intensity of rolling shall be such that the specified density is obtained to a uniform degree throughout the depth of the mixture and within the time limits. A minimum density of ninety-seven percent of the Standard Proctor Maximum Dry Density shall be attained throughout.

The surface of the uncompacted, partially compacted or completely compacted cement stabilized base shall be kept moist at all times until an asphaltic fog coat seal is applied. Care shall be taken to ensure that excessive water is not applied which subsequently damages the mix or subgrade. The water is to be applied as a fine spray, such that segregation of the cement from the sand or gravel material does not occur.

During the course of compaction, care shall be taken to prevent or eliminate all compaction planes in a manner satisfactory to the Consultant.

Following compaction, before setting of the mixture, high spots on the cement stabilized base shall be removed by means of cutting blades or other equipment, in a manner to cause as little disturbance as possible to the compacted material. The excess material shall be removed to the shoulder or adjacent subgrade as directed by the Consultant. Loose material shall not be left on the cement stabilized base surface. Filling low spots with cement stabilized material following compaction will not be permitted.

The Contractor shall take all precautions necessary to protect the base course from damage by public traffic or construction equipment.

3.9.4.6 Time Limits

Unless otherwise specified, not more than two hours shall elapse between the time cement is added to the sand or gravel material and the time of completion of the final compaction. In no case shall the time interval exceed the initial hydration period for the cement as determined by the Consultant.

If the base course operation is being performed in two layers, the two hour time limit will be measured from the time water and cement are added to the sand or gravel of the first layer to the time of completion of final compaction of the uppermost lift. If the Contractor cannot meet this time limit, he will be required to wait the normal five days curing period before applying the next layer.

3.9.4.7 Joint Construction

All joints shall be vertical and uniform in alignment.

Longitudinal joints shall be formed or cut in a vertical plane to the subgrade surface, shall expose a face of thoroughly compacted material, and new material shall be spread and compacted against this face when constructing the adjacent lane or base section.

Unless otherwise directed by the Consultant, transverse construction joints shall be made by trimming the end of the compacted material to a straight line normal to the centreline of the roadbed and with a vertical edge in well compacted material. No mixture shall be placed until the construction joint has been prepared in a manner satisfactory to the Consultant.

3.9.4.8 Curing Seal

A curing fog coat seal of liquid asphalt shall be applied immediately following the final compaction and trimming of the cement stabilized base course. If the base is being constructed in two layers, the application of a curing seal between layers will not be necessary if the second layer is to be placed within the two hour time limit as described in Subsection 3.9.4.6. If the second layer is to be constructed after the five day cure period of the first layer, curing seal will be required on both layers after their respective final compaction.

This fog coat shall be constructed according to Specification 3.19, Prime, Tack and Fog Coats.

3.9.4.9 Temporary Crossings

Temporary crossings across the cement stabilized base shall be constructed only at locations approved by the Consultant. The material placed over the cement stabilized base shall be free from rocks or particles which may cause damage to the surface. The material shall be placed to a width of not less than 3.5 m for single lane or 7 m wide for double lane traffic. The depth of the material shall not be less than 0.3 m. The crossing fill shall extend beyond the width of the cement stabilized base by at least 1.5 m on either side.

Where such crossings are required to accommodate the general public, the Contractor shall maintain suitable signs, barricades, and the necessary flag-persons to direct traffic and to prevent damage to the adjacent cement stabilized base. Such crossings will not be permitted prior to the application of the asphaltic fog coat seal unless authorized by the Consultant.

3.9.4.10 Opening to Traffic

In general, completed sections of cement stabilized base course shall be allowed to cure for a minimum of five days before opening to normal traffic and provided the cement stabilized base has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. If the temperature drops below 5°C during the five day curing period, the curing period may be extended if so directed by the Consultant. Light local traffic and the Contractor's construction equipment only shall be permitted on the cement stabilized base during the curing period provided damage to the Work is prevented and other accommodation of the local traffic is not possible. Where partial widths are constructed, traffic and the Contractor's hauling equipment shall be accommodated on the untreated portion of the subgrade. Such traffic which must travel over the cement stabilized base during the curing shall have speeds restricted sufficiently to prevent surface damage. The Contractor shall reconstruct any portion damaged by traffic at his own expense.

If required by the Consultant, the curing seal shall be protected from traffic by spreading a layer of fine sand over the completed cement stabilized base course.

3.9.4.11 Tack Coat

Prior to the application of the surface course, a tack coat shall be applied to the finished cement stabilized base course surface at the locations and to the dimensions designated by the Consultant and according to Specification 3.19, Prime, Tack and Fog Coats.

3.9.4.12 Application of Asphalt Stabilized Base Course

The time interval between the finishing and compacting of the cement stabilized base course and the placing of the asphalt stabilized base course or asphalt concrete pavement as specified, shall be not less than ten days.

All cement stabilized base course placed during the construction season shall be covered with asphalt stabilized base course or asphalt concrete pavement as specified, prior to seasonal shutdown.

3.9.5 MEASUREMENT AND PAYMENT

3.9.5.1 **Cement Stabilized Base Course**

Measurement of cement stabilized base course will be in tonnes.

Payment will be made at the unit price bid per tonne for "Cement Stabilized Base Course". This payment will be full compensation for supplying water; moistening the subgrade surface; producing, hauling and placing the cement stabilized base course material; supply and application of curing seal and tack coats; protecting the surface; accommodation of traffic; and all other operations and incidentals necessary to complete the Work, including producing, hauling and placing of fines for protection of curing seal coat.

Payment will not be made for any material used to repair failures which may occur in the base course due to the Contractor's faulty workmanship. Any expense incurred in the production, hauling, and placement of such material shall be borne by the Contractor.

3.9.5.2 **Supply of Portland Cement**

Payment for the supply of portland cement will be made at the unit price bid per tonne for "Portland Cement".

3.9.5.3 **Supply of Aggregate**

Aggregate materials incorporated into the Work will be paid for in accordance with Specification 5.2, Supply of Aggregate.

3.9.5.4 **Curing and Tack Coats**

No separate payment will be made for the supply and application of asphalt materials for curing seal coat and fog coat. All costs will be considered incidental to the Work.

3.9.5.5 **Temporary Crossings**

Costs for producing, hauling, placing and subsequent removal and disposal of material for temporary crossings will not be paid for separately, but will be considered to be incidental to the Work.

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3.10 ASPHALT SURFACE TREATMENT**3.10.1 GENERAL****3.10.1.1 Description**

Asphalt surface treatment shall consist of scarifying and salvaging existing asphalt bound aggregate and/or gravel surfacing, adding and blending additional crushed aggregate when required, adding liquid asphalt, mixing and compacting the asphalt bound aggregate on the roadway in accordance with the specifications contained herein.

3.10.2 MATERIALS**3.10.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

3.10.2.2 Asphalt

The Contractor shall supply asphalt materials in accordance with Specification 5.7, Supply of Asphalt.

Asphalt binder shall not be fluxed or cut back with oil, or any other fluxing agent.

Asphalt used for asphalt surface treatment shall be SC-250, SC-800 and/or SC-70, unless otherwise specified.

3.10.3 CONSTRUCTION METHODS**3.10.3.1 Preparing Subgrade Surface**

Where specified by the Consultant, the subgrade surface shall be prepared in accordance with the Provisions of Specification 3.1, Subgrade Preparation, prior to application of the asphalt surface treatment.

3.10.3.2 General

Unless otherwise specified, asphalt surface treatment materials shall be mixed and processed on the subgrade surface of the roadbed.

Application of asphaltic binder shall be performed only when the air temperature in the shade is 5°C or higher, and when the weather conditions are otherwise acceptable to the Consultant. Application temperature of the asphaltic binder will be as specified by the Consultant.

Placement of asphalt surface treatment materials on a frozen subgrade will not be permitted.

3.10.3.3 Road Mixing Methods

When the roadbed to be treated already has surfacing gravel, with or without asphalt, this material shall be scarified with approved equipment only to the depth of the existing surfacing aggregate, windrowed uniformly upon the subgrade, additional aggregate added as directed by the Consultant, and mixed and dried by blading back and forth. When the material has been dried to a moisture content of 2% or lower, it shall be spread by blades and asphalt shall be uniformly applied by an approved type of pressure distributor at a rate of from 45 litres to 90 litres per cubic metre, as directed by the Consultant. Lesser quantities of asphalt may be required when aggregates being used have been treated previously. Care shall be taken to avoid rich or lean areas at the ends of each distributor run. Mixing shall start immediately, and shall continue until uniform colour is obtained and the cutback has been released by thorough aeration of the material.

Mixing shall be accomplished by approved types of pulvi-mixers, motor graders, gravel mixers, or other approved equipment only, and shall be continued until the resulting mixture is entirely uniform in asphalt content. Mixing shall be carried out between passes of the distributor, as well as subsequent to the completion of addition of asphalt.

Mixing equipment used shall be controlled and operated on each pass to pick up and/or mix all the material to be treated, and to avoid cutting into the subgrade or picking up unmixed material on successive passes of the mixer.

The mixture shall then be brought to a single windrow, and from there bladed out to required cross-section and uniform depth. The surface shall then be rolled with pneumatic-tired rollers, or such other equipment as approved by the Consultant, in conjunction with light blading where necessary to maintain the required cross-section and grade. Rolling shall be continued until all aggregate is firmly embedded and the asphalt surface treatment layer is impervious to moisture penetration.

In lieu of mixing the asphaltic binder as specified above, the Contractor may employ such other procedures as approved by the Consultant.

Spreading equipment shall be constructed and operated to produce a layer of material of uniform thickness and width. The type of spreading equipment used shall be approved by the Consultant.

Where the asphalt surface treatment has been aerated or mixed in a blanket type layer on the subgrade, it shall be windrowed to a uniform windrow prior to spreading and compaction.

Where spreading of the asphalt surface treatment mixture is carried out by motor grader, the material shall be thoroughly compacted by equipment hereinbefore specified immediately upon completion of each portion of the spreading operation. Rolling shall be performed in such a manner as to avoid the formation of irregularities.

3.10.4 MISCELLANEOUS CONSTRUCTION REQUIREMENTS**3.10.4.1 General**

Where traffic must travel over the roadway surface during the curing period, the Contractor shall restrict traffic speeds sufficiently to prevent surface damage.

Prior to the final acceptance, the Contractor shall reconstruct, to the satisfaction of the Consultant and at no additional cost to the Department, any portion of the asphalt surface treatment damaged by traffic.

3.10.5 MEASUREMENT AND PAYMENT

3.10.5.1 **Application of Asphalt Surface Treatment**

Payment for asphalt surface treatment will be made at the unit price bid per square metre for "Asphalt Surface Treatment". This payment will be full compensation for applying asphalt binder, mixing, spreading, compacting, maintaining traffic, and all labour, tools, equipment and incidentals necessary to complete the Work.

3.10.5.2 **Crushed Aggregate**

When crushed aggregate is required to complete the Work, payment for "Crushed Aggregate" will be made at the unit price bid per tonne or per cubic metre, whichever is specified in the Tender for "Crushed Aggregate". This payment will be full compensation for processing, hauling and placing the material.

3.10.5.3 **Supply of Aggregate**

Aggregate materials incorporated into the Work will be paid for in accordance with Specification 5.2, Supply of Aggregate.

3.10.5.4 **Supply of Asphalt**

Payment for the supply of asphalt binder will be made at the unit price bid per tonne for "Supply of Asphalt for Surface Treatment."

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3.16 COLD MILLING ASPHALT PAVEMENT**3.16.1 GENERAL****3.16.1.1 Description**

Cold milling asphalt pavement is the process of removing existing pavement from the roadway to the lines and dimensions shown on the Drawings or as directed by the Consultant.

3.16.2 RECLAIMED ASPHALT PAVEMENT (RAP)

The material produced as a result of cold milling will be defined as reclaimed asphalt pavement (RAP).

Ownership of the RAP will be specified in the Special Provisions and shall be one of or a combination of the following:

(a) Department Ownership of the RAP

The Department will retain ownership of the RAP material, and the Contractor shall haul it to a designated location.

(b) Contractor Ownership of the RAP

The Contractor shall assume ownership of the RAP material and shall haul it from the roadway to his own storage site or otherwise dispose of it.

3.16.3 SAMPLING AND TESTING**3.16.3.1 General**

Sampling and testing will only be required if RAP is to be used for the production of asphalt concrete pavement or stockpiled for the Department.

The Consultant shall have access to the Work at all times for taking samples. The Contractor shall provide, at his own expense, sampling stands, sampling devices and other facilities which the Consultant may require to safely obtain representative samples of the item being produced.

3.16.3.2 Methods of Testing

Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) shown in Table 3.16.3.2 will be used to determine material characteristics of the RAP.

TABLE 3.16.3.2 TEST METHODS

TEST DESCRIPTION	TEST METHOD
1. Sampling Mixes	ATT - 37
2. Sieve Analysis, RAP	ATT - 53
3. Extraction	ATT - 12
4. Sieve Analysis, 20 000 Fm Minus	ATT - 26

NOTES:

- (1) In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.
- (2) In all cases the latest amendment or revision current at the closing date of the Tender is implied when reference is made to one of the above standards in the Specification.

3.16.3.3 Quality Control Testing

Quality control testing is the responsibility of the Contractor. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall provide and pay for equipment and qualified personnel to perform all quality control testing necessary to determine and monitor the characteristics of the RAP and to ensure that it meets specification requirements.

Test methods, sampling and minimum frequency of testing are described in Subsection 3.16.3.2, Methods of Testing and Table 3.16.3.3 Quality Control Testing Requirements.

Results of all quality control tests shall be submitted to the Consultant on a daily basis.

**TABLE 3.16.3.3
QUALITY CONTROL TESTING REQUIREMENTS**

TEST	STANDARD	MINIMUM FREQUENCY
Sampling Mixes	ATT - 37	One per 1000 tonnes
RAP Sieve Analysis	ATT - 53	One per 1000 tonnes
RAP Asphalt Content (Extraction)	ATT - 12	One per 1000 tonnes
Extraction Sieve Analysis	ATT - 26	One per extraction test

3.16.3.4 Acceptance Sampling and Testing

Within this specification certain requirements, limits, and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be measured and accepted based on the Consultant's quality assurance test results.

3.16.4 CONSTRUCTION

3.16.4.1 Cold Milling Equipment

The Contractor shall use equipment with automatic grade and slope controls, capable of cold milling existing asphalt pavement to an accurate depth of cut, profile and cross slope and shall be capable of loading the milled material directly into trucks.

The cutting head of the cold milling machine shall be a minimum width of 1.9 metres.

3.16.4.2 Cold Milling Asphalt Pavement

Cold milling asphalt pavement shall be performed in a manner which prevents the tearing and breaking of underlying and adjacent pavement and the contamination of the RAP with granular, subgrade or deleterious materials. All RAP shall be loaded directly to trucks from the milling machine and hauled to stockpile or disposed of.

The milled roadway surface shall be swept clean prior to opening to traffic. At locations including but not limited to urban areas and bridge decks, the Contractor shall sweep the surface in a manner which minimizes dust.

The Contractor shall, at his own expense, promptly repair any localized areas of distress in the milled surface that may present a hazard to traffic.

At the point of daily termination of cold milling operations, changes in roadway surface profile or cross-section shall be limited to 50 mm and longitudinal transitions shall be a maximum of 25 mm vertically per metre.

In the event of rain or other inclement weather, the Contractor shall suspend cold milling operations. The Contractor shall make necessary allowances for drainage of water that may pond in areas where the milled sections have not been paved.

3.16.5 STOCKPILING RECLAIMED ASPHALT PAVEMENT**3.16.5.1 Department Ownership**

When stockpiling of RAP for Department ownership is specified, it shall be carried out in accordance with Specification 3.2, Aggregate Production and Stockpiling, and the following:

(i) A granular stockpile base layer shall be constructed upon the prepared stockpile site to a compacted thickness of at least 150 mm, using granular material containing 100 percent passing the 16 000 sieve, and no more than 10% passing the 80 sieve. The stockpile base layer shall be of such dimensions as to accommodate the maximum quantity of RAP which will exist in the stockpile.

(ii) No equipment shall operate on the stockpile at anytime.

3.16.5.2 Contractor Ownership

When it is specified that the Contractor shall assume ownership of the RAP and he elects to use this material in the production of asphalt concrete pavement, stockpiling of the RAP shall be performed in a manner which prevents contamination and consolidation of the RAP material being used.

All costs associated with the construction of a stockpile base will be considered incidental to the Work, and no separate or additional payment will be made.

3.16.5.3 Gradation of Reclaimed Asphalt Pavement

Reclaimed asphalt pavement to be used in the production of asphalt concrete pavement shall meet the gradation requirements specified in Table 3.16.5.3.

**TABLE 3.16.5.3
GRADATION SPECIFICATIONS FOR RECLAIMED ASPHALT PAVEMENT**

Percent Passing Metric Sieve (CGSB 8-GP-2M) F m	125 000	100
	80 000	99 - 100
	40 000	95 - 100

3.16.5.4 Hauling

Haul of RAP shall be carried out in accordance with Specification 4.5, Hauling.

3.16.6 MEASUREMENT AND PAYMENT

3.16.6.1 Cold Milling Asphalt Pavement

Measurement of cold milling asphalt pavement will be made in square metres of roadway milled, or tonnes or cubic metres (truck box measurement), whichever is specified, of RAP produced.

Payment will be made at the unit price bid per square metre, tonne, or cubic metre, whichever is specified, for "Cold Milling Asphalt Pavement". This payment will be full compensation for cold milling the asphalt pavement, sweeping the milled surface, loading the RAP into trucks, stockpiling or disposing of the RAP and quality control testing as required.

3.16.6.2 Granular Stockpile Base Layer

When RAP is stockpiled for Department ownership, separate payment will be made for the granular stockpile base layer.

Measurement of the granular stockpile base layer will be in tonnes or cubic metres (truck box measurement), whichever is specified.

Payment will be made at the unit price bid per tonne or cubic metre, whichever is specified, for "Granular Stockpile Base Layer". This payment will be full compensation for excavating, processing, hauling, placing and compacting the material.

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3.18 SURFACING BRIDGE DECKS**3.18.1 GENERAL**

The Work shall consist of surfacing bridge decks with asphalt concrete, removing existing asphalt pavements, or removing and replacing asphalt pavement on bridge decks and/or bridge approaches as shown on the Drawings, in accordance with the Special Provisions or as designated by the Consultant.

3.18.2 MATERIALS

Asphalt concrete mix as produced under Specification 3.50, Asphalt Concrete Pavement (EPS), will be accepted under this specification.

The requirements under Section 3.50.2, Materials, in Specification 3.50, Asphalt Concrete Pavement (EPS), shall apply.

3.18.3 CONSTRUCTION

Detouring of traffic will not be allowed unless permission is granted by the Department in writing. The requirements in Specification 3.50, Asphalt Concrete Pavement (EPS) shall apply in all respects for construction of asphalt concrete pavement under this specification except that vibratory compaction will not be permitted. Compaction requirements shall be achieved by static rolling only.

Where an existing pavement is required to be removed from bridge decks and/or approaches, the Work shall be carried out in a manner, and using equipment, acceptable to and approved by the Department prior to the commencement of the Work. Cold milling of ACP on bridge decks will not be permitted.

The Consultant may direct the removal, by cold milling, of asphalt concrete pavement on bridge approaches beyond the tie-in requirements listed in Specification 3.50 for Transverse Pavement Joints. In this case, if a unit price for this work is not contained in the Contract, the Work shall be performed on an "Extra Work" basis in accordance with Specification 1.2, General.

The Contractor shall take ownership of all debris and dispose of it in a manner suitable to the Consultant.

Damage to bridge components and appurtenances due to the Contractor's operations shall be repaired by the Contractor at his own expense.

The exposed concrete bridge deck shall be thoroughly cleaned of all dirt and debris to the satisfaction of the Consultant.

The cleaned bridge deck shall be tack coated with two applications of an SS-1 emulsified asphalt.

The SS-1 emulsion material, as delivered by the Supplier shall be diluted by adding an equal amount of water and the first of the two applications shall be applied at a rate of 1.0 kg per square metre.

The second application shall not proceed until the first has cured or as approved by the Consultant and shall be applied at the rate of 0.5 kg per square metre.

Cutback type asphalts will not normally be used but the Consultant may permit their use for tacking bridge decks if delays will be incurred due to low ambient temperatures that do not permit the use of emulsions.

If cutback asphalt is used for the tack coat, the first coat shall be applied at the rate of 0.5 kg per square metre. The second application shall not proceed until the first has cured or as directed by the Consultant, and shall be applied at the rate of 0.25 kg per square metre.

Normally, the depth of surfacing will be a nominal 50 mm. The Consultant may adjust this depth as necessary to match up to existing gutters, joints, etc. to ensure a satisfactory riding surface is achieved.

The Contractor shall take all necessary precautions to ensure that deck joints and drains are left clear and open upon completion of his paving operation. The finished pavement surface shall be free of depressions capable of retaining water.

Where improvements are to be made to bridge approaches, the Consultant will detail the Work required.

The Department may restrict loading on bridge decks.

3.18.4 MEASUREMENT AND PAYMENT

Removal and disposal of existing asphalt concrete pavement from bridge decks will be measured in square metres and payment will be made at the unit price bid for "Removal of Asphalt Concrete Pavement From Bridge Decks".

Removal and disposal of existing asphalt concrete pavement and other subgrade excavation material from bridge approaches will be measured in cubic metres and payment will be made at the unit price bid for "Subgrade Excavation".

Surfacing bridge decks will be measured in tonnes of mix and payment will be made at the unit price bid for "Asphalt Concrete Pavement-EPS".

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3.19 PRIME, TACK AND FOG COATS**3.19.1 GENERAL****3.19.1.1 Description**

The Work shall consist of placing an asphalt material on a prepared surface at locations shown on the Drawings or designated by the Consultant.

3.19.1.2 Definitions**Prime Coat:**

An application of a liquid asphalt to an absorbent surface to waterproof and promote bonding between the surface being primed and the next course.

Tack Coat:

An application of a liquid asphalt to ensure a bond between the surface being paved and the next course.

Fog Coat:

An application of a liquid asphalt to seal small cracks and surface voids, and as a curing seal for cement stabilized base course.

3.19.2 MATERIALS

The Contractor shall supply the asphalt material in accordance with Specification 5.7, Supply of Asphalt.

The types and grades of liquid asphalts for prime coat, tack coat, curing fog coat for cement stabilized base course, and fog coat shall be as follows:

Prime Coat:

The Contractor's choice of SEP-1, SEP-2 or SS-1 for application through August 31 each season. The Contractor's choice of MC-30, SEP-1, SEP-2 or SS-1 for application after August 31 each season.

Sand used for the blotting of excess asphalt due to prime shall be supplied by the Contractor.

Tack Coat and Curing Fog Coat for Cement Stabilized Base Course:

SS-1 or MS-1 for application throughout the construction season. As well, the Contractor has the option of using RC-30 or RC-70 for application after August 31 each season.

Fog Coat:

SS-1 for application through August 31 each season. The Contractor's choice of MC-30 or SS-1 for application after August 31 each season.

The estimated range in application rates for fog coat to a pavement surface is from 0.4 to 0.7 kilograms per square metre of undiluted SS-1 or 0.2 to 0.5 kilograms per square metre of MC-30. The actual application rate is to be chosen by the Contractor in consultation with the Consultant at the beginning of the project to ensure that complete and uniform coverage is achieved without streaking.

3.19.3 CONSTRUCTION

Except for cement stabilized bases where it is preferred that the Fog Coat seal be applied while the surface is still moist, asphalt material for tack coat and fog coat shall be applied only when the surface to be treated is dry, when the weather is not foggy or rainy, and when the surface temperature is above zero degrees Celsius for application of cutback asphalts and 5 degrees Celsius for emulsions, or as otherwise approved by the Consultant.

If SS-1 is used for fog coat, the material as delivered by the supplier shall be diluted by adding an amount of water to be determined by the Contractor.

The asphalt material shall be applied by means of a self-powered pressure distributor equipped with the following control devices.

- (1) Tachometer.
- (2) Pressure gauge.
- (3) Adjustable length spray bar.
- (4) Positive displacement asphalt pump with separate power unit.
- (5) Heating coils and burner capable of applying even heat to the asphalt material.
- (6) Thermometer well and accurate thermometer.

Before applying asphalt material, the Contractor shall ensure that the distributor meets the following adjustments and requirements:

- (1) The distributor vehicle will maintain a constant height of the spray bar as the tank is unloaded.
- (2) All spray bar nozzles are of the same manufacture, type, and size.
- (3) Clogged nozzles have been removed and cleaned with solvent.
- (4) All nozzles have been set in the spray bar so that the nozzle slots make the same angle (15° to 30°) with the longitudinal axis of the spray bar.
- (5) The spray bar has been adjusted to the correct height to ensure uniform application without streaking.
- (6) The spray bar has a positive shut-off to prevent dripping.
- (7) The distributor is capable of maintaining a uniform speed.

The distributor may be checked for calibration by the Consultant before being used on the Work.

Before applying the asphalt material, loose dirt or other objectionable material shall be removed from the prepared surface by brooming or by other methods acceptable to the Consultant. Where base courses become ravelled, the loose material shall be moistened and re-compacted to achieve a tight, uniform surface.

The asphalt shall be uniformly applied without streaking.

Joints and seams shall not be excessively overlapped. Structures, wheel guards, guardrail, and other roadway appurtenances shall not be spattered by the asphalt material. The Contractor shall remove, at his own expense, any spattering caused by his operation.

Areas missed by the distributor or inaccessible to the distributor shall be treated using a hand spray or pouring pot.

Traffic shall not to be permitted to travel on tack or fog coat until it has cured.

Traffic shall not to be permitted to travel on prime coat until 6 hours after application or until it has cured. After this period of time, excess asphalt material remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface. The "blotter sand" can be any clean sand.

Where traffic must be accommodated, the Contractor shall apply the prime, tack or fog coat covering up to only one-half of the roadway surface at a time. Other portions across the roadway shall not be sprayed until previous applications have properly cured and in the case of prime coat, all puddles and excess free asphalt has been blotted.

In all situations, prime coat and tack coat shall be maintained by the Contractor at his own expense including the cost of the required liquid asphalt. Any area of prime coat or tack coat that has become fouled shall be repaired before asphalt stabilized base course or asphalt concrete pavement is placed.

3.19.4 MEASUREMENT AND PAYMENT

3.19.4.1 **Fog Coat**

3.19.4.1.1 Separate Payment

When the Contract contains separate bid items for the supply of asphalt and application of fog coat, measurement for the supply of asphalt will be by the tonne and measurement for the application of fog coat will be by the square metre.

Measurement for the supply of asphalt will be carried out in accordance with Section 5.7.5, Measurement and Payment, of Specification 5.7, Supply of Asphalt.

Payment for the supply of asphalt will be made at the unit price bid for "Supply of Asphalt for Fog Coat", and will be full compensation for the supply of asphalt material to the project; storing of the material; sampling and quality control.

Payment for the application of fog coat will be made at the unit price bid for "Fog Coat Application", and will be full compensation for surface cleaning and preparation as required; the application of fog coat; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

3.19.4.1.2 Combined Payment

When the Contract does not contain a separate bid item for the supply of asphalt for fog coat, measurement for the supply and application of fog coat will be by the square metre.

Payment will be made at the unit price bid for "Supply and Application of Fog Coat", and will be full compensation for the supply of asphalt material to the project; storing of the material; sampling and quality control; surface cleaning and preparation as required; fog coat application;

and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

3.19.4.2 Prime Coat

All costs associated with the supply, application and maintenance of prime coat shall be included in the unit price bid per tonne for "Granular Base Course", no separate or additional payment will be made.

The supply and application of blotting sand, where required, will be considered incidental to the Work, and no separate or additional payment will be made.

3.19.4.3 Tack Coat

All costs associated with the supply, application and maintenance of tack coat shall be included in the unit price bid per tonne for "Asphalt Concrete Pavement-EPS", no separate or additional payment will be made.

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3.20 SLURRY SEAL**3.20.1 GENERAL**

A slurry seal is a designed mixture of crushed aggregate, additives (as needed), emulsified asphalt, and water applied to a prepared pavement as a surface treatment, at locations and conforming to the lines and dimensions specified.

3.20.2 MATERIALS**3.20.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

3.20.2.2 Additives

Additives, when required, shall be supplied by the Contractor. The Contractor shall arrange delivery, store and handle additives. Acceptable additives will be portland cement and other materials approved by the Consultant.

3.20.2.3 Asphalt

The Contractor shall supply asphalt material in accordance with Specification 5.7, Supply of Asphalt.

The asphalt binder used for slurry seal shall be either a QS-Kh or an SS-1H emulsified asphalt. The Contractor shall choose between the two.

The same asphalt chosen for the slurry seal binder shall be used for tack and fog coat applications.

3.20.2.4 Water

The Contractor shall supply suitable water.

3.20.3 TESTING**3.20.3.1 Materials Testing**

Quality control and quality control testing are the responsibility of the Contractor throughout every stage of the Work, from production of aggregates to the final accepted product. Tests performed by the Consultant will be quality assurance tests and will not be considered as quality control tests.

Quality assurance testing will be done by the Consultant to determine compliance with the Specifications.

The standard test methods to be used for determining material characteristics are:

TABLE 3.20.3.1 - TEST METHODS

	TEST DESCRIPTION METHOD	ALBERTA TRANSPORTATION DESIGNATION
1.	Sampling Slurry Seal Asphalt Mixes	ATT-60
2.	Asphalt Extraction	ATT-12
3.	Sieve Analysis	ATT-26

Testing of materials supplied will be done in accordance with the appropriate sections of Specification 3.2, Aggregate Production and Stockpiling, and Specification 5.7, Supply of Asphalt, by Contractor.

3.20.4 MIX DESIGN AND TRIAL BATCH

3.20.4.1 **Responsibility for Mix Design**

Preparation and submission of mix designs for Consultant approval are the responsibility of the Contractor.

The Contractor shall use licensed Professional Engineering services and a qualified, recognized testing laboratory to assess the aggregate material proposed for use and to carry out the design of the slurry mixture.

3.20.4.2 **Requirements for Mix Design**

The mix design shall follow ASTM D3910, Standard Practice for Design, Testing, and Construction of Slurry Seal. The wet track abrasion test loss shall not exceed 800 g/m². The residual asphalt content shall be between 7.5% and 13.5%. The mix design shall also contain the following information:

- (a) gradation of aggregate to be used,
- (b) the design proportions of each component including additives,
- (c) other characteristics of the aggregate specified in Specification 3.2, Aggregate Production and Stockpiling,
- (d) all test results used in producing the mix design.

3.20.4.3 **Approval of Mix Design and Trial Batch**

The Consultant will require up to 3 working days, from the time of receipt of the mix design, for evaluation of the material characteristics. This mix design will be used for the trial batch.

The Contractor shall mix a trial batch using the mix design submitted and place it in an area of least traffic.

If the mix does not produce an acceptable product, additional trial batches shall be prepared and placed using modified mix designs which must be submitted for approval or modified machine calibrations or both until an acceptable product is produced.

If the trial batch is acceptable, the mix design used for that batch will become the approved mix design.

The Contractor shall cover unaccepted trial batches with a second application of slurry seal.

3.20.5 CONSTRUCTION

3.20.5.1 **Seasonal and Weather Limitations**

The placement of slurry seal shall be limited to the period from May 1 to September 15. Slurry seal shall not be placed when, in the opinion of the Consultant, damage to the finished product may occur for any reason.

The slurry seal shall not be applied when:

- (a) The atmospheric temperature at the construction area is less than 10 degrees Celsius, or
- (b) The weather is misty or rainy, or
- (c) Precipitation is a threat for the construction area within twelve hours as forecast by Environment Canada for the vicinity, or
- (d) An atmospheric temperature at the construction area of less than 5 degrees Celsius is predicted by Environment Canada within twenty-four hours.

3.20.5.2 **Equipment**

3.20.5.2.1 Slurry Seal Machine

Slurry seal shall be mixed in continuous flow travelling pugmill mixers capable of delivering predetermined proportions of emulsion, water and aggregate. Each mixer shall be equipped with feeders that provide accurate metering devices or methods of introducing predetermined amounts of additives when the aggregate is fed. Calibrated controls for aggregate and asphalt emulsion, capable of proportioning accurately, shall be provided.

The spreader box shall be capable of spreading a mat up to 3.7 m wide, and shall have flexible squeegee strike-off strips on each side maintaining contact with the surface to be sealed. The flexible strike-off strips shall make close contact with the surface and shall be adjustable to the various slopes of the surface to be sealed. The box shall contain baffles or other suitable means to help in lateral distribution of slurry and to provide uniform application.

3.20.5.2.2 Compaction Equipment

The slurry seal shall be rolled with a vibratory, double drum, steel roller weighing at least 10 tonnes.

3.20.5.3 **Surface Preparation**

The Contractor shall remove all surface painted markings in areas where slurry seal is to be applied. The method and equipment used by the Contractor shall be such that no structural damage is caused to the existing pavement.

Repair of existing surfaces, including crack filling, prior to sealing will be identified by the Consultant and the required repairs shall be carried out by the Contractor.

The pavement surface to be slurry sealed shall be swept and all dirt, dust, and other objectionable matter removed.

Tack coat shall be applied in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.20.5.4 **Mixing**

The Contractor shall thoroughly mix the slurry seal in a slurry seal machine. If a mineral filler is used it shall be blended into the mixture. A minimum amount of additional water may be added to obtain a fluid, homogeneous mixture.

3.20.5.5 **Application**

After the tack coat has cured sufficiently, the surface to be sealed shall be wetted immediately before application of the slurry seal.

The surface shall be damp, but no standing free water will be permitted.

Slurry seal shall be deposited in a continuous flow from the pugmill mixer into a controlled spreader box. The spreader unit shall proceed at a rate of not more than 55 metres per minute.

Slurry seal shall be applied in the direction of the longitudinal axis of the area to be sealed unless otherwise directed by the Consultant. The application shall be uniform and homogenous with no uncovered areas, ridges or loose aggregate.

Hand squeegees shall be used to spread slurry seal in areas not accessible to the mixer. The Contractor shall protect manholes, valve boxes and bridge expansion joints from application of slurry seal during spreading operations. Spillage shall be removed with hand tools before initial set of the mix.

If the slurry seal is to be applied in two layers, compaction and fog coating of the first layer is not required and the first layer shall be allowed to cure before application of the second layer.

3.20.5.6 **Compaction**

Compaction by rolling shall commence as soon after application as possible and when pickup of the slurry material by the roller is at a minimum. A fog spray of water shall be applied to the roller drums, as necessary, to prevent pickup. The compacted surface shall be free of ridges, oversize rocks and bond failures.

3.20.5.7 **Fog Coat Application**

After compaction and prior to painting of applicable surface markings, the Contractor shall apply a fog coat seal to the entire slurry seal surface in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.20.5.8 **Protection**

The completed slurry seal shall be kept free of all traffic until it has cured sufficiently to prevent pickup of aggregate particles.

3.20.6 MEASUREMENT AND PAYMENT

Slurry seal will be measured in square metres. Payment will be made at the unit price bid per square metre for "Slurry Seal". This payment will be full compensation for designing the mix; supplying and processing the aggregate; supplying the asphalt binder, water, and additives; surface preparation except for the removal of painted lines; processing, hauling and placing the mixture; supplying and applying fog coat; and quality control.

Payment for preparing trial batches of slurry for evaluating the proper proportions of the various ingredients will not be made directly, but will be included in the unit price bid for "Slurry Seal". If the trial batch is acceptable as applied, it will be measured and paid for at the unit price. If it is unacceptable and covered by a second application, no payment will be made for the trial batch applied.

If the Contract stipulates a double layer application each layer will be measured and paid for at the unit price bid for "Slurry Seal".

If a second layer of slurry is required as a result of failure of the first layer, no payment will be made for the failed layer.

Payment for removal of painted lines and markings will be made at the lump sum price bid for "Removal of Painted Markings".

3.20.6.1 Supply of Aggregate

Contrary to Specification 5.2, Supply of Aggregate, separate payment for the supply of aggregate will not be made.

3.20.6.2 Fog Coat

Contrary to Specification 3.19, Prime, Tack and Fog Coats, separate payment for the application of fog coat will not be made.

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3.21 DOUBLE SEAL COAT**3.21.1 GENERAL**

Double seal coat shall consist of a wearing course composed of two applications of processed aggregate held in place by an asphalt binder, spread and rolled on a prepared surface to the lines and dimensions shown on the Drawings or as designated by the Consultant.

3.21.2 MATERIALS**3.21.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

3.21.2.2 Asphalt

The Contractor shall supply a high float type emulsion binder in accordance with Specification 5.7, Supply of Asphalt.

3.21.2.3 Line Painting Materials

The Contractor shall supply all required line painting materials in accordance with Specification 5.20, Supply of Line Painting Materials.

3.21.3 TESTING**3.21.3.1 Quality Control Testing**

Quality control and quality control testing are the responsibility of the Contractor throughout every stage of the Work from the crushing and production of aggregates to the final accepted product. The Contractor shall provide and pay for equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product produced.

3.21.3.2 Testing by the Consultant

The Consultant may from time to time take samples, and carry out testing and inspection of materials incorporated or being incorporated into the Work. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall cooperate with the Consultant for such sampling, testing and inspection. Such testing and inspection shall not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

The Contractor shall provide, at his own expense, stands, sampling devices and other facilities as the Consultant may require to safely obtain representative samples of the item being produced.

3.21.4 EQUIPMENT

The following equipment shall be used:

- (i) A self-powered pressure asphalt distributor meeting the requirements as listed in Specification 3.19, Prime, Tack and Fog Coats.
- (ii) A self-propelled aggregate spreader capable of spreading the aggregate uniformly at the applicable rate in one application over the full width of the asphalt applied. The spreader shall be capable of controlling and adjusting the width and rate of spread. The spreader shall be equipped with the necessary devices to enable it to be attached securely to the aggregate haul truck while in the process of dumping the aggregates into the spreader.
- (iii) Self-propelled pneumatic tire rollers. Wobble wheel type rollers shall not be used. The rollers shall be capable of reversing direction without causing backlash or damage to the seal coat.
- (iv) A sufficient number of power sweepers to adequately broom loose aggregate from all sections of seal coated roadway. All power sweepers shall be equipped with a minimum of one yellow rotating warning light.
- (v) The Contractor shall supply pilot vehicles for conveying traffic. The pilot vehicles shall have sufficient accompanying personnel to provide convoy services on a 24 hour per day availability. The standard number of pilot vehicles to be provided shall be two for two lane highways or as specified in the Special Provisions. Additional vehicles may be required as determined by the Consultant at the time of construction. All pilot vehicles shall be equipped as follows:
 - A two way radio for communication.
 - An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both the front and rear.
 - A sequential arrowboard meeting the requirements described in Specification 1.2 General.
 - The arrowboard shall be controlled from a console located in the vehicle cab.
 - The arrowboard display shall be visible to traffic approaching the rear of the trucks.
 - Additional pilot vehicles beyond the standard number specified, may be exempt from including a sequential arrowboard with the approval of the Consultant.

The Contractor shall cease seal coat application if any equipment integral to either the compaction, sweeping or traffic accommodation operations is not available or is not in good working order, as determined by the Consultant.

3.21.5 ON-SITE COMMUNICATION SYSTEM

The Contractor shall provide an on-site communications system for workers that are remote from the active seal coat zone. Workers are considered remote from the active work zone where they are not in a position to readily walk to an appointed location to use a communications device. The following work activities are considered to be remote from the active work zone:

- Flagging operations
- Traffic convoy operations
- Placing of Davidson roadway markers
- Sweeping operations outside of the active work zone
- Rolling operations outside the active work zone

The Contractor shall also provide communications devices for any other remote activity as directed by the Consultant.

3.21.6 TRAFFIC ACCOMMODATION AND SIGNING

3.21.6.1 **Traffic Accommodation Strategy**

The Contractor's Traffic Accommodation Strategy (TAS) shall address all phases of construction including subsequent brooming and line painting activities. The TAS shall be developed based upon the requirements of Drawing TCS-B-1.17A or TCS-B-1.17B as appropriate.

In addition to the minimum requirements, the Contractor's Traffic Accommodation Strategy shall include the following:

- A strategy for the protection of workers when placing Davidson Temporary Road Pavement Markers.
- A strategy for the accommodation of traffic when seal coating bridge decks.
- A strategy for the accommodation of traffic through all major intersections and approaches.

No seal coat application work shall commence until the Contractor's traffic accommodation strategy has been reviewed and accepted by the Consultant.

During periods of heavy traffic volume, as determined by the Consultant, the Contractor shall shut down construction operations that may impede the safe flow of public traffic.

3.21.6.2 **Pre-Construction Advertising**

The Contractor shall advertise the seal construction a minimum of 7 days in advance of the commencement of work on each respective highway section. Pre-construction advertising for seal coat work at stand alone bridge deck locations is not required.

The mechanism for advertising the seal coat work shall be standard business advertising signs with minimum dimensions of 1.5 m high and 2.4 m wide. Signs shall be comprised of a metal frame with adjustable legs. The signs shall have minimum of 5 lines with 14 letters per line. Letters shall be a minimum of 12.7 cm wide and 20.3 cm high. Wording of the signs shall be as follows, with the applicable lengths and dates entered:

<p>SEAL COAT CONSTRUCTION NEXT (XXX) KM (MONTH) (DAY) - (DAY) EXPECT DELAYS</p>

The signs shall be placed on the outside sideslope, in a level position a minimum of 0.5 m above the edge of pavement. Placement of the sign on the shoulder or in the ditch will not be permitted. The Contractor shall ensure the signs are anchored down to prevent tipping over. Alternative types of signs may be used upon approval by the Consultant.

The Contractor shall revise the dates on the pre-construction advertising signs as required based on any changes to the construction schedule.

Signs shall be installed at locations designated by the Consultant. Depending on the scheduling, the Contractor may be required to install advertising signs at multiple sites simultaneously.

3.21.6.3 Traffic Convoy

Traffic convoy by pilot vehicles not exceeding 50 km per hour shall be used on all seal coat projects.

Traffic convoy shall be initiated at the commencement of seal coat application.

Traffic convoy may be required for subsequent brooming activities depending upon site specific traffic conditions such as length of work zone, available site distances, traffic volumes, etc. Notwithstanding the previous, traffic convoy will be required whenever the length of subsequent brooming activities within the driving lanes is greater than 5 kilometres.

On all highways, traffic convoy shall continue until second brooming of the seal coat is complete and the speed restriction has been increased to 80 km per hour or as otherwise directed by the Consultant.

3.21.6.3.1 Pilot Vehicles for Two-Lane Highways

The number of pilot vehicles required for seal coating operations on two lane highways shall be as follows:

Distance between Flag Stations (km)	1	2	3	4	5	6	7	8	9	10	11
Standard number of Pilot Vehicles	2			3			4				

3.21.7 CONSTRUCTION

3.21.7.1 **General**

Double seal coat construction shall be performed prior to September 15 and during daylight hours only.

The method of application of the double seal coat including application rates for the asphalt binder and the processed aggregate shall be determined by the Contractor.

The Contractor shall also determine the amount of compaction required based on consideration of compaction equipment, atmospheric conditions and acceptance requirements.

Double seal coat shall be constructed in two courses in accordance with the following sections of this specification. A minimum of 48 hours shall be allowed for curing of the first course before application of the second course.

3.21.7.2 **Surface Preparations**

Before the asphalt binder is applied, the surface to be treated shall be swept clean of all dirt, sand, dust or objectionable matter by means of a power sweeper. If base courses become ravelled, the loose material shall be compacted before brooming and a prime coat applied. Prime coat shall be repaired at no direct expense to the Department. Dried mud or other foreign matter which cannot be removed with the power sweeper shall be removed by hand, blade, or other methods.

Application of prime coats shall be in accordance with Specification 3.19, Prime, Tack and Fog Coats.

3.21.7.3 **Application of Asphalt Binder**

For all courses, asphalt binder shall not be applied until the surface has been cleaned as required and the section approved by the Consultant.

The asphalt binder shall be applied with a pressure distributor in a single uniform continuous spread over the section to be treated.

Skipped areas shall be corrected by hand spray. The application of asphalt binder shall not precede the application of seal coat aggregate by more than 30 metres. Asphalt binder shall not be spilled, sprayed or tracked on completed sections of seal coat.

3.21.7.4 **Application of Aggregate**

The application of asphalt binder shall be followed immediately with the applicable course of aggregate, of the designation and class shown on the Drawings. It shall be uniformly spread by means of an approved mechanical spreader.

3.21.7.5 Rolling

Immediately after spreading of each course, the aggregate shall be rolled. One total compaction coverage by the rollers shall be completed within one quarter hour after the aggregate has been spread and rolling shall continue until a smooth, thoroughly compacted surface has been obtained.

3.21.7.6 Initial Brooming

Between the time period of 4 hours and 6 hours after rolling of each course has been completed or after the initial set of the asphalt, the surface shall be broomed to remove any remaining loose aggregate.

3.21.7.7 Repair of Improperly Covered Areas

Any areas of either course that have not been properly covered after brooming, shall be treated using hand methods if necessary.

3.21.7.8 Final Brooming

The Contractor shall continue to broom the surface to remove any loose aggregate when required, and as often as required, during a two week period following the final application or as directed by the Consultant.

All highway-to-highway junctions and all junctions of paved highways with municipal roads shall be swept clear of loose aggregate.

The Contractor shall use a pickup broom for all brooming in urban and other areas where loose aggregate cannot be swept onto sideslopes or onto ditches.

3.21.7.9 Traffic Accommodation and Signing

The Contractor shall erect and maintain temporary construction signs in accordance with the Traffic Accommodation in Work Zones manual.

A Traffic Accommodation Strategy as outlined in Specification 7.1, Traffic Accommodation and Temporary Signing, will be required for all phases of construction including line painting activities. The signing strategy shall be developed based upon the requirements of the Traffic Accommodation in Work Zones, Second Edition, 2001 manual.

3.21.7.9.1 Traffic Convoy

Traffic shall be accommodated through the Work. The Contractor shall, at his own expense, provide flagmen, pilot vehicles and/or illuminated arrow boards as required.

Traffic and construction equipment including aggregate haul trucks shall not travel over uncovered surfaces of fresh asphalt binder. Traffic shall not use the sections of seal coat until after rolling is complete. Traffic convoy, at speeds not exceeding 50 km per hour, shall commence at the start of seal coat application and shall continue up to six hours after all rolling has been completed as directed by the Consultant.

3.21.7.10 Interim Lane Markings

The Contractor shall provide interim painted lane markings on all newly constructed surfaces once sufficient brooming has been complete, or on tacked surfaces that are to be exposed to traffic overnight. All paint spots shall be 100 mm wide and 300 mm long, shall be applied lengthwise to the road surface, shall be spaced 15 m apart on centre in tangent sections and 7.5 m apart on curves, shall employ the same paint colour as the permanent marking and shall be completely covered with glass beads at the time of painting.

3.21.7.11 Protection of Highway Appurtenances

The Contractor shall ensure that all highway appurtenances including wheel guards, guardrail, signs and delineators as well as bridge structures and appurtenances are protected from asphalt and/or aggregate contamination.

In addition to being responsible for the cleanup of any contaminated areas, the Contractor is advised that many bridge components and materials are affected by cleanup and any costs for repair of damaged structures will be charged to the Contractor.

3.21.8 PAINTED ROADWAY LINES AND PAVEMENT MESSAGES

The Contractor shall paint all roadway lines and pavement messages for the areas receiving seal coat in accordance with Specifications 7.2, Painted Roadway Lines, and 7.3, Painted Pavement Messages.

All painted roadway lines and painted pavement messages applied to the final seal coat surface shall be applied twice at the full application rate for each application. The second application shall be completed after the Contractor's final brooming. On two lane highways the second application will be from the opposite direction of the initial application.

In all cases, the roadway shall not be posted at gazetted highway speeds until all work including line painting has been completed. The maximum length of roadway posted at less than gazetted highway speeds shall not exceed 30 km.

3.21.9 REQUIREMENTS FOR ACCEPTANCE

Requirements for the acceptance of the completed double seal coat include the following:

- (i) Materials shall meet all specified requirements;
- (ii) A minimum of 99% chip coverage shall be obtained with no single bare area greater than 0.01 m² in any one square metre;
- (iii) There shall be no streaking or ravelling;
- (iv) The finished surface shall have a uniform, even texture;
- (v) No over-rich or bleeding areas shall be evident;
- (vi) No loose aggregate shall be evident; and
- (vii) All new lane markings as required, have been applied in accordance with Specification 7.2, Painted Roadway Lines.

Work that does not meet the foregoing requirements shall be repaired or reconstructed to the satisfaction of the Consultant.

3.21.10 COMPLETION OF LINE PAINTING

The Contractor shall complete the painting of roadway lines within five days of completing the placing of the double seal on each individual roadway. Failure to meet this requirement will result in a penalty of \$900.00 per day for each calendar day delay in completing the painting. The Department may extend the time allowed to complete the painting up to a maximum of ten days providing:

- (i) The Contractor submits a written request to the Consultant accompanied by a detailed proposed line painting schedule.
- (ii) The reason for the request, stated in the request, is one of the following:
 - (a) The double seal coat requires additional curing time and subsequent brooming work prior to painting the traffic markings, or
 - (b) The work site is not available to the Contractor through no fault of the Contractor, or
 - (c) The Consultant suspends the Work and standby payments are due in accordance with Specification 1.2, General, or
 - (d) There is a delay resulting from an order of a court, or from strikes or lock-outs, or
 - (e) The traffic markings cannot be painted for reasons of inclement weather, or conditions resulting from inclement weather.

3.21.11 MEASUREMENT AND PAYMENT

Double seal coat will be measured in square metres and payment will be made at the unit price bid per square metre for "Application of Seal Coat", for each course applied. This payment will be full compensation for preparing the existing surface; supplying paint and painting interim lane markings; supplying and applying the asphalt binder; supplying, processing, hauling, placing and rolling the aggregate; brooming; quality control; traffic accommodation and traffic convoy services using the standard number of pilot vehicles as specified.

Payment for additional pilot vehicles, as approved by the Consultant, will be paid for as "Extra Work" in accordance with Specification 1.2, General.

No separate payment will be made for any additional equipment, tools or labour employed to satisfy special brooming requirements.

No payment will be made for any costs incurred to rectify defective work.

3.21.11.1 **Line and Pavement Message Painting**

Payment for supplying paint and painting roadway lines, intersections, interchanges and messages will be made in accordance with the applicable sections of Specifications 7.2, Painted Roadway Lines and 7.3, Painted Pavement Messages. This payment will be made separately for each application of painted roadway lines and/or painted pavement messages.

3.21.11.2 Supply of Aggregate

Contrary to Specification 5.2, Supply of Aggregate, no separate payment will be made for supplying aggregate for the seal coat. However, if the Contractor supplies aggregate from a Crown source on undeeded land, operated primarily under lease or licence and for which the Department does not have a reservation, the Department will deduct \$ 0.48 per tonne from the total payments made under the Contract. The tonnage will be determined by multiplying the total square metres for each course applied, by a conversion factor of 20 kilograms per square metre.

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3.22 GRADED AGGREGATE SEAL COAT**3.22.1 GENERAL**

Graded aggregate seal coat shall consist of a surface treatment composed of an asphalt binder and a graded aggregate, spread and compacted in one application on a prepared surface to the lines and dimensions shown on the Drawings or as designated by the Consultant.

3.22.2 MATERIALS**3.22.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

3.22.2.2 Temporary Markers

The Contractor shall supply temporary, reflectorized, centerline markings in accordance with the Alberta Transportation Products List.

3.22.2.3 Asphalt

The Contractor shall supply a high float type emulsified asphalt binder in accordance with Specification 5.7, Supply of Asphalt.

3.22.2.4 Blotter Sand

The Contractor shall maintain a supply of blotter sand on-site at all times. In the case of an emulsion release where the emulsion has the potential to wash off the road surface into nearby ditches or streams, the blotter sand shall be used to soak up the free emulsion.

3.22.2.5 Line Painting Materials

The Contractor shall supply all line painting materials in accordance with Specification 5.20, Supply of Line Painting Materials.

3.22.3 EQUIPMENT

The Contractor shall use the following equipment:

- (a) A self-powered pressure asphalt distributor meeting the requirements as listed in Specification 3.19, Prime, Tack and Fog Coats.
- (b) A sufficient number of power sweepers to adequately broom loose aggregate from all sections of seal coated roadway. All power sweepers shall be equipped with a minimum of one yellow rotating warning light.
- (c) A self-propelled aggregate spreader capable of spreading the aggregate uniformly at the specified rate in one application over the full-width of the asphalt applied. The spreaders shall be capable of controlling and adjusting the width and rate of spread. The spreaders

shall be equipped with the necessary devices to enable it to be attached securely to the aggregate haul truck while in the process of dumping the aggregates into the spreader.

- (d) A minimum of two self-propelled pneumatic rollers, each with a minimum static weight of 9 tonnes. The rollers shall be capable of reversing direction without causing backlash or damage to the seal coat.
- (e) The Contractor shall supply pilot vehicles for conveying traffic. The pilot vehicles shall have sufficient accompanying personnel to provide convoy services on a 24 hour per day availability. All pilot vehicles shall be equipped as follows:
- A two way radio for communication.
 - An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both the front and rear.
 - A sequential arrowboard meeting the requirements as described in Specification 1.2 General.
 - The arrowboard shall be controlled from a console located in the vehicle cab.
 - The arrowboard display shall be visible to traffic approaching the rear of the trucks.
 - Additional pilot vehicles beyond the standard number specified, may be exempt from including a sequential arrowboard with the approval of the Consultant.

The Contractor shall cease seal coat application if any equipment integral to either the compaction, sweeping or traffic accommodation operations is not available or is not in good working order, as determined by the Consultant.

3.22.4 TESTING

3.22.4.1 **Quality Control Testing**

Quality control and quality control testing are the responsibility of the Contractor throughout every stage of the Work from the crushing and production of aggregates to the final accepted product. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall provide and pay for equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product produced.

Quality control testing requirements for aggregates are listed in Specification 3.2, Aggregate Production and Stockpiling.

The Contractor shall provide the Consultant with Daily Inspection Reports containing the following information:

- Date
- Description of seal coat completed – i.e. highway number, control section, lane, beginning and end stations.
- Total area treated
- Target and bulk measured application rates for both the asphalt emulsion and aggregate.

Daily Inspection Reports shall be submitted no later than the day following placement.

3.22.4.2 Testing by the Consultant

The Consultant may from time to time take samples, and carry out testing and inspection of materials incorporated or being incorporated into the Work. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall cooperate with the Consultant for such sampling, testing and inspection. Such testing and inspection shall not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

The Contractor shall provide, at his own expense, stands, sampling devices and other facilities as the Consultant may require to safely obtain representative samples of the item being produced.

3.22.5 ON-SITE COMMUNICATION SYSTEM

The Contractor shall provide an on-site communications system for workers that are remote from the active seal coat zone. Workers are considered remote from the active work zone where they are not in a position to readily walk to an appointed location to use a communications device. The following work activities are considered to be remote from the active work zone:

- Flagging operations
- Traffic convoy operations
- Placing of Davidson roadway markers
- Sweeping operations outside of the active work zone
- Rolling operations outside the active work zone

The Contractor shall also provide communications devices for any other remote activity as directed by the Consultant.

3.22.6 TRAFFIC ACCOMMODATION AND SIGNING**3.22.6.1 Traffic Accommodation Strategy**

The Contractor's Traffic Accommodation Strategy (TAS) shall address all phases of construction including subsequent brooming and line painting activities. The TAS shall be developed based upon the requirements of Drawing TCS-B-1.17A or TCS-B-1.17B as appropriate.

In addition to the minimum requirements, the Contractor's Traffic Accommodation Strategy shall include the following:

- A strategy for the protection of workers when placing Davidson Temporary Road Pavement Markers.
- A strategy for the accommodation of traffic when seal coating bridge decks.
- A strategy for the accommodation of traffic through all major intersections and approaches.

No seal coat application work shall commence until the Contractor's traffic accommodation strategy has been reviewed and accepted by the Consultant.

During periods of heavy traffic volume, as determined by the Consultant, the Contractor shall shut down construction operations that may impede the safe flow of public traffic.

3.22.6.2 Pre-Construction Advertising

The Contractor shall advertise the seal coat construction a minimum of 7 days in advance of the commencement of Work on each respective highway section. Pre-construction advertising for seal coat work at stand alone bridge deck locations is not required.

The mechanism for advertising the seal coat work shall be standard business advertising signs with minimum dimensions of 1.5 m high and 2.4 m wide. Signs shall be comprised of a metal frame with adjustable legs. The signs shall have minimum of 5 lines with 14 letters per line. Letters shall be a minimum of 12.7 cm wide and 20.3 cm high. Wording of the signs shall be as follows, with the applicable lengths and dates entered:

<p>SEAL COAT CONSTRUCTION NEXT (XXX) KM (MONTH) (DAY) - (DAY) EXPECT DELAYS</p>
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The signs shall be placed on the outside sideslope, in a level position a minimum of 0.5 m above the edge of pavement. Placement of the sign on the shoulder or in the ditch will not be permitted. The Contractor shall ensure the signs are anchored down to prevent tipping over. Alternative types of signs may be used upon approval by the Consultant.

The Contractor shall revise the dates on the pre-construction advertising signs as required based on any changes to the construction schedule.

Signs shall be installed at locations designated by the Consultant. Depending on the scheduling, the Contractor may be required to install advertising signs at multiple sites simultaneously.

3.22.6.3 Traffic Convoy

Traffic convoy by pilot vehicles not exceeding 50 km per hour shall be used on all seal coat Projects.

Traffic convoy shall be initiated at the commencement of seal coat application.

Traffic convoy may be required for subsequent brooming activities depending upon site specific traffic conditions such as length of work zone, available site distances, traffic volumes, etc. Notwithstanding the previous, traffic convoy will be required whenever the length of subsequent brooming activities within the driving lanes is greater than 5 kilometres.

On all highways, traffic convoy shall continue until second brooming of the seal coat is complete and the speed restriction has been increased to 80 km per hour or as otherwise directed by the Consultant.

3.22.6.3.1 Pilot Vehicles for Two-Lane Highways

The number of pilot vehicles required for seal coating operations on two lane highways shall be as follows:

Distance between Flag Stations (km)	1	2	3	4	5	6	7	8	9	10	11
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Standard number of Pilot Vehicles	2	3	4
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3.22.7 CONSTRUCTION

The placement of graded aggregate seal coat shall be limited to the period from May 1 to September 15. The extent of surface preparation required and the method of application of the graded aggregate seal coat including application rates for the asphalt binder and the processed aggregate shall be determined by the Contractor.

The Contractor shall also determine the amount of compaction required based on consideration of compaction equipment, atmospheric conditions and acceptance requirements.

Construction shall be carried out during daylight hours only.

3.22.7.1 **Surface Preparations**

Before the asphalt binder is applied, the surface to be treated shall be cleaned of all dirt, sand, dust or objectionable matter. Asphalt binder shall not be applied until the surface has been cleaned as required and the section approved by the Consultant.

3.22.7.2 **Application Areas**

Unless otherwise specified or shown on the Drawings, the Contractor shall not apply seal coat to roadway shoulders or to bridge decks.

The Contractor shall apply seal coat as follows:

- (i) To each through travel lane to the widths shown on the Contract Drawing, regardless of the widths shown on the intersection Drawings.
- (ii) At intersections, to all parallel lanes and their respective tapers, in general conformance with the drawing entitled "Seal Coat Applications at Intersections" (CB6-3.23M1 or CB6-3.23M2 as applicable), or as shown on the shaded intersection Drawings if provided.
- (iii) To all passing and climbing lanes and their respective tapers.
- (iv) Application on bridge decks where required will generally be from curb face to curb face.

3.22.7.3 **Rolling and Brooming**

Immediately after spreading, the aggregate shall be rolled.

After initial set of the binder (normally 1 to 3 hours depending on atmospheric condition), further compaction of the seal coat shall continue by using either further rolling or controlled traffic or a combination of both, until a thoroughly compacted surface is obtained. The Contractor shall determine the amount of additional compaction required based on consideration of compaction equipment, traffic conditions, atmospheric conditions and acceptance requirements.

Once compaction has been achieved, light brooming of the surface shall be undertaken to remove any loose aggregate.

The Contractor shall broom the graded aggregate seal coat in daylight hours only, when required and as often as required during a two week period following the initial application or as directed by the Consultant.

The Contractor shall use a pickup broom for all brooming in urban and other areas where loose aggregate cannot be swept onto sideslopes or onto ditches.

The Contractor shall sweep all paved intersections, and all paved farm and field approaches clear of loose chips.

The Contractor shall use a pick-up broom when sweeping all bridge decks. The Contractor shall hand broom areas where the pick-up broom cannot reach. Under no circumstances shall material be swept over the bridge rail. The Contractor shall ensure that chips or other materials are not propelled into the air during brooming operations.

3.22.7.4 **Protection of Structures**

Structures, curbs, guardrail, and other appurtenances shall not be spattered with the asphalt binder. The Contractor shall remove any spattering caused by his operation. Asphalt binder shall not be spilled, sprayed, or tracked on completed sections of seal coat.

The Contractor shall not operate vibratory rollers in vibratory mode on any bridge deck.

The Contractor shall ensure that bridge expansion joints, drains, curbs and appurtenances are protected from asphalt and/or chip contamination.

In addition to being responsible for the cleanup of any contaminated areas, the Contractor is advised that many bridge components and materials are affected by cleanup and any costs for repair of damaged structures will be charged to the Contractor.

3.22.7.5 **Temporary Markers**

The Contractor shall supply and install temporary reflectorized centreline markings (Davidson Temporary Road Pavement Markers or equivalent) on the centreline of the roadway immediately before applying the asphalt binder. Markers shall be placed at 25 m intervals on tangent sections and at 15 m intervals on curves and shall remain in place.

3.22.8 PAVEMENT MARKINGS

3.22.8.1 **Painted Roadway Lines and Pavement Messages**

The Contractor shall reference and record the location and configuration of all existing painted roadway lines and painted pavement messages for the areas to receive graded aggregate seal coat, and re-establish the markings after seal coat application in accordance with Specifications 7.2, Painted Roadway Lines, and 7.3 Painted Pavement Messages.

Painted roadway lines and painted pavement messages shall be applied twice at the full application rate for each application. On two lane highways, the second application shall be applied from the opposite direction of the initial application.

All edge lines shall be painted completely off the seal coat and will only require one paint application.

In all cases, the roadway shall not be posted at gazetted highway speeds until all work, including line painting, has been completed. The maximum length of roadway posted at less than gazetted highway speeds shall not exceed 30 km.

3.22.8.2 **Durable Pavement Message Markings**

Unless otherwise directed, the Contractor shall preserve all existing durable pavement message markings, maintaining them free of contamination by asphalt binder and/or seal coat aggregate. Where the Contractor fails to preserve existing durable pavement message markings, he shall remove any chip seal coat materials and replace the markings at his own expense.

3.22.9 GROOVED RUMBLE STRIPS

Unless otherwise directed, the Contractor shall preserve all existing shoulder and stop condition grooved rumble strips, maintaining them free of contamination by asphalt binder and/or seal coat aggregate. Where the Contractor fails to preserve existing grooved rumble strips, He shall re-establish the grooved rumble strips at His own expense.

3.22.10 REQUIREMENTS FOR ACCEPTANCE

Requirements for the acceptance of the completed graded aggregate seal coat include the following:

- (i) Materials shall meet all specified requirements;
- (ii) a minimum of 99% aggregate coverage has been obtained with no single bare area greater than 0.01m² in any one square metre,
- (iii) there is no streaking or ravelling,
- (iv) the surface of the seal has a uniform, even texture,
- (v) no over-rich or bleeding areas are evident, and
- (vi) no loose aggregate is evident.
- (vii) All existing pavement markings have been preserved or replaced in accordance with Specifications 7.2, Painted Roadway Lines and 7.3, Painted Pavement Messages.

Graded aggregate seal coat that does not meet the foregoing requirements shall be repaired or reconstructed at the Contractor's expense to the satisfaction of the Consultant.

The Contractor may use hand application methods to reseal small isolated areas in need of repair. Regardless of the method used, all repaired or reconstructed areas shall have a uniform texture and appearance.

3.22.11 COMPLETION OF LINE PAINTING

The Contractor shall complete the replacement of roadway lines within five days of completing the placing of the seal coat on each individual roadway. Failure to meet this requirement will result in a penalty of \$900.00 per day for each calendar day delay in completing the painting. The Department may extend the time allowed to complete the painting up to a maximum of ten days providing:

- (i) The Contractor submits a written request to the Consultant accompanied by a detailed proposed line painting schedule.
- (ii) The reason for the request, stated in the request, is one of the following:
 - (a) The seal coat requires additional curing time and subsequent brooming work prior to painting the traffic markings, or
 - (b) The work site is not available to the Contractor through no fault of the Contractor, or

- (c) The Consultant suspends the Work and standby payments are due in accordance with Specification 1.2, General, or
- (d) There is a delay resulting from an order of a court, or from strikes or lock-outs, or
- (e) The traffic markings cannot be painted for reasons of inclement weather, or conditions resulting from inclement weather.

3.22.12 MEASUREMENT AND PAYMENT

3.22.12.1 **General**

The amount of graded aggregate seal coat or graded aggregate seal coat on bridge decks considered for acceptance will be based upon the estimated quantities as shown in the unit price schedule. Generally, a variance in these quantities will only be considered when the scope of the Work has been modified by the Department. However, the Department reserves the right to measure the Work actually constructed to confirm compliance with the design, and any such measurement will become the basis for the final payment.

Payment will be made at the unit price bid per square metre for "Graded Aggregate Seal Coat" or "Graded Aggregate Seal Coat - Bridge Decks" as applicable. Payment will be full compensation for preparing the existing surface; protecting bridge structures where applicable, supplying and installing temporary lane markers; supplying and applying the asphalt binder; supplying, processing, hauling, placing and rolling the aggregate; brooming the finished surface; replacing and/or maintaining pavement markings; roadway line painting; quality control; traffic accommodation and traffic convoy services using the standard number of pilot vehicles as specified; and all labour equipment, tools and incidentals necessary to complete this work to the satisfaction of the Consultant.

All costs associated with pre-construction advertising, including the fabrication, installation, maintenance, updating, and removal of signs; the provision and operation of the on-site communication system; and the supply and application of blotter sand, as required, will be considered incidental to the Work, and no separate or additional payment will be made.

Payment for the provision of pilot vehicles in excess of the standard number specified, when approved by the Consultant, will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

No separate or additional payment will be made for any additional equipment, tools or labour employed to satisfy special brooming requirements.

No payment will be made for any costs incurred to rectify defective work.

3.22.12.2 **Supply of Aggregate**

The Contractor is advised that if aggregate is supplied from a Crown source on undeeded land, operated primarily under lease or license and for which the Department does not have a reservation, the Department will deduct \$ 0.48 per tonne from the total payments made under the Contract. The tonnage will be determined by multiplying the total square metres of chip seal work performed, by a conversion factor of 20 kilograms per square metre.

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3.24 CHIP SEAL COAT**3.24.1 GENERAL**

Chip seal coat shall consist of a wearing course composed of processed aggregates held in place by an asphalt binder, spread and rolled on a prepared surface to the lines and dimensions shown on the Drawings or as designated by the Consultant.

3.24.2 MATERIALS**3.24.2.1 Aggregate**

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

3.24.2.2 Temporary Markers

The Contractor shall supply temporary, reflectorized, centerline markings in accordance with the Alberta Transportation Products List.

3.24.2.3 Asphalt

The Contractor shall supply a cationic, rapid set asphalt binder in accordance with Specification 5.7, Supply of Asphalt.

3.24.2.4 Water

The Contractor shall supply all water required for washing the aggregate.

3.24.2.5 Blotter Sand

The Contractor shall maintain a supply of blotter sand on-site at all times. In the case of an emulsion release where the emulsion has the potential to wash off the road surface into nearby ditches or streams, the blotter sand shall be used to soak up the free emulsion.

3.24.2.6 Line Painting Materials

The Contractor shall supply all line painting materials in accordance with Specification 5.20, Supply of Line Painting Materials.

3.24.3 TESTING**3.24.3.1 Quality Control Testing**

Quality control and quality control testing are the responsibility of the Contractor throughout every stage of the Work from the crushing and production of aggregates to the final accepted product. The Contractor shall provide and pay for equipment and qualified personnel to perform all field testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product produced.

Quality control testing requirements for aggregates are listed in Specification 3.2, Aggregate Production and Stockpiling.

The Contractor shall provide the Consultant with Daily Inspection Reports containing the following information:

- Date
- Description of seal coat completed – i.e. highway number, control section, lane, beginning and end stations.
- Total area treated
- Target and bulk measured application rates for both the asphalt emulsion and aggregate.

Daily Inspection Reports shall be submitted no later than the day following placement.

3.24.3.2 Testing by the Consultant

The Consultant may from time to time take samples, and carry out testing and inspection of materials incorporated or being incorporated into the Work. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall cooperate with the Consultant for such sampling, testing and inspection. Such testing and inspection shall not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

The Contractor shall provide, at his own expense, such stands, sampling devices and other facilities as the Consultant may require to safely obtain representative samples of the item being produced.

3.24.4 EQUIPMENT

The following equipment shall be used:

- (i) A self-powered pressure asphalt distributor meeting the requirements as listed in Specification 3.19, Prime, Tack and Fog Coats.
- (ii) A self-propelled aggregate spreader capable of spreading the aggregate uniformly at the specified rate in 1-application over the full width of the asphalt applied. The spreader shall be capable of controlling and adjusting the width and rate of spread. The spreader shall be equipped with the necessary devices to enable it to be attached securely to the aggregate haul truck while in the process of dumping the aggregates into the spreader.
- (iii) Self-propelled pneumatic rollers, with a minimum static weight of 9 tonnes, and capable of reversing direction without causing backlash or damage to the chip seal coat. The number of rollers deployed shall be in accordance with the operating conditions outlined in Subsection 3.24.7.5, Rolling and Brooming.
- (iv) A minimum of three power sweepers in working condition prior to the start of seal coat activities. Two of the brooms shall be dedicated to sweeping chip seal coat placed that same day. A third broom shall be used for brooming loose chips on chip seal coat placed in previous days. All power sweepers shall be equipped with a minimum of one yellow rotating warning light.
- (v) The Contractor shall supply pilot vehicles for convoying traffic. The pilot vehicles shall have sufficient accompanying personnel to provide convoy services on a 24 hour per day availability. All pilot vehicles shall be equipped as follows:

- A two way radio for communication.
- An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both the front and rear.
- A sequential arrowboard meeting the requirements as shown in Specification 1.2 General.
- The arrowboard shall be controlled from a console located in the vehicle cab.
- The arrowboard display shall be visible to traffic approaching the rear of the trucks.
- Additional pilot vehicles beyond the standard number specified, may be exempt from including a sequential arrowboard with the approval of the Consultant.

The Contractor shall cease chip seal coat application if any equipment integral to either the compaction, sweeping or traffic accommodation operations is not available or is not in good working order, as determined by the Consultant.

3.24.5 ON-SITE COMMUNICATION SYSTEM

The Contractor shall provide an on-site communications system for workers that are remote from the active chip seal coat zone. Workers are considered remote from the active work zone where they are not in a position to readily walk to an appointed location to use a communications device. The following work activities are considered to be remote from the active work zone:

- Flagging operations
- Traffic convoy operations
- Placing of Davidson roadway markers
- Sweeping operations outside of the active work zone
- Rolling operations outside the active work zone

The Contractor shall also provide communications devices for any other remote activity as directed by the Consultant.

3.24.6 TRAFFIC ACCOMMODATION AND SIGNING

3.24.6.1 **Traffic Accommodation Strategy**

The Contractor's Traffic Accommodation Strategy (TAS) shall address all phases of construction including subsequent brooming and line painting activities. The TAS shall be developed based upon the requirements of Drawing TCS-B-1.17A or TCS-B-1.17B as appropriate.

In addition to the minimum requirements of the guideline diagram for "Typical Signing Seal Coat Operations Four Lane Divided Highway", traffic accommodation on four lane divided highways shall be treated as a "One Lane Closure", and shall utilize traffic cones positioned in accordance with the minimum requirements shown on Traffic Accommodation Guideline Drawing TCS-B-1.1B. Crossing of the centre median by construction equipment or vehicles will not be permitted.

In addition to the minimum requirements, the Contractor's Traffic Accommodation Strategy shall include the following:

- A strategy for the protection of workers when placing Davidson Temporary Road Pavement Markers.

- A strategy for the accommodation of traffic when chip seal coating bridge decks.
- A strategy for the accommodation of traffic through all major intersections and approaches.

No seal coat application work shall commence until the Contractor's traffic accommodation strategy has been reviewed and accepted by the Consultant.

During periods of heavy traffic volume, as determined by the Consultant, the Contractor shall shut down construction operations that may impede the safe flow of public traffic.

On a divided highways, the Contractor shall not close or restrict a roadway lane for a distance greater than 7-kilometres in advance of the aggregate spreader.

3.24.6.2 Pre-Construction Advertising

The Contractor shall advertise the chip seal construction a minimum of 7 days in advance of the commencement of Work on each respective highway section. Pre-construction advertising for seal coat work at stand alone bridge deck locations is not required.

The mechanism for advertising the seal coat work shall be standard business advertising signs with minimum dimensions of 1.5 m high and 2.4 m wide. Signs shall be comprised of a metal frame with adjustable legs. The signs shall have minimum of 5 lines with 14 letters per line. Letters shall be a minimum of 12.7 cm wide and 20.3 cm high. Wording of the signs shall be as follows, with the applicable lengths and dates entered:

<p>CHIP SEAL CONSTRUCTION NEXT (XXX) KM (MONTH) (DAY) - (DAY) EXPECT DELAYS</p>
--

The signs shall be placed in a level position on the outside sideslope, with the bottom of the sign a minimum of 0.5 m above the edge of pavement. Placement of the sign on the shoulder or in the ditch will not be permitted. The Contractor shall ensure the signs are anchored down to prevent tipping over. Alternative types of signs may be used upon approval by the Consultant.

The Contractor shall revise the dates on the pre-construction advertising signs as required based on any changes to the construction schedule.

Signs shall be installed at locations designated by the Consultant. Depending on the scheduling, the Contractor may be required to install advertising signs at multiple sites simultaneously.

3.24.6.3 Traffic Convoy

Traffic convoy by pilot vehicles not exceeding 50 km per hour shall be used on all chip seal coat projects.

On two lane highways, traffic convoy shall be initiated at the commencement of chip seal coat application.

On divided highways, traffic convoy shall commence after rolling is complete.

Traffic convoy may be required for subsequent brooming activities depending upon site specific traffic conditions such as length of work zone, available site distances, traffic volumes, etc. Notwithstanding the previous, traffic convoy will be required whenever the length of subsequent brooming activities within the driving lanes is greater than 5 kilometres.

On all highways, traffic convoy shall continue until second brooming of the chip seal coat is complete and the speed restriction has been increased to 80 km per hour or as otherwise directed by the Consultant.

3.24.6.3.1 Pilot Vehicles on Two-Lane Highways

The number of pilot vehicles required for seal coating operations on two lane highways shall be as follows:

Distance between Flag Stations (km)	1	2	3	4	5	6	7	8	9	10	11
Standard number of Pilot Vehicles	2			3			4				

3.24.6.3.2 Pilot Vehicles on Four-Lane Highways

Unless otherwise specified in the Special Provisions or determined by the Consultant, the Contractor shall provide 4 pilot vehicles for seal coating operations on four lane highways.

3.24.7 CONSTRUCTION

3.24.7.1 **General**

Chip seal coat application shall commence no earlier than May 1, and shall be performed no later than August 15 of any year. The Work shall take place during daylight hours only.

The extent of surface preparation required, and the method of application of the chip seal coat including application rates for the asphalt binder and the processed aggregate shall be determined by the Contractor.

3.24.7.2 **Temporary Markers**

The Contractor shall supply and install temporary reflectorized centreline markings (Davidson Temporary Road Pavement Markers or equivalent) on the centreline of the roadway immediately before applying the asphalt binder. Markers shall be placed at 25 m intervals on tangent sections, and at 15 m intervals on curves; and shall remain in place.

3.24.7.3 **Application Areas**

Unless otherwise specified or shown on the Drawings, the Contractor shall not apply seal coat to roadway shoulders or to bridge decks.

The Contractor shall apply seal coat as follows:

- (i) To each through travel lane to the widths shown on the Contract Drawing, regardless of the widths shown on the intersection Drawings.
- (ii) At intersections, to all parallel lanes and their respective tapers, in general conformance with the Drawing entitled "Seal Coat Applications at Intersections" (CB6-3.23M1 or CB6-3.23M2 as applicable), or as shown on the shaded intersection Drawings if provided.

- (iii) To all passing and climbing lanes and their respective tapers.
- (iv) Application on bridge decks where required will generally be from curb face to curb face.

3.24.7.4 Protection of Bridge Structures

The Contractor shall not operate vibratory rollers in vibratory mode on any bridge deck.

The Contractor shall ensure that bridge expansion joints, drains, curbs and appurtenances are protected from asphalt and/or chip contamination.

In addition to being responsible for the cleanup of any contaminated areas, the Contractor is advised that many bridge components and materials are affected by cleanup and any costs for repair of damaged structures will be charged to the Contractor.

3.24.7.5 Rolling and Brooming

Immediately after spreading, the chips shall be rolled. The Contractor shall use a minimum of two rollers. Additional rollers shall be deployed as required to keep pace with aggregate spreader production, and to ensure that the entire chip treated surface receives a minimum of three complete passes. Roller speeds shall not exceed 8 km/h.

No traffic shall be allowed on freshly placed chip seal coat until rolling has been completed.

After rolling and initial set of the binder, the driving lanes and paved shoulders shall be broomed to remove any loose chips. Any brooming activities performed during days following chip application shall be referred to as "subsequent brooming".

The Contractor shall continue to broom the driving lanes and paved shoulders to remove any loose chips when required, and as often as required, during a two week period following the initial application or as directed by the Consultant.

All highway-to-highway junctions and all junctions of paved highways with municipal roads shall be swept clear of loose chips.

The Contractor shall use a pickup broom for all brooming in urban and other areas where loose chips cannot be swept onto sideslopes or onto ditches.

Brooming operations that are against traffic flow shall only be carried out if the Contractor has implemented proper traffic accommodation operations.

On all highways, brooming operations done during hours of darkness shall be accompanied with a trailing arrow board capable of operating in hazard mode where applicable.

The Contractor shall sweep all paved intersections, and all paved farm and field approaches clear of loose chips.

The Contractor shall use a pick-up broom when sweeping all bridge decks. The Contractor shall hand broom areas where the pick-up broom cannot reach. Under no circumstances shall material be swept over the bridge rail. The Contractor shall ensure that chips or other materials are not propelled into the air during brooming operations.

3.24.7.6 Speed Restrictions

For "subsequent brooming" activities within the driving lanes, the posted speed restriction shall be 50 km per hour for two lane highways and 80 km per hour for multi-lane highways. In all cases, the total length of roadway under 50 km per hour speed restriction, including application activities and subsequent brooming activities, shall not exceed 20 kilometres.

3.24.8 PAVEMENT MARKINGS**3.24.8.1 Painted Roadway Lines and Pavement Messages**

The Contractor shall reference and record the location and configuration of all existing painted roadway lines and painted pavement messages for the areas to receive chip seal coat, and re-establish the markings after seal coat application in accordance with Specifications 7.2, Painted Roadway Lines, and 7.3 Painted Pavement Messages.

Painted roadway lines and painted pavement messages shall be applied twice at the full application rate for each application. On two lane highways, the second application shall be applied from the opposite direction of the initial application.

All edge lines shall be painted completely off the seal coat and will only require one paint application

In all cases, the roadway shall not be posted at gazetted highway speeds until all work, including line painting, has been completed. The maximum length of roadway posted at less than gazetted highway speeds shall not exceed 30 km.

3.24.8.2 Durable Pavement Message Markings

Unless otherwise directed, the Contractor shall preserve all existing durable pavement message markings, maintaining them free of contamination by asphalt binder and/or seal coat aggregate. Where the Contractor fails to preserve existing durable pavement message markings, he shall remove any chip seal coat materials and replace the markings at his own expense.

3.24.9 GROOVED RUMBLE STRIPS

Unless otherwise directed, the Contractor shall preserve all existing shoulder and stop condition grooved rumble strips, maintaining them free of contamination by asphalt binder and/or seal coat aggregate. Where the Contractor fails to preserve existing grooved rumble strips, he shall re-establish the grooved rumble strips at his own expense.

3.24.10 REQUIREMENTS FOR ACCEPTANCE

Requirements for the acceptance of the completed chip seal coat include the following:

- (i) Materials shall meet all specified requirements;
- (ii) A minimum of 99% chip coverage shall be obtained with no single bare area greater than 0.01 m² in any one square metre;
- (iii) There shall be no streaking or ravelling;
- (iv) The finished surface shall have a uniform, even texture;
- (v) No over-rich or bleeding areas shall be evident;
- (vi) No loose chips shall be evident; and

(vii) All existing pavement markings have been preserved or replaced in accordance with Specifications 7.2, Painted Roadway Lines, and 7.3, Painted Pavement Messages.

Work that does not meet the foregoing requirements shall be repaired or reconstructed to the satisfaction of the Consultant.

The Contractor may use hand application methods to reseal small isolated areas in need of repair. Regardless of the method used, all repaired or reconstructed areas shall have a uniform texture and appearance.

3.24.11 TIMING FOR COMPLETION OF PAVEMENT MARKINGS

The Contractor shall complete the first application of paint for roadway lines and pavement messages within five days of completing the placement of chip seal on each separate roadway. Failure to meet this requirement will result in a penalty of \$900.00 per day for each calendar day delay in completing the painting. The Department may extend the time allowed to complete the painting up to a maximum of ten days providing:

- (i) The Contractor submits a written request to the Consultant accompanied by a detailed proposed line painting schedule.
- (ii) The reason for the request, stated in the request, is one of the following:
 - (a) The chip seal coat requires additional curing time and subsequent brooming work prior to painting the traffic markings, or
 - (b) The work site is not available to the Contractor through no fault of the Contractor, or
 - (c) The Consultant suspends the Work and standby payments are due in accordance with Specification 1.2, General, or
 - (d) There is a delay resulting from an order of a court, or from strikes or lock-outs, or
 - (e) The traffic markings cannot be painted for reasons of inclement weather, or conditions resulting from inclement weather.

The second application of paint shall commence no earlier than two weeks following the first application of paint, but shall be completed prior to the specified or adjusted Contract Completion date.

3.24.12 MEASUREMENT AND PAYMENT

3.24.12.1 **General**

The amount of chip seal coat or chip seal coat on bridge decks considered for acceptance will be based upon the estimated quantities as shown in the unit price schedule. Generally, a variance in these quantities will only be considered when the scope of the Work has been modified by the Department. However, the Department reserves the right to measure the Work actually constructed to confirm compliance with the design, and any such measurement will become the basis for the final payment.

Payment will be made at the unit price bid per square metre for "Chip Seal Coat" or "Chip Seal Coat - Bridge Decks" as applicable. Payment will be full compensation for preparing the existing surface; protecting bridge structures where applicable, supplying and installing temporary lane markers; supplying and applying the asphalt binder; supplying, processing, hauling, placing and rolling the aggregate; brooming the finished surface; replacing and/or maintaining pavement markings; roadway line painting; quality control; traffic accommodation and traffic convoy services using the standard number of pilot vehicles as specified; and all

labour equipment, tools and incidentals necessary to complete this work to the satisfaction of the Consultant.

All costs associated with pre-construction advertising, including the fabrication, installation, maintenance, updating, and removal of signs; the provision and operation of the on-site communication system; and the supply and application of blotter sand, as required, will be considered incidental to the Work, and no separate or additional payment will be made.

Payment for the provision of pilot vehicles in excess of the standard number specified, when approved by the Consultant, will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General.

No separate or additional payment will be made for any additional equipment, tools or labour employed to satisfy special brooming requirements.

No payment will be made for any costs incurred to rectify defective work.

3.24.12.2 Supply of Aggregate

The Contractor is advised that if aggregate is supplied from a Crown source on undeeded land, operated primarily under lease or license and for which the Department does not have a reservation, the Department will deduct \$ 0.48 per tonne from the total payments made under the Contract. The tonnage will be determined by multiplying the total square metres of chip seal work performed, by a conversion factor of 20 kilograms per square metre.

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3.26 MICRO-SURFACING**3.26.1 GENERAL**

Micro-surfacing is a slurry seal type of application which is placed on a prepared pavement at locations and conforming to the lines and dimensions specified or as designated by the Consultant. The micro-surfacing treatment is intended to provide a smooth, durable, skid resistant surface. Application can be for rut filling and/or surfacing the entire travel lane. The micro-surfacing mixture shall consist of a cationic polymer modified asphalt, mineral aggregate, mineral filler, field control additive and water.

3.26.2 MATERIALS**3.26.2.1 Aggregate**

The Contractor shall produce aggregate that is 100% manufactured and is evaluated as being fully compatible with the emulsion. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate materials in accordance with Specification 4.5, Hauling.

The aggregate gradation, including mineral filler, shall be within the following limits for the type as specified:

Sieve Size (µm)	Percent Passing
10000	100
5000	70 – 90
2500	45 – 70
1250	28 – 50
630	19 – 34
315	12 – 25
160	7 – 18
80	5 – 15

The Contractor shall split aggregates for the micro-surfacing into coarse and fine fraction prior to crushing of the coarse fraction. The crushed coarse and the fine fraction shall be stockpiled separately.

The Contractor shall select a screen size at which splitting will take place. Splitting of aggregates shall be controlled such that the coarse aggregate fraction, before crushing, shall contain no more than 5% passing the 5 000 sieve.

The aggregate quality shall meet the following requirements:

Plasticity Index	AASHTO T90	Non - Plastic
LA Abrasion Loss	AASHTO T96	30% maximum
Sand Equivalent	AASHTO T176	65% minimum

3.26.2.2 **Mineral Filler**

The Contractor shall supply the mineral filler which shall be introduced into the mineral aggregate. Mineral filler may be any recognized brand of non air-entrained portland cement, hydrated lime or any other approved mineral filler that is free of lumps. The amount and type of mineral filler needed will be determined by the laboratory mix design and will be considered as part of the material gradation requirement. An increase or decrease of less than 1% may be permitted in the field for improving the mix consistency or set times.

3.26.2.3 **Field Control Additive**

The Contractor shall supply a field control additive and apply it as required to effectively maintain the quick-set characteristics of the mix and prevent premature breaking of the material in the spreader box. Additives must be included as part of the mix design and be compatible with the other components of the mix.

3.26.2.4 **Water**

The Contractor shall supply suitable water, free from soluble salts and any other harmful contaminants, for mixing of the micro-surfacing material and pre-wetting of the existing pavement

3.26.2.5 **Asphalt**

The emulsified asphalt shall be a quick-traffic polymer modified asphalt emulsion conforming to the requirements of AASHTO M208 for CSS-1h with the following changes.

- i) The cement mixing test shall be waived for this emulsion.
- ii) The Residue after Distillation shall be tested in accordance with ASTM D244 except that the test temperature shall be a maximum of 210 °C and shall be maintained at 205 °C ± 5 °C for 20 minutes.
- iii) The Residue after Distillation shall be a minimum of 62%.

The Residue after Distillation shall also meet the following requirements:

TEST METHOD	TESTS ON RESIDUE	SPECIFICATION
AASHTO T53	Softening Point	57 °C minimum
AASHTO T49	Penetration at 25 °C	40 - 90 dmm
ASTM 2170	Kinematic Viscosity @ 135 °C	650 cST/sec minimum

The polymer material shall be milled or blended into the asphalt or emulsifier solution prior to the emulsification process.

The addition rate of polymer modifier shall be a minimum of 3% polymer solids by mass of asphalt residue.

3.26.3 MIX DESIGN

Test procedures contained in this specification are based upon the publication prepared by the International Slurry Seal Surfacing Association (ISSA) titled "Recommended Performance Guidelines for Micro-Surfacing A143 (Revised) May 2003".

The Contractor shall supply the mix design, and all components of the mix. The Contractor shall submit a mix design, signed and stamped by a Professional Engineer, to the Consultant a minimum of 5 working days prior to the placement of any micro-surfacing material. The mix design shall be prepared by a testing laboratory that has prior experience in the design of micro-surfacing mixes using ISSA test methods and design procedures. No micro-surfacing material shall be placed prior to the Consultant reviewing and accepting the submitted mix design.

Compatibility of the aggregate, polymer-modified emulsion, mineral filler and other additives shall be verified by the mix design. All component materials used in the mix design shall be representative of the materials proposed by the Contractor for use on this project. The mix design shall list the characteristics and proportions of all materials used in the micro-surfacing formulation.

The micro-surfacing mix design submission shall contain test results for all aggregate and mixture properties as herein specified.

The micro-surfacing material shall meet the following mix design requirements.

ISSA TEST NO.	DESCRIPTION	SPECIFICATION
ISSA TB-139	Wet Cohesion @30 minutes minimum (Set) @60 minutes minimum (Traffic)	12 kg-cm minimum 20 kg-cm minimum or near spin
ISSA TB109	Excess Asphalt by LWT Sand Adhesion	538 g/m ²
ISSA TB-114	Wet Stripping	Pass (90% minimum)
ISSA TB-100	Wet-Track Abrasion Loss One-hour Soak Six-day Soak	538 g/m ² maximum 807 g/m ² maximum
ISSA TB-147	Lateral Displacement Specific Gravity after 1,000 cycles of 11.34 kg	5% maximum 2.10 maximum
ISSA TB-144	Classification Compatibility	11 grade points minimum (AAA, BAA)
ISSA TB-113	Mix Time @ 25 °C	Controllable to 120 s minimum

The mix design proportions shall be within the following limits:

Residual asphalt:	6 to 11.5% by dry weight of aggregate.
Mineral filler:	0.0 to 3.0% by dry weight of aggregate.

The micro-surfacing material shall be designed to accommodate traffic without damage within one hour of placement.

3.26.3.1 Testing

Quality control and quality control testing are the responsibility of the Contractor throughout every stage of the Work, from production of aggregates to the final accepted product. Tests that may be performed by the Consultant to determine compliance with specifications will be quality assurance tests and will not be considered as quality control tests.

The Contractor shall provide and maintain equipment and qualified personnel to perform all testing necessary to determine and monitor the characteristics of the materials produced and incorporated in the micro-surfacing.

The Contractor shall provide safe and convenient means for accurately and representatively sampling each aggregate stream being produced during all screening, splitting and crushing processes.

The Consultant may inspect the aggregate production process and test and monitor the quality of the material being produced by the Contractor at any time and as often as he deems necessary. Such inspection or testing shall not in any way relieve the Contractor of the responsibility for producing aggregates that meet the Specifications in all respects.

Quality control testing and monitoring shall be completed by the Contractor according to the requirements outlined in the following Table, and shall be reported to the Consultant within one working day of the completion of each test.

Quality Control Testing Requirements for Micro-Surfacing Projects

TEST	STANDARD	MINIMUM FREQUENCY
Aggregate Production		
Sieve Analysis	ATT-26	One per 500 tonnes or a minimum of two per project, whichever is greater.
Determining Pit-Run Contamination of the uncrushed coarse fraction	ATT-25, Part II	One per 12 hours of plant production.
Sampling		
Asphalt Cement - provide to Consultant for Quality Assurance testing.	ATT-42	One per day.
Equipment		
Calibration	Note 1	Once per project
Inspection	Note 2	Daily – Provide to consultant the day following application.

Section 3

Specification 3.26 Micro-Surfacing

Note 1 - Machine Calibration. Each mixing unit to be used in performance of the Work shall be calibrated in the presence of the Consultant prior to construction. The calibration shall be documented and shall include the individual calibration of aggregate, mineral filler, and emulsified asphalt at various settings, which can be related to the machine proportioning devices to verify the application rate and mix design compliance.

Note 2 – Daily Inspection Report. The Contractor shall maintain a daily inspection report documenting the following information:

- Highway, Control Section
- Date
- Calibration Control Settings as applicable.
- Beginning and End Stations
- Total Area of Application – square metres
- Counter Readings (Beginning, Ending and Total)
- Quantities of Component materials used.
- Quantity weight of micro-surfacing applied.
- Target application rate of the micro-surfacing (kg/m²)
- Bulk daily application rate of micro-surfacing (kg/m²).
- Results of three random checks for the micro-surfacing application rates using the equipment counters.

3.26.4 EQUIPMENT

3.26.4.1 **General**

The Contractor shall provide all equipment, tools, machines, and incidentals necessary to complete the Work. All equipment shall be maintained in a clean and satisfactory working condition at all times to ensure a high quality product.

3.26.4.2 **Mixing Equipment**

The Contractor shall provide a self-propelled micro-surfacing mixing machine specifically designed and manufactured to lay micro-surfacing. The equipment shall be able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, field control additive, and water to a revolving multi-blade twin shafted mixer and discharge the mixed product on a continuous flow basis. The machine shall be equipped to allow the operator to have full control of the forward and reverse speed during application of the micro-surfacing material.

3.26.4.3 **Proportioning Device**

The Contractor shall provide proportioning devices that are properly marked for the individual volume or weight proportioning of each raw material to be added to the mix. These proportioning devices can be revolution counters or similar devices and are to be used in the material calibration for determining the mix design dial and gate settings and calculating the materials output at any time.

3.26.4.4 **Spreading Equipment**

A mechanical spreader box shall be attached to the paver or slurry machine. The spreader box shall be equipped with rotating paddle shafts to agitate and spread the material throughout the box and be capable of uniformly spreading the micro-surfacing mixture. A front seal shall be provided to ensure no loss of the mixture at the road contact point. The rear seal shall act as the final strike off and shall be adjustable.

Spreading equipment shall be capable of spreading the mixture to fill cracks and minor surface irregularities, and shall leave a uniform application of hi-friction material on the surface. The spreader box and rear strike off shall be so designed and operated that a free flow of material to the rear strike off is achieved.

The spreader box shall have suitable means provided to side shift the box to compensate for any change in longitudinal alignment. All excess material shall be removed from the job site prior to opening the road.

3.26.4.5 Auxiliary Equipment

Surface cleaning equipment, hand tools, and any support equipment shall be provided by the Contractor as necessary to perform the Work.

3.26.4.6 Sampling Requirements

The Contractor may have to arrange to have suitable sampling facilities in order for the Consultant to obtain representative field samples of the micro-surfacing mixture and each of the component materials.

3.26.5 CONSTRUCTION

3.26.5.1 General

The micro-surfacing mixture shall be homogeneous during and following mixing and spreading. The micro-surfacing mixture shall be of the desired consistency when exiting the mixer and no additional materials shall be added. A sufficient amount of material shall be carried in all parts of the spreader box at all times so that complete coverage is obtained. Overloading of the spreader box shall be avoided. No lumping, balling, or unmixed aggregate will be permitted. The material shall not have segregation of the emulsion and aggregate fines from the coarser aggregate.

No streaks, such as those caused by oversize aggregate shall be left in the finished surface. If excessive streaking or drag develops, the operation will be stopped until the Contractor proves to the Consultant that the situation has been corrected.

A summary of the quantity and application rate of micro-surfacing placed and a list of quantities used for each of the components shall be submitted daily to the Consultant.

The application rate for the surface pass shall be 11.0 – 16.3 kg/m², or as directed by the Consultant.

No excessive buildup, uncovered areas, or unsightly appearances will be permitted.

3.26.5.2 Seasonal and Weather Limitations

The placement of micro-surfacing shall be limited to the period from June 1 to September 15. Micro-surfacing shall not be placed when, in the opinion of the Consultant, damage to the finished product may occur for any reason.

The micro-surfacing shall be placed only when the atmospheric temperature is at least 10°C and rising and the weather is free of fog or precipitation and there is no forecast of temperatures below 0°C within 24 hours from the time of application.

3.26.5.3 Surface Preparation

The area to be surfaced shall be thoroughly cleaned of loose aggregate and soil, particularly soil that is bound to the surface.

The surface shall be pre-wetted by fogging, with water, ahead of the spreader box when required by local conditions. The rate of application of the fog spray shall be adjusted during the day to suit temperatures, surface texture, humidity, and dryness of the pavement.

3.26.5.4 Traffic

The modified emulsified asphalt shall be formulated so that the material will cure sufficiently such that rolling traffic can be allowed on the surface within one hour of placing with no damage to the surface. Areas with rut fills deeper than 25 mm and fills in areas where hard, sharp turning or braking occurs may require up to one additional hour of cure time as directed by the Consultant.

The Contractor shall ensure that all lanes of travel remain open for traffic every night.

Adequate traffic control warning devices shall be used to control the movement of traffic in and around the construction site in accordance with the Specifications. Proper lane delineation, subject to the approval of the Consultant, shall be used by the Contractor to protect the micro-surfacing from traffic until the new surface will support traffic without damage. All traffic control signs and devices shall be in accordance with Specification 7.1, Traffic Accommodation and Temporary Signing.

The Contractor shall suspend his operations during periods of high traffic volumes as directed by the Consultant.

3.26.5.5 Evaluation Section

The Contractor shall mix a trial batch using the mix design submitted. Unless otherwise specified, the Contractor may construct his evaluation section of micro-surfacing at any location chosen by the Contractor. The evaluation section shall be between 100 m and 200 m in length. No further micro-surfacing will be permitted until the evaluation section has been inspected and accepted by the Consultant.

The Consultant will inspect the evaluation section one hour after placement. If the evaluation section does not meet the specified acceptance criteria, the Contractor shall repeat the trial batch and evaluation process until an acceptable evaluation section is constructed as determined by the Consultant.

The Consultant may stop operations at any time during the evaluation procedure and may require the Contractor to submit a new mix design.

All section(s) of unacceptable trial batch material placed on the highway surface shall receive a second layer of micro-surfacing in accordance with the Specifications.

3.26.5.6 Handwork

Small areas of non-uniform application shall be spot repaired using hand squeegees to provide complete and uniform coverage. Care shall be exercised to prevent an unsightly appearance from the handwork. A finish equivalent to or better than that applied by the spreader box will be required.

3.26.5.7 Width of Application

The micro-surfacing shall be applied between the painted edge lines of the highway. The Contractor shall apply the micro-surfacing neatly up to the painted edge lines but shall not cover any part of the painted edge lines. All median cross-overs will receive micro-surfacing treatment as directed by the Consultant.

3.26.5.8 Roadway Lines and Pavement Message Markings

The Contractor shall reference and record the location and configuration of all existing roadway lines and message markings to ensure that they are re-established correctly. Where applicable, the Contractor shall preserve all permanent type of markings unless directed otherwise by the Consultant.

The Contractor shall paint all roadway lines and pavement messages for the areas receiving micro-surfacing in accordance with Specifications 7.2, Painted Roadway Lines and 7.3, Painted Pavement Messages.

All painted roadway lines and painted pavement messages applied to the micro-surfacing shall be applied twice at the full application rate for each application. On two lane highways the second application will be from the opposite direction of the initial application.

The Contractor shall re-paint all edge lines upon completion of the micro-surfacing construction. All edge lines shall be painted completely off the newly constructed micro-surface and will require only one paint application.

In all cases, the roadway shall not be posted at gazetted highway speeds until all including line painting has been completed. The maximum length of roadway posted at less than gazetted highway speeds shall not exceed 30 km.

The Contractor shall notify the Consultant of the date and time at which painting is to be undertaken at least three days prior to the scheduled start of painting operations. The Consultant will inspect the project jointly with the Contractor and any painting Sub-Contractor prior to the painting operations to assess the surface condition of the roadway and all requirements for painting as outlined in Section 1.2.30, Preservation of Traffic Markings, of Specification 1.2, General. The scheduling of the site inspection shall be the responsibility of the Contractor. Any painting performed prior to the joint meeting will be considered unauthorized work and may not be paid for.

3.26.6 ACCEPTANCE CRITERIA

Requirements for the acceptance of the completed micro-surfacing include the following:

- (i) Materials shall meet all specified requirements;
- (ii) The finished micro-surfacing shall have a uniform texture free from excessive scratch marks, tears or other surface irregularities. Tear marks in any 12 square metre area per lane are considered excessive if there are:
 - a) four or more marks 12 mm wide and 100 mm long.
 - b) any marks 25 mm wide and 25 mm long.
- (iii) There shall be no longitudinal ripples, raking, wash-boarding, chatter, or other irregularities that will affect the ride quality;
- (iv) The edges of the micro-surfacing shall be finished uniformly, with a neat appearance along the roadway centreline, lane lines, shoulder, pavement edge and curb lines;
- (v) The finished surface shall have a uniform, even texture;
- (vi) No over-rich or bleeding areas shall be evident;
- (vii) No loose chips shall be evident; and
- (viii) All existing pavement markings have been preserved or replaced in accordance with Specifications 7.2, Painted Roadway Lines and 7.3, Painted Pavement Messages.

Work that does not meet the foregoing requirements shall be repaired or reconstructed to the satisfaction of the Consultant.

3.26.7 MEASUREMENT AND PAYMENT3.26.7.1 **General**

Payments will be full compensation for designing the mix, surface preparation, processing, hauling and placing the mixture, traffic control and quality control, supplying and processing of all material including but not limited to; aggregate, emulsified asphalt binder, water, mineral filler and field additives.

Contrary to Specifications 5.20, Supply of Line Painting Materials; 7.2, Painted Roadway Lines and 7.3, Painted Pavement Messages, no separate payment will be made for the supply of painting materials, nor for replacing the lines and pavement message markings. The cost of this work will be considered incidental to the Work and no separate or additional payment will be made.

3.26.7.2 **Trial Batches**

Payment for trial batches will be in accordance with the following:

- When trial batches of micro-surfacing are placed in a location outside the project limits, all costs associated with the trial batch will be considered incidental to the Work and no separate or additional payment will be made;

- When trial batches are placed in a location within the project limits, trial batches that meet the specified acceptance criteria will be paid at the applicable price. If the trial batch fails to meet the specified acceptance criteria, no payment will be made for the unacceptable trial batch.

Micro-surfacing for the repair of unacceptable trial batches placed at locations within the project limits will be paid at the applicable unit price bid.

3.26.7.3 Micro-Surfacing

Measurement of micro-surfacing will be based on the estimated quantities as shown in the unit price schedule unless otherwise specified. A variance in these quantities will only be considered when the scope of the Work has been modified by the Department. The Department reserves the right to measure the Work actually constructed to confirm compliance with the design. Any such measurement will be the basis for the final payment. No allowances will be made for additional quantities that may result from ruts or an otherwise irregular surface cross-section.

Payment for the Work will be made at the unit price bid per square metre for "Micro-Surfacing". The price bid will be considered full compensation for supplying the aggregate and asphalt, and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

3.26.7.4 Rut Repair by Micro-Surfacing

When micro-surfacing is used solely for rut filling, measurement and payment will be based on one of the following methods as specified:

- By the weight of aggregate and asphalt emulsion used to produce the final product. Payment will be made at the unit price bid per tonne for aggregate and the unit price bid per tonne for asphalt emulsion.
- By unit rate. Payment will be made at the unit price bid per linear metre of individual wheel path.

The price bid will be considered full compensation for supplying the aggregate and asphalt, and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

3.26.7.5 Supply of Aggregate

Contrary to Specification 5.2 Supply of Aggregate, no separate payment will be made for supplying aggregate for micro-surfacing. However, if the Contractor supplies aggregate from a Crown source on undeeded land, operated primarily under lease or licence and for which the Department does not have a reservation, the Department will deduct \$0.48 per tonne from the total payments made under the Contract. The tonnage will be determined by summing the aggregate quantities reported on the Contractor's Daily Inspection Report or other means as determined by the Consultant.

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3.30 ASPHALT PAVEMENT CRACK ROUTING AND SEALING**3.30.1 GENERAL**

The purpose of crack sealing is to prolong the life of existing pavements by preventing moisture from penetrating the roadway structure, and by preventing the spalling of material from the edges of the cracks.

The Work shall consist of routing, cleaning and drying cracks and sealing them with crack sealant between the limits shown on the Drawings or as directed by the Consultant.

3.30.2 MATERIALS**3.30.2.1 Crack Sealant**

The Contractor shall choose and supply hot pour rubberized crack sealant material from the proven products of the Alberta Transportation Products List. Products not listed as proven require the Department's approval prior to use.

The Contractor shall provide the Consultant with the following information five days prior to commencing the Work:

- Name and mailing address of crack sealant Supplier and Manufacturer
- Name of crack sealant product to be supplied
- Written confirmation from the Manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meets all specified requirements.

The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

The Contractor shall supply the Consultant with the Manufacturer's quality control test results (indicating at the minimum cone penetration and flow) for each batch of crack sealant. These test results shall be supplied at the time of delivery of each batch of crack sealant to the Work.

All crack sealant supplied shall be subject to inspection, sampling and testing by the Department and the Contractor shall cooperate in the inspection and sampling process. When directed by the Consultant, the Contractor shall obtain representative samples of the crack sealant delivered to the Work.

3.30.2.2 Blotting Agents

When necessary, the Contractor shall supply one of the following blotting agents:

- screened sand with a maximum topsize of 2 mm
- cement
- flyash

The use of other products shall be subject to the approval of the Consultant.

3.30.3 EQUIPMENT

The Contractor shall supply all equipment necessary for completion of the Work including but not limited to the melting kettle, air compressor unit, hot compressed air lance, routing and crack sealing equipment and all related equipment such as fork lifts, hoists, and transport vehicles.

The melting kettle shall consist of a double jacketed oil bath kettle with thermometric controls which automatically control the product temperatures and with continuous agitation equipment to prevent localized variations in temperature. The kettle shall be equipped with two calibrated thermometers to monitor the temperature of the crack sealant and the temperature of the heat transfer oil.

The mechanical router shall be capable of producing the specified rout cross-section.

The compressed air unit shall be equipped with water and oil traps and must produce sufficient air volume and pressure to remove all debris from the cracks. It shall be capable of delivering a continuous stream of clean, dry air at 600 kPa and 4.5 m³/min.

Application equipment shall be capable of regulating the application of crack sealant directly to the road and shall be equipped with a thermometer to monitor the temperature of the material as it is applied.

The hot compressed air lance shall be capable of providing a continuous hot, high pressure air stream (1000°C at a rate of 1000 m/sec) with no flame at the exit nozzle.

3.30.4 CRACK ROUTING AND SEALING

All work shall be performed during daylight hours only. No work shall be performed if the visibility is less than 700 m. No work shall be performed during rain or snow or when the pavement surface is wet. The maximum work area shall be 3 km in length.

The crack sealant shall not be applied when the pavement temperature is below 10° Celsius.

Unless otherwise directed by the Consultant, all transverse cracks between 2 mm and 25 mm in width and longitudinal cracks between 2 mm and 12 mm in width which are within the driving lanes of the pavement surface shall be routed and sealed. Routing and sealing shall extend 0.5 m into the pavement shoulders.

Cracks shall be routed to the applicable cross-section shown on Drawing CB6-10.6M1, keeping the crack in the centre of the rout cross-section.

Prior to the application of crack sealant, the road surface adjacent to the cracks shall be cleaned and all loose material and moisture shall be removed from the routed cracks. All debris resulting from the cleaning and routing operation shall be removed from the road surface. The routed cracks shall be treated with the hot compressed air lance until the pavement in the routed crack is dry and slightly darkened. There shall be a maximum time period of 2 minutes between cleaning and drying the routed cracks and the application of the crack sealant.

Crack sealant shall be heated and applied within the applicable specified temperature ranges and in accordance with the Manufacturer's recommendations. The heat transfer oil in the melting kettle shall not be heated in excess of 50° C above the safe heating temperature.

Routed cracks shall be filled with crack sealant such that upon cooling, the filled crack is as shown on the Drawings.

Excessive crack sealant shall be removed from the pavement surface immediately following application.

Traffic shall be kept off sealed cracks until the crack sealant has cured. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant. When a blotting agent is used, it shall not be applied until the sealant has cooled sufficiently to prevent inclusion of the blotting agent into the sealant.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Consultant at the Contractor's expense.

3.30.5 SAMPLING AND TESTING

3.30.5.1 **General**

Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship supplied. Compliance with these requirements where so specified shall be judged by sampling and testing as described in this section.

Acceptance testing is the responsibility of the Consultant.

Quality control, including the provision of quality control test results for the crack sealant materials, is the responsibility of the Contractor.

Accommodation of traffic for all sampling and testing is the responsibility of the Contractor.

3.30.5.2 **Definitions**

LOT - a day's production of at least 1500 linear metres of crack. If a day's production is less than 1500 linear metres, it shall be added to the production of subsequent days until a minimum of 1500 linear metres is obtained for the Lot. If the last day's production is less than 1500 linear metres of crack, it shall be added to the previous Lot.

3.30.5.3 **Test Methods**

The latest edition of the following standard Alberta Transportation test methods (ATT) will be used for acceptance sampling and testing.

TABLE 3.30.5.3 TEST METHODS

Test Description	Test Method
1. Sampling Crack Sealant	ATT-42
2. Measurement of Rout Cross-section	ATT-73
3. Measurement of Sealant Filling	ATT-73
4. Measurement of Crack Missed	ATT-73
5. Appeal of Quality Assurance Results	ATT-73
6. Random Test Site Selection	ATT-56 Part III

3.30.5.4 Acceptance Sampling and Testing of Crack Sealant Material

The Consultant will obtain a sample of crack sealant material for each Lot in accordance with ATT-42. Testing of crack sealant material will be in accordance with the Manufacturer's specifications. The Department will determine the frequency of testing of sealant. Failing sealant test results will be reported within seven days of the Department's designated quality assurance testing firm receiving the samples. Materials that do not conform to the stated tolerance shall result in a unit price adjustment for the linear metres of crack sealant for the Lot, or rejection as specified in Table 3.30.6.

The Consultant will measure the sealant temperatures. Temperatures measured in excess of 10°C above the Manufacturer's specified safe heating temperature will result in the rejection of the material in use and the Contractor shall dispose of the overheated materials in a manner acceptable to the Consultant.

3.30.5.5 Acceptance Sampling and Testing of Routing and Sealing

The Consultant will measure sections of routed transverse and longitudinal cracks to determine compliance to the specified rout cross-section and the conformance of the rout to the path of the crack being routed. If the existing crack is partially or entirely outside the rout cross-section or is within the rout cross-section but touching the side edge of the rout, it shall be considered "crack missed." The Consultant will measure sections of sealed crack to determine compliance with the specified filling requirements. All sample locations will be determined on the basis of stratified random sampling in accordance with ATT-56 Part III.

The random sites inspected by the Consultant will be a minimum of 1 m in length and, for the purpose of price adjustment, there will be a minimum of 6 sites measured per lot for rout cross-section, crack missed and for filling of the rout with sealant. Sites will be inspected for rout cross-section after routing and before sealant is placed. Sites will be inspected for filling a minimum of 1 hour after the cracks are filled. Inspection for rout cross-section, crack missed and rout filling shall be performed in accordance with ATT-73.

The Contractor shall cooperate with the Consultant obtaining test measurements and the Department will not be responsible for any costs due to delays in the Contractor's operation due to testing activities.

3.30.5.6 Appeal of Acceptance Test Results and Appeal Testing

The following procedures will apply for an appeal:

- (i) Appeals will only be considered if the Contractor can demonstrate to the satisfaction of the Consultant that there is sufficient cause to support the appeal.
- (ii) Acceptance test results for any rejected or penalized Lot may be appealed only once.
- (iii) The Contractor shall serve notice of an appeal to the Consultant, in writing, within 24 hours of receipt of the test results.
- (iv) For an appeal of the rout cross-sections, the Contractor shall locate and prepare the appeal sites at the locations determined by the Consultant. The cracks shall be cleaned to an acceptable condition to allow for the measurement of the rout cross-section and the percent of the crack missed. When the Consultant has completed the measurements, the Contractor shall immediately reseal the test sites. No separate payment will be made for site preparation for retesting and the resealing of cracks.

- (v) For an appeal of the percent of crack filled, the Consultant will determine new test sites and evaluate the filling of the routed crack at these new sites. The Contractor shall provide assistance as required for this appeal testing.
- (vi) For an appeal of the material's characteristics testing, the Consultant will request a retest on the original material sample for the Lot.
- (vii) The results of the original measurements will be averaged with the results of the new tests and the new averages shall form the basis for payment except for Compatibility and Bond tests, where a single acceptable test result will be considered sufficient for acceptance of the applicable characteristic.

If the new averages indicate that a penalty or rejection still apply for the Lot or subplot then the Contractor shall be responsible for the costs of the retesting. The costs for retesting of crack sealant or rout cross-sections shall be \$500.00 per Lot. The cost of retesting for the percent of crack filled shall be \$100.00 per Lot. If the results of retesting indicate that the subject lot has a reduced penalty then the Department will be responsible for the cost of retesting.

3.30.6 MEASUREMENT AND PAYMENT

Measurement will be made in metres of the length of cracks on which crack routing and sealing has been performed.

Payment will be made at the unit price bid per metre for "Crack Routing and Sealing" subject to the unit price adjustments specified in this section. This payment will be full compensation for routing, cleaning and drying the cracks, cleaning the pavement surface, supplying and applying the crack sealant, quality control and traffic accommodation.

When payment adjustments equal 100% or greater, the Contractor may be required to remedy the Lot to meet specified tolerances. This shall include removing all sealant, preparing the routs and resealing. Payment for the Lot shall be based on the new work.

TABLE 3.30.6
LOT UNIT PRICE ADJUSTMENTS

Parameter	Limits	Adjustment Factor
Crack Sealant Material	(based on material specification for each product)	100% penalty if all 5 material parameters exceed specified requirements
Flow	+ 25%	No individual penalty
Cone Penetration	+ 20%	1% per dmm outside limit
Bond Test	Pass	No individual penalty
Resilience	- 20%	1% per point outside limit
Compatibility	Pass	No individual penalty
Rout Cross-section, Crack Missed and Crack Filled	(Function of the specified rout cross-section)	
Width	Maximum of 10% deviation from the specified width	Penalty equal to 0.5 times the % of crack with $\geq 10\%$ deviation less than the specified width
Depth	Maximum of 20% deviation from the specified depth	Penalty equal to 0.5 times the % of crack with $\geq 20\%$ deviation less than the specified depth
% of crack missed	Maximum 5% missed	Penalty equal to the total % of crack missed when $>5\%$ has been missed
Filling of routed crack	Maximum 30 % subsidence from flush fill	Penalty equal to 0.5 times the % of crack underfilled

The unit price applicable to each Lot quantity of "Crack Routed and Sealed" shall be as follows:

$$LU = BP - (BP * (AF + CA))$$

Where: LU is the Lot Unit Price per lineal metre;

BP is the Contract Bid Price per lineal metre for "Crack Routing and Sealing";

AF is the Sum of the Adjustment Factors for the Crack Sealant; and

CA is the Sum of the Adjustments for Crack Missed, Crack Filled and Cross-section deviations.

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3.31 ASPHALT PAVEMENT CRACK SEALING**3.31.1 GENERAL**

The purpose of crack sealing is to prolong the life of existing pavements by preventing moisture from penetrating the roadway structure, and by preventing the spalling of material from the edges of the cracks.

The Work shall consist of sealing cracks with crack sealant between the limits shown on the Drawings or as directed by the Consultant.

3.31.2 MATERIALS

The Contractor shall supply all materials necessary for the Work including the crack sealant.

The Contractor shall supply EC-101 or HC-200 crack sealant in accordance with Specification 5.7, Supply of Asphalt. Products not listed as proven in the Alberta Transportation Products List require Department approval prior to use.

The Contractor shall provide the Consultant with the following information 5 days prior to commencing the Work:

- Name and mailing address of crack sealant Supplier and Manufacturer
- Name of crack sealant product to be supplied
- Written confirmation from the Manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meets all specified requirements.

The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

The Contractor shall supply the Consultant with the Manufacturer's quality control test results (as identified in Table 3.31.2) for each batch of crack sealant. These test results shall be supplied at the time of delivery of each batch of crack sealant to the Work.

TABLE 3.31.2

PRODUCT	QUALITY CONTROL TESTING REQUIREMENTS
COLD POUR	a) Uniformity TLT-226
	b) Viscosity TLT-227
	c) Solids Content (residue by evaporation, procedure A) ASTM D244
	d) Rate of Curing (24 hour) TLT-230
HOT POUR	a) Softening Point ASTM D36
	b) Penetration @ 25°C ASTM D5
	c) Viscosity ASTM D2170

When necessary, the Contractor shall supply one of the following blotting agents:

- screened sand with a maximum topsize of 2 mm
- cement
- flyash

The use of other products shall be subject to the approval of the Department

3.31.3 EQUIPMENT

The Contractor shall supply all equipment necessary for completion of the Work including but not limited to the melting kettle (Hot Pour only), crack sealing equipment and all related equipment such as fork lifts, hoists, and transport vehicles.

The melting kettle shall consist of a double jacketed oil bath kettle with continuous agitation equipment to prevent localized heating. The kettle must be equipped with two thermometers to show the temperature of the crack sealant and the temperature of the heat transfer oil.

Application equipment must be capable of regulating the application of crack sealant directly to the road.

3.31.4 CRACK SEALING

All work shall be performed during daylight hours only. No work shall be performed if the visibility is less than 700 m. No Work shall be performed during rain or snow or when the pavement surface or cracks are wet. The maximum work area shall be 3 km in length.

Crack sealant shall not be applied when the atmospheric temperature at the construction site is below 0° Celsius.

All cracks within the entire width of the pavement surface, which are 5 mm and greater in width shall be sealed.

Prior to the application of crack sealant, the Contractor shall ensure that the road surface adjacent to the cracks is clean.

Hot pour crack sealant shall be heated to the temperature specified by the Manufacturer. Overheating will not be permitted.

Crack sealant shall be applied within the Manufacturer's specified temperature range.

Crack sealant shall be applied so that the crack is flush filled immediately following application and a thin overband of sealant extends approximately 25 mm beyond the edges of the crack.

Excess crack sealant shall be removed from the pavement surface immediately following application. Removal shall involve the use of a squeegee, starting from the centerline and proceeding to the shoulder.

Traffic shall be kept off sealed cracks until the crack sealant will not track under the action of traffic. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Consultant at the Contractor's expense.

Work that does not meet the foregoing requirements shall be repaired or reconstructed to the satisfaction of the Consultant and at the Contractor's expense.

3.31.5 ACCEPTANCE SAMPLING AND TESTING

3.31.5.1 **Acceptance Sampling and Testing of Crack Sealant**

All crack sealant supplied shall be subject to inspection, sampling and testing by the Department and the Contractor shall cooperate in the inspection and sampling process. The Contractor shall obtain and submit to the Consultant two representative samples of crack sealant material in accordance with ATT-42 for each Lot of production.

A Lot is defined as a day's production of at least 5 km of roadway. If a day's production is less than 5 km, it shall be added to the production of subsequent days until a minimum of 5 km is obtained for the Lot. If the last day's production is less than 5 km, it shall be added to the previous Lot.

The Department will determine the frequency of testing of sealant. Cold pour materials that do not conform to the Specification limits shall result in a unit price adjustment for each km of roadway in the Lot in accordance with Table 3.31.6.

3.31.5.2 **Appeal of Acceptance Test Results and Appeal Testing**

The following procedures will apply for an appeal:

- (i) Appeals will only be considered if the Contractor can demonstrate to the satisfaction of the Consultant that there is sufficient cause to support the appeal.
- (ii) Acceptance test results for any penalized Lot may be appealed only once.
- (iii) The Contractor shall serve notice of an appeal to the Consultant, in writing, within 24 hours of receipt of the test results.
- (iv) For an appeal of the materials characteristics testing, the Consultant will conduct a retest on the duplicate material sample for the Lot.
- (v) The results of the original measurements will be averaged with the results of the new tests and the new averages shall form the basis for payment.

3.31.6 MEASUREMENT AND PAYMENT

Measurement will be made of the length of roadway, in kilometres, on which crack sealing has been performed.

A roadway will include all travel lanes, shoulders, acceleration and deceleration lanes, truck turnouts and intersections. A divided or twinned highway will be considered two separate roadways.

Payment will be made at the unit price bid per kilometre for "Crack Sealing" subject to the unit price adjustments specified herein. This payment will be full compensation for cleaning the road surface adjacent to the cracks, supplying and applying the crack sealant, quality control, traffic accommodation and signing.

The following unit price adjustments apply only to EC-101 or other approved cold pour materials and do not relieve the Contractor of the requirements to complete the Work in accordance with these specifications.

TABLE 3.31.6
LOT UNIT PRICE ADJUSTMENTS

Requirement	Unit Price Adjustment
Solids (%)	
≥ 59	No Adjustment
58.9 to 54.0	5 %
53.9 to 49.0	10 %
< 49	15 %

The unit price applicable to each Lot quantity of "Crack Sealing" shall be as follows:

$$Lk = BP - (BP * AF)$$

Where: Lk is the Lot Unit Price per kilometre;
BP is the Contract Bid Price per kilometre; and
AF is the Adjustment Factor for the Crack Sealant.

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3.33 CRACK REPAIR - SPRAY PATCH**3.33.1 GENERAL**

The Work consists of repairing transverse and longitudinal cracks by cleaning the defect of all rock, dirt, sand or other objectionable material, applying asphalt binder as a tack material, filling with a mixture of asphalt binder and crushed aggregate and compacting the mix.

3.33.2 MATERIALS

Aggregate shall be supplied in accordance with Specification 3.2, Aggregate Production and Stockpiling, and Specification 5.2, Supply of Aggregate.

The Contractor shall produce crushed aggregate meeting the following gradation specifications.

<u>Metric Sieve Size Fm</u>	<u>% Passing</u>
12 500	100
10 000	90 - 100
5 000	20 - 100
2 500	5 - 30
1 250	0 - 10

The Contractor shall supply an emulsified asphalt binder appropriate for the aggregate materials used.

3.33.3 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work. The equipment required includes but is not limited to the following:

- A compressor for high pressure air with a minimum rated capacity of 5.2 cubic metres per minute (185 CFM) capable of blowing the crack clean of all dirt, sand, rock, or other objectionable material.
- A proprietary or prototype machine capable of spraying the asphalt into the crack, and then combining crushed aggregate and asphalt and spraying the mixture into the crack.
- Appropriate compaction equipment.

3.33.4 PROCEDURE

The Consultant will determine which cracks are to be repaired. Generally, cracks less than 5 mm width will not require repair. Potholes or other surface defects that are contiguous with cracks are considered to be 'crack related' and are to be repaired by spray patching.

Work shall not be performed when the atmospheric temperature at the work site is below 5°C.

All objectionable material shall be removed from the open crack and surrounding area by blowing with high pressure air streams or other means acceptable to the Consultant.

Cleaned cracks shall be sprayed with the emulsified asphalt, and then sprayed with the combined asphalt and crushed aggregate mixture.

Some over-spraying of the crack will be required to ensure a smooth transition between the repaired crack and the adjacent undisturbed pavement surface.

The repaired area shall be compacted to ensure adequate embedment of the asphalt aggregate mixture into and over the crack.

All loose aggregate and debris shall be swept or removed from the pavement surface and disposed of to the satisfaction of the Consultant. Generally, the debris may be swept or blown evenly over the sideslopes however, when indicated in the Special Provisions, the Contractor shall pickup, haul and dispose of it at a location acceptable to the Consultant.

3.33.5 SCHEDULE LIMITATIONS

The Contractor shall schedule his operations to ensure that crack repair is completed a minimum of two weeks prior to any required pavement overlay.

3.33.6 MEASUREMENT AND PAYMENT

Measurement will be in metres based on the length of cracks treated.

Payment will be made at the unit price bid per metre for "Crack Repair - Spray Patch". This payment will be full compensation for cleaning the cracks; disposing of the debris; tacking; supplying the crushed aggregate and asphalt binder; producing, hauling, placing and compacting the mix; traffic accommodation and signing; and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

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3.35 CRACK REPAIR - MILL AND FILL**3.35.1 GENERAL**

The Work consists of repairing cracks by milling a rectangular trench centered over the crack, filling the trench with asphalt concrete pavement mix, then compacting the mix.

3.35.2 MATERIALS**3.35.2.1 General**

All materials necessary for the described herein shall be supplied by the Contractor.

3.35.2.2 Aggregate

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling. Unless otherwise specified, aggregate shall meet the requirements for Designation 1 material. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

3.35.2.3 Asphalt

The Contractor shall supply asphalt in accordance with Specification 5.7, Supply of Asphalt. The type and grade of asphalt shall be as specified in Subsection 3.35.2.4, Asphalt Mix Design.

The type and grade of liquid asphalt for tack coat shall be in accordance with Section 3.19.2, Materials, of Specification 3.19, Prime, Tack and Fog Coats, unless otherwise specified.

3.35.2.4 Asphalt Mix Design

The asphalt mix design shall be prepared and submitted to the Consultant in accordance with the Asphalt Mix Design and Job Formula Mix Formulas specified in Section 3.50.3, of Specification 3.50, Asphalt Concrete Pavement (EPS), or Section 3.53.3, of Specification 3.53, Asphalt Concrete Pavement – Superpave. Unless otherwise specified, the mix type shall be at the Contractor's discretion.

3.35.3 EQUIPMENT

The Contractor shall supply all equipment necessary for completion of the Work including, but not limited to, the following:

- A dry process cold milling machine capable of milling a rectangular trench meeting the specified dimensions. Milling machines using water to cool the milling head will not be permitted.
- Sweeping and blowing equipment capable of removing all loosened material from the milled trench and off the roadway surface.
- Hand spraying equipment for applying the tack coat.
- All equipment necessary for supplying, placing and compacting the asphalt concrete mix.

3.35.4 CONSTRUCTION

3.35.4.1 **General**

No work shall be carried out when the pavement surface is wet.

The Consultant will designate which cracks are to be repaired.

The maximum work area shall be 3 km in length. For transverse crack repair, work shall be confined to one lane at a time. The Contractor shall include these requirements in his Traffic Accommodation Strategy.

3.35.4.2 **Crack Repair**

Unless otherwise specified, the Contractor shall mill a rectangular trench centered over the crack. Trench dimensions shall be as follows:

- For crack repairs designated as “Mill and Fill”, the trench shall be 400 mm wide by 150 mm deep or the depth of the existing asphalt material, whichever is less.
- For crack repairs designated as “Shallow Mill and Fill”, the trench shall be 400 mm wide by 50 mm deep.

For transverse cracks, the trench shall extend across the width of the lane and 0.3 m on to the shoulder unless otherwise specified.

All loosened material shall be removed from the trench, and the milled surfaces shall be left clean and dry. The milled material shall be swept to the shoulder of the road and disposed of on the sideslope. When identified in the Special Provisions, milled material shall be removed from the roadway and disposed of by the Contractor at a disposal site acceptable to the Consultant.

The Contractor shall apply tack coat to all exposed pavement edges by means of hand spraying.

The asphalt concrete pavement mix shall be placed and compacted to the top of the milled trench in lifts not greater than 75 mm thick to a minimum of 96% Marshall density, or as otherwise specified. Asphalt cores taken for density testing shall be taken from the center of the notch.

The Contractor shall backfill all milled trenches the same day.

Where the drawings show that subsequent lifts of asphalt concrete pavement are to be placed, the Contractor shall schedule his operations to ensure that a minimum of one lift is placed prior to seasonal shutdown.

3.35.5 ACCEPTANCE CRITERIA

The Work shall comply with the following for final acceptance by the Consultant:

- all milled cracks conform with the specified milling profile;
- the milling conforms to the path of the crack with no part of the crack outside or touching the edge of the milled cross-section;
- all milled cracks are filled with the proper asphalt mix;

- the asphalt mix is compacted to the required density;
- the completed work provides a smooth transition between the infilled material and the adjacent undisturbed pavement surface; and
- all milled material has been properly spread over the sideslope or disposed of and the work area left in a neat and tidy condition.

Treated cracks failing to meet these criteria shall be repaired by the Contractor at his own expense.

3.35.6 MEASUREMENT AND PAYMENT

Measurement will be in metres based on the length of cracks acceptably repaired.

Payment will be made at the unit prices bid for "Crack Repair - Mill and Fill" or "Crack Repair – Shallow Mill and Fill, as applicable, and will be full compensation for cold milling; disposal of milled material; supplying and applying tack coat; supplying, placing and compacting the asphalt mix; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

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3.40 CUTTING OF PAVEMENT**3.40.1 GENERAL**

This specification covers the cutting of existing concrete curbs, sidewalks, driveways, asphalt concrete pavement, and base course materials where new surfacing materials are to be placed abutting the existing structure. The location of pavement cuts will be shown on the Drawings, or as specified in the Special Provisions.

3.40.2 CONSTRUCTION

Wherever specified, the Contractor shall cut concrete curbs, sidewalks, driveways, and existing pavement to the full thickness of the structure so that a smooth vertical edge results, against which new materials can be effectively placed and compacted. Rough, jagged edges will not be acceptable.

Unless otherwise specified in the Special Provisions, the Contractor may utilize any cutting methodology, provided the methods and equipment result in a clean and straight vertical cut. All proposed methods and equipment employed by the Contractor shall be reviewed and accepted by the Consultant prior to the start of the Work.

When trench excavation across an existing structure is required, the Contractor shall cut the existing pavement on both sides of the trench to the full depth of the structure. The trench cuts shall result in a trench that is no wider than necessary to permit satisfactory installation of the works, and to thoroughly compact the backfill material.

When the Contractor cuts a trench across existing curb, sidewalk, driveway or roadway, the Contractor shall the backfill the trench with similar or better materials than those excavated. The backfill work shall be performed in accordance with the applicable sections of the Specifications.

All concrete, asphalt concrete pavement, and base course material that is cut-away shall be excavated, loaded, hauled and disposed of at a suitable disposal site provided by the Contractor. Alternatively, if the cut-away debris is sufficiently broken-down such that no piece is larger than 150 mm in any dimension, the Contractor may incorporate the debris in the highway embankment, where such work exists.

3.40.3 MEASUREMENT AND PAYMENT

Cutting of pavement will be measured in lineal metres of structure cut. No allowance will be made based on the depth of cut, or the type of material cut.

Payment for this work will be made at the unit price bid for "Cutting of Pavement". The price bid will be considered full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

The removal and disposal of excavated material will be considered incidental to the Work, and no separate or additional payment will be made.

When the Contractor cuts a trench across existing surfaces, the backfill of the trench with similar or better material will be considered incidental to the Work and no separate or additional payment will be made.

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3.50 ASPHALT CONCRETE PAVEMENT - END PRODUCT SPECIFICATION**3.50.1 GENERAL****3.50.1.1 Description**

Asphalt concrete pavement (ACP) shall consist of crushed aggregates, or a combination of crushed aggregates and reclaimed asphalt pavement (RAP), blend sand material as required and asphalt cement, combined in a hot mix plant, placed and compacted on a prepared surface in conformity to the lines, grades, dimensions and cross-sections as shown on the Drawings or as directed by the Consultant.

3.50.1.2 Definitions

For purposes of this specification, the following definitions will apply:

3.50.1.2.1 Acceptance Limits

- (i) Density and Actual Asphalt Content - Acceptance Limits for density and Actual Asphalt Content are the limiting values of the Lot Mean within which the Lot will be accepted at full, increased, or reduced payment for density, as shown in Table 3.50 A, or full or reduced payment for Actual Asphalt Content as shown in Table 3.50 B.
- (ii) Smoothness - Acceptance Limit for smoothness is the limiting value of the Profile Index within which a Sublot will be accepted with or without penalty assessment as shown in Table 3.50 C.
- (iii) Gradation - Acceptance Limit for gradation is the limiting value of the Lot Mean within which the Lot will be accepted as shown in Table 3.50 E.

3.50.1.2.2 Asphalt Content

- (i) Design Asphalt Content - The Asphalt Content established by the approved mix design.
- (ii) Approved Asphalt Content - The Design Asphalt Content or subsequent adjustments to it. Such adjustments must be approved in writing by the Consultant.
- (iii) Actual Asphalt Content - The amount of asphalt binder in the mix as determined by ATT-12 or ATT-74, and includes an amount to correct for the asphalt binder lost due to absorption by the aggregate or aggregate loss.

This correction may be determined for each change in aggregate or asphalt binder.

3.50.1.2.3 End Product Specification (EPS)

A specification, whereby the Department does not define methods of construction. Under EPS, the Department will monitor the Contractor's control of the process that produces the items of construction and will accept or reject the end product according to a specified acceptance plan. The Contractor is entirely responsible for quality control. End product acceptance is the responsibility of the Department and includes a statistically oriented program of acceptance testing.

3.50.1.2.4 Job Mix Formula

The Job Mix Formula establishes the aggregate proportioning, target aggregate gradation and approved asphalt content to be used for production of asphalt mix and requires the approval of the Consultant on the basis of a mix design.

3.50.1.2.5 Lot

A Lot is a portion of the Work being considered for acceptance and is defined as the following:

- (i) One day's plant production of more than 4 hours where approved changes to the following criteria have not occurred:
 - (a) Job Mix Formula
 - (b) Pavement Density Requirement
 - (c) Project

A change in any one of the above may require a new Lot designation.

- (ii) One day's plant production of less than 4 hours will be dealt with at the Consultants option, as follows:
 - (a) The material will be added to the previous day's Lot if the criteria specified in (i) remains the same or,
 - (b) The material will be added to the next day's Lot with the same criteria specified in (i) or,
 - (c) If it is the last time the mix is produced with these criteria then the production will be designated as a Lot.
- (iii) If the Consultant suspects a portion of a Lot is substandard, he may order extra testing to define the area and severity of the deficiency. A new Lot will be designated for this portion if this extra testing indicates the mix is subject to unit price adjustment or rejection.

3.50.1.2.6 Rejection Limit

- (i) Density and Actual Asphalt Content - Rejection Limit for Density and Actual Asphalt Content is the limiting value of the Lot Mean beyond which a Lot is rejected and not paid for as shown in Tables 3.50 A, and 3.50 B.
- (ii) Smoothness - Rejection Limit for smoothness is the limiting value of the Profile Index (PrI) beyond which a Sublot is rejected and not paid for as shown in Table 3.50 C.
- (iii) Gradation - Rejection limit for gradation is the limiting value of the Lot Mean beyond which a Lot is rejected and not paid for as shown in Table 3.50 E.

3.50.1.2.7 Lot Mean and Range

The Lot Mean is the arithmetic mean of a set of 5 or more test results constituting the sample for the Lot. The Range represents the difference between the highest and lowest values within a set of test results.

3.50.1.2.8 Stratified Random Sample

A Stratified Random Sample is a set of test measurements taken one each from 5 or more separate (stratified) areas or segments within a Lot in an unbiased way.

3.50.1.2.9 Sublot

A Sublot is a portion of a Lot that is one paver width wide and 100 m long on which the calculation for Smoothness and assessment of Workmanship and Obvious Defects are based.

3.50.1.2.10 Alberta Transportation Test Procedures

Test methods designated in these specifications as "ATT" or "TLT" refer to Alberta Transportation Tests.

3.50.1.2.11 Managed Quality Assurance (MQA)

Within this specification, acceptance testing shall be applied using Managed Quality Assurance (MQA) practices. With MQA, certain quality control test results provided by the Contractor may be used in place of corresponding quality assurance test results, as a basis for acceptance and payment. The Lots for which quality control test results are used for acceptance and payment will be at the discretion of the Consultant.

3.50.1.2.12 QC Acceptance Lot

A Lot chosen by the Consultant in which acceptance testing for asphalt content and gradation is based upon the Contractor's quality control test results and for which no corresponding quality assurance test results are available. All other quality assurance testing as outlined in this specification will remain the responsibility of the Consultant.

Quality assurance test results, when available, shall replace any quality control test results used for material acceptance.

3.50.1.2.13 QA Acceptance Lot

A Lot in which all acceptance testing is conducted by the Consultant using quality assurance test procedures as outlined in these specifications. The number and selection of QA Acceptance Lots shall be determined as follows:

- (i) First two Lots of production for each Mix Type used, except for Mix Type S1 in which case the first Lot shall be used, and;
- (ii) Minimum of one additional Lot per 60 000 tonnes, or portion thereof, of total ACP contract tender tonnage and;
- (iii) One additional Lot of top lift production, for each Mix Type, if two or more lifts are specified and;
- (iv) Any additional Lot(s) chosen by the Consultant.

3.50.2 MATERIALS3.50.2.1 **Asphalt**

The Contractor shall supply asphalt material in accordance with Specification 5.7, Supply of Asphalt. The types and grades of asphalt shall be as specified in the Special Provisions.

For ACP mixtures containing RAP and specified to use penetration grade asphalts, the procedures outlined in TLT-300, Recycling of Asphalt Concrete Pavement, shall be used to determine the rheology of the RAP and the grade of virgin asphalt to be used. For ACP mixtures containing RAP and specified to use Performance Graded (PG) asphalts, the RAP rheology and the grade of virgin asphalt to be used shall be determined according to Appendix A of AASHTO M323.

Rheological testing of the RAP is not required for mixtures using a maximum RAP to virgin aggregate ratio of 10/90.

3.50.2.2 Aggregate

The Contractor shall produce crushed aggregates in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul materials in accordance with Specification 4.5, Hauling.

3.50.2.3 Interim Lane Markings

The Contractor shall supply interim lane marking paint and glass beads from the list of approved products shown in the Special Provisions or Specification Amendments.

The Contractor has the option of supplying reflectorized temporary pavement markers or self-adhesive reflectorized pavement marking tape. Acceptable temporary pavement markers are shown on the Alberta Transportation Products List.

3.50.2.4 Reclaimed Asphalt Pavement

Unless specified otherwise, the Contractor may elect to use suitable RAP in the ACP mixture to a maximum RAP to virgin aggregate ratio of 30/70. Suitable RAP shall not contain any other additives including, but not limited to, sulphur, crumb rubber, asphalt rubber, asbestos, produced sand, paving fabrics and reinforcement grids. The handling, stockpiling, storage and hauling of all RAP shall be in accordance with Specification 3.16, Cold Milling Asphalt Pavement, and shall prevent the contamination and consolidation of the material.

3.50.3 ASPHALT MIX DESIGN AND JOB MIX FORMULA

3.50.3.1 Responsibility for Mix Design

Preparation and submission of asphalt mix designs for Consultant verification and approval are the responsibility of the Contractor. The Contractor shall use Professional Engineering services and a qualified testing laboratory licensed to practice in the Province of Alberta, to assess the aggregate materials proposed for use and to carry out the design of the asphalt mixture. The design testing laboratory shall have obtained pre-qualification status from the Department in the category of Mix Design - Marshall.

All costs incurred in mix design formulation are the responsibility of the Contractor. Shipping costs for samples sent to the Consultant for verification and approval are the responsibility of the Contractor.

3.50.3.2 Requirements for Mix Design

The asphalt mix design shall follow the Marshall method of Mix Design as outlined in design procedure TLT-301. The mix design, at the Design Asphalt Content, shall meet the requirements in Table 3.50.3.2 for the Asphalt Concrete Mix Type specified.

TABLE 3.50.3.2 ASPHALT CONCRETE MIX TYPES AND CHARACTERISTICS

Mix Type	Aggregate Criteria				Marshall Mix Design Criteria						
	Top Size (mm) (Class for Des. 1 Aggregate)	% MF. -5000 (min) Note 1	% Fractures +5000 (2 faces) (min)	Marshall Stability N (min)	No. of Blows	Flow (mm)	Air Voids (%)	VMA % (min) by % Air Voids		Voids Filled with Asphalt %	Retained Stability % (min)
								3.5	4.0		
H1	16.0	75	98 (one face) 90	12 000	75	2.0 to 3.5	Note 3	13.0	13.5	65-75	70
H2	12.5	70	80	11 500	75	2.0 to 3.5	Note 3	13.5	14.0	65-75	70
M1	12.5	50	60	8 000	75	2.0 to 3.5	Note 3	13.5	14.0	65-75	70
L1	12.5	Note 5	60	5 300	50	2.0 to 4.0	Note 3, 4	13.5	14.0	65-78	70
S1	10.0	Note 5	70	5 300	Note 2	2.0 to 4.0	Note 3	14.5	15.0	65-78	70
S2	10.0	75	90	10 000	75	2.0 to 3.5	Note 3	14.5	15.0	65-78	70
S3	25.0	Note 5	70	10 000	75	2.0 to 4.0	Note 3	11.5	12.0	65-78	70

Design Air Voids	Minimum Theoretical Film Thickness Requirements (µm)	
	Mix Types H1, H2, M1	Mix Type L1, S2, S1 (note 7)
4.0 and 3.9	6.0	6.5
3.7 and 3.8	6.1	6.6
3.5 and 3.6	6.2	6.7
3.3 and 3.4 (L1 for Community Airports only)	-	6.8
3.0, 3.1 and 3.2	-	6.9

Note 1 - The Percentage of Manufactured Fines in the -5000 Portion of the Combined Aggregate.

Note 2 - Use the same number of blows as for the surface course or 50 blows if used as a surface course.

Note 3 - The Design Air Voids shall be chosen as the lowest value, within the range of 3.5 to 4.0% inclusive, such that all other mix design criteria are met.

Note 4 - Air Void limits listed in Note 3 shall be reduced by 0.5% for community airports. VMA at 3.0% Air Voids shall be a minimum of 13.0%. A 300-400A asphalt is normally used for community airports

Note 5 - All fines manufactured by the process of crushing shall be incorporated into the mix.

Note 6 - Theoretical Film Thickness shall be as follows, depending on the specified Mix Type and Design Air Voids. The Theoretical Film Thickness value shall be established in accordance with TLT-311.

Note 7 - S1 requirement only for a surface course

3.50.3.3 Verification of Mix Design

The Contractor shall submit the mix design to the Consultant for verification. The Contractor's submission shall include the following information:

- (i) Aggregate source name(s) and location(s).
- (ii) The gradation of each aggregate to be used in the mixture.
- (iii) The percentage by mass of each aggregate to be used in the mixture.
- (iv) The mix design gradation of the combined aggregate.
- (v) Other characteristics of the combined aggregate specified in Specification 3.2, Aggregate Production and Stockpiling.
- (vi) All Marshall Mix Design characteristics, including graphs used in arriving at the final mix design, the bulk specific gravity of the combined aggregates, theoretical maximum specific gravities, and the asphalt absorption of the combined aggregates.
- (vii) Identification of each asphalt supplier by name, location and types and grades of asphalt to be supplied.
- (viii) Percent uncompacted voids (Fine Aggregate Angularity) of loosely compacted minus 2500 portion of the combined aggregate in accordance with TLT-125. No minimum value specified.
- (ix) For each asphalt supplied, asphalt specific gravity and recommended mixing and compaction temperatures for the preparation of design specimens.
- (x) Voids table to include Air Voids, VMA and Voids Filled with Asphalt for various asphalt contents (0.1 % increments) and bulk densities (increments of 5 kg/m³).
- (xi) Mix design submissions using RAP shall include the RAP source name(s) and location(s), all RAP asphalt content and gradation test results, the bulk specific gravity of the RAP aggregate, the percentage by weight of RAP to be used in the mixture, and, when required, all RAP rheological test results, the design rheology and all blending charts used.

The Consultant will require up to 5 working days from the time of receipt of the mix design to complete the design verification.

Where required by the Consultant for any change in the nature or sources of the aggregates or RAP, or where a new mix design is desired by the Contractor, the Contractor shall provide a separate and complete mix design. This new mix design shall be subject to verification by the Consultant.

The Consultant may, at any time, require the Contractor to provide representative samples of each of the aggregate components, asphalt cement and RAP for verification purposes. A sufficient quantity of each component shall be provided to result in a 100 kg sample of combined aggregate at design proportions. The Consultant will require up to 5 working days from the time of receipt of the sample to verify the mix design. The cost of such mix design verification will be borne by the Department.

The Contractor shall not produce any asphalt mix prior to receiving the Consultant's written notice that the mix design has been verified. Any mix produced prior to receiving such notice will not be accepted.

The aggregate proportioning, target gradation and asphalt content for the approved mix design will then be the Design Mix Formula and will become the Job Mix Formula for the start in production of asphalt mix.

The Contractor is responsible for producing mixes which conform with the Specifications.

3.50.3.4 Variation from Approved Job Mix Formula

Once the Job Mix Formula has been established and approved, no alteration will be permitted unless reviewed and approved by the Consultant.

The Lot Mean Marshall Air Voids, as determined by the Consultant, shall not vary from the air voids in the approved mix design by more than 0.5%.

If the sum of any approved alterations to the Job Mix Formula is in excess of any one of the following limits away from the Design Mix Formula, a new mix design is required.

- $\pm 5\%$ passing the 5 000 μm sieve.
- $\pm 1.0\%$ passing the 80 μm sieve.
- $\pm 0.3\%$ asphalt content.
- $\pm 5\%$ in target proportion of RAP.

Unless otherwise approved by the Consultant, the Contractor may not request more than three alterations to the Job Mix Formula without the provision of a new mix design.

Any change to the approved Job Mix Formula shall not result in a Theoretical Film Thickness value less than that specified in Table 3.50.3.2 Asphalt Concrete Mix types and Characteristics for the applicable Design Air Voids.

Any change in the target proportion for RAP shall meet the requirements of Section 3.50.2, Materials, for rheological testing of the blended asphalt and maximum RAP to virgin aggregate ratio.

3.50.4 SAMPLING AND TESTING

3.50.4.1 General

During the progress of the Work, tests will be carried out on materials and workmanship in order to ensure compliance with the requirements of the Specifications.

Where it is required in these specifications that the Contractor submit samples of materials or mixtures to the Consultant for approval, these samples shall be submitted in sufficient time for proper testing.

The Consultant's approval of any materials or mixture shall in no way relieve the Contractor from his obligation to provide materials, mixtures and workmanship in accordance with the Specifications.

Where specified, random sampling procedures shall be followed, and where no specific random sampling procedure is specified the sampling procedure shall be as identified by the Consultant in the case of acceptance testing and by the Contractor in the case of quality control testing.

The Consultant shall have access to the Work at all times for taking samples. The Contractor shall provide any assistance necessary for taking samples and shall reinstate pavement layers or other structures to the satisfaction of the Consultant at the positions where samples have been taken. Compensation for providing assistance with sampling and for reinstatement where samples are taken shall be included in the unit price bid for the various items of Work tested and no separate payment will be made.

The Contractor shall provide, at his own expense, sampling stands, sampling devices and other facilities which the Consultant may require to safely obtain representative samples of the item being produced.

When required, the Contractor shall provide and prepare, to the satisfaction of the Consultant, a suitable site for the parking of a mobile laboratory trailer. The Contractor shall provide power to the mobile laboratory trailer, at his own expense.

3.50.4.2 Methods of Testing For Acceptance and Appeal Testing

Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) shown in Table 3.50.4.2 will be used to determine material characteristics.

**TABLE 3.50.4.2 -
TEST METHODS ON MANAGED QA PROJECTS**

	TEST DESCRIPTION	TEST METHOD
1	Sampling Mixes	ATT-37
2	Coring	ATT-5
3	Extraction	ATT-12
4	Correction Factor, Extracted Asphalt Content	ATT-12 Part III
5	Percent Fracture	ATT-50
6	Sieve Analysis	ATT-26
7	Density, Immersion Method, Waxed Asphalt Concrete Specimens	ATT-6
8	Density, Immersion Method, Saturated Surface Dry Asphalt Concrete Specimens	ATT-7
9	Voids Calculations, Asphalt Concrete Specimens	ATT-36
10	Percent Compaction, Asphalt Concrete Pavement	ATT-67
11	Forming Marshall Specimens, Field Method	ATT-13
12	Moisture Content, Oven Method Asphalt Concrete Mixes	ATT-15
13	Smoothness of Pavements, Profilograph Method	ATT-59
14	Stratified Random Test Sites for A.C.P. Projects	ATT-56
15	Appeal Testing, Asphalt Content, Density and Gradation	ATT-68
16	Asphalt Content, Ignition Method	ATT-74
17	Correction Factor, Ignition Asphalt Content	ATT-74 Part II
ADDITIONAL TEST METHODS FOR QC ACCEPTANCE LOTS ONLY		
18	Asphalt Content	AASHTO T164 , T287 or ATT-12 or ATT-74

NOTES:

- In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.
- In all cases the latest amendment or revision current at the closing date of the Tender is implied when reference is made to one of the above standards in the Specification.

3.50.4.3 Quality Control Testing

Quality control testing is the responsibility of the Contractor throughout every stage of the Work from the crushing and production of aggregates to the final accepted product. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall provide and pay for equipment and qualified personnel to obtain all quality assurance core samples and perform all quality control testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product produced.

If the Contractor elects to use RAP, the asphalt content and gradation of the RAP shall be determined according to and at the frequencies specified in Specification 3.16, Cold Milling Asphalt Pavement. When required, the RAP rheology shall be determined at a minimum frequency of one per 5 000 t of RAP and a minimum of three samples shall be tested for each RAP source.

Test methods, sampling and minimum frequency of testing are described in Subsection 3.50.4.2, Methods of Testing For Acceptance and Appeal Testing, and Table 3.50.4.3, Quality Control Testing Requirements. The Consultant may require an increase in the frequency of any quality control test which has a specified minimum frequency. The Contractor shall arrange and pay for any additional tests required by the Consultant.

Results of all quality control tests shall be submitted to the Consultant as they become available. In addition, the quality control test results for mix asphalt content and aggregate gradation shall be provided to the Consultant no later than 12:00 noon of the day following placement.

The Contractor shall bear the cost of all consulting services retained by him.

The Contractor shall be totally responsible for production of aggregate and mixes that meet all the specified requirements.

**Table 3.50.4.3
QUALITY CONTROL TESTING REQUIREMENTS - MANAGED QA TESTING PROJECTS**

TEST	STANDARD	MINIMUM FREQUENCY
AGGREGATE PRODUCTION		See Specification 3.2
ASPHALT MIX PLANT		
Calibration	ATT-17	Once per project or as required
Inspection	ATT-16	(2)
SAMPLES		
Asphalt Cement	ATT-42	See Specification 5.7
Tack, Prime and Fog Materials	ATT-42	See Specification 5.7
Cold Feed Aggregate	ATT-38	

TEST	STANDARD	MINIMUM FREQUENCY
Mix	ATT-37	(2)
QA Cores - Stratified Random Test Sites Chosen By The Consultant	ATT-56	One per segment for each Lot. One per segment for selected Lots as directed by the Consultant.
i) QA Cores for Pavement Density	ATT-5	
ii) QA Cores for Asphalt Content and Gradation	ATT-5	
TESTS WITH SPECIFIED MINIMUM FREQUENCIES		
Mix Asphalt Content	AASHTO T-164, T287 or ATT-12 or ATT-74	(2)
Correction Factors	ATT-12, Part III or ATT-74, Part II	As Required
Mix Moisture Content	ATT-15	(2)
Aggregate Sieve Analysis	ATT-26	(2)
Pavement Segregation	Segregation Rating Manual	Each Lot
TESTS WITH NO SPECIFIED MINIMUM FREQUENCIES		
Field Formed Marshall Briquettes	ATT-13	(1)
Density Immersion Method, Saturated Surface Dry	ATT-7	(1)
Void Calculations, Cores or Formed Specimens	ATT-36	(1)
Temperatures	ATT-30	(1)
Percent Compaction, Cores or Nuclear Density	ATT-67, ATT-5 or ATT-11	(1)
Random Test Site Locations	ATT-56	(1)
Correction Factors, Nuclear Moisture-Density Measurement	ATT-48	(1)
Pavement Smoothness	ATT-59	(1)

(1) Minimum Frequency not Specified.

(2) When a Lot has eight hours of plant production or more, a minimum of four plant checks plus four asphalt contents and four sieve analysis of the combined aggregate (any combination of cold feed, extraction or ignition) are required. When a Lot has less than eight hours of plant production, these tests shall be performed once for every two full hours of plant production.

3.50.4.4 Acceptance Sampling and Testing

3.50.4.4.1 General

Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be determined by statistical testing as described in this Section.

Acceptance testing is the responsibility of the Consultant except for Lots designated by the Consultant as QC Acceptance Lots in which case the Contractor's quality control test results for asphalt content and aggregate gradation only, may be used towards determining conditional material acceptance.

The Contractor shall provide to the Consultant all quality assurance density cores and any additional cores requested by the Consultant for quality assurance testing for asphalt content and gradation by 12:00 noon of the day following placement, unless otherwise permitted by the

Consultant. Prior to the Contractor obtaining the cores, the Consultant may provide the Contractor with new or different random sample locations. The Consultant may have the Contractor obtain cores for quality assurance testing at any time throughout the project for any Lot. All cores provided to the Consultant shall be in their original condition. Core preparation or sawing shall be done by the Consultant.

All costs associated with pavement coring for both quality control and quality assurance testing shall be the responsibility of the Contractor.

Initial acceptance testing will be performed free of cost to the Contractor. The Contractor shall be responsible for the cost of all Quality Assurance testing performed on material that is used to replace or overlay material that has been previously rejected.

The Contractor shall be responsible for the cost of all Quality Assurance re-testing performed following attempts to improve smoothness or to remove bumps or dips.

After all quality control tests for the Lot are reported to the Consultant, the Consultant will provide the Contractor with a copy of the results of acceptance tests within one working day of their availability.

If the Consultant determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, he will replace the faulty tests with new tests.

If the testing equipment malfunction, improper testing procedures or calculations were on the part of the Consultant, the Contractor shall be reimbursed \$50 per location for obtaining cores.

3.50.4.4.2 Acceptance Sampling and Testing Procedures

3.50.4.4.2.1 Pavement Sampling for Density, Asphalt Content and Gradation

Pavement sampling will be done using stratified random sampling procedures. A minimum of 5 tests per Lot will be selected as follows:

- (i) The Lot will be divided into 5 or more segments of approximately equal quantity.
- (ii) In each segment a test site will be located by using random numbers to determine the longitudinal distance from the end of the segment and the lateral distance from the edge of the segment. In no case will a lateral distance be less than 0.5 m from the shoulder or 0.3 m from any other edge of a mat except when matching mats, in which case the test site may be within 0.3 m of the joint.

For lifts of 20 mm or less, samples for asphalt content and gradation may be obtained by the Consultant using the Sampling Mix Behind Paver method described in ATT-37. If sufficient numbers of mix samples cannot be obtained in this manner, stratified random core samples shall be taken by the Contractor as determined by the Consultant in order to perform the minimum five tests per Lot.

On Lots designated by the Consultant as QC Acceptance Lots, material sampling for quality control testing of asphalt content and gradation may consist of cold feed aggregate or loose mix or core samples as outlined in ATT-37, ATT-38 or ATT-56.

3.50.4.4.2.2 Pavement Sampling for Smoothness

The surface of the Sublots in the final lift of asphalt concrete pavement will be profiled by the Consultant in accordance with ATT-59 using a California Cox Model Profilograph. Other makes of Profilograph machines may be used if they have been individually approved by the Department. Profiles will be made approximately at the traffic wheel paths.

Smoothness testing will also be undertaken on all passing, climbing, deceleration and acceleration lanes that are greater than 100 m in length, and on all interchange ramps.

The following pavement surfaces will be excluded from profilograph smoothness testing.

- i) Main alignment portions, interchange ramps and all other lanes where the regular posted speed (i.e. without construction activities) is less than 70 kilometres per hour.
- ii) Turn lanes and storage lanes.
- iii) Tapers
- iv) Portions of pavement which, as determined by the Consultant, are influenced by man holes, water valves or other embedded hardware.

All pavement surfaces within the driving lanes of the above exclusions shall show no variation greater than 6 mm from the edge of a 3 m straightedge placed in any direction, excluding deviations due to crown breaks as shown on the Drawings. Locations for testing and the need for testing of straightedge deviation will be as determined by the Consultant.

Smoothness testing will extend completely across all transverse joints between existing pavement and ACP placed under this Contract. Penalty assessments and acceptance/rejection criteria will apply to all such bumps and dips identified. PrI assessment for smoothness will be determined starting at the location where all wheels of the Profilograph are on ACP placed under this Contract.

Weather permitting, acceptance testing for smoothness will normally be completed within two weeks following the completion of all paving work subject to smoothness testing. All smoothness acceptance criteria will apply regardless of the year that the pavement is placed and the year that it is tested. Requests by the Contractor to have portions of the Work tested prior to the completion of all paving will be considered subject to the availability of the Consultant's Profilograph testing crew and seasonal weather conditions. In such cases the Contractor will be invoiced by the Department at a rate of \$750 to cover the extra mobilization and travel costs associated with each occurrence.

3.50.4.4.2.3 Asphalt Mix Sampling

Sampling of the asphalt mixture for Marshall compaction comparison will be done by the Consultant using the procedures identified in ATT-37.

3.50.4.4.2.4 Exclusions to Random Sampling

Random sampling methods will not be applied when the Consultant samples mix behind the paver on lifts of 20 mm or less; nor to small areas such as tapers, approaches, areas of handwork, gores; nor for asphalt mix used for isolated leveling and repair of failed areas; nor for aggregate or asphalt mix chosen for QC Acceptance Lot testing.

3.50.4.5 Re-testing Following Attempts to Improve Smoothness

When the test results on a Sublot of ACP indicate a penalty or rejection because of smoothness, the Contractor may make one attempt to improve the smoothness on the Sublot by additional work; in which case the following shall apply:

- (i) the Contractor shall notify the Consultant in writing that he will make one attempt to improve smoothness.
- (ii) additional work on a Sublot to improve smoothness shall be completed within 10 calendar days from the time the Contractor receives written notification from the Consultant indicating the smoothness test results for that Sublot.
- (iii) additional work to improve smoothness will only be allowed on Sublots that are in penalty or reject according to the criteria contained in Table 3.50 C, except for removal of bumps and dips over 8 mm.

The Contractor shall not undertake any method of repair that is detrimental to the quality of the pavement. Any method of heating that has a detrimental effect on the pavement in the opinion of the Consultant, will not be allowed.

The Consultant will re-test any Sublots in which the Contractor has made one attempt to improve smoothness. The Sublot assessment for smoothness will be based upon the re-tested values.

3.50.4.6 Aggregate Gradation Requirements

The following requirements apply to asphalt concrete pavement material in all lifts except preliminary leveling and those Lots designated as QC Acceptance Lots.

Price adjustments for aggregate gradation variation will be based on the variation of the Lot Mean Gradation from the Job Mix Formula tolerance, for each sieve size, as shown in Tables 3.50 D and 3.50 E and the corresponding adjustment points as shown in Table 3.50 F.

For lifts greater than 20 mm in thickness, the Lot Mean Gradation will be determined using the sieve analysis of core samples. For lifts 20 mm or less, the Lot Mean Gradation will be determined using the sieve analysis of mix and/or core samples.

When the Lot Mean Gradation is outside the Job Mix Formula tolerance, the penalty assessment will be \$0.04 per tonne for each Mean Adjustment Point, up to the limits shown in Table 3.2.3.1 of Specification 3.2, Aggregate Production and Stockpiling. When the Lot Mean Gradation is outside the limits of Table 3.2.3.1, the penalty assessment will be \$0.40 per tonne for each Mean Adjustment Point outside those limits, regardless of the Job Mix Formula tolerance. If the maximum deviation shown in Table 3.50 E is exceeded, the lot is rejected.

When the Lot Mean Gradation for all sieve sizes is within the Job Mix Formula tolerance and within the limits of Table 3.2.3.1 and individual test results for each sieve size are within the allowable range shown in Table 3.50 D, a bonus of \$0.20 per tonne will be applied.

3.50.4.7 Pavement Segregation Requirements**3.50.4.7.1 General**

The finished surface of the top lift of ACP shall have a uniform texture and be free of segregated areas.

3.50.4.7.2 Classifying Pavement Segregation

A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement. For the purposes of classifying pavement segregation, only segregated areas greater than 0.1m² and centre-of-paver streaks greater than 1 m in length will be considered. Moderate or severe segregated areas which do not meet these size parameters will be considered obvious defects. Pavement segregation will be classified as follows:

Slight - The matrix, asphalt cement and fine aggregate is in place between the coarse aggregate. However, there is more stone in comparison to the surrounding acceptable mix.

Moderate - Significantly more stone than the surrounding mix; moderately segregated areas usually exhibit a lack of surrounding matrix.

Severe - Appears as an area of very stony mix, stone against stone, with very little or no matrix.

Centre-of-Paver Streak - Appears as a continuous or semi-continuous longitudinal "streak" typically located in the middle of the paver "mat".

3.50.4.7.3 Inspections for Pavement Segregation

3.50.4.7.3.1 Inspections by the Contractor

The Contractor shall perform a daily inspection of the paving operations on all lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Contractor shall take immediate corrective action to his operations to prevent any further occurrence of segregation.

3.50.4.7.3.2 Inspections by the Consultant

(i) Inspections During Construction

The Consultant will inspect the lower lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Consultant will immediately notify the Contractor so that corrective action can be taken to prevent further occurrence of segregation.

The Consultant will also inspect the top lift of pavement. Typically, each pavement Lot would be inspected, as soon as possible after the Lot is placed. During the inspection(s) of the top lift, the Consultant will identify and record any areas of slight, moderate and severe segregation and any areas of center-of-paver streak. Areas requiring repair in accordance with Subsection 3.50.4.7.4 will be marked by the Consultant. The Consultant will provide the Contractor with a written assessment indicating location and severity of the segregated areas as soon as practical following each inspection.

(ii) Inspection Following Construction

An inspection following construction will not normally be conducted unless the Department has concerns that additional segregation, not identified during construction, may be present. If deemed necessary by the Department, this inspection will be conducted approximately 2 weeks after the completion of all paving work.

During this inspection, the Consultant will identify and record any areas of slight, moderate and severe segregation and any areas of centre-of-paver streak which were not identified in the inspections during construction. The Consultant will provide the Contractor with a written assessment indicating location and severity of the segregated areas as soon as practical following this inspection.

3.50.4.7.4 Repairing Pavement Segregation

Pavement segregation identified during post construction inspection(s) will not require repair. However, this will not relieve the Contractor from his responsibility to repair any obvious defects, deteriorated repairs or failures which become evident within the warranty period.

Pavement segregation identified in the inspections performed during construction shall be repaired by the Contractor at his expense and in accordance with the following:

- Moderate and severe segregation in the top lift of pavement and on entrances and intersections shall require repair.
- For entrances and the portion of intersections outside the through travel lanes and shoulders, areas of moderate and severe segregation shall be repaired in accordance with the methods of repair listed for moderate segregation. Intersections and entrances shall also be neatly shaped, smooth and free of surface defects and depressions.
- Slight segregation on any lift of pavement will not require repair.
- Moderate segregation on lower lifts will not require repair.
- Severe segregation on lower lifts will only require repair in instances where, in the opinion of the Consultant, the segregated area will affect the long term structural integrity of the pavement structure. Such repair will not be required in instances where the Consultant determines that the paver screed is "dragging" due to distortion of the existing surface.
- Only moderate and severely segregated centre-of-paver streak on the top lift of pavement will require repair.

The following methods of repair are pre-approved:

- Moderate Segregation - The Contractor has the option of using a slurry patch or a hot mix patch.
- Severe Segregation - The Contractor has the option of removal and replacement or overlay.

Any other methods of repair proposed by the Contractor will be subject to the approval of the Consultant with the exception that the application of asphalt (by distributor, hand spraying, squeegeeing, etc.) will not be permitted as a method of repair under any circumstances.

Repairs for segregation using an overlay shall be for the entire pavement width. Repairs for segregation using removal and replacement shall be for the full lane width, full lane width and shoulder or the shoulder only as applicable, depending on the extent of the segregated area. The full depth of the asphalt lift shall be removed and replaced with new ACP using an appropriate paver and cold milling equipment. All ACP material used for overlay and removal and replacement repairs shall have a tack coat applied prior to placement and will be subject to the requirements of Subsection 3.50.6.3, End Product Rejection.

The Consultant will mark out the area of repair. The "marked area" shall extend a minimum of 0.5 m beyond the segregated area. For centre-of-paver streak, the "marked area" shall extend a minimum of 100 mm laterally and 0.5 m longitudinally beyond the streak.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Consultant. Traffic shall be kept off all repairs for a sufficient period of time to ensure that tracking does not occur.

All hot mix and other repairs for which compaction is normally required shall be properly compacted.

In the event repairs cover existing roadway lines or markings, the Contractor shall reinstate the lines and markings at his expense and to the satisfaction of the Consultant.

Repairing pavement segregation will not affect the assessment of segregation payment adjustments.

Repairs shall be completed during construction or shortly after construction, except when prevented by inclement weather or seasonal shutdown. In these cases, the Contractor shall complete the repairs prior to June 15 of the following year.

3.50.4.8 **Appeal of Acceptance Test Results and Appeal Testing**

3.50.4.8.1 Density, Asphalt Content and Gradation

Appeal testing will be done using ATT-68. The Contractor may appeal the results of acceptance testing of Density, Asphalt Content or Gradation for any rejected or penalized Lot only once. Appeals will only be considered if cause can be shown. Quality Control test results for density that are provided to the Consultant subsequent to the Contractor's receipt of the quality assurance test results for that Lot will not be considered when evaluating cause for an appeal. The appeal shall be for all tests within the Lot, and there will be no appeal allowed for single tests within a Lot.

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

The following procedures will apply for an appeal:

- (i) For Gradation and Asphalt Content appeals, the Contractor shall serve notice of appeal to the Consultant, in writing, within 48 hours of receipt of the test results.

For all other appeals notice shall be served to the Consultant, in writing, within 24 hours of receipt of the test results.

- (ii) The Consultant will arrange and pay for an independent testing laboratory certified to operate in the Province of Alberta, 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.
- (iii) The Consultant will determine the number and location of the new tests for each segment in accordance with Subsection 3.50.4.4.2. The Contractor shall sample the pavement at such locations and provide the samples to the Consultant.
- (iv) For appeals other than gradation appeals, the single high and single low test results from the old Lot will be rejected and the remaining test results will be added to the results of the new tests. A new Lot Mean for the test results will be determined and used for acceptance and unit price adjustment.

For gradation appeals, all tests from the old Lot will be retained and averaged with the new appeal tests. A new Lot Mean and Range for all tests will be determined and used for acceptance and unit price adjustment.

The new values, thus determined, in all cases, will be binding on the Contractor and the Department.

3.50.4.8.2 Smoothness

The Contractor may appeal acceptance test results of smoothness of any rejected or penalized Sublot once. The appeal shall be in writing and submitted within 24 hours of receipt of the test results.

Any attempt to improve smoothness on the appealed Sublot after the Consultant has tested the Lot for acceptance shall void the appeal and the original test results will apply.

The appeal testing will be performed by a firm that is pre-qualified by the Department for QA smoothness testing. The new results will be binding on the Contractor and the Department.

3.50.4.8.3 Segregation Rating

The Contractor may appeal the segregation rating in any portion of the Work or the entire project for lane.km(s) that are not in bonus.

The following procedures will apply for an appeal:

- (i) The Contractor must serve written notice of the appeal to the Consultant within 7 days of receipt of a written segregation assessment. The written notice shall detail the lane-km(s) and nature of the appeal.
- (ii) The Department will determine a representative sample of the portion of the Work appealed, and will reassess this area. Generally, this reassessment will be completed within 1 week of the Consultant's receipt of the written notice of appeal.

Based on the reassessment of the representative sample, the Department will determine whether or not a reassessment of the entire appealed Work is necessary.

3.50.4.8.4 Payment of Appeal Testing Costs for Asphalt Content, Smoothness or Gradation

If the new results show that a penalty no longer applies, then sampling and testing costs for the appeal procedures for that Lot will be the responsibility of the Department. Furthermore, in such cases the Contractor shall be reimbursed sampling costs at the rate of \$50 per location.

If the new results verify that any unit price reduction or rejection remains valid for that Lot, then the Contractor will be invoiced by the Department for the testing costs for the appeal procedures at the following rates:

Asphalt Content: \$2,000.00 for the first appeal Lot,
\$1,000.00 for all subsequent Lots, if an asphalt correction factor is not required.

Gradation: \$ 1,000.00 per appeal.

Profilograph: \$ 150.00 per hour (travel time, testing time and standby time).

3.50.4.8.5 Payment of Appeal Testing Costs for Density

If the new results indicate that the new Lot Mean for Density is no longer in a penalty situation and that the Lot Mean has increased by more than 0.8%, then the costs of sampling and testing for the appeal procedures shall be the responsibility of the Department. Furthermore, in such cases the Contractor shall be reimbursed sampling costs at the rate of \$50 per location.

If the new results indicate that the Lot Mean for Density is either in a penalty situation or has not increased by more than 0.8%, then the Contractor shall be invoiced by the Department for the sampling and testing costs for the appeal procedures at a rate of \$250.00 per Lot appealed.

3.50.4.8.6 Payment of Appeal Testing Costs for Segregation Rating

If a reassessment of the appealed Work results in a change in the original rating, the revised rating will apply. If the overall payment adjustment for the appealed Work is reduced by an amount of \$1,000 or greater, the cost of the reassessment will be borne by the Department.

If there is no change to the overall payment adjustment or if the overall payment is decreased by an amount less than \$1,000.00 or if the overall payment adjustment is increased, the Contractor will be charged an amount of \$3,500.00 for the appeal.

3.50.5 CONSTRUCTION

3.50.5.1 **Equipment**

3.50.5.1.1 General

Equipment shall be designed and operated to produce an end product complying with the requirements of this specification.

3.50.5.1.2 Mixing Plant

Mixing plants shall be operated in accordance with the Manufacturer's recommendations and shall be calibrated prior to commencing production of the specified mix. The Contractor shall provide the Consultant with a certificate of calibration which certifies that the plant has been calibrated to produce a uniform mixture in accordance with the Job Mix Formula.

When asphalt concrete pavement contains reclaimed asphalt pavement, the mixing plant shall be capable of thoroughly separating and heating the RAP particles and blending the RAP with virgin aggregate and any required asphalt cement, to create a homogeneous mix at the plant discharge. The plant shall also contain specialized mixing equipment that will prevent the RAP from coming into direct contact with the flame, thus minimizing "blue smoke" and oxidation of the asphalt in the RAP.

3.50.5.1.3 Mix Production

Aggregate and asphalt shall be combined to produce a uniform mixture of specified gradation at an asphalt content in accordance with the approved Job Mix Formula and in which all particles of aggregate are uniformly coated.

Unless otherwise specified, the maximum mixing temperature for all grades of asphalt shall be 155° C or for Performance Grade specified asphalts, as recommended in writing by the asphalt supplier.

Plant emissions shall not exceed the limits set by Alberta Environment.

3.50.5.2 Preparation of Existing Surface

3.50.5.2.1 General

Failed areas in existing surfaces shall be repaired in accordance with Specification 3.1, Subgrade Preparation, or as directed by the Consultant. Areas requiring repair will be identified by the Consultant in consultation with the Contractor.

Before the asphalt mix is placed, dirt and other objectionable material shall be removed from the surface to be paved, by brooming or other methods and a tack coat or prime coat shall be applied in accordance with Specification 3.19, Prime, Tack and Fog Coats.

Existing fillets and ramps at approaches to railway crossings and bridge structures, or adjacent to paved surfaces or other structures, shall be removed to the depths shown on the Drawings or as directed by the Consultant. The removed material shall be disposed of and the exposed surfaces shall be prepared as directed by the Consultant.

Contact edges of existing mats and contact faces of curbs, gutters, manholes, sidewalks and bridge structures shall be coated with a thin film of liquid asphalt material before placing the asphalt mix.

3.50.5.2.2 Preliminary Leveling

Areas that require preliminary leveling will be as shown on the Drawings or as identified in the field by the Consultant. Generally, areas that show depressions, rutting or other deformations to a depth of 15 mm or greater will be designated by the Consultant for preliminary leveling.

Pavement lifts that are specified, or shown on the Drawings, with designated lift thickness less than 20 mm shall be considered as preliminary leveling and shall be placed using a paver. Preliminary leveling not specified to be placed using a paver lift shall be spread using a motor grader or other methods approved by the Consultant. All of the following shall apply for acceptance:

- (i) if the material type for preliminary leveling is not specified or shown on the Drawings it shall be the same Designation and Class as specified for the subsequent lift of asphalt concrete pavement;
- (ii) regardless of how the asphalt mix is spread, a minimum of one pneumatic tired roller shall be used for compaction, and a minimum density of 91.0% of the Marshall density, as determined by the Consultant, is required;
- (iii) preliminary leveling is intended to be a separate operation and shall not be done as part of the construction of the subsequent lift of asphalt concrete pavement.

For the purposes of determining the unit price adjustments listed in Table 3.50 A and lump sum Sublot assessments listed in Table 3.50 C, preliminary leveling is not considered to be a lift.

3.50.5.2.3 Transverse Pavement Joints

Transverse joints between existing pavement and ACP placed under this Contract shall be of a vertical butt type, well bonded, sealed and finished to provide a continuous, smooth profile across the joint. This shall include tie-ins to all paved road allowances, median cross-overs, and approaches to bridges and railway crossings. Tie-ins to streets, parking lots and other urban approaches shall be as specified in the Special Provisions. To accomplish this, the

existing pavement shall be cold-milled to expose a vertical surface, of a depth equal to the thickness of the final lift, against which new ACP may be placed. In longitudinal section the minimum slope of the milled area shall be 200 horizontal to 1 vertical, all in general conformance with Drawing CB6-3.50 M16. In plan, the Contractor shall have the option of cutting the joint in any of the three ways following:

- (i) The joint shall be cut at 45° to the centreline of the roadway across the full width of each mat; or
- (ii) The joint shall be cut at 45° to the roadway centreline across the travel lanes and contiguously at 90° to the roadway centreline elsewhere; or
- (iii) For median cross-overs, bridges and railway crossings the joint shall be cut parallel to the crossing.

When the existing pavement has been removed in advance of paving the joint area, the Contractor shall construct a smooth taper at the joint area to a slope of at least 50 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed as directed by the Consultant. The transverse joint shall be straight and have a vertical face when the taper is removed.

3.50.5.3 Transporting the Asphalt Mix

The mix shall be transported in accordance with the requirements of Specification 4.5, Hauling. Trucks used for transportation of the mix shall be compatible with the size and capacity of the spreading equipment.

Truck boxes shall be clean, free from accumulations of asphalt mix and foreign material. Excess truck box lubricants such as light oil, detergent or lime solutions shall not be allowed to contaminate the mix, and shall be disposed of in an environmentally acceptable manner. Petroleum based truck box lubricants shall not be used.

During transport, the mix shall be completely covered to protect it from precipitation and excessive heat loss by securely fastened waterproofed tarpaulins, unless otherwise approved by the Consultant.

3.50.5.4 Placing the Mix

Asphalt mix shall be placed only on dry surfaces.

Unless otherwise shown on the Drawings, the asphalt mix shall be placed in the following lift thicknesses:

- (i) in a single lift when the design compacted total thickness is 70 mm or less.
- (ii) in two or more lifts when the design compacted total thickness is greater than 70 mm. The lift thickness selection shall be determined by the Contractor except that:
 - (a) the maximum thickness of any lift shall be 100 mm.
 - (b) the minimum thickness of a top lift shall be 50 mm, unless it is placed directly over a Mix Type S3, in which case the minimum thickness shall be 60 mm.
 - (c) When a total ACP thickness of 80 mm is specified, the thickness of the first lift shall be 30 mm and the final lift shall be 50 mm.

- (d) When a total ACP thickness of 90 mm or more is specified, the minimum thickness of all lifts except the top lift shall be 40 mm or greater.
- (e) The minimum lift thickness for any lift using a Mix type S3 shall be 80 mm.

Lift thickness will normally be designed and expressed in increments of 10 mm.

Longitudinal joints will not be permitted between the edges of driving lanes in the final lift of ACP. Longitudinal joints shall be offset a minimum of 150 mm from one lift to the next.

Longitudinal and transverse joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joints. Surplus material at longitudinal joints shall be disposed of in a manner acceptable to the Consultant. Broadcasting surplus material across the mat will not be permitted.

All longitudinal joints shall be straight and uniform with no lateral waviness. Any mat contact that is not straight or uniform as determined by the Consultant shall be trimmed by saw-cutting or using some other method acceptable to the Consultant prior to placing the adjacent mat. The material removed shall be disposed of to the satisfaction of the Consultant.

Any mat with a contact edge that has deteriorated, cracked or slumped due to improper rolling or vehicle traffic shall be trimmed by saw-cutting or some other method acceptable to the Consultant prior to placing the adjacent mat. The length of contact edge to be trimmed, removed and disposed of will be as determined by the Consultant.

If required by the Consultant the contact edge of any mat placed by the Contractor shall be coated with a thin film of liquid asphalt before placing the adjacent mat.

When paving is discontinued in any lane or in any lift, the mat shall be tapered to a slope of 10 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed. The transverse joint shall be straight and have a vertical face when the taper is removed.

Transverse construction joints from one lift to the next shall be separated by at least 2 m.

Where the construction of a top lift of pavement next to a concrete curb section or curb and gutter section will be delayed, the Contractor shall construct a temporary asphalt concrete fillet next to the concrete section in accordance with the Drawings or as directed by the Consultant. These fillets shall be removed when paving is resumed.

Placement of ACP adjacent to guardrail shall be in accordance with Typical Barrier Drawing No. TEB 3.56.

3.50.5.5 Road Intersections and Entrances

Road intersections and entrances shall be paved in accordance with the Drawings or as herein described in these specifications.

On all road intersections, median cross overs and residential farm entrances, the asphalt mix shall be spread by means of a paver. No grader laying will be permitted except for bottom lift or preliminary leveling.

On all other entrances, the asphalt mix shall be spread by means determined by the Contractor and in a manner acceptable to the Consultant.

3.50.5.6 Compacting the Mix

All asphalt mix, including those areas of the mat which are excluded from testing as noted in Subsection 3.50.4.4.2, shall be thoroughly compacted, and after final rolling the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

The rollers or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion. Excess water or release agents shall not be used.

After final rolling is complete, the Contractor shall ensure that the finished mat has cooled for a minimum period of 2 hours before opening the section to traffic.

3.50.5.7 Asphalt Mix for Others

The Contractor shall make available, on request, additional asphalt mix for the use of the Department. The estimated quantity of additional mix is shown in the unit price schedule as "Asphalt Mix For Others." This additional mix will be picked up at the mixing plant by other forces at times that are mutually agreeable to the Contractor and the Consultant.

3.50.5.8 Interim Lane Markings

The Contractor shall provide interim lane markings on all newly constructed ACP surfaces, or on tacked surfaces that are to be exposed to traffic overnight.

When paint is used, the paint shall be the same colour as the permanent markings designed for the Work.

All paint spots shall be 100 mm wide and 300 mm long, shall be applied lengthwise to the road surface, shall be spaced 15 m apart on centre in tangent sections and 7.5 m apart on curves and shall be completely covered with glass beads at the time of painting.

When self-adhesive, reflectorized pavement marking tape is used, the spacing shall be the same as is used for paint spots. Tape on lower lifts does not need to be removed prior to placement of the next lift of pavement. If tape is used on the upper lift, it shall be removed immediately prior to painting the permanent lane markings.

When temporary pavement markers are used, they shall be placed at 25 m intervals on tangent sections and at 15 m intervals on curves. Markers used on the upper lift must remain in place until the permanent markings are applied. Markers used on lower lifts, shall be removed immediately prior to placement of the next lift of pavement.

3.50.5.9 Grooved Rumble Strips

When specified in the Special Provisions, the Contractor shall construct grooved rumble strips as shown on Drawing CB6-3.50M15.

No grooving will be done across intersections or accesses nor at any other locations specified by the Consultant.

The grooving shall be applied only to the top lift of the pavement and may be formed by any means which the Contractor may propose and which are acceptable to the Consultant. The Contractor shall remove and repair any grooving placed beyond the limits outlined, at his own expense.

3.50.6 END PRODUCT ACCEPTANCE OR REJECTION3.50.6.1 **General**

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the Specifications and Drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

3.50.6.2 **End Product Acceptance**3.50.6.2.1 Acceptance at Full or Increased Payment

Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects and if:

- (i) The Lot Mean for density of the compacted mix in the Lot is not in penalty or reject according to the criteria outlined in Table 3.50 A.
- (ii) The Lot Mean for Actual Asphalt Content of the mix, is within 0.3 of the Approved Asphalt Content. On QC Acceptance Lots, where quality assurance test results for asphalt content are not available, the Contractor's quality control test results shall be used. Quality assurance test results when available shall replace any corresponding quality control test results.
- (iii) For smoothness, full payment will occur if the Profile Index of all Sublots in the Lot in the top lift of pavement are not in penalty or reject according to the criteria outlined in Table 3.50 C.

Increased payment will occur if the Profile Index of all Sublots in the Lot in the top lift of pavement is 0.

- (iv) Individual bumps and dips in the top lift of pavement do not exceed 8 mm.
- (v) For gradation in QA Acceptance Lots only, full payment will occur if there are no Lot Mean Adjustments for gradation and increased payment will occur if there are no Lot Mean Adjustments and the Maximum Range as shown in Table 3.50 D is not exceeded for any sieve size in the Lot.

For gradation in QC Acceptance Lots, consideration is only given to acceptance at full payment. No increased payment will be applied using quality control test results.

3.50.6.2.2 Acceptance at Reduced or Adjusted Payment

Acceptance of any Lot at reduced payment will occur if it contains no obvious defects and if;

- (i) The quality assurance test results are such that the Lot or Sublot meets with requirements for acceptance at a reduced payment. For asphalt content and aggregate gradation no decreased payment will be applied using quality control test results.
- (ii) The Lot or Sublot is approved in respect of all other requirements.
- (iii) The Contractor has not notified the Consultant in writing that he will exercise his option to repair or remove and replace the Work at his own cost with work meeting the requirements for acceptance at full or increased payment.

- (iv) Individual bumps and dips measuring 12 mm or greater have been repaired.
- (v) Individual bumps and dips exceeding 8 mm and less than 12 mm which have been designated by the Consultant as unacceptable, have been repaired.

Both bonus and penalty adjustments may be made for any Lot in accordance with Section 3.50.7, Measurement and Payment.

3.50.6.3 End Product Rejection

If the Lot Mean for Density, Actual Asphalt Content or Gradation are outside the applicable acceptance limits, then the Lot is rejected automatically, regardless of the values of the other control characteristics.

If the smoothness of the top lift of any Sublot is outside the acceptance limit, then the Sublot is rejected automatically, regardless of the values of the other control characteristics.

The finished surface of any lift shall have a uniform close texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Consultant such as, but not limited to the following, will be cause for automatic rejection of asphalt concrete pavement regardless of the values of any other control characteristic.

- (i) Individual bumps and dips 12 mm or greater. The Consultant may reject asphalt concrete pavement with individual bumps and dips exceeding 8 mm and less than 12 mm.
- (ii) Segregated areas not already covered in Subsection 3.50.4.7, Pavement Segregation Requirements.
- (iii) Areas of excess or insufficient asphalt.
- (iv) Improper matching of longitudinal and transverse joints.
- (v) Roller marks.
- (vi) Tire marks.
- (vii) Cracking or tearing.
- (viii) Sampling locations not properly reinstated.
- (ix) Improperly constructed patches.
- (x) Top lift surfaces, which are torn due to the dragging of the paver screed.
- (xi) Any final lift surface with a variation greater than 6 mm from the edge of a 3 m straightedge placed in any direction on the surface.

When ACP is rejected by reason of obvious defects, the minimum area of rejection will be Sublot size as defined in Subsection 3.50.1.2 of this specification.

Rejected work shall be promptly repaired, remedied, overlaid, or removed and replaced all in a manner acceptable to the Consultant. The Contractor shall be responsible for all costs including materials.

No payment will be made for work in any Lot or Sublot which has been rejected, until the defects have been remedied.

If an overlay is used as a corrective measure on a defective Lot or Sublot, the overlay thickness will be subject to the approval of the Consultant. Where an overlay is used as a corrective measure in any lane, adjacent lanes shall also be overlaid to the same thickness and length, regardless of whether the adjacent lanes were acceptable or not. The overlay will be subject to the same specifications as the original pavement, except that the minimum thickness of an overlay shall be the lesser of 40 mm or the design lift thickness of the defective material.

3.50.7 MEASUREMENT AND PAYMENT

The unit prices for the following items of work shall be full compensation for all labour, material, tools, equipment and incidentals necessary to complete the Work in accordance with these specifications.

3.50.7.1 **Asphalt Concrete Pavement - EPS**

Accepted asphalt concrete pavement will be measured in tonnes and will be paid for at the unit price bid per tonne for "Asphalt Concrete Pavement - EPS" for the asphalt mix specified subject to the unit price adjustments and assessments hereinafter specified. This payment will be full compensation for supplying, applying and maintaining tack coat; supplying the asphalt binder; processing, hauling and placing the mix; interim lane marking and quality control.

3.50.7.1.1 Pay For Acceptable Work

The following end product properties of "Asphalt Concrete Pavement - EPS" will be measured for acceptance in accordance with Subsection 3.50.4.4, Acceptance Sampling and Testing.

- (i) Density
- (ii) Actual Asphalt Content
- (iii) Smoothness
- (iv) Aggregate Gradation

For the Density, Actual Asphalt Content and Gradation of a Lot to be acceptable, the Lot Means must be within the acceptance limits shown in Tables 3.50 A, 3.50 B and 3.50 E respectively.

For each Lot, the unit price adjustments for Density and Actual Asphalt Content will be the amounts shown in Tables 3.50 A and 3.50 B for the Sample Mean of the test results for that Lot.

For each Lot, the unit price adjustment for Gradation will be as defined in Subsection 3.50.4.6, Aggregate Gradation Requirements.

The Unit Price applicable to each Lot quantity of "Asphalt Concrete Pavement - EPS" will be calculated as follows:

$$\boxed{\begin{array}{c} \text{Lot Unit} \\ \text{Price} \\ \text{Per Tonne} \end{array}} = \boxed{\begin{array}{c} \text{Contract Unit} \\ \text{Price Bid Per} \\ \text{Tonne} \end{array}} + \boxed{\begin{array}{c} \text{the sum of the} \\ \text{unit price} \\ \text{adjustment for} \\ \text{PAd and PAa} \\ \text{and PAg} \end{array}}$$

where:

PAd = Unit Price Adjustment for Density
(bonus or penalty)

PAa = Unit Price Adjustment for Asphalt Content (penalty only; QA Acceptance Lots
only)

PAg = Unit Price Adjustment for Gradation (bonus or penalty; QA Acceptance Lots only)

If the Lot Mean for Density, Actual Asphalt Content or Gradation for any Lot is outside the acceptance limit, the Lot is rejected, and no payment will be made for the quantity of asphalt concrete pavement in that Lot, until the defect has been remedied.

For the Smoothness of any Sublot in the top lift of ACP to be acceptable, the P_{rl} must be within the limits shown in Table 3.50 C. For each Sublot in the top lift of ACP, the penalty assessment for Smoothness will be the amounts shown in Table 3.50 C for the P_{rl} of that Sublot. All of these penalty assessments so determined will be deducted from the payment made for Asphalt Concrete Pavement-EPS.

Every Sublot in the top lift of ACP that is outside the acceptance limit for smoothness will be rejected and payment will not be made for the quantity of asphalt concrete pavement in these Sublots until they have been made acceptable. Payment for the remainder of the Lot will be made in accordance with the above formula using PAd, PAa and PAg as determined for the Lot from which will be subtracted any penalty assessment for smoothness.

No payment will be made for any material, equipment or manpower used to improve acceptable work that is or was subject to unit price adjustment or penalty assessment.

3.50.7.1.2 Segregation Payment Adjustments

Payment adjustments for pavement segregation shall apply to the top lift of ACP only and in accordance with the following:

- Segregated areas, centre-of-paver streak and any repaired segregated areas identified by the Consultant either during construction or during the inspection conducted 2 weeks after the completion of paving work, will be used to determine payment adjustments. Payment adjustments will not apply to segregated areas 0.1 m² or less or on centre-of-paver streaks 1 metre or less in length.
- Segregated areas (excluding centre-of-paver streaks) separated by less than 3 metres shall be considered a single area for the determination of payment adjustments. For centre-of-paver streaks, each area will be measured separately for payment adjustments.
- Payment adjustments for segregation will not apply to entrances or the portion of an intersection outside the through travel lanes and shoulders.
- Payment adjustments will not apply to instances where the Consultant determines that the paver screed is "dragging".
- If a segregated area is identified by the Contractor and repaired prior to inspection by the Consultant it will be classified as "moderate" for the purpose of determining payment adjustments.
- Payment adjustments will apply regardless of the year the pavement is placed and the year the pavement is inspected.

The total payment adjustment for segregation is determined as follows:

- Each lane.km of the completed pavement will be inspected separately by the Consultant. A "lane" includes the adjoining shoulder. Measurement of lane.kms will be made in 1 kilometre (or partial kilometre) long segments, 1 lane wide as shown on the contract plan. Acceleration and deceleration lanes and interchange ramps are considered separate lanes.

For each lane.km, the Consultant will determine the following:

- the total number of slight segregated areas and
- the total number of moderate and severe segregated areas and
- the total length of centre-of-paver streak (determined by adding each instance of streak that is in excess of 1 metre in length)

These values will be used for the "segregation frequencies" and "length of centre-of-paver streak" in Tables A, B & C as applicable, with the exception that for partial lane-kms, the segregation frequency for slight segregation will be calculated by dividing the actual number of slight segregated areas by length of the segment assessed (expressed in kilometres) and rounding to the nearest whole number.

Table A, Payment Adjustment for Slight Segregation

Segregation Frequency of Slight Areas (per lane·km)	Payment Adjustment \$ per lane·km
0	(1)
1 or 2	(2)
Greater than 2	- (number of areas - 2) x \$100

Table B, Payment Adjustment for Moderate and Severe Segregation

Segregation Frequency of Moderate and Severe Areas (per lane·km)	Payment Adjustment \$ per lane·km
0	(1)
Greater than 0	- (number of areas) x \$500

Table C, Payment Adjustment for Centre-of-Paver Streak

Length of Centre-of-Paver Streak (per lane·km)	Payment Adjustment \$ per lane·km
1 metre or less	(1)
Greater than 1 metre	- \$1.50 per linear metre

- (1) Lane kilometres with no areas of segregation of any type or severity, or any centre-of-paver streaks will be assigned a bonus payment of \$1,000 per lane.km. For partial lane.kms the bonus will be pro-rated based upon the actual length of the segment assessed.
- (2) Lane kilometres with 1 or 2 areas of slight segregation, no moderate or severely segregated areas and no centre-of-paver streak will be assigned a bonus payment of \$500 per lane.km. For partial lane.kms the bonus will be pro-rated based upon the actual length of the segment assessed.

Notes:

- Total payment adjustment per lane-km for segregation will be the sum of Tables A, B and C.
- For partial lane kilometres, the payment adjustments for Table A will be prorated based upon the actual length of segment assessed.
- The maximum penalty adjustment for segregation shall be limited to \$2,000 per lane-km. For partial lane-kms, this adjustment will be prorated based upon the actual length of segment assessed.

3.50.7.1.3 Payment For Work That Had Been Rejected, But Was Made Acceptable

When defects have been remedied in Lots or Sublots which had been rejected, payment for the original quantity of material in those Lots or Sublots will be made subject to unit price adjustments and penalty assessments determined as follows:

- (i) Penalty or bonus assessments will be made for smoothness as follows:

Penalty or bonus assessments for P_{RI} will be the amounts shown in the applicable section of Table 3.50 C and will be based on Profilograph tests following any corrective action taken by the Contractor.

The penalty assessment for each bump or dip over 8 mm will be \$300.00 for multi-lift pavements and \$100.00 for single-lift or curb and gutter applications. Penalty assessments for bumps and dips will be based on initial profilograph testing conducted by the Consultant. Repairs carried out by the Contractor will not affect the penalty assessment for bumps and dips.

If bumps or dips are treated by the Contractor prior to Profilograph tests by the Consultant, such defects will be considered greater than 8 mm and will be assessed at the applicable penalty assessment rates.

- (ii) The unit price adjustment for Asphalt Content, Density and Gradation 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 Sublot, prior tests on the uncovered area will be averaged with new tests on the corrective work.

The unit price adjustment determined through re-testing of the corrective work will be applied to that quantity of material in the Lot or Sublot which was originally rejected, to determine payment.

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed entirely at the Contractor's expense.

3.50.7.2 Repair of Failed Areas in Existing Surfaces

Repair of failed areas in existing surfaces as identified under Subsection 3.50.5.2 will be paid for at the Contract unit prices bid for the Work. Unit price adjustment will not apply to material used to repair failed areas in existing surfaces.

3.50.7.3 Removal and Disposal of Fillet and Ramp Material

The removal and disposal of fillet and/or ramp material will be considered incidental to the Work and will not be paid for separately.

3.50.7.4 Transverse Pavement Joints

Constructing transverse pavement joints including any required cold-milling will be considered incidental to the Work and will not be paid for separately.

3.50.7.5 Preliminary Leveling

Accepted material used for preliminary leveling will be measured and paid for at the unit price bid for Asphalt Concrete Pavement - EPS where applicable. Unit Price Adjustments will not apply to material used for leveling. No payment will be made for unacceptable material.

3.50.7.6 Asphalt Mix for Others

Accepted additional asphalt concrete mixture will be measured in tonnes and paid for at the unit price bid for "Asphalt Mix for Others".

Unit price adjustment will not apply to additional asphalt concrete received at the plant by other forces.

3.50.7.7 Grooved Rumble Strips

Measurement of shoulder grooving will be made parallel to the road centreline, to the nearest 0.001 km of through highway chainage for each side of the road where accepted grooving is performed.

Payment for shoulder grooving will be made at the unit price bid per kilometre for "Grooved Rumble Strips". This payment will be full compensation for all labour, equipment, tools, materials and incidentals necessary to complete the Work to the satisfaction of the Consultant.

TABLE 3.50 A UNIT PRICE ADJUSTMENT FOR DENSITY					
% OF MARSHALL DENSITY	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
≥ 98.0	+ 1.00	+1.00	+ 1.00	+ 1.00	+ 1.00
97.9	+ 0.90	+ 0.90	+ 0.90	+ 0.90	+ 0.90
97.8	+ 0.80	+ 0.80	+ 0.80	+ 0.80	+ 0.80
97.7	+ 0.70	+ 0.70	+ 0.70	+ 0.70	+ 0.70
97.6	+ 0.60	+ 0.60	+ 0.60	+ 0.60	+ 0.60
97.5	+ 0.50	+ 0.50	+ 0.50	+ 0.50	+ 0.50
97.4	+ 0.40	+ 0.40	+ 0.40	+ 0.40	+ 0.40
97.3	+ 0.30	+ 0.30	+ 0.30	+ 0.30	+ 0.30
97.2	+ 0.20	+ 0.20	+ 0.20	+ 0.20	+ 0.20
97.1	+ 0.10	+ 0.10	+ 0.10	+ 0.10	+ 0.10
97.0	0.00	0.00	0.00	0.00	0.00
96.9	-0.20	0.00	0.00	-0.20	0.00
96.8	-0.40	0.00	0.00	-0.40	0.00
96.7	-0.60	0.00	0.00	-0.60	0.00
96.6	-0.80	0.00	0.00	-0.80	0.00
96.5	-1.00	0.00	0.00	-1.00	0.00
96.4	-1.20	0.00	0.00	-1.20	0.00
96.3	-1.40	0.00	0.00	-1.40	0.00
96.2	-1.60	0.00	0.00	-1.60	0.00
96.1	-1.80	0.00	0.00	-1.80	0.00
96.0	-2.00	0.00	0.00	-2.00	0.00
95.9	-2.20	0.00	0.00	-2.20	-0.20
95.8	-2.40	0.00	0.00	-2.40	-0.40
95.7	-2.60	0.00	0.00	-2.60	-0.60
95.6	-2.80	0.00	0.00	-2.80	-0.80
95.5	-3.00	0.00	0.00	-3.00	-1.00
95.4	-3.20	0.00	0.00	-3.20	-1.20
95.3	-3.40	0.00	0.00	-3.40	-1.40
95.2	-3.60	0.00	0.00	-3.60	-1.60
95.1	-3.80	0.00	0.00	-3.80	-1.80
95.0	-4.00	0.00	0.00	-4.00	-2.00
94.9	-4.40	0.00	0.00	-4.40	-2.20
94.8	-4.80	0.00	0.00	-4.80	-2.40
94.7	-5.20	0.00	0.00	-5.20	-2.60
94.6	-5.60	0.00	0.00	-5.60	-2.80
94.5	-6.00	0.00	0.00	-6.00	-3.00
94.4	-6.40	0.00	0.00	-6.40	-3.20
94.3	-6.80	0.00	0.00	-6.80	-3.40
94.2	-7.20	0.00	0.00	-7.20	-3.60
94.1	-7.60	0.00	0.00	-7.60	-3.80
94.0	-8.00	0.00	0.00	-8.00	-4.00
93.9	50% OF UNIT PRICE	-0.20	0.00	OVERLAY OR RM.&RP.	-4.40
93.8	50% OF UNIT PRICE	-0.40	0.00	OVERLAY OR RM.&RP.	-4.80

TABLE 3.50 A UNIT PRICE ADJUSTMENT FOR DENSITY					
% OF MARSHALL DENSITY	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
93.7	50% OF UNIT PRICE	-0.60	0.00	OVERLAY OR RM.&RP.	-5.20
93.6	50% OF UNIT PRICE	-0.80	0.00	OVERLAY OR RM.&RP.	-5.60
93.5	50% OF UNIT PRICE	-1.00	0.00	OVERLAY OR RM.&RP.	-6.00
93.4	50% OF UNIT PRICE	-1.20	0.00	OVERLAY OR RM.&RP.	-6.40
93.3	50% OF UNIT PRICE	-1.40	0.00	OVERLAY OR RM.&RP.	-6.80
93.2	50% OF UNIT PRICE	-1.60	0.00	OVERLAY OR RM.&RP.	-7.20
93.1	50% OF UNIT PRICE	-1.80	0.00	OVERLAY OR RM.&RP.	-7.60
93.0	50% OF UNIT PRICE	-2.00	0.00	OVERLAY OR RM.&RP.	-8.00
92.9	50% OF UNIT PRICE	-2.20	-0.20	OVERLAY OR RM.&RP.	-8.40
92.8	50% OF UNIT PRICE	-2.40	-0.40	OVERLAY OR RM.&RP.	-8.80
92.7	50% OF UNIT PRICE	-2.60	-0.60	OVERLAY OR RM.&RP.	-9.20
92.6	50% OF UNIT PRICE	-2.80	-0.80	OVERLAY OR RM.&RP.	-9.60
92.5	50% OF UNIT PRICE	-3.00	-1.00	OVERLAY OR RM.&RP.	-10.00
92.4	50% OF UNIT PRICE	-3.20	-1.20	OVERLAY OR RM.&RP.	-10.40
92.3	50% OF UNIT PRICE	-3.40	-1.40	OVERLAY OR RM.&RP.	-10.80
92.2	50% OF UNIT PRICE	-3.60	-1.60	OVERLAY OR RM.&RP.	-11.20
92.1	50% OF UNIT PRICE	-3.80	-1.80	OVERLAY OR RM.&RP.	-11.60
92.0	50% OF UNIT PRICE	-4.00	-2.00	OVERLAY OR RM.&RP.	-12.00
91.9	50% OF UNIT PRICE	-4.40	-2.20	REMOVE & REPLACE	-12.40
91.8	50% OF UNIT PRICE	-4.80	-2.40	REMOVE & REPLACE	-12.80
91.7	50% OF UNIT PRICE	-5.20	-2.60	REMOVE & REPLACE	-13.20
91.6	50% OF UNIT PRICE	-5.60	-2.80	REMOVE & REPLACE	-13.60
91.5	50% OF UNIT PRICE	-6.00	-3.00	REMOVE & REPLACE	-14.00
91.4	50% OF UNIT PRICE	-6.40	-3.20	REMOVE & REPLACE	-14.40
91.3	50% OF UNIT PRICE	-6.80	-3.40	REMOVE & REPLACE	-14.80
91.2	50% OF UNIT PRICE	-7.20	-3.60	REMOVE & REPLACE	-15.20
91.1	50% OF UNIT PRICE	-7.60	-3.80	REMOVE & REPLACE	-15.60
91.0	50% OF UNIT PRICE	-8.00	-4.00	REMOVE & REPLACE	-16.00
90.9	REMOVE & REPLACE	50% OF UNIT PRICE	-4.40	REMOVE & REPLACE	50% OF UNIT PRICE
90.8	REMOVE & REPLACE	50% OF UNIT PRICE	-4.80	REMOVE & REPLACE	50% OF UNIT PRICE
90.7	REMOVE & REPLACE	50% OF UNIT PRICE	-5.20	REMOVE & REPLACE	50% OF UNIT PRICE
90.6	REMOVE & REPLACE	50% OF UNIT PRICE	-5.60	REMOVE & REPLACE	50% OF UNIT PRICE
90.5	REMOVE & REPLACE	50% OF UNIT PRICE	-6.00	REMOVE & REPLACE	50% OF UNIT PRICE
90.4	REMOVE & REPLACE	50% OF UNIT PRICE	-6.40	REMOVE & REPLACE	50% OF UNIT PRICE
90.3	REMOVE & REPLACE	50% OF UNIT PRICE	-6.80	REMOVE & REPLACE	50% OF UNIT PRICE
90.2	REMOVE & REPLACE	50% OF UNIT PRICE	-7.20	REMOVE & REPLACE	50% OF UNIT PRICE
90.1	REMOVE & REPLACE	50% OF UNIT PRICE	-7.60	REMOVE & REPLACE	50% OF UNIT PRICE
90.0	REMOVE & REPLACE	50% OF UNIT PRICE	-8.00	REMOVE & REPLACE	50% OF UNIT PRICE
89.9	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.8	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.7	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.6	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.5	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.4	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.

TABLE 3.50 A UNIT PRICE ADJUSTMENT FOR DENSITY					
% OF MARSHALL DENSITY	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE				
	DESIGN LIFT THICKNESS				
Lot Mean	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY	LESS THAN 35 MM AND GREATER THAN 20 MM TOP LIFT ONLY
89.3	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.2	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.1	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
89.0	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.9	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.8	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.7	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.6	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.5	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.4	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.3	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.2	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.1	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
88.0	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE	OVERLAY OR RM.&RP.
≤ 87.9	REMOVE & REPLACE	REMOVE & REPLACE	REMOVE & REPLACE	REMOVE & REPLACE	OVERLAY OR RM.&RP.

- Notes: - Single lifts only are considered "Top Lifts".
- Preliminary leveling is not considered a "Lift".

**TABLE 3.50 B
UNIT PRICE ADJUSTMENT FOR ASPHALT CONTENT**

Deviation of the Actual Asphalt Content from the Approved Asphalt Content	Unit Price Adjustment for Asphalt Content PAa \$ per tonne			
	Top Lift		Lower Lift	
	Below	Above	Below	Above
From 0 to 0.30	0.0	0.0	0.0	0.0
From 0.31 to 0.35	-2.6	-0.9	-2.6	-0.9
From 0.36 to 0.40	-3.8	-1.8	-3.8	-1.8
From 0.41 to 0.45	-5.0	-2.7	-5.0	-2.7
From 0.46 to 0.50	-6.1	-3.6	-6.1	-3.6
From 0.51 to 0.55	-	-	-7.2	-4.5
From 0.56 to 0.60	-	-	-8.4	-5.4
From 0.61 to 0.65	-	-	-9.5	-6.3

- Notes: - For top lift deviations of more than 0.50% the Contractor shall either overlay or remove and replace the previously placed mix.
- For lower lift deviations of more than 0.65%, the Department will determine whether removal and replacement is necessary. For material that is allowed to stay in place, payment will be at 50% of the unit price bid.

TABLE 3.50 C
LUMP SUM SUBLOT ASSESSMENT FOR SMOOTHNESS

Prl	Assessment for Smoothness of Top Lift \$ per Sublot Lump Sum		
	C1	C2	C3
0	30	30	30
>0 and 10 or less	0	0	0
11	-40	0	0
12	-70	0	0
13	-100	0	0
14	-130	0	0
15	-170	0	0
16	-200	-40	0
17	-230	-80	0
18	-260	-120	0
19	-290	-160	0
20	-320	-200	0
21	-350	-240	0
22	-380	-280	0
23	-410	-320	-10
24	REJECT	REJECT ⁽¹⁾	-40
25	"	"	-70
26	"	"	-100
27	"	"	-130
28	"	"	-160
29	"	"	-190
30	"	"	-220
Greater than 30	"	"	REJECT ⁽¹⁾

⁽¹⁾ Sublot may be accepted, subject to approval of the Department, with an assessment of -\$400

Pavement smoothness will be assessed based upon the type of construction as follows.

Type of Construction	Table 3.50 C Assessment Column
Two or more paver laid lifts, minimum design lift thickness of 20 mm.	C1
Single lift with design lift thickness greater than or equal to 45 mm	C2
Hot In-Place Recycling or Mill and Inlay	C3
Curb and Gutter	C3
Single Lift with design lift thickness less than 45 mm.	C3

Penalty assessments for bumps and dips will be applied to all applicable top lifts of pavements

TABLE 3.50 D
GRADATION TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA AND MAXIMUM RANGE
BETWEEN INDIVIDUAL TEST RESULTS IN A LOT

CHARACTERISTICS	SIEVE SIZE μm					
	⁽¹⁾ 20000, 16000, 12500 10000, 5000	1250	630	315	160	80
Tolerances for the Lot Mean from the Job Mix Formula	+/-5	+/-3	+/-2	+/-2	+/-1.5	+/-1.5
Maximum Range Between Individual Test Results in a Lot	10	6	5	4	3	3

⁽¹⁾ Include all sieve sizes up to one size smaller than top size.

TABLE 3.50 E
MAXIMUM DEVIATION FOR THE LOT MEAN FROM THE GRADATION LIMITS SPECIFIED IN TABLE 3.2.3.1
OF SPECIFICATION 3.2 AGGREGATE PRODUCTION AND STOCKPILING

CHARACTERISTIC	SIEVE SIZE μm		
	⁽¹⁾ 20000, 16000, 12500, 10000	5000, 1250, 630, 315	160, 80
Maximum Deviation for the Lot Mean from Specification 3.2 Gradation Limits	2	1	0.5

⁽¹⁾ Include all sieve sizes up to one size smaller than top size.

TABLE 3.50 F
“A” AND “B” ADJUSTMENT POINTS FOR DEVIATION IN GRADATION

SIEVE SIZE μm	MEAN
⁽¹⁾ 20000, 16000, 12500, 10000, 5000	5 for each 1% Deviation
1250	1 for each 1% Deviation
630	2 for each 1% Deviation
315	2 for each 1% Deviation
160	0.2 for each 0.1% Deviation
80 Deviation \leq 1.0%	1.0 for each 0.1% Deviation
80 Deviation $>$ 1.0%	2.0 for each additional 0.1% Deviation

⁽¹⁾ Include all sieve sizes up to one size smaller than top size.

Lot Mean Adjustment points will be calculated for each Lot. If the Lot Mean does not exceed the requirements in Table 3.50 E, a Lot Gradation Price Adjustment per tonne will be applied based on the following formula:.,

$$\text{PAg} = (\text{A} \times \text{\$0.04}) + (\text{B} \times \text{\$0.40}) + \text{Bonus}$$

Where:

- PAg** = Unit Price Adjustment for Gradation (bonus or penalty; QA Acceptance Lots only)
- A** = Mean Adjustment Points assessed within the gradation limits specified in Specification 3.2 but beyond the Job Mix Formula tolerance requirements in Table 3.50 D.
- B** = Mean Adjustment Points assessed outside the gradation limits specified in Specification 3.2 regardless of the Job Mix Formula tolerance.
- Bonus** = +\$0.20 when there are no Mean Adjustment Points and the maximum range as shown in Table 3.50 D, is not exceeded for any sieve size in the Lot.

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3.52 MILLED RUMBLE STRIPS**3.52.1 GENERAL**

This specification covers the construction of milled rumble strips on the shoulders of roadways to alert drivers when they leave the travel lanes and across the travel lanes to alert drivers of an upcoming stop condition.

3.52.2 EQUIPMENT**3.52.2.1 General**

The Contractor shall provide all equipment necessary for completion of the Work.

3.52.2.2 Milling Machine

The milling machine shall be equipped to meet or exceed the following requirements:

- (i) For milling of shoulder strips, the cutting head shall be capable of producing grooves meeting the requirements as shown on Drawing No. CB6-3.52M1 or CB6-3.52M2 as applicable.

For milling of rumble strips for stop conditions, the cutting head shall be capable of producing grooves meeting the requirements as shown on Drawing. No. CB6-3.52M3.

- (ii) The machine shall either be equipped with an integral sweeping device mounted directly behind the cutter or,

a separate sweeping operation shall be conducted as construction of the rumble strips progresses within the signed construction zone.

3.52.3 CONSTRUCTION**3.52.3.1 General**

All work shall be performed during daylight hours only. No work shall be performed if the visibility is less than 700 m. The maximum work area shall be 4 km in length.

The Contractor shall supply a sequential arrowboard in accordance with Specification 1.2, General.

3.52.3.2 Construction of Milled Rumble Strips

For milling of shoulder strips, the Contractor has the option of choosing either the intermittent typical layout or the continuous typical layout for milled rumble strips. The Contractor shall construct milled rumble strips as shown on either Drawing CB6-3.52M1, Typical Layout for Continuous Milled Rumble Strips for Shoulders, or CB6-3.52M2, Typical Layout for Intermittent Milled Rumble Strips for Shoulders.

When required, the Contractor shall construct milled rumble strips for stop conditions as shown on Drawing CB6-3.52M3 - Typical Layout for Milled Rumble Strips for Stop Conditions. Due to space constraints, it may not be possible to construct all of the strips at some intersections. In

these cases, the Contractor shall construct the number of strips as shown in the Special Provisions or as directed by the Consultant.

No grooving will be done across intersections, tapers or accesses nor at any other locations specified by the Consultant.

After milling the grooves, the Contractor shall pickup and dispose of all detritus created from the milling operation.

Patterns of milled rumble strips constructed outside the tolerances as shown on the Drawings or exhibiting obvious defects will be rejected, and the Contractor shall be responsible for repairing the unacceptable work.

3.52.4 MEASUREMENT AND PAYMENT

3.52.4.1 Milled Rumble Strips

Measurement of milled rumble strips will be made parallel to the road centreline, to the nearest 0.001 km of through highway chainage for each side of the road where accepted milled rumble strips have been constructed.

Payment will be made at the unit price bid per kilometre per side for "Milled Rumble Strips." Payment will be the same for either the continuous or intermittent layout pattern. This payment will be full compensation for constructing the milled rumble strips, removing and disposing of all debris and traffic accommodation.

3.52.4.2 Milled Rumble Strips for Stop Conditions

Milled Rumble strips for stop conditions will be measured by the set as the total of all completed strips at each stop location.

Payment will be made at the unit price bid per set for "Milled Rumble Strips for Stop Conditions". This payment will be full compensation for constructing the milled rumble strips, removing and disposing of all debris and traffic accommodation.

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3.53 ASPHALT CONCRETE PAVEMENT - SUPERPAVE**3.53.1 GENERAL****3.53.1.1 Description**

Asphalt concrete pavement (ACP) shall consist of crushed aggregates, or a combination of crushed aggregates and reclaimed asphalt pavement (RAP), blend sand material as required and asphalt cement, combined in a hot mix plant, placed and compacted on a prepared surface in conformity to the lines, grades, dimensions and cross-sections as shown on the Drawings or as directed by the Consultant.

This specification shall apply only to mixes specified to be designed using the superpave mix design procedure and shall not be used for mixes designated according to Alberta Transportation's conventional mix type specifications.

3.53.1.2 Definitions

For purposes of this specification, the following definitions will apply:

3.53.1.2.1 Acceptance Limits

- (i) Density and Actual Asphalt Content - Acceptance Limits for density and Actual Asphalt Content are the limiting values of the Lot Mean within which the Lot will be accepted at full, increased, or reduced payment for density, as shown in Table 3.53 A, or full or reduced payment for Actual Asphalt Content as shown in Table 3.53 B.
- (ii) Smoothness - Acceptance Limit for smoothness is the limiting value of the Profile Index within which a Sublot will be accepted with or without penalty assessment as shown in Table 3.53 C.

3.53.1.2.2 Asphalt Content

- (i) Design Asphalt Content - The Asphalt Content established by the approved mix design.
- (ii) Approved Asphalt Content - The Design Asphalt Content or subsequent adjustments to it. Such adjustments must be approved in writing by the Consultant.
- (iii) Actual Asphalt Content - The amount of asphalt binder in the mix as determined by ATT-12 or ATT-74, and includes an amount to correct for the asphalt binder lost due to absorption by the aggregate or aggregate loss.

This correction may be determined for each change in aggregate or asphalt binder.

3.53.1.2.3 End Product Specification (EPS)

A specification, whereby the Department does not define methods of construction. Under EPS, the Department will monitor the Contractor's control of the process that produces the items of construction and will accept or reject the end product according to a specified acceptance plan. The Contractor is entirely responsible for quality control. End product acceptance is the responsibility of the Department and includes a statistically oriented program of acceptance testing.

3.53.1.2.4 Job Mix Formula

The Job Mix Formula establishes the aggregate proportioning, target aggregate gradation and approved asphalt content to be used for production of asphalt mix and requires the approval of the Consultant on the basis of a mix design.

3.53.1.2.5 Lot

A Lot is a portion of the Work being considered for acceptance and is defined as the following:

- (i) One day's plant production of more than 4 hours where approved changes to the following criteria have not occurred:
 - a) Job Mix Formula
 - b) Pavement Density Requirement
 - c) Project

A change in any one of the above may require a new Lot designation.

- (ii) One day's plant production of less than 4 hours will be dealt with at the Consultant's option, as follows:
 - a) The material will be added to the previous day's Lot if the criteria specified in (i) remains the same or,
 - b) The material will be added to the next day's Lot with the same criteria specified in (i) or,
 - c) If it is the last time the mix is produced with these criteria then the production will be designated as a Lot.
- (iii) If the Consultant suspects a portion of a Lot is substandard, he may order extra testing to define the area and severity of the deficiency. A new Lot will be designated for this portion if this extra testing indicates the mix is subject to unit price adjustment or rejection.

3.53.1.2.6 Rejection Limit

- (i) Density and Actual Asphalt Content - Rejection Limit for Density and Actual Asphalt Content is the limiting value of the Lot Mean beyond which a Lot is rejected and not paid for as shown in Tables 3.53 A, and 3.53 B.
- (ii) Smoothness - Rejection Limit for smoothness is the limiting value of the Profile Index (PrI) beyond which a Sublot is rejected and not paid for as shown in Table 3.53 C.

3.53.1.2.7 Lot Mean and Range

The Lot Mean is the arithmetic mean of a set of 5 or more test results constituting the sample for the Lot. The Range represents the difference between the highest and lowest values within a set of test results.

3.53.1.2.8 Stratified Random Sample

A Stratified Random Sample is a set of test measurements taken one each from 5 or more separate (stratified) areas or segments within a Lot in an unbiased way.

3.53.1.2.9 Sublot

A Sublot is a portion of a Lot that is one paver width wide and 100 m long on which the calculation for Smoothness and assessment of Workmanship and Obvious Defects are based.

3.53.1.2.10 Alberta Transportation Test Procedures

Test methods designated in these specifications as "ATT" or "TLT" refer to Alberta Transportation Tests.

3.53.1.2.11 Superpave Mix Design Procedure

Mix design procedure developed as a product of the Strategic Highway Research Program (SHRP) and described in the latest edition of the American Association of State Highway and Transportation Officials (AASHTO) Standard Specification for Superpave Volumetric Mix Design, Designation M323.

3.53.1.2.12 Managed Quality Assurance (MQA)

Within this specification, acceptance testing shall be applied using Managed Quality Assurance (MQA) practices. With MQA, certain quality control test results provided by the Contractor may be used in place of corresponding quality assurance test results, as a basis for acceptance and payment. The Lots for which quality control test results are used for acceptance and payment will be at the discretion of the Consultant.

3.53.1.2.13 QC Acceptance Lot

A Lot chosen by the Consultant in which acceptance testing for asphalt content and gradation is based upon the Contractor's quality control test results and for which no corresponding quality assurance test results are available. All other quality assurance testing as outlined in this specification will remain the responsibility of the Consultant.

Quality assurance test results, when available, shall replace any quality control test results used for material acceptance.

3.53.1.2.14 QA Acceptance Lot

A Lot in which all acceptance testing is conducted by the Consultant using quality assurance test procedures as outlined in these specifications. The number and selection of QA Acceptance Lots shall be determined as follows:

- (i) First two Lots of production for each Mix Type used, and;
- (ii) Minimum of one additional Lot per 60 000 tonnes, or portion thereof, of total ACP contract tender tonnage and;
- (iii) One additional Lot of top lift production, for each Mix Type, if two or more lifts are specified and;
- (iv) Any additional Lot(s) chosen by the Consultant.

3.53.2 MATERIALS3.53.2.1 **Asphalt**

The Contractor shall supply asphalt material in accordance with Specification 5.7, Supply of Asphalt. The types and grades of asphalt shall be as specified in the Special Provisions.

For ACP mixtures containing RAP and specified to use penetration grade asphalts, the procedures outlined in TLT-300, Recycling of Asphalt Concrete Pavement, shall be used to determine the rheology of the RAP and the grade of virgin asphalt to be used. For ACP mixtures containing RAP and specified to use Performance Graded (PG) asphalts, the RAP rheology and the grade of virgin asphalt to be used shall be determined according to Appendix A of AASHTO M232.

Rheological testing of the RAP is not required for mixtures using a maximum RAP to virgin aggregate ratio of 10/90.

3.53.2.2 **Aggregate**

The Contractor shall produce crushed aggregates in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of material specified. The Contractor shall supply aggregate materials in accordance with Specification 5.2, Supply of Aggregate, and haul materials in accordance with Specification 4.5, Hauling.

For Superpave designated aggregates, Table 3.2.3.1 Specifications for Aggregate, shall be replaced with Table 3.53.2.2A, Superpave Aggregate Gradation Specifications. Metric sieves in accordance with CGSB Spec. 8-GP-2M shall be used in place of the sieves specified in the AASHTO specifications.

Specifications for other aggregate properties are given in Table 3.53.2.2C, Superpave Aggregate Properties.

Table 3.53.2.2A Superpave Aggregate Gradation Specifications (% Passing)

Sieve Size (μm)	Nominal Maximum Size (mm)		
	10.0	12.5	20.0
50 000	-	-	-
40 000	-	-	-
25 000	-	-	min. 100
20 000	-	min. 100	90 -100
12 500	min. 100	90 -100	max. 90
10 000	90 - 100	max. 90	-
5 000	max 90	-	-
2 500	32 - 67	28 - 58	23 - 49
1 250	-	-	-
630	-	-	-
315	-	-	-
80	2 - 10	2 - 10	2 - 8

Note: Gradation Classification – The combined aggregate gradation shall be classified as coarse-graded when it passes below the Primary Control Sieve (PCS) as defined in Table 3.53.2.2B. All other gradations shall be classified as fine-graded.

Table 3.53.2.2B Gradation Classification

	PCS for Nominal Maximum Aggregate Size (% Passing)		
	10.0 mm	12.5 mm	20.0 mm
Primary Control Sieve (µm)	2 500	2 500	5 000
PCS Control Point (% Passing)	47	39	47

Table 3.53.2.2C Superpave Aggregate Properties

Property and Test Method	Aggregate Angularity		Elongated Particles ⁽³⁾	Clay Content	Detrimental Matter	Plasticity Index
	Coarse ⁽¹⁾	Fine ⁽²⁾				
	ATT-50	TLT-125	ASTM 4791	AASHTO T 176	TLT 107	AASHTO T90
Traffic (ESALs million)					As listed for Des. 1 aggregates in Specification 3.2 Aggregate Production and Stockpiling	Non Plastic
<1.0	-/60	40	10	40		
1.0 to <3	75/-70	45	10	45		
3 to <6	85/80	45	10	45		
6 to < 10	95/90	45	10	45		
10 to < 20	95/90	45	10	45		
20	95/90	45	10	50		
⁽¹⁾ "85/80" denotes that 85% of the coarse aggregate has one fractured face and 80% two fractured faces. ⁽²⁾ Minimum % air voids in loosely compacted fine aggregate. ⁽³⁾ Maximum weight % of thin or elongated particles; ratio of 5:1. Note: Disregard the mention of AASHTO values for coarse and fine aggregate angularity listed for pavement layers > 100 mm from pavement surface.						

3.53.2.3 Interim Lane Markings

The Contractor shall supply interim lane marking paint and glass beads from the list of approved products shown in the Special Provisions or Specification Amendments.

The Contractor has the option of supplying reflectorized temporary pavement markers or self-adhesive reflectorized pavement marking tape. Acceptable temporary pavement markers are shown on the Alberta Transportation Products List.

3.53.2.4 Reclaimed Asphalt Pavement

Unless specified otherwise, the Contractor may elect to use RAP in the ACP mixture to a maximum RAP to virgin aggregate ratio of 30/70. The handling, stockpiling, storage and hauling of all RAP shall be in accordance with Specification 3.16, Cold Milling Asphalt Pavement, and shall prevent the contamination and consolidation of the material.

3.53.3 ASPHALT MIX DESIGN AND JOB MIX FORMULA3.53.3.1 **Responsibility for Mix Design**

Preparation and submission of asphalt mix designs for Consultant verification and approval are the responsibility of the Contractor. The Contractor shall use Professional Engineering services and a qualified testing laboratory licensed to practice in the Province of Alberta, to assess the aggregate materials proposed for use and to carry out the design of the asphalt mixture. The design testing laboratory for superpave mixes shall have obtained pre-qualification status from the Department in the category of Asphalt Concrete Mix Design - Superpave.

All costs incurred in mix design formulation are the responsibility of the Contractor. Shipping costs for samples sent to the Consultant for verification and approval are the responsibility of the Contractor.

3.53.3.2 **Requirements for Mix Design**

The asphalt mix design shall follow the AASHTO Designation M323 Standard Specification for Superpave Volumetric Mix Design with design criteria changes as outlined in this section. The bulk specific gravity of the RAP aggregate shall be determined according to TLT-301. The mix design, at the Design Asphalt Content, shall meet the requirements in Tables 3.53.3.2.2A and B for the superpave mix type specified in the Special Provisions and design requirements listed under Subsection 3.53.3.2.3, Moisture Susceptibility Criteria.

3.53.3.2.1 Superpave Mix Type Designations

Superpave mix types shall be expressed as Traffic-S-Agg. where:

Traffic - Design Traffic loadings is expressed within one of the following ranges

- "1" - for $< 1.0 \times 10^6$ ESALs
- "3" - for 1.0 and $< 3.0 \times 10^6$ ESALs
- "6" - for 3.0 and $< 6.0 \times 10^6$ ESALs
- "10" - for 6.0 and $< 10 \times 10^6$ ESALs
- "20" - for 10 and $< 20 \times 10^6$ ESALs
- "100" - for $> 20 \times 10^6$ ESALs

S - Value of "C" for coarse mixes or "F" for fine mixes to be chosen by the Contractor as follows:

- C - If design aggregate gradation falls below the Control Point for the PCS as outlined in Table 3.53.2.2B, Gradation Classification,
- F - If design aggregate gradation falls on or above the Control Point for the PCS as outlined in Table 3.53.2.2B, Gradation Classification.

Agg. - Expressed as 10, 12.5 or 20 based upon Nominal Maximum Aggregate Size as chosen by the Consultant.

Example: A superpave mix type 3-S-12.5 has a design traffic loading between 1.0 and 3×10^6 ESALs and is to use a 12.5 mm Nominal Maximum Size aggregate.

3.53.3.2.2 Superpave Design Criteria**Table 3.53.3.2.2A Superpave Volumetric Criteria**

Traffic ¹ (ESALs millions)	Required Density (% of Max. Specific Gravity)			Air Voids (%)	Voids Filled with Asphalt (%)
	N _{initial}	N _{design}	N _{maximum}		
3.0	90.5	= 96	< 98	4	65 - 78
3.0 to > 10	< 89	= 96	< 98	4	65 - 75 ²
Minimum Voids in Mineral Aggregate Criteria					
Nominal Aggregate Size (mm)					
10			15		
12.5			14		
20			13		

- (1) Design ESALs are the anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years and choose the appropriate N_{design} level.
- (2) For 10 mm nominal maximum size mixtures, the specified VFA range shall be 73% to 76% for the design traffic levels 3 million ESALs.

Table 3.53.3.2.2B Superpave Dust Proportion Criteria

Fines/Asphalt Ratio	
All aggregate sizes and traffic levels "F" design aggregate gradations	0.6 to 1.2
All aggregate sizes and traffic levels "C" design aggregate gradations	0.7 to 1.5
Note: The Fines/Asphalt (F/A) ratio is defined as the ratio of the percent of aggregate passing the 80µm sieve to the percent of effective asphalt content (by weight of dry aggregate).	

The number of gyrations shall be selected according to the design traffic loadings listed in the superpave mix type designation and compactive effort requirements listed in Table 3.53.3.2.2C, Superpave Design Gyrotory Compactive Effort.

Table 3.53.3.2.2C Superpave Design Gyrotory Compactive Effort

Design Traffic Loading (ESALs millions)	Number of Gyrotations		
	N _{initial}	N _{design}	N _{maximum}
<3	7	75	115
3 to < 20	8	100	160
≥ 20	9	125	205

3.53.3.2.3 Moisture Susceptibility Criteria

The moisture susceptibility of the superpave mix will be evaluated for acceptance according to AASHTO T 283, Resistance of Compacted Bituminous Mixture to Moisture Induced Damage, using 150 mm diameter Gyrotory compacted specimens. The minimum acceptance value shall be 75% for specimens subjected to the freeze-thaw conditioning.

3.53.3.3 **Approval of Mix Design**

Mix designs shall be subject to the approval of the Consultant. The Contractor shall submit the mix design to the Consultant for verification and approval. The Contractor's submission shall include the following information:

- (i) Aggregate source name(s) and location(s).
- (ii) The gradation of each aggregate to be used in the mixture using the sieve sizes listed in Table 3.53.2.2A, Superpave Aggregate Gradation Specifications.
- (iii) The percentage by mass of each aggregate to be used in the mixture.
- (iv) The mix design gradation of the combined aggregate.
- (v) Other characteristics of the combined aggregate specified in Table 3.53.2.2C, Superpave Aggregate Properties.
- (vi) All superpave mix design characteristics, including graphs used in arriving at the final mix design, the bulk specific gravity of the combined aggregates, graph of theoretical maximum specific gravities, the asphalt absorption of the combined aggregates and tensile strength ratio (both with and without freeze-thaw conditioning).
- (vii) Identification of each asphalt supplier by name, location and types and grades of asphalt to be supplied.
- (viii) For each asphalt supplied, asphalt specific gravity and recommended mixing and compaction temperatures for the preparation of design specimens.
- (ix) Voids table to include Air Voids, VMA and Voids Filled with Asphalt for various asphalt contents (0.1% increments) and bulk densities (increments of 5 kg/m³).
- (x) Mix design submissions using RAP shall include the RAP source name(s) and location(s), all RAP asphalt content and gradation test results, the bulk specific gravity of the RAP aggregate, the percentage by weight of RAP to be used in the mixture, and, when required, all RAP rheological test results, the design rheology and all blending information used.

The Consultant will require up to 5 working days from the time of receipt of the mix design to complete the design evaluation.

Where required by the Consultant for any change in the nature or sources of the aggregates or RAP, or where a new mix design is desired by the Contractor, the Contractor shall provide a separate and complete mix design. This new mix design shall be subject to the approval of the Consultant.

The Consultant may, at any time, require the Contractor to provide representative samples of each of the aggregate components and RAP for verification purposes. A sufficient quantity of each component shall be provided to result in a 100 kg sample of combined aggregate at design proportions. The Consultant will require up to 5 working days from the time of receipt of the sample to verify the mix design. The cost of such mix design verification will be borne by the Department.

Asphalt mix produced prior to the Contractor receiving the written approval of the mix design, will not be accepted.

The aggregate proportioning, target gradation and asphalt content for the approved mix design will then be the Design Mix Formula and will become the Job Mix Formula for the start in production of asphalt mix.

The Contractor is responsible for producing mixes which conform to the Specifications.

3.53.3.4 Variation from Approved Job Mix Formula

Once the Job Mix Formula has been established and approved, no alteration will be permitted unless reviewed and approved by the Consultant.

The Lot Mean Gyrotory Air Voids at N_{design} , as determined by the Consultant, shall not vary from the corresponding air voids in the approved mix design by more than 0.5%.

If the sum of any approved alterations to the Job Mix Formula are in excess of any one of the following limits away from the Design Mix Formula, a new mix design is required.

- $\pm 5\%$ passing the 5 000 μm sieve.
- $\pm 1.0\%$ passing the 80 μm sieve.
- $\pm 0.3\%$ asphalt content.
- $\pm 5\%$ in target proportion of RAP.

Unless otherwise approved by the Consultant, the Contractor may not request more than three alterations to the Job Mix Formula without the provision of a new mix design.

All Job Mix formulas shall meet the aggregate gradation requirements of Table 3.53.2.2A and the dust proportion criteria listed in Table 3.53.3.2.2B.

3.53.4 SAMPLING AND TESTING

3.53.4.1 General

During the progress of the Work, tests will be carried out on materials and workmanship in order to ensure compliance with the requirements of the Specifications.

Where it is required in these specifications that the Contractor submit samples of materials or mixtures to the Consultant for approval, these samples shall be submitted in sufficient time for proper testing.

The Consultant's approval of any materials or mixture shall in no way relieve the Contractor from his obligation to provide materials, mixtures and workmanship in accordance with the Specifications.

Where specified, random sampling procedures shall be followed, and where no specific random sampling procedure is specified, the sampling procedure shall be as identified by the Consultant in the case of acceptance testing and by the Contractor in the case of quality control testing.

The Consultant shall have access to the Work at all times for taking samples. The Contractor shall provide any assistance necessary for taking samples and shall reinstate pavement layers or other structures to the satisfaction of the Consultant at the positions where samples have been taken. Compensation for providing assistance with sampling and for reinstatement where samples are taken shall be included in the unit price bid for the various items of Work tested and no separate payment will be made.

The Contractor shall provide, at his own expense, sampling stands, sampling devices and other facilities which the Consultant may require to safely obtain representative samples of the item being produced.

When required, the Contractor shall provide and prepare, to the satisfaction of the Consultant, a suitable site for the parking of a mobile laboratory trailer. The Contractor shall provide power to the mobile laboratory trailer, at his own expense.

3.53.4.2 Methods of Testing For Acceptance and Appeal Testing

Unless otherwise specified, the latest edition of the following standard Alberta Transportation test methods (ATT) shown in Table 3.53.4.2 will be used to determine material characteristics.

TABLE 3.53.4.2
TEST METHODS ON MANAGED QA PROJECTS

	TEST DESCRIPTION	TEST METHOD
1.	Sampling Mixes	ATT-37
2.	Coring	ATT-5
3.	Extraction	ATT-12
4.	Correction Factor, Extracted Asphalt Content	ATT-12 Part III
5.	Percent Fracture	ATT-50
6.	Sieve Analysis	ATT-26
7.	Density, Immersion Method, Waxed Asphalt Concrete Specimens	ATT-6
8.	Density, Immersion Method, Saturated Surface Dry Asphalt Concrete Specimens	ATT-7
9.	Voids Calculations, Asphalt Concrete Specimens	ATT-36
10.	Percent Compaction, Asphalt Concrete Pavement	ATT-67
11.	Forming Gyrotory Specimens	AASHTO TP4
12.	Moisture Content, Oven Method Asphalt Concrete Mixes	ATT-15

TEST DESCRIPTION		TEST METHOD
13.	Smoothness of Pavements, Profilograph Method	ATT-59
14.	Stratified Random Test Sites for A.C.P. Projects	ATT-56
15.	Appeal Testing, Asphalt Content, Density and Gradation	ATT-68
16.	Asphalt Content, Ignition Method	ATT-74
17.	Correction Factor, Ignition Asphalt Content	ATT-74 Part II
18.	Maximum Specific Gravity of Bituminous Mixes	ASTM D2041
Additional Test Methods for QC Acceptance Lots Only		
19.	Asphalt Content	AASHTO T164, T287 or ATT-12 or ATT-74

NOTES:

- In all test methods used as reference in this specification, metric sieves as specified in Canadian General Standards Board Specification 8-GP-2M shall be substituted for any other specified wire cloth sieves in accordance with Specification 3.2, Aggregate Production and Stockpiling.
- In all cases the latest amendment or revision current at the closing date of the Tender is implied when reference is made to one of the above standards in the Specification.

3.53.4.3 Quality Control Testing

Quality control testing is the responsibility of the Contractor throughout every stage of the Work from the crushing and production of aggregates to the final accepted product. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall provide and pay for equipment and qualified personnel to obtain all quality assurance core samples and perform all quality control testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product produced.

When the Contractor elects to use RAP, the asphalt content and gradation of the RAP shall be determined according to and at the frequencies specified in Specification 3.16, Cold Milling Asphalt Pavement. When required, the RAP rheology shall be determined at a minimum frequency of one per 5 000 t of RAP and a minimum of three samples shall be tested for each RAP source.

Test methods, sampling and minimum frequency of testing are described in Subsection 3.53.4.2, Methods of Testing For Acceptance and Appeal Testing, and Table 3.53.4.3, Quality Control Testing Requirements - Superpave, Managed QA Testing Projects. The Consultant may require an increase in the frequency of any quality control test which has a specified minimum frequency. The Contractor shall arrange and pay for any additional tests required by the Consultant.

Results of all quality control tests shall be submitted to the Consultant as they become available. In addition, the quality control test results for mix asphalt content and aggregate gradation shall be provided to the Consultant no later than 12:00 noon of the day following placement.

The Contractor shall bear the cost of all consulting services retained by him.

The Contractor shall be totally responsible for production of aggregate and mixes that meet all the specified requirements.

TABLE 3.53.4.3
QUALITY CONTROL TESTING REQUIREMENTS- SUPERPAVE, MANAGED QA TESTING PROJECTS

TEST	STANDARD	MINIMUM FREQUENCY
AGGREGATE PRODUCTION		See Specification 3.2
ASPHALT MIX PLANT		
Calibration	ATT-17	Once per project or as required ⁽²⁾
Inspection	ATT-16	
SAMPLES		
Asphalt Cement	ATT-42	See Specification 5.7
Tack, Prime and Fog Materials	ATT-42	See Specification 5.7
Cold Feed Aggregate		(2)
QC Testing	ATT-38	
Mix	ATT-37	(2)
QA Cores - Stratified Random Test Sites Chosen By The Consultant	ATT-56	One per segment for each Lot.
i) QA Cores for Pavement Density	ATT-5	One per segment for selected Lots as directed by the Consultant.
ii) QA Cores for Asphalt Content and Gradation	ATT-5	
TESTS WITH SPECIFIED MINIMUM FREQUENCIES		
Mix Asphalt Content	AASHTO T-164, T287 or ATT-12 or ATT-74	(2)
Correction Factors	ATT-12, Part III or ATT-74, Part II	As Required
Mix Moisture Content	ATT-15	(2)
Aggregate Sieve Analysis	ATT-26	(2)
Pavement Segregation	Segregation Rating Manual	Each Lot
TESTS WITH NO SPECIFIED MINIMUM FREQUENCIES		
Field Formed Gyrotory Briquettes	AASHTO TP4	(1)
Maximum Specific Gravity of Bituminous Mixes (Gmm)	ASTM D2041	(1)
Density Immersion Method, Saturated Surface Dry	ATT-7	(1)
Void Calculations, Cores or Formed Specimens	ATT-36	(1 & 3)
Temperatures	ATT-30	(1)
Percent Compaction, Cores or Nuclear Density	ATT-67, ATT-5 or ATT-11	(1 & 3)
Random Test Site Locations	ATT-56	(1)
Correction Factors, Nuclear Moisture-Density Measurement	ATT-48	(1)
Pavement Smoothness	ATT-59	(1)

(1) Minimum Frequency not specified.

(2) When a Lot has eight hours of plant production or more, a minimum of four plant checks plus four asphalt contents and four sieve analysis of the combined aggregate (any combination of cold feed, extraction or

- ignition) are required. When a Lot has less than eight hours of plant production, these tests shall be performed once for every two full hours of plant production.
- (3) Percent compaction and core air voids based upon the Lot Mean Maximum Specific Gravity (Gmm). Air voids on Gyrotory formed specimens based upon corresponding individual Maximum Specific Gravity (Gmm) test values.

3.53.4.4 Acceptance Sampling and Testing

3.53.4.4.1 General

Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be determined by statistical testing as described in this section.

Acceptance testing is the responsibility of the Consultant except for Lots designated by the Consultant as QC Acceptance Lots in which case the Contractor's quality control test results for asphalt content and aggregate gradation only, may be used towards determining conditional material acceptance.

The Contractor shall provide to the Consultant all quality assurance density cores and any additional cores requested by the Consultant for quality assurance testing for asphalt content and gradation, by 12:00 noon of the day following placement, unless otherwise directed by the Consultant. Prior to the Contractor obtaining the cores, the Consultant may provide the Contractor with new or different random sample locations. The Consultant may have the Contractor obtain cores for quality assurance testing at any time throughout the project for any Lot. All cores provided to the Consultant shall be in their original condition. Core preparation or sawing shall be done by the Consultant.

All costs associated with pavement coring for quality control and quality assurance testing shall be the responsibility of the Contractor.

Initial acceptance testing will be performed free of cost to the Contractor. The Contractor shall be responsible for the cost of all Quality Assurance testing performed on material that is used to replace or overlay material that has been previously rejected.

The Contractor shall be responsible for the cost of all Quality Assurance retesting performed following attempts to improve smoothness or to remove bumps or dips.

After all quality control tests for the Lot are reported to the Consultant, the Consultant will provide the Contractor with a copy of the results of acceptance tests within one working day of their availability.

If the Consultant determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, he will replace the faulty tests with new tests.

If the testing equipment malfunction, improper testing procedures or calculations were on the part of the Consultant, the Contractor shall be reimbursed \$50 per locations for obtaining cores.

3.53.4.4.2 Acceptance Sampling and Testing Procedures

3.53.4.4.2.1 Pavement Sampling for Density, Asphalt Content and Gradation

Pavement sampling will be done using stratified random sampling procedures. A minimum of 5 tests per Lot will be selected as follows:

- (i) The Lot will be divided into 5 or more segments of approximately equal quantity.
- (ii) In each segment a test site will be located by using random numbers to determine the longitudinal distance from the end of the segment and the lateral distance from the edge of the segment. In no case will a lateral distance be less than 0.5 m from the shoulder or 0.3 m from any other edge of a mat except when matching mats, in which case the test site may be within 0.3 m of the joint.

For lifts of 20 mm or less, samples for asphalt content and gradation may be obtained by the Consultant using the Sampling Mix Behind Paver method described in ATT-37. If sufficient numbers of mix samples cannot be obtained in this manner, stratified random core samples shall be taken by the Contractor as determined by the Consultant in order to perform the minimum five tests per Lot.

On Lots designated by the Consultant as QC Acceptance Lots, material sampling for quality control testing of asphalt content and gradation may consist of cold feed aggregate or loose mix or core samples as outlined in ATT-37, ATT-38 or ATT-56.

3.53.4.4.2.2 Pavement Sampling for Smoothness

The surface of the Sublots in the final lift of asphalt concrete pavement will be profiled by the Consultant in accordance with ATT-59 using a California Cox Model Profilograph. Other makes of Profilograph machines may be used if they have been individually approved by the Department. Profiles will be made approximately at the traffic wheel paths.

Smoothness testing will also be undertaken on all passing, climbing, deceleration and acceleration lanes that are greater than 100 m in length, and on all interchange ramps. Tapers will not be subject to smoothness testing.

The following pavement surfaces will be excluded from profilograph smoothness testing.

- i) Main alignment portions, interchange ramps and all other lanes where the regular posted speed (i.e. without construction activities) is less than 70 kilometres per hour.
- ii) Turn lanes and storage lanes.
- iii) Tapers
- iv) Portions of pavement which, as determined by the Consultant, are influenced by man holes, water valves or other embedded hardware.

All pavement surfaces within the driving lanes of the above exclusions shall show no variation greater than 6 mm from the edge of a 3 m straightedge placed in any direction, excluding deviations due to crown breaks as shown on the Drawings. Locations for testing and the need for testing of straightedge deviation will be as determined by the Consultant.

Smoothness testing will extend completely across all transverse joints between existing pavement and ACP placed under this Contract. Penalty assessments and acceptance/rejection criteria will apply to all such bumps and dips identified. PrI assessment for smoothness will be

determined starting at the location where all wheels of the Profilograph are on ACP placed under this Contract.

Weather permitting, acceptance testing for smoothness will normally be completed within two weeks following the completion of all paving work subject to smoothness testing. All smoothness acceptance criteria will apply regardless of the year that the pavement is placed and the year that it is tested. Requests by the Contractor to have portions of the Work tested prior to the completion of all paving will be considered subject to the availability of the Consultant's Profilograph testing crew and seasonal weather conditions. In such cases the Contractor will be invoiced by the Department at a rate of \$750 to cover the extra mobilization and travel costs associated with this testing.

3.53.4.4.2.3 Asphalt Mix Sampling

Sampling of the asphalt mixture for Gyratory compaction comparison will be done by the Consultant using the procedures identified in ATT-37.

3.53.4.4.2.4 Exclusions to Random Sampling

Random sampling methods will not be applied when the Consultant samples mix behind the paver on lifts of 20 mm or less; nor to small areas such as tapers, approaches, areas of handwork, gores; nor for asphalt mix used for isolated leveling and repair of failed areas; nor for aggregate or asphalt mix chosen for QC Acceptance Lot testing.

3.53.4.5 Retesting Following Attempts to Improve Smoothness

When the test results on a Sublot of ACP indicate a penalty or rejection because of smoothness, the Contractor, at his option, may make one attempt to improve the smoothness on the Sublot by additional work in which case the following shall apply:

- (i) the Contractor shall notify the Consultant in writing that he will make one attempt to improve smoothness.
- (ii) additional work on a Sublot to improve smoothness shall be completed within 10 calendar days from the time the Contractor receives written notification from the Consultant indicating the smoothness test results for that Sublot.
- (iii) additional work to improve smoothness will only be allowed on Sublots that are in penalty or reject according to the criteria contained in Table 3.53 C, except for removal of bumps and dips over 8 mm.

The Contractor shall not undertake any method of repair that is detrimental to the quality of the pavement. Any method of heating that has a detrimental effect on the pavement in the opinion of the Consultant, will not be allowed.

The Consultant will re-test any sublots in which the Contractor has made one attempt to improve smoothness. The subplot assessment for smoothness will be based upon the re-tested values.

3.53.4.6 Aggregate Gradation Requirements

The following requirements apply to asphalt concrete pavement material in all lifts except preliminary leveling and those Lots designated as QC Acceptance Lots.

Price adjustments for aggregate gradation variation will be based on the variation of the Lot Mean Gradation from the Job Mix Formula tolerance, for each size, as shown in Table 3.53 D and the corresponding adjustment points as shown in Table 3.53 E.

For lifts greater than 20 mm in thickness, the Lot Mean Gradation will be determined using the sieve analysis of core samples. For lifts 20 mm or less, the Lot Mean Gradation will be determined using the sieve analysis of mix and/or core samples.

When the Lot Mean Gradation is outside the Job Mix Formula tolerance, the penalty assessment will be \$0.04 per tonne for each Mean Adjustment Point within the limits shown in Table 3.53.2.2A (excluding the requirements of Table 3.53.2.2B). When the Lot Mean Gradation is outside the limits of Table 3.53.2.2A (excluding the requirements of Table 3.53.2.2B) the penalty assessment will be \$0.40 per tonne for each Mean Adjustment Point outside those limits, regardless of the Job Mix Formula tolerance.

When the Lot Mean Gradation for all sieve sizes is within the Job Mix Formula tolerance and within the limits of Table 3.53.2.2A (excluding the requirements of Table 3.53.2.2B) and individual test results for each sieve size are within the allowable range shown in Table 3.53 D, a bonus of \$0.20 per tonne will be applied.

3.53.4.7 Pavement Segregation Requirements

3.53.4.7.1 General

The finished surface of the top lift of ACP shall have a uniform texture and be free of segregated areas.

3.53.4.7.2 Classifying Pavement Segregation

A segregated area is defined as an area of the pavement where the texture differs visually from the texture of the surrounding pavement. For the purposes of classifying pavement segregation, only segregated areas greater than 0.1m² and centre-of-paver streaks greater than 1 m in length will be considered. Moderate or severe segregated areas which do not meet these size parameters will be considered obvious defects. Pavement segregation will be classified as follows:

- Slight - The matrix, asphalt cement and fine aggregate is in place between the coarse aggregate. However, there is more stone in comparison to the surrounding acceptable mix.
- Moderate - Significantly more stone than the surrounding mix; moderately segregated areas usually exhibit a lack of surrounding matrix.
- Severe - Appears as an area of very stony mix, stone against stone, with very little or no matrix.

Centre-of-Paver Streak - Appears as a continuous or semi-continuous longitudinal "streak" typically located in the middle of the paver "mat".

3.53.4.7.3 Inspections for Pavement Segregation

3.53.4.7.3.1 Inspections by the Contractor

The Contractor shall perform a daily inspection of the paving operations on all lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Contractor shall take immediate corrective action to his operations to prevent any further occurrence of segregation.

3.53.4.7.3.2 Inspections by the Consultant

(i) Inspections During Construction

The Consultant shall inspect the lower lifts of pavement to identify any instances of pavement segregation. If segregation is evident, the Consultant shall immediately notify the Contractor so that corrective action can be taken to prevent further occurrence of segregation.

The Consultant shall also inspect the top lift of pavement. Typically, each pavement Lot would be inspected, as soon as possible after the Lot is placed. During the inspection(s) of the top lift, the Consultant will identify and record any areas of moderate and severe segregation and any areas of center-of-paver streak. Areas requiring repair in accordance with Subsection 3.53.4.7.4, Repairing Pavement Segregation, shall be marked. The Consultant will provide the Contractor with a written assessment (location and severity) of the segregated areas as soon as possible following each inspection.

(ii) Inspection Following Construction

The Consultant shall conduct a second inspection of the top lift, normally 2 weeks after the completion of paving work. During this inspection, the Consultant will identify and record any areas of slight, moderate and severe segregation and any areas of centre-of-paver streak which were not identified in the inspections during construction. The Consultant will provide the Contractor with a written assessment (location and severity) of the segregated areas as soon as possible following this inspection.

Requests by the Contractor to have the second inspection conducted on portions of the Work prior to the completion of all paving work will be considered subject to the availability of the Consultant's engineering staff and seasonal weather conditions. This is meant to apply for projects that are not anticipated to be completed prior to winter shut down or where the Contractor has moved his paving operations offsite for an extended period of time. For such inspections the Contractor will be invoiced by the Department at a rate of \$750 per inspection to cover the extra mobilization and travel costs associated with this work.

3.53.4.7.4 Repairing Pavement Segregation

Pavement segregation identified during the inspection performed 2 weeks after the completion of paving operations will not require repair. However, this shall not relieve the Contractor from his responsibility to repair any obvious defects, deteriorated repairs or failures which become evident within the warranty period.

Pavement segregation identified in the inspections performed during construction shall be repaired by the Contractor at his expense and in accordance with the following:

- Moderate and severe segregation in the top lift of pavement and on entrances and intersections shall require repair.
- For entrances and the portion of intersections outside the through travel lanes and shoulders, areas of moderate and severe segregation shall be repaired in accordance with the methods of repair listed for moderate segregation. Intersections and entrances shall also be neatly shaped, smooth and free of surface defects and depressions.
- Slight segregation on any lift of pavement will not require repair.
- Moderate segregation on lower lifts will not require repair.
- Severe segregation on lower lifts will only require repair in instances where, in the opinion of the Consultant, the segregated area will affect the long term structural integrity of the pavement structure. Such repair will not be required in instances where the Consultant determines that the paver screed is "dragging" due to distortion of the existing surface.
- Only moderate and severely segregated centre-of-paver streak on the top lift of pavement will require repair.

The following methods of repair are pre-approved:

Moderate Segregation - The Contractor has the option of using a slurry patch or a hot mix patch.

Severe Segregation - The Contractor has the option of removal and replacement or overlay.

Any other methods of repair proposed by the Contractor will be subject to the approval of the Consultant with the exception that the application of asphalt (by distributor, hand spraying, squeegeeing, etc.) shall not be permitted as a method of repair under any circumstances.

Repairs for segregation using an overlay shall be for the entire pavement width. Repairs for segregation using removal and replacement shall be for the full lane width, full lane width and shoulder or the shoulder only as applicable, depending on the extent of the segregated area. The full depth of the asphalt lift shall be removed and replaced with new ACP using an appropriate paver and cold milling equipment. All ACP material used for overlay and removal and replacement repairs shall have a tack coat applied prior to placement and will be subject to the requirements of Subsection 3.53.6.3, End Product Rejection.

The Consultant will mark out the area of repair. The "marked area" shall extend a minimum of 0.5 m beyond the segregated area. For centre-of-paver streak, the "marked area" shall extend a minimum of 100 mm laterally and 0.5 m longitudinally beyond the streak.

All repairs shall be regular in shape and finished using good workmanship practices to provide an appearance suitable to the Consultant. Traffic shall be kept off all repairs for a sufficient period of time to ensure that tracking does not occur.

All hot mix and other repairs for which compaction is normally required shall be properly compacted.

In the event repairs cover existing roadway lines or markings, the Contractor shall reinstate the lines and markings at his expense and to the satisfaction of the Consultant.

Repairing pavement segregation will not affect the assessment of segregation payment adjustments.

Repairs shall be completed during construction or shortly after construction, except when prevented by inclement weather or seasonal shutdown. In these cases, the Contractor shall complete the repairs prior to June 15 of the following year.

3.53.4.8 **Appeal of Acceptance Test Results and Appeal Testing**

3.53.4.8.1 Density, Asphalt Content and Gradation

Appeal testing will be done using ATT-68. The Contractor may appeal the results of acceptance testing of Density, Asphalt Content or Gradation for any rejected or penalized Lot only once. Appeals will only be considered if cause can be shown. Quality Control test results for density which are provided to the Consultant subsequent to the Contractor's receipt of the quality assurance test results for that Lot will not be considered when evaluating cause for an appeal. The appeal shall be for all tests within the Lot, and there will be no appeal allowed for single tests within a Lot.

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

The following procedures will apply for an appeal:

- (i) For Gradation and Asphalt Content appeals, the Contractor shall serve notice of appeal to the Consultant, in writing, within 48 hours of receipt of the test results.

For all other appeals notice shall be served to the Consultant, in writing, within 24 hours of receipt of the test results.

- (ii) The Consultant will arrange and pay for an independent testing laboratory certified to operate in the Province of Alberta, 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.
- (iii) The Consultant will determine the number and location of the new tests for each segment in accordance with Subsection 3.53.4.4.2, Acceptance Sampling and Testing Procedures. The Contractor shall sample the pavement at such locations and provide the samples to the Consultant.
- (iv) For appeals other than gradation appeals, the single high and single low test results from the old Lot will be rejected and the remaining test results will be added to the results of the new tests. A new Lot Mean for the test results will be determined and used for acceptance and unit price adjustment.

For gradation appeals, all tests from the old Lot will be retained and averaged with the new appeal tests. A new Lot Mean and Range for all tests will be determined and used for acceptance and unit price adjustment.

The new values, thus determined, in all cases, will be binding on the Contractor and the Department.

3.53.4.8.2 Smoothness

The Contractor may appeal acceptance test results of smoothness of any rejected or penalized Sublot once. The appeal shall be in writing and submitted within 24 hours of receipt of the test results.

Any attempt to improve smoothness on the appealed Sublot after the Consultant has tested the Lot for acceptance shall void the appeal and the original test results will apply.

The appeal testing will be performed by a firm that is pre-qualified by the Department for QA smoothness testing. The new results will be binding on the Contractor and the Department.

3.53.4.8.3 Segregation Rating

The Contractor may appeal the rating of segregated areas classified as moderate or severe in any portion of the Work or the entire project for lane.km(s) that are not in bonus.

The following procedures will apply for an appeal:

- (i) The Contractor must serve written notice of the appeal to the Consultant within 7 days of receipt of the final segregation assessment. The written notice shall detail the location(s) and nature of the appeal.
- (ii) The Consultant will determine a representative sample of the portion of the Work appealed, and will reassess this area. Generally, this reassessment will be completed within 2 weeks of the Consultant's receipt of the written notice of appeal.

Based on the reassessment of the representative sample, the Consultant will determine whether or not a reassessment of the entire appealed work is necessary.

3.53.4.8.4 Payment of Appeal Testing Costs for Asphalt Content, Smoothness or Gradation

If the new results show that a penalty no longer applies, then sampling and testing costs for the appeal procedures for that Lot will be the responsibility of the Department. Furthermore, in such cases the Contractor shall be reimbursed sampling costs at the rate of \$50 per location.

If the new results verify that any unit price reduction or rejection remains valid for that Lot, then the Contractor will be invoiced by the Department for the testing costs for the appeal procedures at the following rates:

Asphalt Content: \$ 2,000.00 for the first appeal Lot
\$ 1,000.00 for subsequent Lots if an asphalt correction factor is not required.

Gradation: \$ 1,000.00 per appeal

Profilograph: \$ 150.00 per hour (travel time, testing time and standby time)

3.53.4.8.5 Payment of Appeal Testing Costs for Density

If the new results indicate that the new Lot Mean for Density is no longer in a penalty situation and that the Lot Mean has increased by more than 0.8%, then the costs of sampling and testing for the appeal procedures shall be the responsibility of the Department. Furthermore, in such cases the Contractor shall be reimbursed sampling costs at the rate of \$50 per location.

If the new results indicate that the Lot Mean for Density is either in a penalty situation or has not increased by more than 0.8%, then the Contractor shall be invoiced by the Department for the sampling and testing costs for the appeal procedures at a rate of \$250.00 per Lot appealed.

3.53.4.8.6 Payment of Appeal Testing Costs for Segregation Rating

If a reassessment of the appealed work results in a change in the original rating, the revised rating will apply.

If the overall payment adjustment for segregation is reduced as a result of an appeal, the cost of the reassessment will be borne by the Department.

If there is no change to the overall payment adjustment for segregation or if the overall payment adjustment is increased, the Contractor will be charged an amount of \$3,500.00.

3.53.5 CONSTRUCTION

3.53.5.1 **Equipment**

3.53.5.1.1 General

Equipment shall be designed and operated to produce an end product complying with the requirements of this specification.

3.53.5.1.2 Mixing Plant

Mixing plants shall be operated in accordance with the Manufacturer's recommendations and shall be calibrated prior to commencing production of the specified mix. The Contractor shall provide the Consultant with a certificate of calibration which certifies that the plant has been calibrated to produce a uniform mixture in accordance with the Job Mix Formula.

When asphalt concrete pavement contains reclaimed asphalt pavement, the mixing plant shall be capable of thoroughly separating and heating the RAP particles and blending the RAP with virgin aggregate and any required asphalt cement, to create a homogeneous mix at the plant discharge. The plant shall also contain specialized mixing equipment that will prevent the RAP from coming into direct contact with the flame, thus minimizing "blue smoke" and oxidation of the asphalt in the RAP.

3.53.5.1.3 Mix Production

Aggregate and asphalt shall be combined to produce a uniform mixture of specified gradation at an asphalt content in accordance with the approved Job Mix Formula and in which all particles of aggregate are uniformly coated.

Unless otherwise specified, the maximum mixing temperature for all grades of asphalt shall be 155° C, or for Performance Grade specified asphalt, as recommended in writing by the asphalt supplier.

Plant emissions shall not exceed the limits set by Alberta Environment.

3.53.5.2 Preparation of Existing Surface

3.53.5.2.1 General

Failed areas in existing surfaces shall be repaired in accordance with Specification 3.1, Subgrade Preparation, or as directed by the Consultant. Areas requiring repair will be identified by the Consultant in consultation with the Contractor.

Before the asphalt mix is placed, dirt and other objectionable material shall be removed from the surface to be paved, by brooming or other methods and a tack coat or prime coat shall be applied in accordance with Specification 3.19, Prime, Tack and Fog Coats.

Existing fillets and ramps at approaches to railway crossings and bridge structures, or adjacent to paved surfaces or other structures, shall be removed to the depths shown on the Drawings or as directed by the Consultant. The removed material shall be disposed of and the exposed surfaces shall be prepared as directed by the Consultant.

Contact edges of existing mats and contact faces of curbs, gutters, manholes, sidewalks and bridge structures shall be coated with a thin film of liquid asphalt material before placing the asphalt mix.

3.53.5.2.2 Preliminary Leveling

Areas that require preliminary leveling will be as shown on the Drawings or as identified in the field by the Consultant. Generally, areas that show depressions, rutting or other deformations to a depth of 15 mm or greater will be designated by the Consultant for preliminary leveling.

Pavement lifts that are specified, or shown on the Drawings, with designated lift thickness less than 20 mm shall be considered as preliminary leveling and shall be placed using a paver. Preliminary leveling not specified to be placed using a paver lift shall be spread using a motor grader or other methods approved by the Consultant. All of the following shall apply for acceptance:

- (i) if the material type for preliminary leveling is not specified or shown on the Drawings it shall be the same Designation and Class as specified for the subsequent lift of asphalt concrete pavement;
- (ii) regardless of how the asphalt mix is spread, a minimum of one pneumatic tired roller shall be used for compaction, and a minimum density of 91.0% of the Marshall density, as determined by the Consultant, is required;
- (iii) preliminary leveling is intended to be a separate operation and shall not be done as part of the construction of the subsequent lift of asphalt concrete pavement.

For the purposes of determining the unit price adjustments listed in Table 3.53 A and lump sum subplot assessments listed in Table 3.53 C, preliminary leveling is not considered to be a lift.

3.53.5.2.3 Transverse Pavement Joints

Transverse joints between existing pavement and ACP placed under this Contract shall be of a vertical butt type, well bonded, sealed and finished to provide a continuous, smooth profile across the joint. This shall include tie-ins to all paved road allowances, median cross-overs, and approaches to bridges and railway crossings. Tie-ins to streets, parking lots and other urban approaches shall be as specified in the Special Provisions. To accomplish this, the

existing pavement shall be cold-milled to expose a vertical surface, of a depth equal to the thickness of the final lift, against which new ACP may be placed. In longitudinal section the minimum slope of the milled area shall be 200 horizontal to 1 vertical, all in general conformance with Drawing CB6-3.50M16. In plan, the Contractor shall have the option of cutting the joint in any of the three ways following:

- (i) The joint shall be cut at 45° to the centreline of the roadway across the full width of each mat; or
- (ii) The joint shall be cut at 45° to the roadway centreline across the travel lanes and contiguously at 90° to the roadway centreline elsewhere; or
- (iii) For median cross-overs, bridges and railway crossings the joint shall be cut parallel to the crossing.

When the existing pavement has been removed in advance of paving the joint area, the Contractor shall construct a smooth taper at the joint area to a slope of at least 50 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed as directed by the Consultant. The transverse joint shall be straight and have a vertical face when the taper is removed.

3.53.5.3 Transporting the Asphalt Mix

The mix shall be transported in accordance with Specification 4.5, Hauling. Trucks used for transportation of the mix shall be compatible with the size and capacity of the spreading equipment.

Truck boxes shall be clean, free from accumulations of asphalt mix and foreign material. Excess truck box lubricants such as light oil, detergent or lime solutions shall not be allowed to contaminate the mix, and shall be disposed of in an environmentally acceptable manner. Petroleum based truck box lubricants shall not be used.

During transport, the mix shall be completely covered to protect it from precipitation and excessive heat loss by securely fastened waterproofed tarpaulins, unless otherwise approved by the Consultant.

3.53.5.4 Placing the Mix

Asphalt mix shall be placed only on dry surfaces.

Unless otherwise shown on the plans, the asphalt mix shall be placed in the following lift thicknesses:

- (i) in a single lift when the design compacted total thickness is 70 mm or less.
- (ii) in two or more lifts when the design compacted total thickness is greater than 70 mm. The lift thickness selection shall be determined by the Contractor except that:
 - a) the maximum thickness of any lift shall be 100 mm.
 - b) the minimum thickness of a top lift shall be 50 mm.
 - c) When a total ACP thickness of 80 mm is specified, the thickness of the first lift shall be 30 mm and the final lift shall be 50 mm.

- d) When a total ACP thickness of 90 mm or more is specified, the minimum thickness of all lifts except the top lift shall be 40 mm or greater.

Lift thickness will normally be designed and expressed in increments of 10 mm.

Longitudinal joints will not be permitted between the edges of driving lanes in the final lift of ACP. Longitudinal joints shall be offset a minimum of 150 mm from one lift to the next.

Longitudinal and transverse joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joints. Surplus material at longitudinal joints shall be disposed of in a manner acceptable to the Consultant. Broadcasting surplus material across the mat will not be permitted.

All longitudinal joints shall be straight and uniform with no lateral waviness. Any mat contact that is not straight or uniform as determined by the Consultant shall be trimmed by saw-cutting or using some other method acceptable to the Consultant prior to placing the adjacent mat. The material removed shall be disposed of to the satisfaction of the Consultant.

Any mat with a contact edge that has deteriorated, cracked or slumped due to improper rolling or vehicle traffic shall be trimmed by saw-cutting or some other method acceptable to the Consultant prior to placing the adjacent mat. The length of contact edge to be trimmed, removed and disposed of will be as determined by the Consultant.

If required by the Consultant the contact edge of any mat placed by the Contractor shall be coated with a thin film of liquid asphalt before placing the adjacent mat.

When paving is discontinued in any lane, the mat shall be tapered to a slope of 10 horizontal to 1 vertical. The taper may be placed on tar paper and shall be removed when paving is resumed. The transverse joint shall be straight and have a vertical face when the taper is removed.

Transverse construction joints from one lift to the next shall be separated by at least 2 m.

Where the construction of a top lift of pavement next to a concrete curb section or curb and gutter section will be delayed, the Contractor shall construct a temporary asphalt concrete fillet next to the concrete section in accordance with the Drawings or as directed by the Consultant. These fillets shall be removed when paving is resumed.

Placement of ACP adjacent to guardrail shall conform with Typical Barrier Drawing No. TEB 3.56.

3.53.5.5 Road Intersections and Entrances

Road intersections and entrances shall be paved in accordance with the Drawings or as herein described in these specifications.

On all road intersections, median cross-overs and residential farm entrances, the asphalt mix shall be spread by means of a paver. No grader laying will be permitted except for bottom lift or preliminary leveling.

On all other entrances, the asphalt mix shall be spread by means determined by the Contractor and in a manner acceptable to the Consultant.

3.53.5.6 Compacting the Mix

All asphalt mix, including those areas of the mat which are excluded from testing as noted in Subsection 3.53.4.4.2.1, shall be thoroughly compacted, and after final rolling the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

The rollers or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion. Excess water or release agents shall not be used.

After final rolling is complete, the Contractor shall ensure that the finished mat has cooled for a minimum period of 2 hours before opening the section to traffic.

3.53.5.7 Asphalt Mix for Others

The Contractor shall make available, on request, additional asphalt mix for the use of the Department. The estimated quantity of additional mix is shown in the unit price schedule as "Asphalt Mix for Others." This additional mix will be picked up at the mixing plant by other forces at times that are mutually agreeable to the Contractor and the Consultant.

3.53.5.8 Interim Lane Markings

The Contractor shall provide interim lane markings on all newly constructed ACP surfaces, or on tacked surfaces that are to be exposed to traffic overnight.

When paint is used, the paint shall be the same colour as the permanent markings designed for the Work.

All paint spots shall be 100 mm wide and 300 mm long, shall be applied lengthwise to the road surface, shall be spaced 15 m apart on centre in tangent sections and 7.5 m apart on curves and shall be completely covered with glass beads at the time of painting.

When self-adhesive, reflectorized pavement marking tape is used, the spacing shall be the same as is used for paint spots. Tape on lower lifts does not need to be removed prior to placement of the next lift of pavement. If tape is used on the upper lift, it shall be removed immediately prior to painting the permanent lane markings.

When temporary pavement markers are used, they shall be placed at 25 m intervals on tangent sections and at 15 m intervals on curves. Markers used on the upper lift must remain in place until the permanent markings are applied. Markers used on lower lifts, shall be removed immediately prior to placement of the next lift of pavement.

3.53.5.9 Grooved Rumble Strips

When specified in the Special Provisions, the Contractor shall construct grooved rumble strips as shown on Drawing CB6-3.50M15.

No grooving will be done across intersections or accesses nor at any other locations specified by the Consultant.

The grooving shall be applied only to the top lift of the pavement and may be formed by any means which the Contractor may propose and which are acceptable to the Consultant. The Contractor shall remove and repair any grooving placed beyond the limits outlined, at his own expense.

3.53.6 END PRODUCT ACCEPTANCE OR REJECTION**3.53.6.1 General**

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the Specifications and Drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

3.53.6.2 End Product Acceptance**3.53.6.2.1 Acceptance at Full or Increased Payment**

Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects and if:

- (i) The Lot Mean for density of the compacted mix in the Lot is not in penalty or reject according to the criteria outlined in Table 3.53 A.
- (ii) The Lot Mean for Actual Asphalt Content of the mix, is within 0.3 of the Approved Asphalt Content. On QC Acceptance Lots, where quality assurance test results for asphalt content are not available, the Contractor's quality control test results shall be used. Quality assurance test results when available shall replace any corresponding quality control test results.
- (iii) For smoothness, full payment will occur if the Profile Index of all Sublots in the Lot in the top lift of pavement are not in penalty or reject according to the criteria outlined in Table 3.53 C.

Increased payment will occur if the Profile Index of all Sublots in the Lot in the top lift of pavement is 0.

- (iv) Individual bumps and dips in the top lift of pavement do not exceed 8 mm.
- (v) For gradation in QA Acceptance Lots only, full payment will occur if there are no Lot Mean Adjustments for gradation and increased payment will occur if there are no Lot Mean Adjustments and the Maximum Range as shown in Table 3.53 D is not exceeded for any sieve size in the Lot.

For gradation in QC Acceptance Lots, consideration is only given to acceptance at full payment. No increased payment will be applied using quality control test results.

3.53.6.2.2 Acceptance at Reduced or Adjusted Payment

Acceptance of any Lot at reduced payment will occur if it contains no obvious defects and if;

- (i) the quality assurance test results are such that the Lot or Sublot meets with requirements for acceptance at a reduced payment. For asphalt content and aggregate gradation no decreased payment will be applied using quality control test results.
- (ii) the Lot or Sublot is approved in respect of all other requirements.
- (iii) the Contractor has not notified the Consultant in writing that he will exercise his option to repair or remove and replace the Work at his own cost with work meeting the requirements for acceptance at full or increased payment.
- (iv) individual bumps and dips measuring 12 mm or greater have been repaired.

- (v) individual bumps and dips exceeding 8 mm and less than 12 mm which have been designated by the Consultant as unacceptable, have been repaired.

Both bonus and penalty adjustments may be made for any Lot in accordance with Section 3.53.7, Measurement and Payment.

3.53.6.3 End Product Rejection

If the Lot Mean for Density or Actual Asphalt Content are outside the applicable acceptance limits, then the Lot is rejected automatically, regardless of the values of the other control characteristics.

If the smoothness of the top lift of any Sublot is outside the acceptance limit, then the Sublot is rejected automatically, regardless of the values of the other control characteristics.

The finished surface of any lift shall have a uniform close texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Consultant such as, but not limited to the following, will be cause for automatic rejection of asphalt concrete pavement regardless of the values of any other control characteristic.

- (i) individual bumps and dips 12 mm or greater. The Consultant may reject asphalt concrete pavement with individual bumps and dips exceeding 8 mm and less than 12 mm.
- (ii) segregated areas not already covered in Subsection 3.53.4.7, Pavement Segregation Requirements.
- (iii) areas of excess or insufficient asphalt.
- (iv) improper matching of longitudinal and transverse joints.
- (v) roller marks.
- (vi) tire marks.
- (vii) cracking or tearing.
- (viii) sampling locations not properly reinstated.
- (ix) improperly constructed patches.
- (x) top lift surfaces, which are torn due to the dragging of the paver screed.
- (xi) Any final lift surface with a variation greater than 6 mm from the edge of a 3 m straightedge placed in any direction on the surface.

When ACP is rejected by reason of obvious defects, the minimum area of rejection will be Sublot size as defined in Subsection 3.53.1.2 of this specification.

Rejected work shall be promptly repaired, remedied, overlaid, or removed and replaced all in a manner acceptable to the Consultant. The Contractor shall be responsible for all costs including materials.

No payment will be made for work in any Lot or Sublot which has been rejected, until the defects have been remedied.

If an overlay is used as a corrective measure on a defective Lot or Sublot, the overlay thickness will be subject to the approval of the Consultant. Where an overlay is used as a corrective measure in any lane, adjacent lanes shall also be overlaid to the same thickness and length,

regardless of whether the adjacent lanes were acceptable or not. The overlay will be subject to the same specifications as the original pavement, except that the minimum thickness of an overlay shall be the lesser of 40 mm or the design lift thickness of the defective material.

3.53.7 MEASUREMENT AND PAYMENT

3.53.7.1 **General**

The unit prices for the following items of work shall be full compensation for all labour, material, tools, equipment and incidentals necessary to complete the Work in accordance with these specifications.

3.53.7.2 **Asphalt Concrete Pavement - Superpave**

Accepted asphalt concrete pavement will be measured in tonnes and will be paid for at the unit price bid per tonne for "Asphalt Concrete Pavement - Superpave" subject to the unit price adjustments and assessments hereinafter specified. This payment will be full compensation for supplying, applying and maintaining tack coat; supplying the asphalt binder; processing, hauling and placing the mix; interim lane marking and quality control.

3.53.7.2.1 Pay For Acceptable Work

The following end product properties of "Asphalt Concrete Pavement - Superpave" will be measured for acceptance in accordance with Subsection 3.53.4.4, Acceptance Sampling and Testing.

- (i) Density
- (ii) Actual Asphalt Content
- (iii) Smoothness
- (iv) Aggregate Gradation

For the Density, Actual Asphalt Content of a Lot to be acceptable, the Lot Means must be within the acceptance limits shown in Tables 3.53 A and 3.53 B respectively.

For each Lot, the unit price adjustments for Density and Actual Asphalt Content will be the amounts shown in Tables 3.53 A and 3.53 B for the Sample Mean of the test results for that Lot.

For each Lot, the unit price adjustment for Gradation will be as defined in Subsection 3.53.4.6, Aggregate Gradation Requirements.

The unit price applicable to each Lot quantity of "Asphalt Concrete Pavement - Superpave" will be calculated as follows:

$$\boxed{\begin{array}{c} \text{Lot Unit} \\ \text{Price} \\ \text{Per Tonne} \end{array}} = \boxed{\begin{array}{c} \text{Contract Unit} \\ \text{Price Bid Per} \\ \text{Tonne} \end{array}} + \boxed{\begin{array}{c} \text{the sum of the} \\ \text{unit price} \\ \text{adjustment for} \\ \text{PAd and PAa} \\ \text{and PAg} \end{array}}$$

where:

PAd = Unit Price Adjustment for Density (bonus or penalty)

PAa = Unit Price Adjustment for Asphalt Content (penalty only; QA Acceptance Lots only)

PAg = Unit Price Adjustment for Gradation (bonus or penalty; QA Acceptance Lots only)

If the Lot Mean for Density, Actual Asphalt Content or Gradation for any Lot is outside the acceptance limit, the Lot is rejected, and no payment will be made for the quantity of asphalt concrete pavement in that Lot, until the defect has been remedied.

For the Smoothness of any Sublot in the top lift of ACP to be acceptable, the P_{rl} must be within the limits shown in Table 3.53 C. For each Sublot in the top lift of ACP, the penalty assessment for Smoothness will be the amounts shown in Table 3.53 C for the P_{rl} of that Sublot. All of these penalty assessments so determined will be deducted from the payment made for Asphalt Concrete Pavement-Superpave.

Every Sublot in the top lift of ACP that is outside the acceptance limit for smoothness will be rejected and payment will not be made for the quantity of asphalt concrete pavement in these Sublots until they have been made acceptable. Payment for the remainder of the Lot will be made in accordance with the above formula using P_{Ad}, P_{Aa} and P_{Ag} as determined for the Lot from which will be subtracted any penalty assessment for smoothness.

No payment will be made for any material, equipment or manpower used to improve acceptable work that is or was subject to unit price adjustment or penalty assessment.

3.53.7.2.2 Segregation Payment Adjustments

Payment adjustments for pavement segregation shall apply to the top lift of ACP only and in accordance with the following:

- Segregated areas, centre-of-paver streak and any repaired segregated areas identified by the Consultant either during construction or during the inspection conducted 2 weeks after the completion of paving work, will be used to determine payment adjustments. Payment adjustments will not apply to segregated areas 0.1 m² or less or on centre-of-paver streaks 1 m or less in length.
- Segregated areas (excluding centre-of-paver streaks) separated by less than 3 m shall be considered a single area for the determination of payment adjustments. For centre-of-paver streak, each area will be measured separately for payment adjustments.
- Payment adjustments for segregation will not apply to entrances or the portion of an intersection outside the through travel lanes and shoulders.
- If a segregated area is identified by the Contractor and repaired prior to inspection by the Consultant it will be classified as "moderate" for the purpose of determining payment adjustments.
- Payment adjustments will apply regardless of the year the pavement is placed and the year the pavement is inspected.
- Payment adjustments will not apply to instances where the Consultant determines that the paver screed is "dragging".

The total payment adjustment for segregation is determined as follows:

- Each lane.km of the completed pavement is inspected separately by the Consultant. A "lane" includes the adjoining shoulder. Measurement of lane.kms will be made in 1 kilometre (or partial kilometre) long segments, 1 lane wide as shown on the Contract Drawing. Acceleration and deceleration lanes and interchange ramps are considered separate lanes.

For each lane.km, the Consultant will determine the following:

- (i) the total number of slight segregated areas and
- (ii) the total number of moderate and severe segregated areas and
- (iii) the total length of centre-of-paver streak (determined by adding each instance of streak that is in excess of 1 m in length)

These values will be used for the "segregation frequencies" and "length of centre-of-paver streak" in Tables A, B & C as applicable, with the exception that for partial lane-kms, the segregation frequency for slight segregation will be calculated by dividing the actual number of slight segregated areas by length of the segment assessed (expressed in kilometres) and rounding to the nearest whole number.

Table A
Payment Adjustment for Slight Segregation

Segregation Frequency of Slight Areas (per lane-km)	Payment Adjustment \$ per lane-km
0	(3)
1 or 2	(4)
Greater than 2	- (number of areas - 2) x \$100

Table B
Payment Adjustment for Moderate and Severe Segregation

Segregation Frequency of Moderate and Severe Areas (per lane-km)	Payment Adjustment \$ per lane-km
0	(3)
Greater than 0	- (number of areas) x \$500

Table C
Payment Adjustment for Centre-of-Paver Streak

Length of Centre-of-Paver Streak (per lane-km)	Payment Adjustment \$ per lane-km
1 metre or less	(3)
Greater than 1 metre	- \$1.50 per linear metre

- (1) Total payment adjustment per lane-km for segregation will be the sum of Tables A, B and C.
- (2) For partial lane kilometres, the payment adjustments for Table A will be prorated based upon the actual length of segment assessed.
- (3) Lane kilometres with no areas of segregation of any type or severity, or any centre-of-paver streaks will be assigned a bonus payment of \$1000 per lane.km. For partial lane.kms the bonus will be prorated based upon the actual length of the segment assessed.

- (4) Lane kilometres with 1 or 2 areas of slight segregation, no moderate or severely segregated areas and no centre-of-paver streak will be assigned a bonus payment of \$500 per lane.km.
(For partial lane.kms the bonus will be prorated based upon the actual length of the segment assessed.)
- (5) The maximum penalty adjustment for segregation shall be limited to \$2,000 per lane.km. For partial lane-kms, this adjustment will be prorated based upon the actual length of segment assessed.

3.53.7.2.3 Payment For Work That Had Been Rejected, But Was Made Acceptable

When defects have been remedied in Lots or Sublots which had been rejected, payment for the original quantity of material in those Lots or Sublots will be made subject to unit price adjustments and penalty assessments determined as follows:

- (i) Penalty or bonus assessments will be made for smoothness as follows:

Penalty or bonus assessments for P_{RI} will be the amounts shown in the applicable section of Table 3.53 C and will be based on Profilograph tests following the Contractor's corrective efforts for any bumps and dips.

The penalty assessment for each bump or dip over 8 mm will be \$300.00 for multi-lift pavements and \$100.00 for single-lift or curb and gutter applications. Penalty assessments for bumps and dips will be based on initial profilograph testing conducted by the Consultant. Repairs carried out by the Contractor will not affect the penalty assessment for bumps and dips.

If bumps or dips are treated by the Contractor prior to Profilograph tests by the Consultant, such defects will be considered greater than 8 mm and will be assessed at the applicable penalty assessment rates.

- (ii) The unit price adjustment for Asphalt Content, Density and Gradation 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 Sublot, prior tests on the uncovered area will be averaged with new tests on the corrective work.

The unit price adjustment determined through retesting of the corrective work will be applied to that quantity of material in the Lot or Sublot which was originally rejected, to determine payment.

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed entirely at the Contractor's expense.

3.53.7.3 **Repair of Failed Areas in Existing Surfaces**

Repair of failed areas in existing surfaces as identified under Subsection 3.53.5.2 will be paid for at the Contract unit prices bid for the Work. Unit price adjustment will not apply to material used to repair failed areas in existing surfaces.

3.53.7.4 **Removal and Disposal of Fillet and Ramp Material**

The removal and disposal of fillet and/or ramp material will be considered incidental to the Work and will not be paid for separately.

3.53.7.5 **Transverse Pavement Joints**

Constructing transverse pavement joints including any required cold-milling will be considered incidental to the Work and will not be paid for separately.

3.53.7.6 Preliminary Leveling

Accepted material used for preliminary leveling will be measured and paid for at the unit price bid for "Asphalt Concrete Pavement – Superpave" where applicable. Unit price adjustments will not apply to material used for leveling. No payment will be made for unacceptable material.

3.53.7.7 Asphalt Mix for Others

Accepted additional asphalt concrete mixture will be measured in tonnes and paid for at the unit price bid for "Asphalt Mix For Others".

Unit price adjustment will not apply to additional asphalt concrete received at the plant by other forces.

3.53.7.8 Grooved Rumble Strips

Measurement of shoulder grooving will be made parallel to the road centreline, to the nearest 0.001 km of through highway chainage for each side of the road where accepted grooving is performed.

Payment for shoulder grooving will be made at the unit price bid per kilometre for "Grooved Rumble Strips". This payment will be full compensation for all labour, equipment, tools, materials and incidentals necessary to complete the Work.

TABLE 3.53 A UNIT PRICE ADJUSTMENT FOR DENSITY				
% of Maximum Specific Gravity	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE			
	DESIGN LIFT THICKNESS			
LOT MEAN	35 MM OR GREATER	LESS THAN 35 MM AND GREATER THAN 20 MM	20 MM	35 MM OR GREATER
	LOWER LIFTS	LOWER LIFTS	LOWER LIFTS	TOP LIFT ONLY
≥ 94.0	+ 1.00	+ 1.00	+ 1.00	+ 1.00
93.9	+ 0.90	+ 0.90	+ 0.90	+ 0.90
93.8	+ 0.80	+ 0.80	+ 0.80	+ 0.80
93.7	+ 0.70	+ 0.70	+ 0.70	+ 0.70
93.6	+ 0.60	+ 0.60	+ 0.60	+ 0.60
93.5	+ 0.50	+ 0.50	+ 0.50	+ 0.50
93.4	+ 0.40	+ 0.40	+ 0.40	+ 0.40
93.3	+ 0.30	+ 0.30	+ 0.30	+ 0.30
93.2	+ 0.20	+ 0.20	+ 0.20	+ 0.20
93.1	+ 0.10	+ 0.10	+ 0.10	+ 0.10
93.0	0.00	0.00	0.00	0.00
92.9	-0.20	0.00	0.00	-0.20
92.8	-0.40	0.00	0.00	-0.40
92.7	-0.60	0.00	0.00	-0.60
92.6	-0.80	0.00	0.00	-0.80
92.5	-1.00	0.00	0.00	-1.00
92.4	-1.20	0.00	0.00	-1.20
92.3	-1.40	0.00	0.00	-1.40
92.2	-1.60	0.00	0.00	-1.60
92.1	-1.80	0.00	0.00	-1.80
92.0	-2.00	0.00	0.00	-2.00
91.9	-2.20	0.00	0.00	-2.20
91.8	-2.40	0.00	0.00	-2.40
91.7	-2.60	0.00	0.00	-2.60
91.6	-2.80	0.00	0.00	-2.80
91.5	-3.00	0.00	0.00	-3.00
91.4	-3.20	0.00	0.00	-3.20

TABLE 3.53 A UNIT PRICE ADJUSTMENT FOR DENSITY				
% of Maximum Specific Gravity	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE			
LOT MEAN	DESIGN LIFT THICKNESS			
	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY
91.3	-3.40	0.00	0.00	-3.40
91.2	-3.60	0.00	0.00	-3.60
91.1	-3.80	0.00	0.00	-3.80
91.0	-4.00	0.00	0.00	-4.00
90.9	-4.40	0.00	0.00	-4.40
90.8	-4.80	0.00	0.00	-4.80
90.7	-5.20	0.00	0.00	-5.20
90.6	-5.60	0.00	0.00	-5.60
90.5	-6.00	0.00	0.00	-6.00
90.4	-6.40	0.00	0.00	-6.40
90.3	-6.80	0.00	0.00	-6.80
90.2	-7.20	0.00	0.00	-7.20
90.1	-7.60	0.00	0.00	-7.60
90.0	-8.00	0.00	0.00	-8.00
89.9	50% OF UNIT PRICE	-0.20	0.00	OVERLAY OR RM.&RP.
89.8	50% OF UNIT PRICE	-0.40	0.00	OVERLAY OR RM.&RP.
89.7	50% OF UNIT PRICE	-0.60	0.00	OVERLAY OR RM.&RP.
89.6	50% OF UNIT PRICE	-0.80	0.00	OVERLAY OR RM.&RP.
89.5	50% OF UNIT PRICE	-1.00	0.00	OVERLAY OR RM.&RP.
89.4	50% OF UNIT PRICE	-1.20	0.00	OVERLAY OR RM.&RP.
89.3	50% OF UNIT PRICE	-1.40	0.00	OVERLAY OR RM.&RP.
89.2	50% OF UNIT PRICE	-1.60	0.00	OVERLAY OR RM.&RP.
89.1	50% OF UNIT PRICE	-1.80	0.00	OVERLAY OR RM.&RP.
89.0	50% OF UNIT PRICE	-2.00	0.00	OVERLAY OR RM.&RP.
88.9	50% OF UNIT PRICE	-2.20	-0.20	OVERLAY OR RM.&RP.
88.8	50% OF UNIT PRICE	-2.40	-0.40	OVERLAY OR RM.&RP.
88.7	50% OF UNIT PRICE	-2.60	-0.60	OVERLAY OR RM.&RP.
88.6	50% OF UNIT PRICE	-2.80	-0.80	OVERLAY OR RM.&RP.
88.5	50% OF UNIT PRICE	-3.00	-1.00	OVERLAY OR RM.&RP.
88.4	50% OF UNIT PRICE	-3.20	-1.20	OVERLAY OR RM.&RP.
88.3	50% OF UNIT PRICE	-3.40	-1.40	OVERLAY OR RM.&RP.
88.2	50% OF UNIT PRICE	-3.60	-1.60	OVERLAY OR RM.&RP.
88.1	50% OF UNIT PRICE	-3.80	-1.80	OVERLAY OR RM.&RP.
88.0	50% OF UNIT PRICE	-4.00	-2.00	OVERLAY OR RM.&RP.
87.9	50% OF UNIT PRICE	-4.40	-2.20	REMOVE & REPLACE
87.8	50% OF UNIT PRICE	-4.80	-2.40	REMOVE & REPLACE
87.7	50% OF UNIT PRICE	-5.20	-2.60	REMOVE & REPLACE
87.6	50% OF UNIT PRICE	-5.60	-2.80	REMOVE & REPLACE
87.5	50% OF UNIT PRICE	-6.00	-3.00	REMOVE & REPLACE
87.4	50% OF UNIT PRICE	-6.40	-3.20	REMOVE & REPLACE
87.3	50% OF UNIT PRICE	-6.80	-3.40	REMOVE & REPLACE
87.2	50% OF UNIT PRICE	-7.20	-3.60	REMOVE & REPLACE
87.1	50% OF UNIT PRICE	-7.60	-3.80	REMOVE & REPLACE
87.0	REMOVE & REPLACE	-8.00	-4.00	REMOVE & REPLACE
86.9	REMOVE & REPLACE	50% OF UNIT PRICE	-4.40	REMOVE & REPLACE
86.8	REMOVE & REPLACE	50% OF UNIT PRICE	-4.80	REMOVE & REPLACE
86.7	REMOVE & REPLACE	50% OF UNIT PRICE	-5.20	REMOVE & REPLACE
86.6	REMOVE & REPLACE	50% OF UNIT PRICE	-5.60	REMOVE & REPLACE
86.5	REMOVE & REPLACE	50% OF UNIT PRICE	-6.00	REMOVE & REPLACE
86.4	REMOVE & REPLACE	50% OF UNIT PRICE	-6.40	REMOVE & REPLACE
86.3	REMOVE & REPLACE	50% OF UNIT PRICE	-6.80	REMOVE & REPLACE
86.2	REMOVE & REPLACE	50% OF UNIT PRICE	-7.20	REMOVE & REPLACE
86.1	REMOVE & REPLACE	50% OF UNIT PRICE	-7.60	REMOVE & REPLACE
86.0	REMOVE & REPLACE	50% OF UNIT PRICE	-8.00	REMOVE & REPLACE
85.9	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.8	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.7	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.6	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE

TABLE 3.53 A UNIT PRICE ADJUSTMENT FOR DENSITY				
% of Maximum Specific Gravity	UNIT PRICE ADJUSTMENT - DOLLARS PER TONNE			
LOT MEAN	DESIGN LIFT THICKNESS			
	35 MM OR GREATER LOWER LIFTS	LESS THAN 35 MM AND GREATER THAN 20 MM LOWER LIFTS	20 MM LOWER LIFTS	35 MM OR GREATER TOP LIFT ONLY
85.5	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.4	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.3	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.2	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.1	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
85.0	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.9	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.8	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.7	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.6	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.5	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.4	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.3	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.2	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
84.1	REMOVE & REPLACE	REMOVE & REPLACE	50% OF UNIT PRICE	REMOVE & REPLACE
≤ 84.0	REMOVE & REPLACE	REMOVE & REPLACE	REMOVE & REPLACE	REMOVE & REPLACE

Notes: - Single lifts only are considered "Top Lifts"
- Preliminary leveling is not considered a "Lift".

**TABLE 3.53 B
UNIT PRICE ADJUSTMENT FOR ASPHALT CONTENT**

Deviation of the Actual Asphalt Content from the Approved Asphalt Content	Unit Price Adjustment for Asphalt Content PAA \$ per tonne			
	Top Lift		Lower Lift	
	Below	Above	Below	Above
From 0 to 0.30	0.00	0.00	0.00	0.00
From 0.31 to 0.35	-2.60	-0.90	-2.60	-0.90
From 0.36 to 0.40	-3.80	-1.80	-3.80	-1.80
From 0.41 to 0.45	-5.00	-2.70	-5.00	-2.70
From 0.46 to 0.50	-6.10	-3.60	-6.10	-3.60
From 0.51 to 0.55	-	-	-7.20	-4.50
From 0.56 to 0.60	-	-	-8.40	-5.40
From 0.61 to 0.65	-	-	-9.50	-6.30

For top lift deviations of more than 0.50% the Contractor shall either overlay or remove and replace the previously placed mix.

For lower lift deviations of more than 0.65%, the Department will determine whether removal and replacement is necessary. For material that is allowed to stay in place, payment will be at 50% of the unit price bid.

TABLE 3.53 C
LUMP SUM SUBLOT ASSESSMENT FOR SMOOTHNESS

Prl	Assessment for Smoothness of Top Lift \$ per Sublot Lump Sum		
	C1	C2	C3
0	30.00	30.00	30.00
>0 and 10 or less	0	0.00	0.00
11	-40.00	0.00	0.00
12	-70.00	0.00	0.00
13	-100.00	0.00	0.00
14	-130.00	0.00	0.00
15	-170.00	0.00	0.00
16	-200.00	-40.00	0.00
17	-230.00	-80.00	0.00
18	-260.00	-120.00	0.00
19	-290.00	-160.00	0.00
20	-320.00	-200.00	0.00
21	-350.00	-240.00	0.00
22	-380.00	-280.00	0.00
23	-410.00	-320.00	-10.00
24	REJECT	REJECT	-40.00
25	"	"	-70.00
26	"	"	-100.00
27	"	"	-130.00
28	"	"	-160.00
29	"	"	-190.00
30	"	"	-220.00
Greater than 30	"	"	REJECT ⁽¹⁾

⁽¹⁾ Sublot may be accepted, subject to approval of the Department, with an assessment of -\$400.

Pavement smoothness will be assessed based upon the type of construction as follows.

Type of Construction	Table 3.50 C Assessment Column
Two or more paver laid lifts, minimum design lift thickness of 20 mm.	C1
Single lift with design lift thickness greater than or equal to 45 mm	C2
Hot In-Place Recycling or Mill and Inlay	C3
Curb and Gutter	C3
Single Lift with design lift thickness less than 45 mm.	C3

Penalty assessments for bumps and dips will be applied to all applicable top lifts of pavements

**TABLE 3.53 D TOLERANCES FOR THE LOT MEAN FROM THE JOB MIX FORMULA AND
MAXIMUM RANGE BETWEEN INDIVIDUAL TEST RESULTS IN A LOT**

CHARACTERISTICS	SIEVE SIZE μm				
	(1)	1250	630	315	80
Tolerances for the Lot Mean from the Job Mix Formula	+/-5	+/-3	+/-2	+/-2	+/-1.5
Maximum Range Between Individual Test Results in a Lot	10	6	5	4	3

(1) Include all sieves; 2 500, 5 000, 10 000, 12 500, 20 000, 25 000 up to nominal maximum size.

**TABLE 3.53 E ADJUSTMENT POINTS FOR DEVIATIONS
BEYOND THE REQUIREMENTS IN TABLE 3.53 D**

SIEVE SIZE μm	MEAN
(1)	5 for each 1% Deviation
2 500, 1250	1 for each 1% Deviation
630	2 for each 1% Deviation
315	2 for each 1% Deviation
80 Deviation \leq 1.0%	1.0 for each 0.1% Deviation
80 Deviation $>$ 1.0%	2.0 for each additional 0.1% Deviation

(1) Include all sieve sizes; 5 000, 10 000, 12 500, 20 000, 25 000 up to nominal maximum size.

Lot Mean Adjustment points will be calculated for each Lot. A Lot Gradation Price Adjustment per tonne will be applied based upon on the following formula:

$$\text{PAg} = (\text{A} \times -\$0.04) + (\text{B} \times -\$0.40) + \text{Bonus}$$

Where:

- PAg = Unit Price Adjustment for Gradation (bonus or penalty; QA Acceptance Lots only)
- A = Mean Adjustment Points assessed within the gradation limits specified in Table 3.53.2.2A (excluding the requirements of Table 3.53.2.2B).
- B = Mean Adjustment Points assessed outside the gradation limits specified in Table 3.53.2.2A (excluding the requirements of Table 3.53.2.2B).
- Bonus= +\$0.20 when there are no Mean Adjustment Points and the maximum range as shown in Table 3.53 D, is not exceeded for any sieve size in the Lot.

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3.60 SIDESLOPE IMPROVEMENT**3.60.1 GENERAL**

This specification covers the reconstruction and improvement of the sideslopes in the areas as shown on the Drawings; as described in the Special Provisions; and as determined by the Consultant.

3.60.2 MATERIALS

The Consultant will estimate the amount of embankment material required to perform the Work and will determine possible availability within the right-of-way. When possible sources of sideslope material are indicated in the Special Provisions, the material will be considered Department Supply. Otherwise, all required sideslope embankment material will be considered Contractor Supply. The amount of excavation or fill amount required will vary according to the typical cross sections shown on the Drawings.

Indication of the availability of material by the Department does not guarantee the quantity or suitability of the material and Bidders are advised that only material approved by the Consultant at the time of construction may be used. Department Supply material which is found unsuitable at the time of construction shall be replaced with approved material by the Contractor and this will not be considered as a basis for claim.

Borrow excavation shall be in accordance with Subsection 2.3.4.6, Borrow Excavation, of Specification 2.3, Grading.

3.60.2.1 Department Supply

Generally, Department Supply materials shall be obtained from reshaping ditches and backslopes or from designated borrow sources. Unless otherwise indicated in the Special Provisions, all suitable material from within the right-of-way shall be used prior to obtaining material from borrow sources.

3.60.2.2 Contractor Supply

When the Contract does not specify that material is available from a Department Source, the Contractor shall supply all embankment material required for the sidesloping work from sources of his own choosing. Only material approved by the Consultant may be used.

3.60.3 CONSTRUCTION

The Consultant may adjust ditch elevations and sideslope ratio to ensure positive drainage.

Prior to modifying the existing sideslopes, the Contractor shall denude the sideslopes of all vegetation and topsoil and windrow this material.

To ensure a proper bond between the existing and new material, the denuded sideslopes shall be scarified to a depth of 150 mm, or as approved by the Consultant. Embankment material, as required, shall be added and compacted to the satisfaction of the Consultant. Typical compaction equipment (eg. packers) will not normally be required.

The Contractor shall perform the sidesloping work so that there is sufficient width available to construct base course and/or asphalt concrete pavement to the depths indicated on the Drawings and to maintain a consistent finished pavement width, with uniform sideslope configuration for the full height of the highway grade, all as shown on the Drawings.

Existing guardrail shall be removed and then reinstalled after the completion of the Work. The Work shall be carried out in accordance with Specification 2.19, Guardrail and Guide Posts.

Existing culverts shall be extended or shortened or grouted as noted on the Drawings or as determined by the Consultant and in accordance with Specification 2.4, Culverts.

The Contractor shall keep the roadway surface free of dirt and debris during sidesloping work. Equipment shall not be driven over culvert ends. Material placement and trimming shall be performed using methods acceptable to by the Consultant.

The Contractor shall remove and dispose of any rocks and debris within the sidesloping area larger than 100 mm in dimension.

Any sign posts that are damaged as a result of this work shall be replaced at the Contractor's expense.

Upon completion of the sidesloping work, the Contractor shall uniformly redistribute the windrowed vegetation and topsoil material on the finished sideslopes. All disturbed areas shall be seeded in accordance with Specification 2.20, Seeding.

3.60.4 MEASUREMENT AND PAYMENT

Sideslope improvement work will be measured in kilometres per side to the nearest 0.1 km as determined by the Consultant.

Payment for sideslope improvement work will be made at the unit price bid per kilometre for "Sideslope Improvement" and will include denuding the sideslopes of vegetation and topsoil, supply of borrow material, excavating, loading, hauling, placing, finishing, redistribution of denuded topsoil, seeding and all labour, equipment, tools and incidentals necessary to complete the Work.

All other work including extending culverts and removing and reinstalling signs, guide posts and guardrail will be paid for at the applicable unit prices bid for the types of work incorporated.

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4.1 ASPHALT CURB, MEDIANS, TRAFFIC ISLANDS AND FLUMES**4.1.1 GENERAL****4.1.1.1 Description**

This work shall consist of the construction of asphalt curbs, medians, traffic islands and flumes, using well graded crushed aggregate, and asphalt cement, combined as hereinafter specified, placed and compacted on a prepared base, in conformity with lines, grade and cross-section as shown on the Drawings, at specified locations or as directed by the Consultant.

4.1.2 MATERIALS**4.1.2.1 General**

All materials necessary for the construction of the works described herein shall be supplied by the Contractor.

4.1.2.2 Aggregate

The Contractor shall produce crushed aggregate in accordance with Specification 3.2, Aggregate Production and Stockpiling. Unless otherwise specified or directed by the Consultant, aggregate shall meet the requirements for Designation 1 Class 12.5 material. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

4.1.2.3 Asphalt

The Contractor shall supply asphalt in accordance with Specification 5.7, Supply of Asphalt. The type and grade of asphalt shall be as specified in Subsection 4.1.2.4, Asphalt Mix Design.

Asphalt used for tack coats shall be of the type and grade designated by the Consultant.

4.1.2.4 Asphalt Mix Design

The asphalt mix design shall be prepared and submitted according to the requirements of Section 3.50.3, Asphalt Mix Design and Job Mix Formula. Unless otherwise specified, a Mix Type L1 shall be used in accordance with the following design requirements:

- (i) Asphalt cement grade shall be either 120-150A, 150-200A or 200-300A (the stiffest asphalt cement grade shall be used on projects that specify more than one grade).
- (ii) Design Air Voids shall be 3%.

4.1.3 CONSTRUCTION**4.1.3.1 Preparation of Surface for Asphalt Curbs**

Before placing asphalt curbs, the existing surface in the curb locations shall be cleaned of all foreign, loose or deleterious material. All broken or defective areas in the locations shall be repaired by removing the broken and defective material and replacing it with asphalt concrete patching material as directed by the Consultant.

Asphalt Curb, Medians, Traffic Islands and Flumes

An asphalt tack coat shall be uniformly applied at the location, rate, temperature, and to the dimensions as approved by the Consultant. The surface to be tacked shall be dry and free from loose or deleterious material when the tack coat is applied.

Following the curing of the asphalt tack coat, depressions shall be eliminated by placing asphalt concrete leveling patches at the locations and to the dimensions designated by the Consultant.

The asphalt concrete material used for patching and leveling shall conform to, and be placed in accordance with the requirements of Specification 3.50, Asphalt Concrete Pavement (EPS), using the Designation and Class of aggregate specified or directed by the Consultant. The patching and leveling shall be performed in such a way as to result in a surface which is tight, neat, uniform, and well bonded to the underlying surface. The patched and leveled areas shall be fully compacted so that the final surface is flush with the surrounding surface, and does not pond water when asphalt curb construction is complete.

An asphalt tack coat shall be applied to leveled and patched areas as directed by the Consultant.

4.1.3.2 Mixing and Placing Asphalt Curb Material

The bituminous mixture shall be produced, transported, and placed in accordance with the requirements of Specification 3.50, Asphalt Concrete Pavement (EPS).

Mix temperatures shall be sufficiently high to enable adequate mixing and compaction, but shall not be so high as to cause asphalt damage or curb instability.

The placing, compacting and finishing of asphalt curbs shall be accomplished by use of a mechanical curb machine of a type approved by the Consultant. The bituminous mixture shall be laid only upon a dry, clean surface, on which the tack coat has fully cured and under weather conditions acceptable to the Consultant.

Curb shall be placed in a continuous, one step operation, in one direction, with a minimum number of joints. Where joints are absolutely necessary, they shall be constructed so that they are virtually indistinguishable from the adjacent curb. Cold joints shall be tacked before new material is placed against them.

The finished asphalt curb shall be true to alignment and cross-section, thoroughly compacted, and shall have a smooth, tight, uniform surface texture which is free from segregation, defects, blemishes or other irregularities.

4.1.3.3 Gravel Fill for Asphalt Curb, Medians and Traffic Islands

Median fill gravel shall be placed within the asphalt curbs forming the outside perimeter of medians and traffic islands, and shall be thoroughly compacted in layers not exceeding 150 mm in depth, to a tight, smooth surface within 50 mm of the top of the curbs, or as otherwise specified.

4.1.3.4 Median Surfacing

The compacted gravel fill within medians and traffic islands shall be surfaced with asphalt concrete material in accordance with the requirements of Specification 3.50, Asphalt Concrete Pavement (EPS), using the Designation and Class of aggregate specified or directed by the Consultant. The finished surface shall be true to cross-section and grade, thoroughly compacted, and shall have a smooth, tight, uniform surface texture.

4.1.3.5 Asphalt Flumes

Where asphalt flume outlet drains are specified, they shall be constructed in accordance with the typical plans and the requirements of Specification 3.50, Asphalt Concrete Pavement (EPS), using the Designation and Class of aggregate specified or directed by the Consultant. The finished surface shall be true to the lines, grades and cross-sections established by the Consultant, and shall be smooth, tight, and compact over its entire length. The excavated material from the flume trench shall be spread uniformly over the adjacent sideslope as directed by the Consultant.

The flume bedding material shall be select pit-run gravel, or crushed aggregate of the Designation and Class specified, or as otherwise directed by the Consultant. Bedding material shall be placed and thoroughly compacted to the depths and widths specified or as directed by the Consultant.

Hand laid rock forms shall be produced and placed in a neat manner, in accordance with the Typical Plans.

4.1.3.6 Protection

Care shall be taken to prevent damage to the work during subsequent construction operations forming part of this Contract. All means and materials required to protect the Work from damage shall be provided by the Contractor at his expense. Works damaged by traffic, construction operations, weather conditions or any other cause, for the duration of the Contract, shall be repaired, or removed and replaced as directed by the Consultant, at the Contractor's expense.

4.1.3.7 Cleanup

All construction materials and other debris, resulting from the execution of the Work covered by these specifications, shall be removed and disposed of to the satisfaction of the Consultant.

4.1.4 MEASUREMENT AND PAYMENT

4.1.4.1 Repair and Leveling Patches

Measurement and payment for asphalt concrete material for repair and leveling patches will be made in accordance with Specification 3.50, Asphalt Concrete Pavement (EPS).

4.1.4.2 Asphalt Curbs

Measurement of asphalt curbs will be by the length in metres, along the centreline of the curb.

Payment will be made at the unit price bid per metre for "Asphalt Curb". This payment will be full compensation for preparing the original surface; supplying and applying the tack coat; supplying asphalt binder; and processing, hauling and placing the bituminous mixture.

4.1.4.3 Gravel for Median Fill

Measurement of gravel fill material for medians and traffic islands will be in tonnes.

Payment will be made at the unit price bid per tonne for "Median Fill Gravel". This payment will be full compensation for producing, hauling and placing the fill material.

4.1.4.4 Median Surfacing

Measurement of median surfacing will be in tonnes.

Payment will be made at the unit price bid per tonne for "Median Surfacing". This payment will be full compensation for producing, hauling and placing the asphalt concrete material.

4.1.4.5 Asphalt Flume Outlet Drains

Measurement of asphalt flume outlet drains will be by length in metres, along the flow line of the flume.

Payment will be made at the unit price bid per metre for "Asphalt Flume Outlet Drains". This payment will be full compensation for excavating and disposing of earth materials for the flume trench; producing, hauling and placing of hand-laid rock forms, bedding aggregate and asphalt concrete materials.

4.1.4.6 Supply of Aggregate

Aggregate materials incorporated into the Work will be paid for in accordance with Specification 5.2, Supply of Aggregate.

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Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2 CONCRETE CURBS, GUTTERS, SIDEWALKS, MEDIANS AND TRAFFIC ISLANDS****4.2.1 GENERAL**

The Work shall include construction of the following items:

- (a) Curbs, gutters and combination curb and gutter sections,
- (b) Curbs for medians and traffic islands which have concrete, asphalt or topsoil surfacing,
- (c) Solid concrete medians, traffic islands and sign islands,
- (d) Separate sidewalks,
- (e) Monolithic sidewalk curb and gutter sections,
- (f) Concrete swales,
- (g) Outlet gutters, and
- (h) Concrete barriers.

These cast-in-place, extruded or precast structures shall consist of air entrained portland cement concrete with or without reinforcing steel, prepared in accordance with the Specifications and to the lines, grades and typical cross-sections as shown on the Drawings or as designated by the Consultant.

Curbs shall include mountable, semi-mountable and barrier types.

4.2.2 MATERIALS**4.2.2.1 General**

The Contractor shall supply all materials, including forms for the construction of the Work.

4.2.2.2 Aggregate

The Contractor shall produce aggregate materials in accordance with Specification 3.2, Aggregate Production and Stockpiling. Gravel or sand bedding material shall be select and shall consist of well graded sand or a well graded mixture of natural sand, gravel and/or crushed rock, all of which shall pass a 40 mm sieve opening. Any processing required to meet this gradation requirement shall be the responsibility of the Contractor. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate, and haul aggregate in accordance with Specification 4.5, Hauling.

4.2.2.3 Portland Cement Concrete

Portland cement concrete shall comply with the requirements of Specification 5.5, Supply of Portland Cement Concrete, for Class C concrete. For precast F-type barrier curbs the compressive strength of the concrete at 28 days shall be 40 MPa.

4.2.2.4 Expansion Joint Fillers

Preformed expansion joint fillers shall conform to the requirements in the most recent edition of A.S.T.M. Designation D1751 and shall be of adequate dimensions to fill the joint fully and continuously throughout its entire depth.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2.2.5 Curing and Sealing Compounds**

Curing compound shall conform to the most recent edition of A.S.T.M. Designation C309 and shall contain white fugitive dye. The Contractor shall not add any material to the curing compound as delivered by the Manufacturer.

Sealing compounds are not normally required for this work. When use of a sealer is specified, the Contractor shall select one of the approved Type 1b Bridge Concrete Sealers identified on the Alberta Transportation Products List.

4.2.2.6 Reinforcing Bars and Wires

Steel reinforcing bars shall be deformed bars in accordance with the most recent edition of CSA G30.12 - M "Billet Steel Bars for Concrete Reinforcement". For F type barrier curbs the bars shall also be epoxy coated.

Cold drawn wire or welded wire fabric for concrete reinforcement shall conform to the requirements of the latest edition of CSA G30.5.

4.2.2.7 Median Fill Materials

Fill material for medians to be surfaced with portland cement concrete or asphalt concrete shall be crushed aggregate of the Designation and Class specified. The Contractor shall process the material by crushing if required to meet the Specifications.

Fill material for medians to be topsoiled shall be clayey soil free of stones, clods, sticks, roots, concrete and other debris.

Asphalt concrete for median surfacing shall be supplied, produced and placed in accordance with the requirements of Specification 3.50, Asphalt Concrete Pavement (EPS). Unless otherwise specified in the Special Provisions, the Mix Type shall be as used elsewhere on the project. Gradation of the median surfacing asphalt concrete aggregate shall be in accordance with the requirements for the Designation and Class specified or directed by the Consultant.

Topsoil for medians shall meet the requirements of Specification 2.6, Topsoil Placement.

4.2.3 SAMPLING AND TESTING

Sampling and testing shall meet the requirements of Specification 5.5, Supply of Portland Cement Concrete.

4.2.4 CONSTRUCTION**4.2.4.1 General**

The Contractor shall be responsible for the proper adjustment and calibration of his equipment.

4.2.4.2 Preparation of Base and Bedding

Soft, yielding or unsuitable base material shall be removed and disposed of, as directed by the Consultant, and replaced with approved material. The base material shall be thoroughly compacted to 95% of Standard Proctor Density at optimum moisture to a depth of 150 mm and finished to a smooth, uniform surface, true to established line and grade. Base preparation shall

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands

extend sufficiently beyond the edges of the structure to enable forming and construction of the Work.

The Contractor shall place and compact gravel or sand bedding course upon the prepared base to a minimum compacted depth of 50 mm, or as otherwise specified or directed by the Consultant. Gravel or sand bedding shall be placed to the widths as specified or as directed by the Consultant, and shall be thoroughly compacted to a smooth, uniform surface, true to established lines and grade. Bedding material shall extend sufficiently beyond the edges of the structure to enable support, forming and construction of the Work.

4.2.4.3 Adjusting Catch Basins and Manholes

Raising or lowering catch basin or manhole frames, when necessary, to match sidewalk or curb and gutter grades shall be in accordance with Specification 2.10, Manholes, Inlets and Catch Basins.

4.2.4.4 Forms

Steel or wood forms shall conform to the shape, lines and dimensions of the concrete shown on the Drawings. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and shall be free from loose knots or other defects. Forms shall extend the full depth of the section being formed, and shall be secure and sufficiently tight to prevent leakage of mortar. Forms shall be properly braced or tied together to maintain position and shape, and shall be thoroughly cleaned and coated with a non-staining form-release oil, before concrete is placed therein. Forms shall not be disturbed until the concrete has hardened sufficiently to prevent damage.

Where form ties are used they shall be cut off inside the surface of the concrete and the holes shall be patched.

4.2.4.5 Extrusion

Where slip-form paving machines or concrete extruding machines are used for placing concrete, they shall meet the following requirements:

- (a) The machines shall be approved by the Consultant prior to commencement of the Work.
- (b) The vibrators on the equipment shall be adequate to produce a dense mass free of voids with a smooth surface free of honeycombing.
- (c) The equipment shall have automatic grade and line control.
- (d) The equipment shall, in a single pass, provide the specified shape and cross-section for the concrete items to be constructed.

4.2.4.6 Steel Reinforcement

Steel reinforcement, dowels or tie bars, when specified, shall be properly spaced, aligned, and held in correct position during the placement of the concrete by the use of bar chairs or other approved devices. Longitudinal bars shall extend through all contraction joints, and shall terminate a minimum of 50 mm from any expansion or construction joint. Bars shall overlap at splices by at least 300 mm.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2.4.7 Wire Mesh Reinforcement**

Wire mesh reinforcement, when specified, shall be properly placed and held in position during the placement of the concrete by use of chairs or other approved devices. Joints in the wire mesh shall be overlapped 100 mm. Wire mesh reinforcement shall terminate a minimum of 50 mm from any expansion or construction joint.

4.2.4.8 Placing Concrete

The bedding shall be in a moist condition immediately prior to the time the concrete is placed. The concrete shall be spread uniformly to the required cross-section, without segregation, and thoroughly consolidated to eliminate excess air voids and to bring sufficient mortar to the surface for proper finishing. Before final finishing, surfaces shall be tested with a 3 m straightedge, and any irregularities of more than 6 mm in 3 m shall be corrected.

Concrete placement between construction joints shall be continuous. Where there is a delay of more than 30 minutes in the placement of concrete a construction joint shall be formed.

Concrete shall not be placed during rain or during other adverse weather conditions.

Concrete shall not be placed on frozen base or frozen bedding.

4.2.4.9 Crossings

Lane, commercial and private crossings shall be constructed on prepared bases at locations and to the depths and widths as indicated on the Drawings and as directed by the Consultant. When specified, crossings shall be reinforced with steel wire mesh.

4.2.4.10 Precast Sections

Precast sections shall be placed on a prepared base, to the line and grade specified, as shown on the Drawings or as directed by the Consultant.

4.2.4.11 Joints**4.2.4.11.1 General**

Joints shall be perpendicular to the subgrade and at right angles to the longitudinal axis of the structure. Joints shall be formed and edged with a 6 mm radius so as to leave a neat finished appearance.

4.2.4.11.2 Contraction Joints

For barriers, curbs, combination curb and gutter sections, separate sidewalks, and monolithic sidewalk, curb and gutter sections, contraction joints shall be formed every 3 m except where shorter spacing is necessary for closures, but no section shall be less than 1 m in length. Contraction joints shall be made by the use of one of the following methods:

- (i) Sawing a joint 50 mm deep with a concrete saw early enough after the concrete has set to prevent uncontrolled cracking, but not so soon as to displace the aggregate from the edges of the cut. The timing of sawing shall be the Contractor's responsibility.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands

- (ii) Forming a joint 50 mm deep by inserting into the plastic concrete a metal or fibre strip or a polyethylene film, finishing the edges to a 6 mm radius, and removing the insert as soon as initial set of the concrete has taken place.
- (iii) Forming a joint 50 mm deep with a jointing tool with a thin metal blade to impress a permanent plane of weakness into the plastic concrete.

For sidewalk construction a surface joint 15 mm in depth shall be constructed alternating with and halfway between contraction joints. This joint shall not extend into the curb and gutter section.

An additional surface joint 15 mm in depth shall be constructed longitudinally in monolithic curb, gutter and sidewalk for the purposes of delineating the back of the curb. This joint shall be located at the distance from the back of sidewalk as shown on the Drawings and shall be continuous for the entire length of the structure including driveway and lane crossings.

4.2.4.11.3 Expansion Joints

Expansion joints shall be constructed with a preformed expansion joint filler to the full depth of the concrete at the following locations:

- (i) where the concrete structure abuts a building, pole or other permanent structure;
- (ii) at construction joints;
- (iii) where shown on the Drawings; and
- (iv) where directed by the Consultant.

4.2.4.11.4 Construction Joints

Construction joints shall be formed using steel divider plates, at specified locations, or as otherwise designated by the Consultant. Should concrete placing operations be unavoidably interrupted, construction joints shall be formed at the last fully completed panel.

Construction joint divider plates shall be left in place until the concrete has set sufficiently to hold its shape, and shall be removed without damaging the concrete.

Steel dowels, greased on one end, shall be incorporated into construction joints where specified or as directed by the Consultant.

4.2.4.12 Finishing

Exposed concrete surfaces shall have a brush finish. The brush grooves shall be transverse on the sidewalk and longitudinal on the curb and gutter.

Exposed edges on sidewalks including contraction and surface joints, shall be tooled for a width of 50 mm and rounded to a radius of 6 mm, or as otherwise specified.

The finished concrete shall be true to cross-section, line and grade, and the surface shall be tight, smooth and free of honeycombing and irregularities. Concrete with honeycombing or other irregularities shall be removed and replaced as directed by the Consultant.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2.4.13 Identification of Work**

Identification marks showing the name of the Contractor and the year constructed, shall be placed at the end of each block or at the terminal points of the Work in each block, in a neat, easily legible form, as approved by the Consultant.

4.2.4.14 Curing, Sealing and Protection**4.2.4.14.1 Curing**

Immediately after finishing, the concrete shall be protected against moisture loss by the application of an approved curing compound. The application rate and method of application shall be in accordance with the Manufacturer's recommendations.

Curing compounds shall be applied by spraying with pressure equipment. To ensure complete coverage, approximately one-half the quantity for a given area shall be applied in one direction and the remainder applied at right angles to this direction.

Curing compounds shall not be used on a surface where a bond is required with additional concrete to be placed later, or where a sealing compound is specified to be used. In such cases the concrete surface shall be moist cured by using wet burlap or polyethylene film.

4.2.4.14.2 Sealing

When sealing is specified, sealing compounds shall not be applied until a minimum of 14 days following placement of the concrete. The concrete shall be dry and swept clean prior to application of sealing solution as directed by the Consultant.

The minimum application rate and method of application shall be in accordance with the Manufacturer's recommendations.

4.2.4.14.3 Protection

Concrete shall be protected against damage in accordance with Specification 5.5, Supply of Portland Cement Concrete.

4.2.4.15 Backfill

For outlet gutters, sidewalks and monolithic curb, gutter and sidewalks, the Contractor shall backfill as soon as possible after the removal of forms. The backfill shall be mechanically tamped and trimmed.

For curb and gutter the Contractor shall backfill behind the curb with suitable material after the seven day curing and protection period has elapsed. The backfill shall extend to at least 600 mm behind the curb and shall be compacted in two lifts. The densities shall be obtained by means of a hand operated mechanical tamper or other equipment as approved by the Consultant.

Organic soils shall not be permitted for backfilling, except where topsoil is specified for the top 100 mm of fill.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2.4.16 Fill for Medians, Sign Islands and Traffic Islands****4.2.4.16.1 Topsoiled Medians**

Fill for medians to be topsoiled shall be placed and moderately compacted to a smooth surface 150 mm below the top of the median curb. The material shall be classified in accordance with Specification 2.3, Grading.

4.2.4.16.2 Other Medians

Fill for medians to be asphalt concrete surfaced or concrete surfaced shall be crushed aggregate placed and compacted as shown on the Drawings, and as directed by the Consultant.

4.2.4.17 Median Surfacing**4.2.4.17.1 Topsoil Surfacing**

Topsoil surfacing of medians shall be placed in accordance with Specification 2.6, Topsoil Placement

4.2.4.17.2 Asphalt Concrete Surfacing

Asphalt concrete material for median surfacing shall be supplied and placed in accordance with Specification 3.50, Asphalt Concrete Pavement (EPS), except that the density requirements will not apply. The finished surface shall be true to cross-section and grade, shall be compacted and shall have a smooth, tight, uniform surface.

4.2.4.17.3 Concrete Surfacing

Concrete material for median surfacing shall be supplied in accordance with the requirements of Specification 5.5, Supply of Portland Cement Concrete, and placed, finished, cured and sealed in accordance with the appropriate sections of this specification.

4.2.5 MEASUREMENT AND PAYMENT**4.2.5.1 General**

The quantities, determined as specified, will be paid for at the contract unit prices which shall be compensation in full for base preparation and the furnishing of labour, materials, equipment, tools and incidentals necessary to complete the Work in accordance with the Drawings and Specifications.

4.2.5.2 Excavation, Base Preparation, and Gravel or Sand Bedding

Where the excavation and base preparation is done as part of road construction, which is part of the Work, payment for the excavation and base preparation will be made in accordance with the appropriate unit prices bid for this Work. Otherwise, excavation, base preparation and bedding will not be measured and paid for separately but will be included in the Contract unit price for the concrete structure.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands**4.2.5.3 Concrete Structures****4.2.5.3.1 Solid Concrete Medians and Islands**

Solid concrete medians and solid concrete islands will be measured in square metres of completed top surface area and payment will be made at the applicable unit price bid per square metre for "Solid Concrete Medians" or "Solid Concrete Islands." These payments will be full compensation for supplying and installing any curbing or curb and gutter forming part of the solid concrete median or island.

4.2.5.3.2 Curbs, Gutters, Combination Curb and Gutter Sections, Sidewalks, Monolithic Sidewalk Curb and Gutter Sections, Concrete Barriers, and Swales or Combinations Thereof

Measurement will be made in linear metres to the nearest 0.1 metre and payment will be made at the applicable unit price bid for:

- (i) "Concrete Curb", measured along the length of the curb, with separate payment for each type of curb.
- (ii) "Gutters", and "Outlet Gutter", measured along the length of the gutter.
- (iii) "Curb and Gutter", measured along the length of the curb face.
- (iv) "Concrete Sidewalk", measured along the length, with separate payment for each specified width.
- (v) "Monolithic sidewalk, Curb and Gutter", measured along the length, with separate payment for each specified width.
- (vi) "Concrete Swale", measured along the flow line.
- (vii) "Concrete Barrier", measured along the length.

4.2.5.3.3 Rip-Rap for Outlet Gutters

Contrary to Specification 2.5, Riprap, riprap for outlet gutters will be measured in square metres and payment will be made at the unit price bid for "Rock Rip-Rap - Hand-Laid". This payment will be full compensation for supplying and installing the riprap.

4.2.5.4 Median Fill

Granular fill material for asphalt concrete or portland cement concrete surfaced medians will be measured in tones. Payment will be made at the unit price bid for "Granular Fill for Medians".

Earth fill material will be measured and paid for separately at the applicable unit prices bid for the classification of excavation used in accordance with Specification 2.3, Grading.

4.2.5.5 Median Surfacing

Median asphalt concrete surfacing will be measured in tonnes. Payment will be made at the Contract unit price for "Median Asphalt Concrete Surfacing" for the quantity incorporated into the Work.

Concrete Curbs, Gutters, Sidewalks, Medians and Traffic Islands

Median portland cement concrete surfacing will be measured in square metres based on the width excluding the curbs and will be paid for at the unit price per square metre for "Median Concrete Surfacing". Separate payment will be made for the curb or curb and gutter section forming the perimeter of the median.

Median topsoiling will be measured and paid for in accordance with Specification 2.6, Topsoil Placement.

4.2.5.6 Backfilling

No separate payment will be made for backfilling behind structures. The cost of this work will be included in the Contract unit price for the particular structure involved.

4.2.5.7 Supply of Aggregate

Payment for the supply of aggregate for median fill and median surfacing will be made in accordance with Specification 5.2, Supply of Aggregate.

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4.5 HAULING**4.5.1 GENERAL****4.5.1.1 Description**

This specification applies to the hauling of all granular materials produced under Specification 3.2, Aggregate Production and Stockpiling, including blend sand, and the hauling of all mixtures of granular material with asphalt or cement produced under the applicable specification as required by the Drawings, Special Provisions or as designated by the Consultant. This specification covers the following:

- (a) The administration of haul roads from all aggregate sources;
- (b) Hauling granular materials and mixtures of granular material with asphalt or cement bid by unit weight or volume;
- (c) Hauling granular materials and mixtures of granular material with asphalt or cement bid "In-Place".

4.5.1.2 Definitions

For purposes of this specification, the following definitions will apply:

4.5.1.2.1 Aggregate Sources

The categories of aggregate sources are as specified in Specification 5.2, Supply of Aggregate.

4.5.1.2.2 Hauling

The process of transporting material from its point of loading to its designated delivery point.

4.5.1.2.3 Haul Road

A route over which materials are hauled for the performance of the Contract with the exception of any portion of the highway or road within the contract construction limits.

4.5.1.2.4 Conversion Factors

Where the application of conversion factors is necessary, the following standard values shall be used:

- 1.63 t/m³ for gravel (pit-run and crushed, regardless of class), and
- 1.36 t/m³ for sand.

4.5.2 IDENTIFICATION OF HAUL ROUTES

At the time of Contract execution, the Contractor shall provide land title or public land standing reports, and shall state the location of his proposed aggregate sources and haul routes. The Contractor shall be responsible for obtaining authority to haul over the proposed haul routes from the agency having jurisdiction. The use of provincial highways as haul routes is subject to prior approval by the Department.

The Contractor shall abide by all road restrictions established by the road or bridge authority having jurisdiction, including all roads and portions of the highway or road within the Contract construction limits.

4.5.3 HAULING

4.5.3.1 **Vehicle Requirements**

Haul vehicles shall comply with the Alberta Traffic Safety Act and have Alberta Class 1 registration.

Haul vehicles shall be registered by the Contractor and bear a project registration number.

For vehicles hauling on a cubic metre basis the approved capacity will be the struck measure of the box as calculated by the Consultant to the closest 0.1 cubic metres.

4.5.3.2 **Hauling Restrictions**

The Consultant may direct that hauling operations will not be permitted if excessive damage to highways or public roads will occur or when hauling operations cause serious hazards or difficulties to the travelling public.

The conditions when this may occur will generally be:

- (a) When spring thaw is taking place;
- (b) During or after heavy rainfall;
- (c) During periods of exceptionally heavy traffic.

The Contractor shall abide by all load restrictions established by the road or bridge authority having jurisdiction.

If work must be carried over from one construction season to the next, the Consultant may order that when work closes down for the season, the Contractor shall repair any damage to public roads caused by his hauling operations.

4.5.3.3 **Construction, Initial Conditioning and Maintenance of Haul Roads**

The Contractor shall initially condition, maintain and restore roads used as haul roads to the satisfaction of the agency having jurisdiction and in the case of Provincially owned or controlled roads, to the satisfaction of the Consultant. The Contractor shall also be responsible for construction of new haul roads where necessary.

All costs incurred in such work shall be borne by the Contractor, except that the Department will share in the cost of the asphalt mixes required for the repair of paved surfaces on roads maintained by the Department in accordance with the following:

- (a) On contracts with unit prices for asphalt mixes the Contractor shall supply and place the asphalt mix and the Department will pay for the quantity of mix used at 90% (ninety percent) of the applicable unit prices.

The Contractor shall, at his own expense, spread and compact the asphalt mixes.

- (b) On contracts that do not include unit prices for asphalt mixes the Department will select the material source and pay for the asphalt mix required including haul.

The Contractor shall, at his own expense, spread and compact the asphalt mixes.

4.5.4 HAUL COMPUTATIONS

4.5.4.1 **Contracts With Bid Unit Prices for Haul**

The haul distance will be the measured distance in kilometres and hundredths of a kilometre along the designated route between the point of loading to trucks and the designated delivery point.

Haul will not be calculated for blend sand material obtained within 100 m of a mixing plant or of the point of blending.

For the purpose of this specification, the designated delivery point shall be considered as the centre of the project kilometre, except:

- (a) if a section is shorter than one kilometre, the designated delivery point will be the centre of the section.
- (b) if a dead haul road splits a project kilometre into two sections, the designated delivery point will be the centre of each section.

4.5.5 MEASUREMENT AND PAYMENT

4.5.5.1 **Haul**

The haul distance will be measured in kilometres and hundredths of a kilometre along the designated route between the point of loading and the designated delivery point, and will be measured for record purposes and to enable computation of the Average Actual Haul Distance.

4.5.5.2 **Haul Roads**

Except for the supply of asphalt mixes for the repair of paved surfaces on haul roads, as defined in Subsection 4.5.3.3 of this specification, the cost of new construction, initial conditioning, maintenance and final restoration of haul roads shall be the responsibility of the Contractor.

The Contractor shall initially condition, maintain and restore roads used as haul roads to the satisfaction of the agency having jurisdiction and in the case of provincially owned or controlled roads, to the satisfaction of the Consultant who will be the final authority.

The Contractor shall control dust on haul roads using water or other dust abatement materials approved by the Consultant. The Contractor shall supply and apply the materials and pay for all costs of dust control.

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5.2 SUPPLY OF AGGREGATE**5.2.1 GENERAL**

This specification covers the general requirements for the supply of aggregate materials by the Contractor. Aggregate materials are considered the total of the granular portion of construction materials consisting of the coarse and fine gravel splits, blend sand and manufactured fines when required.

5.2.2 AGGREGATE CATEGORIES

For the purposes of administering the operational and payment conditions concerning the supply of aggregate for the Work, aggregate sources are categorized as follows:

5.2.2.1 Aggregate Sources Controlled by the Department

The following are deemed to be aggregate sources controlled by the Department:

- (i) a source owned by the Department, or
- (ii) a Crown source for which the Department has a reservation, or
- (iii) a private source for which the Department has a royalty agreement, and holds an approval under the Environmental Protection and Enhancement Act.

5.2.2.1.1 Designated Sources

When it is specified in the Contract that the Contractor shall only use the Department sources (pits, stockpiles or quarry sites) for the production of crushed or uncrushed aggregate, these sources shall be termed "Designated Sources".

5.2.2.2 Aggregate Sources Not Controlled by the Department

The following are deemed to be aggregate sources not controlled by the Department:

- (i) a Crown source on undeeded land, operated primarily under lease or license and for which the Department does not have a reservation.
- (ii) a private source for which the Department does not have a royalty agreement, and does not hold an approval under the Environmental Protection and Enhancement Act.

5.2.3 GENERAL REQUIREMENTS FOR THE USE OF ALL AGGREGATE SOURCES

When supplying aggregate from any source, the Contractor shall:

- (i) ensure a Conservation and Reclamation Approval or Registration from Alberta Environment, or a lease or license to extract from Alberta Sustainable Resource Development, and a clearance from the Archaeological Survey of Alberta are in place prior to commencement of the Work;
- (ii) assume full responsibility for the quantity and quality of the material in the aggregate source;
- (iii) specify the location of the proposed aggregate source(s) and haul routes, prior to Contract award;
- (iv) acquire the necessary rights to remove materials from all aggregate sources except sources controlled by the Department;

- (v) explore and develop the aggregate sources; and
- (vi) save the Department harmless from any and all claims resulting from the use of the aggregate sources.

The Department will not consider the use of aggregates from existing stockpiles unless the Contractor can satisfy the Department that the aggregate in question meets all required specifications. Agreement by the Department that such pre-prepared aggregates can be used will not constitute acceptance of the material in stockpile. Acceptance of such material will be based on testing done by the Consultant as the material is incorporated into the Work.

5.2.4 PIT OPERATIONS

5.2.4.1 **General**

In all aggregate sources, the Contractor shall comply with the conditions set by Alberta Environment or Alberta Sustainable Resource Development when removing topsoil, subsoil and inorganic overburden, including material in a frozen condition. The standards and conditions for appropriate development and reclamation as required by Alberta Environment or Alberta Sustainable Resource Development shall apply to all sources.

5.2.4.2 **Pit Operations in Aggregate Sources Controlled by the Department**

5.2.4.2.1 General Operating Requirements

Except where modified by the Special Provisions, the Contractor's operations in an aggregate source controlled by the Department shall be in accordance with the following requirements.

All reject material produced in an aggregate source controlled by the Department shall be disposed of as directed by the Consultant and the Contractor shall have no claim to the material.

When aggregate is to be produced from a source which has been partially excavated previously, the new excavation shall proceed as an extension of the previous excavation provided that suitable material is obtainable. If required, stockpiled materials from previous operations shall be removed and deposited as indicated on the Plans and in the Special Provisions unless otherwise directed by the Consultant. The aggregate exposed shall be processed and used.

Normally, the cleared area shall extend beyond the final position of an open face by a minimum distance of four times the expected depth of excavation. Clearing and timber salvage, if required, shall be carried out in accordance with Specification 2.1, Clearing.

The Contractor shall erect and maintain any temporary fences and livestock guards that may be required to prevent livestock from straying into the aggregate source.

Inorganic overburden shall be removed to a minimum 10 m beyond the top of the backsloped aggregate face. Topsoil and subsoil shall be stripped to a minimum distance of 5 m beyond the top of the backsloped overburden face. The stripped buffers shall be maintained throughout the project.

Prior to the placement of excavated inorganic overburden, the Contractor shall remove the full depth of both topsoil and subsoil layers and stockpile the materials in separate stockpiles. In addition, unless otherwise directed by the Consultant, the Contractor shall remove and

separately stockpile the full depth of both topsoil and subsoil layers from all temporary work sites including but not limited to, the crusher, plant, camp, parking areas and all access roads.

Prior to the placement of excavated subsoil, the Contractor shall remove and stockpile the full depth of topsoil layer.

The aggregate area to be used shall be stripped in stages as follows. The first stage shall be the removal and stockpiling of topsoil. The second stage shall be the removal and stockpiling of the subsoil. The final stage shall be the removal and deposition of the inorganic overburden, as indicated on the Plans or in the Special Provisions, or as directed by the Consultant. The Contractor shall remove all materials in a manner that prevents contamination of one material with another. Dozers shall not be used for the removal topsoil or subsoil unless specifically authorized by the Consultant in writing. Topsoil, subsoil, and inorganic overburden shall be stockpiled uniformly and compactly in separate piles in the area(s) designated by the Consultant. Stockpiling of all stripped materials shall be completed in a manner that will minimize surface damage and interruption of natural drainage.

Unless otherwise directed by the Consultant, where stockpiles of topsoil, subsoil and inorganic overburden exist from previous pit operations, the Contractor shall utilize the same stockpile locations for the deposit of excavated topsoil, subsoil and inorganic overburden.

During the term of the Contract, the Contractor shall prevent erosion of all topsoil, subsoil, and inorganic overburden stockpiles resulting from his operations. In the event such piles remain at the completion of construction, they shall be seeded by the Contractor.

All materials required for seeding shall be supplied by the Contractor. Grass seed shall conform to Specification 2.20, Seeding. The composition and application rate of the grass seed mixture will be determined by the Consultant at the time of construction.

The excavation of aggregate shall advance uniformly to obtain maximum yield from the deposit. Under no circumstances will waste of useable material be permitted, and excavations shall be continued to depths below water level if suitable material is available.

The Contractor shall clean-up the areas of pits affected by operations performed under this Contract in accordance with the following:

- (i) All faces with potential future use for the removal of aggregate shall be sloped at a ratio of at least two horizontal to one vertical.
- (ii) Faces designated to be abandoned in a deposit shall be sloped at a ratio of at least four horizontal to one vertical.
- (iii) At boundaries of authorization or property lines, sloping shall be at a ratio of at least four horizontal to one vertical with the top of slopes terminating at a minimum distance of three metres from the boundary.
- (iv) Upon completion of the Work, the site shall be left in a neat and presentable condition. All fences removed for purposes of entry shall be replaced in a condition equal to or better than they were before being removed, and all debris, including construction materials and garbage, resulting from the Contractor's operations shall be removed and disposed of as required by the Consultant. The Contractor shall not drain, spill or bury at this site any garbage, sewage, outhouse waste, fluids, oils, fuels, mechanical parts or equipment.
- (v) All asphalt material produced by the Contractor shall be removed from the site, unless otherwise outlined in the special provisions. All reject asphalt material produced by the Contractor shall be disposed of in accordance with Environment Regulations.

In addition to the foregoing sloping operations, where practical, the Consultant may order that flatter slopes be constructed on selected areas using stockpiled overburden material. The quantity of overburden material available will determine the amount of sloping to be done. This operation may require some site preparation such as ripping of the compacted earth floor.

5.2.4.2.2 Supply, Installation and Maintenance of Pit Signage

The Contractor shall be responsible for maintaining signage in Department controlled pits in accordance with the requirements of Drawings TEB 1.59 and TEB 1.60, as applicable. This shall include the removal, salvage and re-installation of existing signs as required to accommodate the Contractor's operations, and the replacement of previously damaged signs with new ones. Warning signs removed to accommodate the Contractor's operations shall be re-installed as soon as practicable.

At the completion of all pit operations, the Contractor shall supply and install any additional signage required in the pit.

Signs supplied by the Contractor shall be new, and shall meet the requirements of Specification 5.18, Supply of Permanent Highway Signs, Posts and Bases.

5.2.4.3 Pit Operations in Aggregate Sources Not Controlled by the Department

All aspects of clearing, removal of overburden, protection and safety of livestock, general pit management and clean up shall be the responsibility of the Contractor.

5.2.5 MEASUREMENT AND PAYMENT

5.2.5.1 General

Payment for the supply of aggregate will not be made separately when the applicable specification states that the cost of supplying aggregate is considered incidental to the Work, or is included in the unit price bid for the Work for which the aggregate is being produced. If this is the case for all applicable specifications for the Work, the Contract will not contain a bid item for the supply of aggregate.

In Contracts that contain a bid item for supplying aggregate, payments made for the supply of aggregate will be considered full compensation for the cost of the aggregate material. All other costs incurred by the Contractor including, but not limited to, the cost of obtaining approvals and rights to use a source, exploration, development, reclamation, clearing, removal and stockpiling of topsoil, subsoil, and inorganic overburden, erosion protection, seeding, and the erection and removal of temporary fences will be considered incidental to the Work, and no separate or additional payment will be made.

Payment for all costs associated with the supply and installation of new pit signage, if required, will be made in accordance with Section 1.2.25, Extra Work, of Specification 1.2, General. Signs damaged as the result of the Contractor's operations shall be replaced by the Contractor at his expense. All costs associated with the removal, salvage and re-installation of existing signs to accommodate the Contractor's operations will be considered incidental to the Work, and no separate or additional payment will be made.

5.2.5.2 Designated Sources

Unless otherwise specified, the aggregate in designated sources will be supplied free of cost to the Contractor.

5.2.5.3 Supply of Aggregate Bid Item

The Specification Amendment Table contained in the Special Provisions will indicate whether or not the Contractor has the option of using a specific aggregate source controlled by the Department for the supply of aggregate for the Work.

If the Table indicates that the Contractor has the option of using a specific aggregate source controlled by the Department, the tender will contain a Bid Item for "Supply of Aggregate – With Option". In such cases, the Department will establish the unit price for this work and insert the amount in the Unit Price Schedule.

If the Table indicates that the Contractor may not use an aggregate source controlled by the Department for the supply of aggregate for the Work, the tender will contain a Bid Item for "Supply of Aggregate – No Option", and the Contractor shall bid a unit price for this work.

5.2.5.4 Payment

The payment conditions for supplying aggregate vary depending on the category of the aggregate source used. Categories of aggregate sources are listed in Section 5.2.2, Aggregate Categories. Further, it is possible that more than one aggregate source may be used for the supply of aggregate for the Work (e.g. Portions or all of the pit-run gravel and/or the blend sand components of the aggregate may be obtained from separate aggregate sources of different categories).

The payment conditions for the various categories of aggregate sources are as follows:

No payment will be made for the quantity of aggregate material obtained from a source controlled by the Department.

Payment for the quantity of aggregate obtained from a source not controlled by the Department will be made in accordance with the following:

- (i) For material obtained from crown sources not controlled by the Department, payment will be made at the unit price per tonne established by the Department or bid by the Contractor (as applicable) for the item "Supply of Aggregate", minus \$0.48 per tonne. The \$0.48 reduction recognizes that royalty payments to Alberta Sustainable Resource Development are not applicable to Public Works projects.
- (ii) For material obtained from private sources not controlled by the Department, payment will be made at the unit price per tonne established by the Department or bid by the Contractor (as applicable) for the item "Supply of Aggregate."
- (iii) The quantity for payment will be determined by the Consultant by measuring the material containing the aggregate which has been incorporated into the accepted Work and calculating the quantity of aggregate obtained from sources not controlled by the Department. In the event the material containing the aggregate contains asphalt, no deduction will be made for the asphalt material.
- (iv) When the material measurement is by volume, a conversion factor of 1.632 tonnes per cubic metre will be used to determine the weight of a gravel component and 1.365 tonnes per cubic metre will be used for a blend sand component.

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5.5 SUPPLY OF PORTLAND CEMENT CONCRETE**5.5.1 DESCRIPTION****5.5.1.1 General**

Portland cement concrete shall consist of a mixture of portland cement, fine aggregate, coarse aggregate, water, and admixtures where required, combined in proportions to meet the Specifications contained herein.

5.5.1.2 Class of Concrete

The Contractor shall supply portland cement concrete in accordance with the following requirements for the Class of concrete specified or designated by the Consultant:

Class of Concrete	Minimum Compressive Strength @ 28 Days MPa	Size of Coarse Aggregate mm	Range of Slump mm	Entrained Air Cont. %	Maximum Water/Cement Ratio
A ⁽¹⁾	25	40 to 5	50 to 70	4 - 7	0.45
B	25	28 to 5	50 to 70	4 - 7	0.45
C	30	20 to 5	60 to 80	5 - 8	0.42
D	30	14 to 5	50 to 70	5 - 8	0.42
Pile	25	28 to 5	100 to 140	4 - 7	0.45

(1) The Contractor will be permitted to supply Class "B" concrete where Class "A" has been specified; payment will be as if Class "A" had been supplied.

All properties shall be determined in accordance with the requirements of the latest version of CSA Standards A23.1, Concrete Materials and Methods of Concrete Construction, and A23.2, Methods of Test and Standard Practices for Concrete.

5.5.2 MATERIALS**5.5.2.1 Portland Cement**

The Contractor shall supply portland cement conforming to the requirements of Specification 5.11, Supply of Portland Cement, and concrete products in accordance with A23.1

Unless otherwise specified, directed or approved by the Consultant, Normal Type GU Portland Cement shall be used.

5.5.2.2 Water

Mixing and curing water shall be supplied by the Contractor.

Water shall conform to the requirements of the latest version of CSA Standard A23.1. Water used in portland cement concrete construction shall be subject to the prior approval of the Consultant.

5.5.2.3 Aggregates

The Contractor shall supply aggregates conforming to the requirements of the latest version of CSA Standard A23.1. Aggregates used in portland cement concrete shall be subject to the prior approval of the Consultant.

5.5.2.4 Air-Entraining Admixtures

Air-entraining admixtures shall be supplied by the Contractor.

Air-entraining admixtures shall conform to the requirements ASTM C260.

5.5.2.5 Other Admixtures

All approved admixtures, such as water reducing agents, and super plasticizers shall conform to ASTM C494 and be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, except when approved by the Department/Consultant. Retarders or set controlling admixtures may be used for concrete specified with corrosion inhibitor.

5.5.2.6 Fly Ash

Fly ash may only be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive.

Fly ash, when approved by the Consultant, shall not exceed 30% by mass of cementing materials. All fly ash shall conform to the requirements of CSA-A3000-03 Cementitious Material Compendium for Type "F" or "CI" fly ash. Characteristic data for fly ash is required to assure conformance to the standards.

Only approved compatible super plasticizing admixtures and air entraining agents shall be used with fly ash.

5.5.3 CONSTRUCTION

5.5.3.1 Care and Storage of Materials

All portland cement concrete materials shall be handled and protected in such a way as to prevent segregation, damage and contamination.

All cement, aggregate and other concrete construction materials shall be stored in accordance with the requirements of the latest version of CSA Standards A5, A3001 Cementitious Materials for Use in Concrete and A23.1. Any segregated, damaged, or contaminated materials shall be rejected.

5.5.3.2 Aggregate Tests and Concrete Mix Design

The Contractor shall be responsible for providing the concrete mix designs, and shall submit the mix design for class of concrete to the Consultant for review a minimum of one week prior to the scheduled placing of concrete.

For each concrete mix design, the following aggregate analysis shall be provided:

- "Fine and Coarse Aggregate Sieve" (CSA A23.2-2A)

- Amount of material finer than 80 μ m in aggregate (CSA A23.2-5A)
- "Organic Impurities in Sands for Concrete"
- "Assessment of Potential for Deleterious Alkali-Aggregate Reactivity (AAR)" (CSA A23.2-27A)
- "Sources of proposed aggregate"

The analysis of the aggregates shall fully represent the material to be used in production.

If the fine aggregate consists of a blend from more than one source, the "Fine Aggregate Sieve" analysis shall show the gradation of the blended fine aggregates. Similarly in the case of blended coarse aggregates, the "Coarse Aggregate Sieve" analysis shall indicate the gradation of the blended coarse aggregates. Aggregate gradations for the coarse and fine aggregate shall meet the criteria outlined in Tables 10 and 11 of CSA A23.1-04.

Fine aggregate, tested in accordance with CSA Test Method A23.2-7A, "Organic Impurities in Sands for Concrete", shall produce a colour not darker than the Standard colour (Organic Plate Number 3). Aggregate producing a colour darker than the Standard colour will be rejected in the absence of a satisfactory record of performance of a similar class of concrete (minimum 30 tests over the last 12 months); Provisions 4.2.3.3.2 (a) & (b) of CSA Standard CAN3-A23.1-04 shall not apply.

The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA A23.2-27A. This assessment shall include the risk level associated with structure size and environment, the level of prevention related to service life requirements and the determination of the appropriate preventative measures. Unless otherwise indicated the service life is considered to be 50 years. Test data, less than 18-months old, evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA A23.2-14A or CSA A23.2-25A shall be provided by the Contractor for the Consultant's review. In the absence of current test data and outside of areas of known highly reactive aggregate, the aggregate shall be presumed to be moderately reactive.

For all concrete mixes the minimum cement content, excluding supplementary cementing materials, shall be 300 kg/m³.

Concrete mixes that will be placed by concrete pump shall be designed for pumping.

The sampling and testing of aggregates, and the concrete mix design shall be completed by a CSA certified and qualified concrete testing laboratory that has a permit to practice in the Province of Alberta. The testing laboratory shall provide an engineering opinion that concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

If, during the progress of the Work, it is determined that the concrete has inadequate workability, or does not meet the requirements of the Specification, the Contractor shall provide a new mix design for the Consultants approval, in accordance with the foregoing requirements.

All concrete shall be proportioned in accordance with the approved mix designs.

All costs associated with aggregate testing and providing the mix designs shall be the responsibility of the Contractor.

5.5.3.3 Consistency

The slump shall be in accordance with the Specifications contained herein, however, the slump for slip-formed concrete shall be limited to a maximum of 50 mm, or to such other value as may be necessary to enable the material to be slip-formed without subsequent distortion.

Generally, mass and mechanically vibrated concrete shall have slumps in the lower portion of the specified range, and heavily reinforced and/or inaccessible sections shall have slumps in the higher end of the range.

5.5.3.4 Concrete Production

Portland cement concrete shall be produced in accordance with the requirements of the latest version of CSA Standard A23.1, unless otherwise approved by the Consultant.

5.5.3.5 Delivery

Delivery of portland cement concrete shall be regulated so as to enable continuous deposition until the placement of each concrete section is completed.

5.5.3.6 Protection

Curing and protection of the placed concrete shall be in accordance with Section 7.4, Curing and Protection, of CSA A23.1-04 for a Curing Type 2 concrete surface.

Concrete shall be protected against damage from freezing, rain, dust, rapid temperature change or other adverse weather effects.

For a minimum of 7 days after finishing, or until the concrete has attained 70% of the specified concrete strength, whichever is greater; concrete shall be protected against damage by any form of traffic. The Contractor may block off areas containing fresh concrete to safeguard the Work from traffic.

Hot-weather curing requirements shall apply when the concrete is placed with an air temperature of 27°C or higher, or when the air temperature is forecast to exceed this value during the 7 day curing period. During periods of hot-weather curing, the Contractor shall use a water spray or saturated absorptive fabric to achieve cooling by evaporation.

Methods and materials used for protecting concrete from damage shall be the responsibility of the Contractor, and will be subject to prior approval of the Consultant.

Concrete damaged by moisture loss, freezing, rain, traffic, construction operations, or any other cause shall be repaired, or removed and replaced to the satisfaction of the Consultant, at the Contractor's expense.

5.5.4 SAMPLING AND TESTING

5.5.4.1 Quality Control Testing

Quality control testing will be the responsibility of the Contractor. The Contractor shall determine the type and frequency of testing required and shall provide and pay for all equipment and personnel necessary to complete such testing. Results of all quality control testing shall be submitted to the Consultant as they become available.

5.5.4.2 Acceptance Sampling and Testing

Acceptance testing is the responsibility of the Consultant. The Consultant will take samples, and carry out quality assurance testing and inspection of materials incorporated or being incorporated into the Work. The Contractor shall cooperate with the Consultant during the sampling, testing and inspection. Such inspection shall not relieve the Contractor from any obligation to perform all the Work strictly in accordance with the requirements of the Contract.

Locations for routine quality assurance testing shall be randomly selected as far as it is practical to do so. This will not limit the Consultant from testing at any additional locations as he deems necessary.

Results of the quality assurance tests will be made available to the Contractor for his information. The Contractor shall be responsible for interpretation of test results and alter his operation if necessary, so that the product meets the Specifications.

5.5.4.3 Test Methods

Unless otherwise specified, the most recent editions of the following standard test methods and frequencies will be used to determine the material characteristics.

Test Description	Method No.	Frequency
Sampling Concrete	CSA A23.2-1C	Minimum of one per day ⁽¹⁾
Slump	CSA-A23.2-5C	Minimum of one per day ⁽²⁾
Entrained Air	CSA-A23.2-4C	Minimum of one per day ⁽²⁾
Making and Curing Compressive Strength Specimens	CSA-A23.2-3C	Minimum of one per day ⁽¹⁾
Compressive Strength	CSA-A23.2-9C	Minimum of one per day ⁽¹⁾

⁽¹⁾ On larger pours a strength test will be taken on approximately each 30 m³ portion of the concrete pour. A compressive strength test will consist of four standard test specimens. One cylinder will be tested at seven days. The 28 day test result will be the average of the remaining three specimens.

⁽²⁾ For each compressive strength test a slump test will be performed and the amount of entrained air measured.

5.5.4.4 Slump and Air Content

In the event that slump and/or air content test results are outside the specified tolerance range as determined by the Consultant's testing, the Consultant may accept adjustments of the deficient condition as an alternate to rejection provided adjustments are made within 90 minutes from batching of the concrete. Concrete that does not meet this requirement is subject to rejection.

On-site addition of water to a concrete batch will only be permitted by the Consultant provided the specified water-to-cement ratio is not exceeded. The Consultant reserves the right to reject any batch in the event of confirmed unacceptability, and to require immediate removal of any concrete from this batch that may have already been placed.

Placed concrete that does not meet the specified air content criteria will not be accepted by the Consultant unless core sample testing conducted by the Contractor indicates that the air content and air-void system parameters of the suspect material is considered satisfactory in accordance with the latest version of CSA-A23.1 clauses 4.3.3.2 and 4.3.3.3. Sampling and testing costs associated with verifying the suitability of suspect concrete will be the responsibility of the Contractor.

5.5.5 REQUIREMENTS FOR ACCEPTANCE

5.5.5.1 **General**

The Department reserves the right to reject any concrete whatsoever that does not meet all the requirements for the specified class of concrete. The Department may however, accept concrete the strength of which falls below the specified strength requirements.

In such cases, payment will be made in accordance with Subsection 5.5.5.2. The bid price can either be unit price or lump sum.

5.5.5.2 **Payment Scales**

Strength Test Result	Minimum Compressive Strength Requirement @ 28 Days MPa			
	20	25	30	35
35 MPa and over	Full Payment	Full Payment	Full Payment	Full Payment
34 MPa to 35 MPa	Full Payment	Full Payment	Full Payment	\$10 /m ³ Penalty
33 MPa to 34 MPa	Full Payment	Full Payment	Full Payment	\$20 /m ³ Penalty
32 MPa to 33 MPa	Full Payment	Full Payment	Full Payment	\$30 /m ³ Penalty
31 MPa to 32 MPa	Full Payment	Full Payment	Full Payment	\$40 /m ³ Penalty
30 MPa to 31 MPa	Full Payment	Full Payment	Full Payment	\$50 /m ³ Penalty
29 MPa to 30 MPa	Full Payment	Full Payment	\$10 /m ³ Penalty	\$60 /m ³ Penalty
28 MPa to 29 MPa	Full Payment	Full Payment	\$20 /m ³ Penalty	\$70 /m ³ Penalty
27 MPa to 28 MPa	Full Payment	Full Payment	\$30 /m ³ Penalty	Reject
26 MPa to 27 MPa	Full Payment	Full Payment	\$40 /m ³ Penalty	Reject
25 MPa to 26 MPa	Full Payment	Full Payment	\$50 /m ³ Penalty	Reject
24 MPa to 25 MPa	Full Payment	\$10 /m ³ Penalty	Reject	Reject
23 MPa to 24 MPa	Full Payment	\$20 /m ³ Penalty	Reject	Reject
22 MPa to 23 MPa	Full Payment	\$30 /m ³ Penalty	Reject	Reject
21 MPa to 22 MPa	Full Payment	\$40 /m ³ Penalty	Reject	Reject
20 MPa to 21 MPa	Full Payment	\$50 /m ³ Penalty	Reject	Reject
19 MPa to 20 MPa	\$10 /m ³ Penalty	Reject	Reject	Reject
18 MPa to 19 MPa	\$20 /m ³ Penalty	Reject	Reject	Reject
17 MPa to 18 MPa	\$30 /m ³ Penalty	Reject	Reject	Reject
16 MPa to 17 MPa	\$40 /m ³ Penalty	Reject	Reject	Reject

Strength Test Result	Minimum Compressive Strength Requirement @ 28 Days MPa			
	20	25	30	35
15 MPa to 16 MPa	\$50 /m ³ Penalty	Reject	Reject	Reject
Less than 15 MPa	Reject	Reject	Reject	Reject

The reduced payment shall apply to the volume of concrete as determined by the Consultant.

Removing and replacing of rejected concrete construction shall be done at the Contractor's expense. Any work deemed by the Consultant as defective or damaged by weather, traffic or other causes, shall be repaired or removed and replaced at the Contractor's expense.

5.5.6 PAYMENT

All costs associated with the supply and production of accepted portland cement concrete shall be included in the unit price bid for the respective structure for which the concrete is being used; no separate or additional payment will be made.

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5.7 SUPPLY OF ASPHALT**5.7.1 GENERAL**

The Work consists of supplying asphalt materials including ordering, scheduling, delivering, supplying storage facilities, handling, storing, sampling, testing and other related work.

For purposes of this specification, the term "Asphalt Supplier" shall mean the party awarded an order by the Contractor for the supply of asphalt.

5.7.2 MATERIALS**5.7.2.1 General**

The Contractor shall supply the types and grades of asphalt specified in the Contract. Asphalt suppliers' materials must be pre-qualified by the Department. Pre-qualified suppliers are listed in the Alberta Transportation Products List.

All asphalt binders shall be prepared from petroleum oils. They shall be free from impurities. Solvents used in the manufacture of cut-back asphalts shall be derived from petroleum oils. Emulsifiers used to stabilize asphalt emulsions shall not be harmful to the performance of the asphalt in service.

The Contractor shall ensure that the asphalt supplied meets all requirements for the types and grades specified. The Contractor may be required to use more than one type or grade of asphalt for a particular purpose. Any change in asphalt type or grade must be approved by the Consultant. The Contractor shall notify the Consultant of any changes in asphalt material suppliers.

Performance grade asphalt cements (PGAC) shall meet the requirements of AASHTO M320 Standard Specification for Performance Graded Asphalt Binder. For asphalts designated as a PG 58-37, Table 1, Performance Graded Asphalt Binder Specification contained in AASHTO M320 shall be modified in accordance with the following criteria:

- The test temperature for creep stiffness and direct tension shall be -27°C;
- The test temperature for the Dynamic Shear on PAV residue shall be 15°C.

The Department reserves the right to discontinue the use of any asphalt product that fails to handle or perform to expectation or satisfaction, regardless of its compliance with the Specifications.

5.7.2.2 Delivery, Handling and Storage

When requested by the Consultant, the Contractor shall supply the Consultant with the asphalt suppliers' weigh-bills and records of all asphalt received and/or returned on a daily basis. On projects where PGAC is supplied, the Contractor shall supply the Consultant with all asphalt suppliers' weigh-bills and records of all asphalt received and/or returned on a daily basis.

The Contractor shall provide, maintain and reclaim asphalt storage facilities.

Storage facilities for asphalt cement shall be capable of heating the material under effective and positive control at all times and shall contain provision for measuring and sampling.

For Performance Grade Asphalt Cements (PGAC), the Contractor shall follow the Suppliers' specified handling and storage requirements for each grade of PGAC.

No asphalt type or grade shall be diluted or mixed with a different type or grade, or with any other material, without the specific approval of the Consultant. Performance Grade asphalts from different suppliers shall not be mixed, regardless of grade.

The Contractor shall prevent contamination of the asphalt, by asphalt of another type or grade, by solvent, or by any other material. Asphalt storage tanks shall be emptied of one type or grade of asphalt, and cleaned as necessary to prevent detrimental contamination of the asphalt, before placing another type or grade of asphalt therein. Asphalt emulsions shall be protected from freezing.

5.7.3 SAMPLING AND TESTING

5.7.3.1 **General**

The Contractor shall obtain representative, uncontaminated samples of all asphalt materials delivered to the project for quality assurance testing in accordance with ATT-42, Sampling Asphalt and Table 5.7.3. The Consultant may require increases in the minimum frequencies specified for quality assurance sampling. In addition, all asphalt shall be subject to inspection, sampling and testing by the Department or its designated agents. The Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the asphalt, and shall cooperate in the inspection and sampling process when requested to do so.

The Contractor shall ensure that all asphalt delivery tanks are equipped with sampling valves maintained in good operating condition which are designed and located to enable safe, representative sampling into the appropriate one or two litre containers.

5.7.3.2 **Quality Control**

Quality control and quality control testing is the responsibility of the Contractor. Quality control testing shall be carried out by a qualified Supplier's laboratory or a qualified testing laboratory licensed to practice in the Province of Alberta.

5.7.3.2.1 Quality Control Plan - Performance Grade Asphalt Cements

The Contractor shall provide a Quality Control Plan jointly prepared with the asphalt supplier detailing the quality control activities related to the use of the Performance Grade Asphalt Cement. The Plan shall be submitted at least 14 calendar days prior to the use of any PGAC product in the Contract.

Hot mix production shall not commence until the Plan has been accepted, in writing, by the Department. The requirement for the Contractor to provide a Quality Control Plan may be waived if the current Quality Control Plan used by the asphalt supplier has been previously approved in writing by the Department.

As a minimum, the Plan shall provide the following information:

- (i) The type of facility from which the material(s) will be supplied (refinery, terminal) and its location.
- (ii) Name and telephone number of the person responsible for quality control at the facility.

- (iii) The method and frequency for initial testing, specification compliance testing and any other testing employed to either guide the manufacturing process of the PGAC or to ensure the on-going compliance of the material to contract specifications.
- (iv) Specification compliance testing shall be carried out prior to shipping the materials from the Supplier's facility to the hot mix plant. The Plan shall provide an outline of the procedures to be followed for checking transport vehicles before loading to prevent contamination of shipments. The outline shall include a statement that the transport vehicles inspection report, signed by the responsible inspector, shall be maintained in the Supplier's records and shall be made available to the Department upon request.
- (v) The Plan shall identify the QC laboratory and detail control charting or any such statistical procedures which will be used to track the quality of the material(s). The Plan shall indicate which accreditation programs, proficiency sample testing programs or other correlation programs that the QC laboratory has or is currently participating in. Proof of good standing in such programs is required.
- (vi) The Plan shall detail the methods to be used to identify and provide for the exclusion of materials which do not conform to specifications, prior to incorporating them into the hot mix.

5.7.3.3 Quality Assurance

The Contractor shall deliver all quality assurance samples to the Consultant on the day they were sampled. The Consultant will forward the samples to the Department's designated quality assurance laboratory for testing and will accept or reject asphalt material based on the test results.

**TABLE 5.7.3
SAMPLING FREQUENCY FOR QUALITY ASSURANCE**

MATERIAL	MINIMUM FREQUENCY ⁽¹⁾ (FOR EACH ASPHALT TYPE)
Asphalt Cement - Penetration grades	One per five Lots
Asphalt Cement - Performance Grade	One per three Lots
Liquid Asphalt (ASBC)	One per day
Prime, Tack, Curing Seal, and Fog Coat	One for each 100 tonnes
Seal Coats, Slurry Seals	One per day

⁽¹⁾ Minimum of one sample for each asphalt type or as listed above, whichever is greater.

5.7.4 ACCEPTANCE

Asphalt materials supplied and incorporated into the Work will be considered for acceptance provided the specified quality assurance samples have been provided to the Consultant within the time frame specified and where both the Work and the asphalt material meet specifications.

In the event quality assurance test results are not available to the Consultant at the time he prepares the monthly progress payment estimates, the Consultant may request payment for asphalt material which has not been accepted. However, should the Contractor fail to supply the required samples or the asphalt material fails to meet the specification requirements, the Consultant may deduct such payments from the subsequent monthly progress payment estimates. In the case where the Contract does not contain a bid item for the particular asphalt material, the deducted payment will be determined by the Consultant and will be equal to the estimated value of the asphalt material that fails to meet the specification requirements.

5.7.5 MEASUREMENT AND PAYMENT

Where the Contract contains bid items for the supply of asphalt, measurement will be based on the Suppliers' weigh bills however, the Consultant may check quantities delivered by weighing the delivery vehicles before and after unloading. Where the Contract does not otherwise require the installation of a weigh scale for weighing materials, the Consultant will determine quantities by measuring the liquid level in the tank truck or storage tank, at his discretion. When asphalt quantities are determined by this method, the Contractor shall calibrate the distributor trucks and storage tanks.

If there is a variance between quantities measured by the Consultant and the Suppliers' weigh-bills, the Consultant will determine the quantity on which payment will be based.

Where the Contract contains bid items for the supply of asphalt, payment for accepted asphalt material will be made at the applicable unit price bid per tonne.

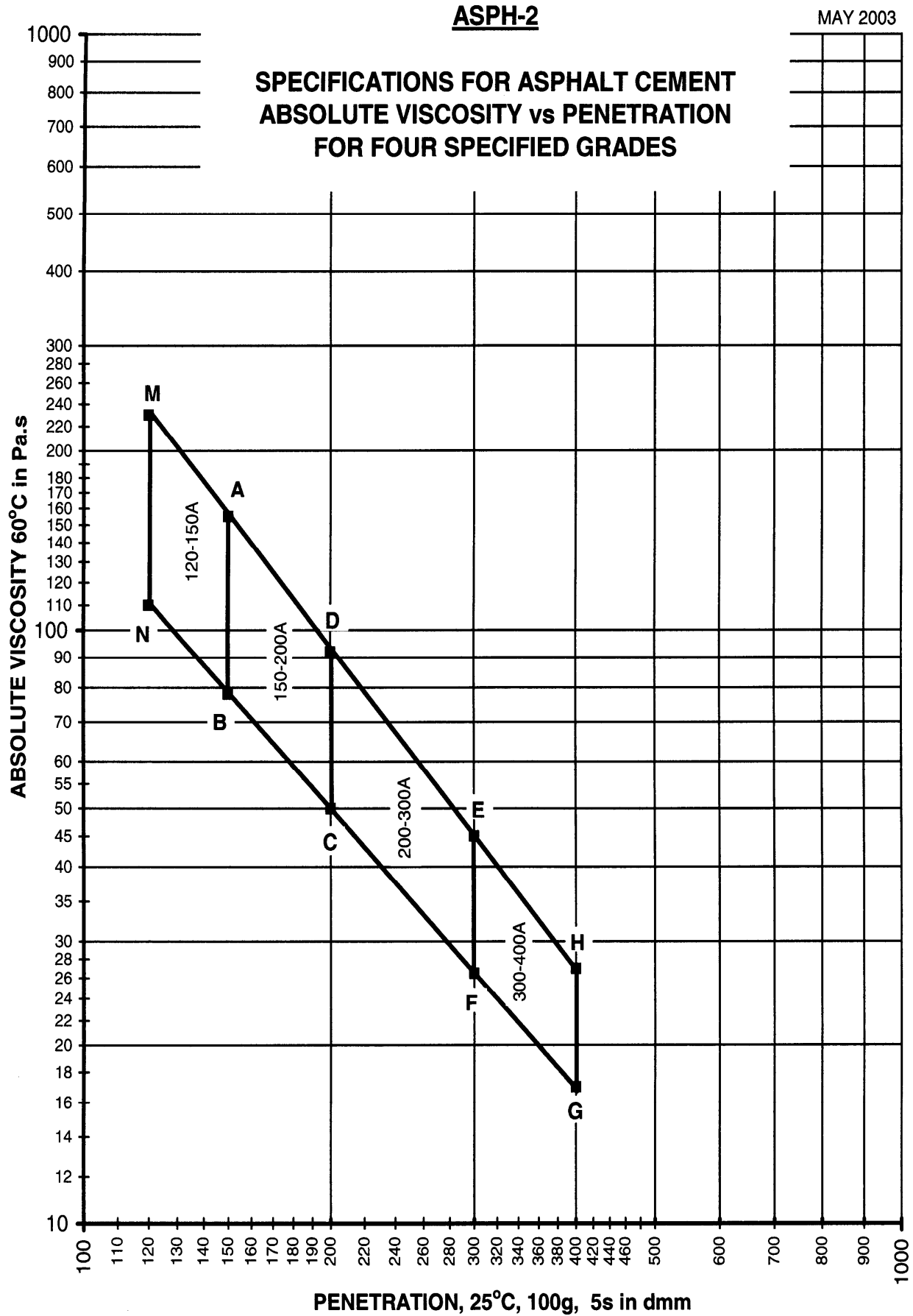
Where the Contract does not contain bid items for the supply of asphalt, accepted asphalt material will not be paid for separately. Payment will be considered included in the unit price bid for the Contract item for which the asphalt material is used.

Payment will be full compensation for supplying asphalt material to the project; storing the material; sampling and quality control.

ASPH-1 SPECIFICATIONS FOR ASPHALT CEMENTS: Asphalt cements shall conform to the requirements specified in the following table:

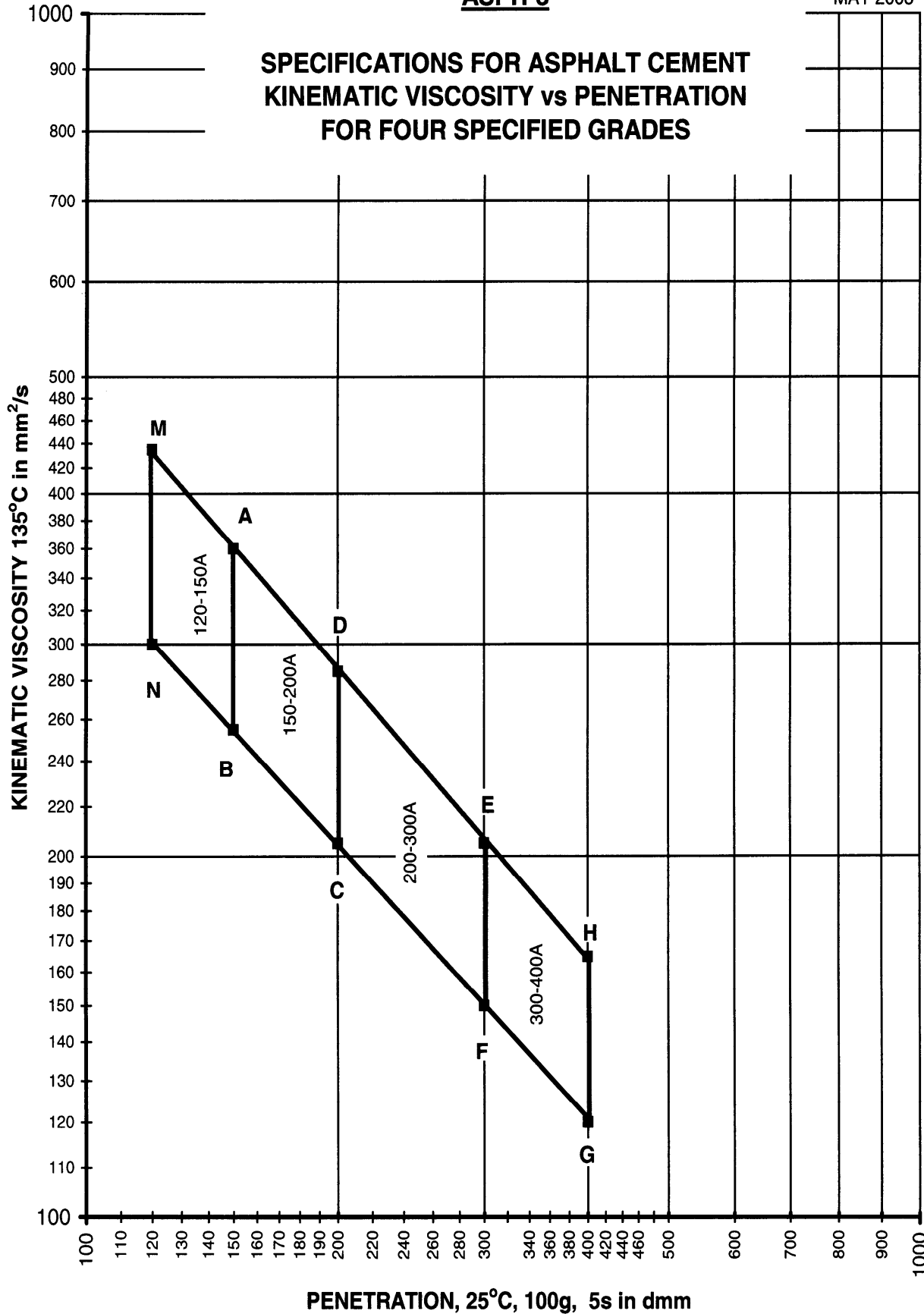
TEST CHARACTERISTICS		PREMIUM GRADES OF ASPHALT CEMENTS																																																															
		A.S.T.M. TEST METHODS	120-150(A)	150-200(A)	200-300(A)	300-400(A)																																																											
Absolute Viscosity, 60°C, Pa.s Penetration, 25°C, 100 g, 5 s, dmm	D2171	The viscosity and penetration values must fall within the area bounded by M-N-B-A-M, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Abs. Visc.</td><td>Pen.</td></tr> <tr><td>M</td><td>230</td><td>120</td></tr> <tr><td>N</td><td>110</td><td>120</td></tr> <tr><td>B</td><td>78</td><td>150</td></tr> <tr><td>A</td><td>155</td><td>150</td></tr> </table>	Pt.	Abs. Visc.	Pen.	M	230	120	N	110	120	B	78	150	A	155	150	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Abs. Visc.</td><td>Pen.</td></tr> <tr><td>A</td><td>155</td><td>150</td></tr> <tr><td>B</td><td>78</td><td>150</td></tr> <tr><td>C</td><td>50</td><td>200</td></tr> <tr><td>D</td><td>92</td><td>200</td></tr> </table>	Pt.	Abs. Visc.	Pen.	A	155	150	B	78	150	C	50	200	D	92	200	The viscosity and penetration values must fall within the area bounded by C-D-E-F-C, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Abs. Visc.</td><td>Pen.</td></tr> <tr><td>C</td><td>50</td><td>200</td></tr> <tr><td>D</td><td>92</td><td>200</td></tr> <tr><td>E</td><td>45</td><td>300</td></tr> <tr><td>F</td><td>26.5</td><td>300</td></tr> </table>	Pt.	Abs. Visc.	Pen.	C	50	200	D	92	200	E	45	300	F	26.5	300	The viscosity and penetration values must fall within the area bounded by E-F-G-H-E, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Abs. Visc.</td><td>Pen.</td></tr> <tr><td>E</td><td>45</td><td>300</td></tr> <tr><td>F</td><td>26.5</td><td>300</td></tr> <tr><td>G</td><td>17</td><td>400</td></tr> <tr><td>H</td><td>27</td><td>400</td></tr> </table>	Pt.	Abs. Visc.	Pen.	E	45	300	F	26.5	300	G	17	400	H	27	400
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Kinematic Viscosity, 135°C, mm ² /s Penetration, 25°C, 100g, 5s, dmm	D2170 D5	The viscosity and penetration values must fall within the area bounded by M-N-B-A-M, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Kin. Visc.</td><td>Pen.</td></tr> <tr><td>M</td><td>435</td><td>120</td></tr> <tr><td>N</td><td>300</td><td>120</td></tr> <tr><td>B</td><td>255</td><td>150</td></tr> <tr><td>A</td><td>360</td><td>150</td></tr> </table>	Pt.	Kin. Visc.	Pen.	M	435	120	N	300	120	B	255	150	A	360	150	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>kin. Visc.</td><td>Pen.</td></tr> <tr><td>A</td><td>360</td><td>150</td></tr> <tr><td>B</td><td>255</td><td>150</td></tr> <tr><td>C</td><td>205</td><td>200</td></tr> <tr><td>D</td><td>285</td><td>200</td></tr> </table>	Pt.	kin. Visc.	Pen.	A	360	150	B	255	150	C	205	200	D	285	200	The viscosity and penetration values must fall within the area bounded by C-D-E-F-C, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Kin. Visc.</td><td>Pen.</td></tr> <tr><td>C</td><td>205</td><td>200</td></tr> <tr><td>D</td><td>285</td><td>200</td></tr> <tr><td>E</td><td>205</td><td>300</td></tr> <tr><td>F</td><td>150</td><td>300</td></tr> </table>	Pt.	Kin. Visc.	Pen.	C	205	200	D	285	200	E	205	300	F	150	300	The viscosity and penetration values must fall within the area bounded by E-F-G-H-E, plotted as straight lines on a full logarithmic plot (log-log), with the co-ordinates of the points as follows: <table border="1"> <tr><td>Pt.</td><td>Kin. Visc.</td><td>Pen.</td></tr> <tr><td>E</td><td>205</td><td>300</td></tr> <tr><td>F</td><td>150</td><td>300</td></tr> <tr><td>G</td><td>120</td><td>400</td></tr> <tr><td>H</td><td>165</td><td>400</td></tr> </table>	Pt.	Kin. Visc.	Pen.	E	205	300	F	150	300	G	120	400	H	165	400
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G	120	400																																																															
H	165	400																																																															
Flash Point, Cleveland Open Cup, °C minimum	D92	220	205	175	175																																																												
Solubility in Trichloroethylene, % minimum	D2042	99.5	99.5	99.5	99.5																																																												
Tests on Residue from Thin-Film Oven Test: Ratio of Absolute Viscosity of Residue from Thin-Film Oven Test to Original Absolute Viscosity, maximum	D1754 D2171	4.0	4.0	4.0	4.0																																																												
Ductility, 25°C, cm, minimum	D113	100	100	---	---																																																												
Ductility, 15.6°C, cm, min.		---	---	100	100																																																												

General Requirements - The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 175°C.
 - The temperature at delivery to the site shall be between 135°C and 175°C.



ASPH-3

MAY 2003



ASPH-4

SPECIFICATIONS FOR SLOW CURING LIQUID ASPHALTS: Slow curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

ASPHALT GRADE REQUIREMENTS	SC-70		SC-250		SC-800		SC-3000		A.S.T.M. TEST METHOD
	min.	max.	min.	max.	min.	max.	min.	max.	
Flash Point, Cleveland Open Cup, °C	65	-	80	-	90	-	105	-	D92
Kinematic Viscosity at 60°C, mm ² /s	70	180	250	500	800	1 600	3 000	6 000	D2170
Distillation Test: Total distillate to 360°C; % by volume	10	30	4	20	2	12	-	5	(2) TLT-214
Distillation Residue; Kinematic Viscosity at 60°C, mm ² /s	400	7 000	800	10 000	2 000	16 000	4 000	35 000	D2170
Residue of 100 penetration, % by mass Asphalt Residue;	50	-	60	-	70	-	80	-	D243
	100	-	100	-	100	-	100	-	D113
Ductility of 100 penetration residue at 25°C, cm ⁽¹⁾	100	-	100	-	100	-	100	-	D113
Solubility of Distillation Residue to 360°C, in Trichloroethylene, % by mass	99.0	-	99.0	-	99.0	-	99.0	-	D2042
Water, % by mass or volume	-	0.5	-	0.5	-	0.5	-	0.5	D95
Delivery Temperature, °C	55	75	75	95	90	110	110	130	

(1) If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 15°C is more than 100.

(2) Alberta Transportation Laboratory Test.

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.

-The asphalt shall be uniform in character.

ASPH-5

SPECIFICATIONS FOR MEDIUM-CURING LIQUID ASPHALTS: Medium curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

ASPHALT GRADE	MC-30		MC-70		MC-250		MC-800		A.S.T.M. TEST METHOD
	min.	max.	min.	max.	min.	max.	min.	max.	
Flash Point, Open Tag, °C	38	-	38	-	65	-	65	-	D1310
Kinematic Viscosity at 60°C, mm ² /s	30	60	70	140	250	500	800	1 600	D2170
% by volume of total distillate to 360°C, -to 225°C -to 260°C -to 315°C	-	25	-	20	-	10	-	-	(2) TLT-214
	40	70	20	60	15	55	-	35	
	75	93	65	90	60	87	45	80	
Residue from distillation to 360°C, Volume % by difference	50	-	55	-	67	-	75	-	
Test on Residue from Distillation:									
a) Penetration at 25°C, 100 g, 5 s, dmm	120	250	120	250	120	250	120	250	D5
b) Ductility at 25°C, cm ⁽¹⁾	100	-	100	-	100	-	100	-	D113
c) Solubility in Trichloroethylene, % by mass	99.5	-	99.5	-	99.5	-	99.5	-	D2042
Water, % by mass or volume	-	0.2	-	0.2	-	0.2	-	0.2	D95
Delivery Temperature, °C	35	55	55	75	75	95	90	110	

⁽¹⁾ If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 15°C is more than 100.

⁽²⁾ Alberta Transportation Laboratory Test.

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.
 -The asphalt shall be produced by the refining of petroleum and shall be uniform in character.

ASPH-6

SPECIFICATIONS FOR RAPID-CURING LIQUID ASPHALTS: Rapid curing liquid asphalts shall conform to the requirements specified in the following table, for the grade designated by Consultant:

ASPHALT GRADE	RC-30		RC-70		RC-250		A.S.T.M. TEST METHOD
	min.	max.	min.	max.	min.	max.	
Flash Point, Open Tag, °C	-	-	-	-	27	-	D1310
Kinematic Viscosity at 60°C, mm ² /s	30	60	70	140	250	500	D2170
Distillation Test: % by volume of total distillate to 360°C, -to 190°C -to 225°C -to 260°C -to 315°C	15 55 75 90	- - - -	10 50 70 85	- - - -	- 35 60 80	- - - -	(2) TLT-214
Residue from distillation to 360°C, Volume % by difference	50	-	55	-	65	-	
Tests on Residue from Distillation: a) Penetration at 25°C, 100 g, 5 s, dmm b) Ductility at 25°C, cm (1) c) Solubility in Trichloroethylene, % by mass	80 100 99.5	120 - -	80 100 99.5	120 - -	80 100 99.5	120 - -	D5 D113 D2042
Water, % by mass or volume	-	0.2	-	0.2	-	0.2	D95
Delivery Temperature, °C	35	55	55	75	75	95	

(1) If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 15°C is more than 100.

(2) Alberta Transportation Laboratory Test.

General Requirements: -The asphalt shall not foam when heated to the application temperature range recommended by the Asphalt Institute.
-The asphalt shall be produced by the refining of petroleum and shall be uniform in character.

ASPH-7

SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALTS: Anionic emulsified asphalts shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

ASPHALT TYPE	RAPID SETTING (RS)				MEDIUM SETTING (MS)				SLOW SETTING (SS)				A.S.T.M. TEST METHOD
	RS-1		RS-2		MS-1		SS-1		SS-1H				
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.			
ASPHALT GRADE REQUIREMENTS													
Viscosity at 25°C, SF s	20	100	-	-	20	100	20	100	20	60	20	60	D244
Viscosity at 50°C, SF s	-	-	50	300	-	-	-	-	-	-	-	-	
Residue by Distillation, % by mass	55	(1)	60	(1)	55	(1)	55	(1)	55	(1)	55	(1)	D6997
Settlement in 5 d, % difference by mass (2)	-	3	-	3	-	5	-	5	-	5	-	5	D6930
Storage Stability Test, 24 h, % by mass (3)	-	1	-	1	-	1	-	1	-	1	-	1	D6930
Sieve Test, % retained on a No. 1000 Sieve, % by mass (4)	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	D6933
Demulsibility, 35 ml of 1.11 g/l CaCl ₂ , % by mass	60	-	60	-	-	-	-	-	-	-	-	-	D6936
Cement Mixing Test, % by mass	-	-	-	-	-	-	-	-	-	2.0	-	2.0	D6935
Particle Charge (5)	Negative		Negative		Negative		Negative		-		-		D244
Tests on Residue from Distillation:													
a) Penetration at 25°C, 100 g, 5 s, dmm	100	200	100	200	100	200	100	200	100	200	40	100	D5
b) Ductility at 25°C, and 5 cm/min., cm	60	-	60	-	60	-	60	-	60	-	60	-	D113
c) Solubility in Trichloroethylene, % by mass	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	D2042
Delivery Temperature, °C	35	65	45	70	40	70	40	70	40	70	40	70	

(1) Upper limit on % residue is governed by the consistency limits.

(2) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time.

(3) The 24 hour storage stability test may be used instead of the 5 day settlement test. In case of dispute the 5 day storage settlement test shall govern.

(4) CGSB 8-GP-2M, Sieves, Testing, Woven Wire, Metric

(5) Particle Charge Test (Qualitative) - The rapid setting grades will be tested for particle charge according to the procedure described in ASTM D 244, with the modification that the asphalt deposit will, for anionic emulsions, be found on the anode (positive electrode), and shall be continuous and opaque. In the event of dispute, the test will be repeated using freshly distilled water as the wash water for the electrodes, before evaluating the asphalt deposit.

General Requirements: -All tests shall be performed within 15 days of date of delivery.

-The asphalt shall be uniform in character, and shall have a refined petroleum base.

ASPH-8

SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALTS: Cationic emulsified asphalts shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

ASPHALT TYPE AND GRADE REQUIREMENTS	RS-1K		RS-2K		CRS-2		QS-Kh		A.S.T.M. TEST METHOD
	min.	max.	min.	max.	min.	max.	min.	max.	
Viscosity at 25°C, SF s	-	-	-	-	-	-	20	100	D244
Viscosity at 50°C, SF s	75	200	150	400	100	400	-	-	D6997
Residue by Distillation, % by mass	65	⁽¹⁾	65	⁽¹⁾	65	-	57	⁽¹⁾	D6930
Settlement in 5 d, % difference by mass ⁽²⁾	-	5	-	5	-	-	-	5	D6930
Storage Stability Test, 24 h, % by mass ⁽³⁾	-	1	-	1	-	1.5 ⁽⁸⁾	-	1	D6930
Demulsibility. 35 ml of 0.5 % by weight solution of sodium dioctyl sulphosuccinate, % by mass					60				D6936
Oil Portion of Distillate, % by volume of emulsion	-	3	-	3	-	3	-	-	D6997
Sieve Test, % retained on No. 1 000 Sieve ⁽⁴⁾⁽⁵⁾ , by mass	-	0.10	-	0.10	-	0.10 ⁽⁸⁾	-	0.10	D6933
Particle Charge ⁽⁶⁾	Positive		Positive		Positive		Positive		D244
Tests on Residue from Distillation:									
a) Penetration at 25°C, 100 g, 5 s, dmm	100	250	100	250	100	250	40	125	D5
b) Apparent Viscosity at 60°C, Pa.s					See Figure 1				
c) Ductility at 25°C, (4) and 5 cm/min., cm ⁽⁷⁾	60	-	60	-	60	-	60	-	D113
d) Solubility in Trichloroethylene, % by mass	97.5	-	97.5	-	97.5	-	97.5	-	D2042
Delivery Temperature, °C	60	80	60	85					

⁽¹⁾ Upper limit on % residue is governed by the consistency limits.

⁽²⁾ The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time.

⁽³⁾ The 24 hour storage stability test may be used instead of the 5 day settlement test, however in case of dispute the 5 day storage settlement test shall govern.

⁽⁴⁾ CGS 8-GP-2M, Sieves, Testing, Woven Wire, Metric

⁽⁵⁾ Replace sodium oleate solution (2%) with distilled water, use distilled water in all operations including wetting and subsequent washing of wire cloth sieves.

⁽⁶⁾ Particle Charge Test (Qualitative)- The emulsion will be tested for particle charge according to the procedure described in ASTM D 244, and it is required that the layer of asphalt deposited be continuous and opaque. In the event of dispute, the test will be repeated using freshly distilled water as the wash water for the electrodes, before evaluating the asphalt deposit.

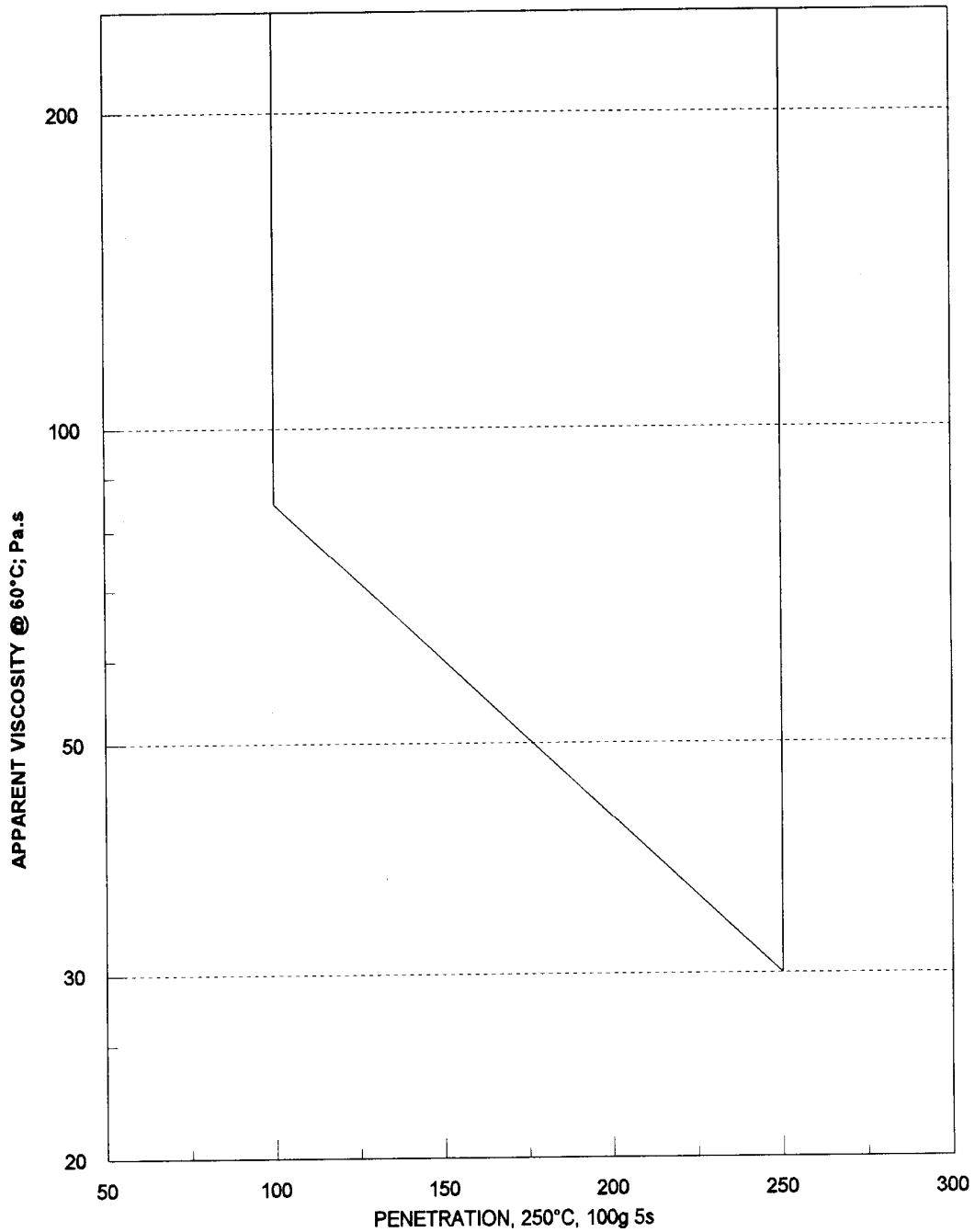
⁽⁷⁾ Ductility - Ductility will be measured at 25°C for 100-200 penetration asphalts, and at 15°C for 200-250 penetration asphalts.

⁽⁸⁾ Requirements for Storage Stability and Sieve Test are waived if emulsion performs satisfactorily during application.

General Requirements: -All tests shall be performed within 15 days of date of delivery;

-The asphalt shall be uniform in character, and shall have a refined petroleum base.

FIGURE 1
MINIMUM VISCOSITY FOR CRS-2 DISTILLATION RESIDUE



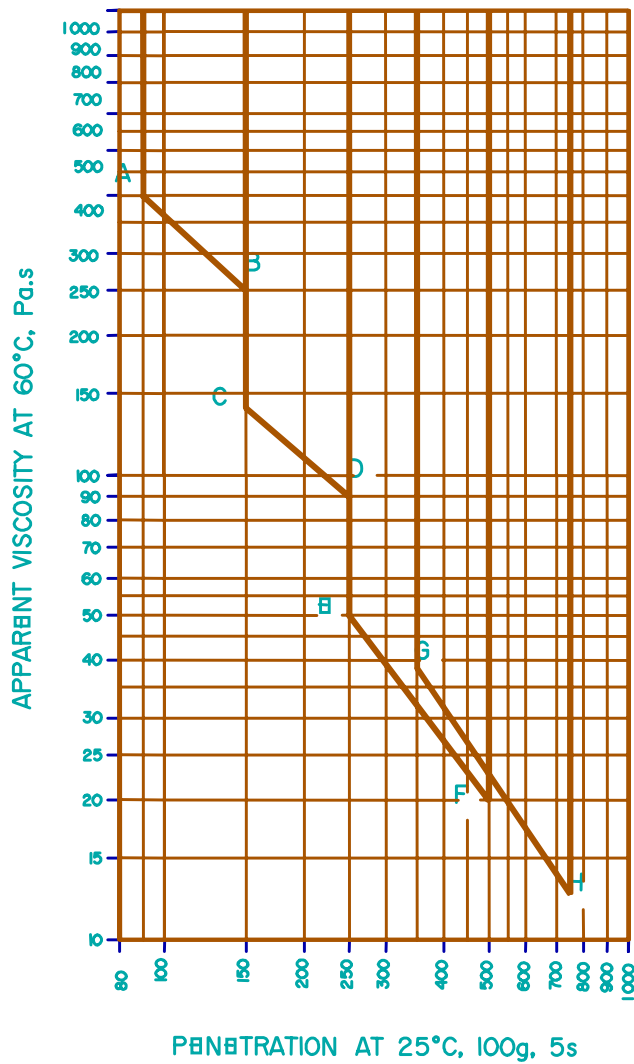
ASPH-9

SPECIFICATIONS FOR HIGH FLOAT EMULSIFIED ASPHALTS: High Float emulsified asphalt shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

GRADE	HF-100S		HF-150S		HF-250S		HF-350S		HF-300M		HF-500M		HF-1000M		TEST ⁽¹⁾ METHODS
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	
REQUIREMENTS															
Residue by Distillation, % by mass	62	(2)	62	(2)	62	(2)	65	(2)	65	(2)	65	(2)	65	(2)	Par. 6.2.1
Oil Portion of Distillate, % by volume of emulsion	1	4	1	4	1	6	1.5	6	1	6	1	1	2	1	A.S.T.M. D6997 & Par. 6.2.2
Viscosity at 50°C, SF s	30	150	30	150	35	150	75	400	50	---	50	---	50	---	ASTM D244
Sieve Test, % retained on No. 1000 sieve % by mass ⁽³⁾	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	0.10	---	---	Par. 6.2.2
Coating Test (see Notes 4 & 5)	(4)		(4)		(4)		(5)		(5)		(5)		(5)		ASTM D6998
Workability at -10°C	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Par. 6.2.3
Storage Stability Test, 24h, % by mass	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	---	ASTM D6930
Demulsibility, 50 ml, 5.55 g/l CaCl ₂ , % by mass	60	---	60	---	---	---	---	---	---	---	---	---	---	---	ASTM D6936
Tests on Residue from Distillation:															
a) Penetration at 25°C, 100 g, 5 s, dmm	90	150	150	250	250	500	350	750	300	---	500	---	---	---	Par. 6.2.4
b) Apparent Viscosity at 60°C, Pa.s	Requirements outlined on the chart beneath Figure 1														
	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---	1200	---	Par. 6.2.5/ A
c) Float Test at 60°C, s	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	97.5	---	Par./A1.6.2.6
d) Solubility in Trichloroethylene, % by mass	40	70	40	70	40	70	40	70	40	70	40	70	40	70	ASTM D2042
Delivery Temperature, °C	40	70	40	70	40	70	40	70	40	70	40	70	40	70	

- (1) Test methods are as outlined in CGSB CAN2-16.5-M84.
- (2) Upper limit on % residue is governed by the viscosity limits.
- (3) CGSB 8-GP-2M, Sieves, Testing, Woven Wire, Metric
- (4) Follow ASTM D244, except that the mixture of limestone and emulsified asphalt shall be capable of being mixed vigorously for 5 min., at the end of which period the stone shall be thoroughly and uniformly coated. The mixture shall then be completely immersed in tap water and the water poured off. The stone shall then not be less than 90% coated.
- (5) Follow ASTM D244, except that the mixture of limestone and emulsified asphalt shall be mixed vigorously for 5 min., then allowed to stand for 3h, after which the mixture shall be capable of being mixed an additional 5 min. The mixture shall then be rinsed twice with approximately its own volume of tap water, without showing appreciable loss of bituminous film. After the second mixing the aggregate shall be at least 90% coated.

ASPH-9 (cont.)



Viscosity shall be within the graphic regions above the line designated by specific letters, and between penetration limits contained in vertical lines extending upwards from these points.

Viscosity value shall be reported at $0.5s^{-1}$ for grades HF-100S and HF-150S and at $1.0s^{-1}$ for grades HF-250S and HF-350S.

Grade of HF Emulsified Asphalt	HF-100S	HF-150S	HF-250S	HF-350S
	A, B	C, D	E, F	G, H

FIGURE 1

Viscosity Requirements for Distillation Residues from High-Float Emulsified Asphalts

ASPH-10

SPECIFICATIONS FOR EMULSIFIED ASPHALT PRIMER: Emulsified asphalt primers shall conform to the requirements specified in the following table, for the grade designated by the Consultant:

ASPHALT GRADE REQUIREMENTS	SEP-1		SEP-2		A.S.T.M. TEST METHOD
	min.	max.	min.	max.	
Viscosity at 25°C, SF s	-	-	15	100	D88
Viscosity at 50°C, SF s	35	200	-	-	D244
Flash point, open Tag, °C	45	-	90	-	D3143
Residue by Distillation, % by mass	40	(1)	40	(1)	D6997
Oil Portion of Distillate, % by volume of emulsion	12	29	12	29	D6997
Settlement in 5 d	no visible separation		-	2	D6930
Miscibility with Water (2)	is not miscible with water		pass		D6999
Tests on Residue from Distillation:					
a) Penetration at 25°C, 100 g, 5 s, dmm	100	300	100	300	D5
b) Solubility in Trichloroethylene, % by mass	97.5	-	97.5	-	D2042

(1) Upper limit on % residue is governed by the consistency limits.

(2) Follow ASTM D6999 except add the emulsified primer to the water. After two hours the water should be clear.

ASPH-11

SPECIFICATION FOR EMULSIFIED DUST SUPPRESSANTS:

Emulsified Dust Suppressants shall conform to the requirements specified in the following table:

GRADE	EDS-1		EDS-2		ASTM Test Method
	Minimum	Maximum	Minimum	Maximum	
Viscosity 25°C, SFs 50°C, SFs	10	35	35	100	D244
Residue by distillation to 260°C, % by mass	40	-	40	-	D6997
Oil portion of distillate, % by volume of emulsion	-	5	-	10	D6997
Settlement, 5 days	-		No visible separation		D6930
Storage Stability, 24 hours	No visible separation ⁽¹⁾		-		D6930
Workability ⁽²⁾	Pass		Pass		-
Flash Point, Open Tag, °C	-	-	45	-	D3143
Miscibility with water	Pass		Pass ⁽³⁾		D6999
Kinematic viscosity of residue from distillation, 60°C, mm ² /s	25	100	25	300	D2170

⁽¹⁾ If EDS-1 is retained in storage for an extended period of time, it should be circulated prior to use.

⁽²⁾ When 500 grams of sand and 50 g of emulsion are mixed for 5 minutes at ambient temperature, the sand shall be 100% coated. The mixture shall be oven dried at 120°C to remove all the moisture. After cooling to room temperature, the mix shall be easily workable for the next 24 hours.

⁽³⁾ Follow ASTM D6999 except add the EDS-2 to water. After 2 hours the water should be clear.

ASPH-12

SPECIFICATION FOR COLD POUR RUBBER FILLED EMULSIFIED BITUMINOUS CRACK SEALANT:

Cold Pout Rubber Filled Emulsified Bituminous Crack Sealants shall conform to the requirements specified in the following table:

TYPE	EC-101		Test Method*
	Minimum	Maximum	
Uniformity, 24 hours	Pass		TLT-226
Stormer viscosity at 25°C, Krebs	70	90	TLT-227
Solids content, %	59	-	ASTM D244 (Residue by Evaporation Procedure A)
Ash content, %	-	2.0	TLT-229
Rate of curing, % loss	50% 24 hrs.	80% 6 days	-
Low temperature flexibility, -4°C, 30s	Pass (no cracks)		TLT-231
Elastic recovery, % recovered	40	-	TLT-232

* TLT Refers to: Alberta Transportation Laboratory Test

ASPH-13

SPECIFICATION FOR HOT POUR BITUMINOUS CRACK SEALANT:

Hot Pour Bituminous Crack Sealants shall conform to the requirements specified in the following table:

TYPE	HC-200		Test Method
	Minimum	Maximum	
REQUIREMENTS			
Softening Point, °C	80	95	ASTM D36
Flash Point, Cleveland Open Cup, °C	230	-	ASTM D92
Penetration 0°C, 200g, 60s, dmm 25°C, 100g, 5s, dmm 46°C, 50g, 5s, dmm	30 55	65 150	ASTM D5
Ductility, 25°C, cm	45	-	ASTM D113
Solubility in Trichloroethylene, %	98	-	ASTM D2042
Kinematic viscosity at 177°C, mm ² /s	-	1500	ASTM D2170

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5.11 SUPPLY OF PORTLAND CEMENT**5.11.1 GENERAL**

This specification covers the supply of portland cement.

5.11.2 MATERIALS

The Contractor shall supply cement meeting the requirements of the latest version of Canadian Standards Association A3001 Cementitious Materials for Use in Concrete, for the type of cement specified.

Unless otherwise approved by the Consultant, the specification requirements shall apply to the cement in the delivery vehicle at the cement storage site.

The Contractor shall, at his expense and to the satisfaction of the Consultant; prevent contamination of the cement, by cement of another type or by any other material; maintain records of times of receipt of cement delivery orders, cement departure from the source, arrival at the cement storage site, and start and completion of unloading, and provide this information to the Consultant upon request.

The Contractor shall provide the Consultant with a "Certificate of Compliance" acceptable to the Consultant, for the portland cement to be used in the Work.

The Consultant may verify the quality of the material at any time. Sampling and testing for verification purposes will be in accordance with the latest version of Canadian Standards Association A3001.

5.11.3 MEASUREMENT AND PAYMENT

Where the Contract contains bid items for the supply of portland cement, measurement will be based on the Suppliers' weigh bills however, the Consultant may check quantities delivered by weighing the delivery vehicles before and after unloading. If there is a variance between quantities measured by the Consultant and the Suppliers' weigh-bills, the Consultant will determine the quantity on which payment will be based.

Where the Contract contains bid items for the supply of portland cement, payment for accepted portland cement material will be made at the applicable unit price bid per tonne.

Where the Contract does not contain bid items for the supply of portland cement, accepted cement material will not be paid for separately. Payment will be considered included in the unit price bid for the Contract item for which the portland cement is used.

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5.14 SUPPLY OF FENCE MATERIAL**5.14.1 GENERAL****5.14.1.1 Description**

The Work consists of supplying all required materials for the construction of fence including but not limited to:

- (a) Split Cedar Posts
- (b) Pressure Treated Wood Posts and Braces
- (c) Two Strand Barbed Wire
- (d) Single Strand Barbed Wire
- (e) Woven Wire (Paige Wire)
- (f) Brace Wire
- (g) Staples
- (h) Metal Stays
- (i) Chain Link Fence

5.14.1.2 Abbreviations and Definitions

Wherever in these specifications the following abbreviations are used, the intent and meaning shall be as follows:

A.S.T.M.: The American Society for Testing Materials

C.S.A.: The Canadian Standards Association

5.14.2 MATERIALS**5.14.2.1 General for Wood Posts**

Posts shall be of sound quality, free from all decay, shakes, splits, multiple crooks or any other defects which would render them structurally unsuitable for the purpose intended. All posts shall comply with the minimum-maximum top diameter as specified. The top of the post shall mean the small end of the post. The ends of the posts shall be cut square and the length of individual posts shall not vary by more than plus or minus 25 mm from the length required for the applicable installation.

5.14.2.2 Split Cedar Posts

Untreated split cedar posts shall be cut from sound timber and shall have an allowable taper from end to end not exceeding 114 mm in perimeter.

5.14.2.3 Pressure Treated Wood Posts and Braces

Pressure treated wood posts and braces shall be fir or pine timber, as specified. Knots that are sound, well spaced, smoothly trimmed and which do not impair the strength of the posts or braces will be permitted providing they do not exceed 38 mm in diameter on any face. Posts shall be naturally round and shall have all bark peeled or otherwise removed. Allowable taper from end to end of posts shall not exceed 38 mm in diameter.

Braces shall be sawn square or rectangular to the standard nominal dimensions as specified.

Posts and braces shall be treated by pressure methods with 50/50 creosote-petroleum solution or a chromated copper arsenate solution. The preservative agent shall conform to the requirements of the current edition of C.S.A. Standard 080. The minimum retention of preservative in the wood, as determined by assay, shall be as specified in the following table:

	Round Posts	Sawn Braces
Sample Zone for Assay (mm from surface)	0-19	0-16
Minimum Net Retention (kg/m ³) Creosote - Petroleum	96	96
Chromated Copper Arsenate (CCA)	6.4	6.4

Requirements for the preservative treatment of round posts and sawn braces shall conform to the current requirements of C.S.A. Standard 080 with specific attention to 080.1, 080.2 and 080.5.

5.14.2.4 Metal Stays and Keeper Wire

5.14.2.4.1 Metal Stays

Metal stays shall be fabricated from high tensile steel sheet conforming to the requirements of the current "Standard Specification for Weight (mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coatings", A.S.T.M. Designation A90, with additions as described in this specification.

Metal stays shall conform to the following minimum requirements:

- Length 860 mm
- Yield Strength..... 22 727 kg
- High Tensile Steel Breaking Strength 29 545 kg
- Barbed Wire Slot Sized 4.75 mm x 15.90 mm

Reflective sheeting for metal stays shall meet or exceed the requirements as specified in ASTM-D4956, Performance Requirements Type III, High Intensity Retro-reflective Sheeting.

5.14.2.4.2 Keeper Wire

High Tensile Galvanized Keeper Wire shall conform to the requirements of the current "Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs," A.S.T.M. Designation A227, with additions as described in this specification.

Keeper wire shall conform to the following minimum requirements:

- Length 860 mm
- Yield Strength..... 35 909 kg
- High Tensile Wire Breaking Strength 41 818 kg

5.14.2.5 Two Strand Barbed Wire

Two strand barbed wire shall conform to the requirements of the current "Standard Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire", A.S.T.M. Designation A121, (Class 1 or better) and shall consist of two strands of 2.5 mm thickness wire, twisted with four-point, 2.0 mm thickness round barbs spaced not more than 152 mm apart.

Each spool delivered to the job site shall be legibly marked showing the mass, linear measure, thickness and name or mark and address of the Manufacturer.

5.14.2.6 Single Strand Barbed Wire

Single strand barbed wire shall conform to the requirements of the current edition A.S.T.M. Designation A121, "Standard Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire". The requirements regarding uniform twisting of strands will be waived.

Single strand barbed wire shall conform to the following minimum requirements:

Measure of wire per spool	402 m
Minimum mass per spool	24 kg
Wire thickness	2.64 mm
Minimum tensile breaking strength of wire	500 kg
Barb spacing	125 mm
Number of points per barb	4

The barbs shall be firmly and securely fixed in position.

5.14.2.7 Woven Wire (Paige Wire)

Woven wire shall conform to the requirements of the current "Standard Specification for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing", A.S.T.M. Designation A116, (Class 1 or better), except that Section 5 of the A.S.T.M. Specification shall be deleted and replaced with the requirements pertaining to size and style of the woven wire mesh as hereinafter provided.

Each roll delivered to the job site shall be legibly marked showing the length, name or mark and address of the Manufacturer.

All wire of a specified class for use on a particular project shall be of identical design unless otherwise specified by the Consultant.

The woven wire mesh design shall conform with one of the following Classes as specified:

5.14.2.7.1 Class "C" Woven Wire

812 mm overall height with not lighter than 3.35 mm thickness top and bottom wires, and not lighter than 2.34 mm thickness filler wires. Vertical stay wires shall be spaced at intervals not greater than 152 mm. There shall be a minimum of eight (8) horizontal line wires forming vertical spaces graduated from 76 mm at the bottom of the mesh to 152 mm at the top. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, hinge-locking design which will prevent slippage of the wires. The minimum weight of Class "C" woven wire shall be 0.60 kg per metre.

5.14.2.7.2 Class "D" Woven Wire

978 mm overall height with not lighter than 3.35 mm thickness top and bottom wires, and not lighter than 2.64 mm thickness filler wires. Vertical stay wires shall be spaced at intervals not greater than 152 mm. There shall be a minimum of nine (9) horizontal line wires forming vertical spaces graduated from 76 mm at the bottom of the mesh and 178 mm at the top. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, hinge-locking design which will prevent slippage of the wires. The minimum weight of Class "D" woven wire shall be 0.66 kg per metre.

5.14.2.7.3 Class "E" Woven Wire

1 066 mm overall height with not lighter than 3.35 mm thickness wire throughout. Vertical stay wires shall be spaced at 300 mm intervals. There shall be a minimum of eight (8) horizontal line wires forming vertical spaces graduated from 127 mm at the bottom of the mesh to 178 mm at the top of the mesh. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, tight-lock design which will prevent slippage of the wires. The minimum weight of Class "E" woven wire shall be 0.84 kg per metre.

5.14.2.7.4 Class "F" Woven Wire

2 134 mm overall height with not lighter than 3.66 mm thickness wire throughout. Vertical stay wires shall be spaced at 152 mm intervals. Horizontal wires shall be spaced at 152 mm intervals, top to bottom. Joints or knots between vertical stay wires and horizontal line wires shall be of a rigid, tight-lock design which will prevent slippage of the wires. The minimum weight of Class "F" woven wire shall be 2.84 kg per metre.

5.14.2.8 **Brace Wire**

Brace wire shall be 3.66 mm thickness soft galvanized wire and the weight of 30.5 m of wire shall not be less than 2.5 kg.

5.14.2.9 **Staples**

Wire staples shall be standard 40 mm long staples, manufactured from 3.66 mm thick galvanized wire. There shall be approximately 140 staples per kilogram.

5.14.3 CHAIN LINK FENCE MATERIALS

5.14.3.1 **Pipe Material**

All pipe shall be seamless steel pipe fabricated in accordance with ASTM A53 and CAN/CGSB-138.2, butt welded, hot dipped zinc coated with not less than 610 g/m² of total surface area.

- Line posts that support the fence where the fabric is continuous, shall be 60.3 mm O.D. pipes with 3.91 mm wall thickness
- Terminal posts, end posts, corner posts, straining posts, gate posts and posts where fencing or fabric is discontinuous shall be 88.9 mm O.D. pipes with 5.49 mm wall thickness
- Top rails shall be continuous, joined with couplings and shall be 42.2 mm O.D. pipes with 3.56 mm wall thickness
- Braces that extend from the terminal posts to the nearest line post along fabric attached to the terminal post, shall be 42.2 mm O.D. pipes with 3.56 mm wall thickness

- Galvanized steel or aluminum post tops that permit the passage of the top rail, with one cap for each post except where a combination post top cap and barbed wire supporting arm is required

5.14.3.2 Fence Fabric

Chain link fence fabric shall be zinc-coated steel wire fabric in accordance with ASTM A392. The fabric wire shall be 3.55 mm diameter, woven into a 50 mm diamond mesh.

Steel clamps, bands, clips, tension bars and bolts shall all be hot dipped galvanized in accordance with ASTM A525M and of sufficient strength to maintain the integrity of the fence.

Tension bars shall be 5 mm by 20 mm, with lengths equal to the height of the fabric.

Tension bands shall be 20 mm in width and 3 mm in thickness.

Tension wire shall be 5 mm in diameter, single strand, galvanized with zinc coating of 610 g/m.

5.14.3.3 Gates

Gates shall be fabricated from galvanized steel pipe in accordance with CAN/CGSB-138.4, consisting of 42.2 mm O.D. pipes with 4.85 mm wall thickness for the frames and 33.4 mm O.D. pipes with 9.09 mm wall thickness for the interior bracing.

Welded joints shall be complete with galvanizing malleable iron hinges, latch, and latch catch with provisions for a padlock that can be attached and operated from either side of the installed gate. Suitable hinges to permit a 90° swing both in and out. Double gates shall be equipped with a drop bar locking device and a hasp for locking with a padlock.

5.14.3.4 Concrete

The concrete used for anchoring posts shall be Class "S" concrete supplied in accordance with Specification 5.5, Supply of Portland Cement Concrete, of the Standard Specifications for Highway Construction.

5.14.3 INSPECTION, SAMPLING AND TESTING

At the time of shipment, the Contractor shall provide certification indicating the specification number according to which the material being supplied was produced and tested.

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so. The Contractor shall be responsible for any costs resulting from such inspections, including the cost of replacing any fence materials damaged by such inspection, sampling or testing.

Any material found unacceptable by the Consultant shall be immediately removed and replaced with acceptable material by the Contractor, at the Contractor's expense.

5.14.4 MEASUREMENT AND PAYMENT

No separate payment will be made for the supply of fencing materials. The costs of supplying and delivering fence materials to the job site will be included in the unit price bid for the applicable fence installation.

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5.16 SUPPLY OF REINFORCED CONCRETE CULVERT**5.16.1 GENERAL**

This specification covers the supply and fabrication of the following material by the Contractor:

- (1) Reinforced Concrete Pipe
- (2) Reinforced Concrete Box Culvert
- (3) Joints and Fittings
- (4) Precast Reinforced Concrete Manhole Risers and Tops
- (5) Concrete Masonry Units for Construction of Catch Basins and Manhole
- (6) Rubber Gasket Joints, and
- (7) Cement Mortar

All references to "Standards" or "Specifications" refer to the latest edition at the time of tender.

5.16.2 MATERIALS**5.16.2.1 Reinforced Concrete Pipe****5.16.2.1.1 Round and Elliptical Pipe**

Reinforced concrete pipe shall conform to the material and fabrication requirements of the A.S.T.M. Specification C 76M.

The following information shall be clearly marked on each section of pipe:

- (1) The pipe class
- (2) The date of manufacture, and
- (3) The name or trade-mark of the Manufacturer.

This information shall be marked on the outside for pipe sizes up to and including 900 mm diameter and on the inside for pipe sizes over 900 mm diameter.

End sections shall be supplied with either square or sloped ends as required by the order. The dimensions of the sloped ends shall conform to details shown on the Drawings.

5.16.2.1.2 Curved Pipe Sections

Curved pipe sections shall conform to all the Specification requirements of round and elliptical Pipe as described in Subsection 5.16.2.1.1.

The ends of the pipe sections shall be beveled to the degree corresponding to the desired radius of curvature and shall be so formed that when the pipe sections are laid together they will form a continuous and uniform curved line.

5.16.2.2 Reinforced Concrete Box Culverts

Reinforced concrete box culvert shall conform to the material and fabrication requirements of A.S.T.M. Specification C 1433M.

The following information shall be clearly marked on each concrete box section:

- (1) Box section span, rise, table number, maximum and minimum design earth cover
- (2) The date of manufacture, and
- (3) Name or trademark of the Manufacturer.

Each box section shall be marked by indentation on either the inner or outer surface. In addition, the word "top" shall be lettered with waterproof paint on the inside top surface.

End sections shall be supplied either square or beveled as required by the order. The dimensions of the beveled ends shall conform to details shown on the Drawings.

5.16.2.3 Joints, Fittings and Bends

The reinforced concrete box sections shall be produced with tongue and groove ends conforming to the fabrication requirements of ASTM Specification C1433M, Section 8, Joints.

Fittings shall include special sections fabricated for the purpose of connecting manholes and branch lines to the main conduit. The pipe sections utilized in forming the joint, fitting or bend shall conform to all the specification requirements of round and elliptical pipe as specified in Subsection 5.16.2.1.1. The Sections shall be fabricated to form an integral unit, and the class of pipe shall be not less than specified on the Detail Drawing for the unit. The connection at the joint shall permit the utilization and development of the same degree of beam and circumferential strength as the main section of the conduit adjacent thereto.

5.16.2.4 Precast Reinforced Concrete Manhole Risers and Tops

Precast reinforced concrete manhole risers and tops shall conform to all the material and fabrication requirements of A.S.T.M. Specification C 478.

5.16.2.5 Concrete Masonry Units for Construction of Catch Basins and Manholes

Concrete masonry units for construction of catch basins and manholes shall conform to all the material and fabrication requirements of the A.S.T.M. Specification C 139.

5.16.2.6 Rubber Gasket Joints

Joints for circular concrete sewer and culvert pipe using flexible watertight rubber-type gaskets shall conform to all the material and fabrication requirements of A.S.T.M. Specification C 443.

5.16.2.7 Cement Mortar

The cement mortar mixture shall be composed of one part portland cement and two parts sand by volume. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. The sand shall conform to the requirements of A.A.S.H.T.O. Specification M 45, or shall be an equivalent, subject to approval by the Consultant. The cement shall conform to the requirements of A.A.S.H.T.O. Specification M85.

5.16.3 INSPECTION, SAMPLING AND TESTING

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so. Inspection, sampling and testing of reinforced concrete pipe, reinforced concrete box culvert and related joints and fittings shall be in accordance with the methods prescribed in A.S.T.M. Specification C 76M and C1433M. In particular, acceptance shall be on the basis of load bearing tests, material tests and inspection of the completed product.

Inspection, sampling and testing of precast reinforced concrete manhole risers and tops shall be in accordance with the methods prescribed in A.S.T.M. Specification C 478.

Inspection, sampling and testing of concrete masonry units for construction of catch basins and manholes shall be in accordance with the methods prescribed in A.S.T.M. Specification C 139.

All materials which do not meet requirements of the Specifications shall be rejected. No rejected material, the defects of which have subsequently been corrected, shall be used unless approval in writing has been given by the Consultant. Stocked materials, even though accepted in delivery, shall be subject to test and shall meet requirements of the Specifications at the time they are to be used in the Work.

5.16.4 MEASUREMENT AND PAYMENT

Payment for the supply of reinforced concrete pipe and reinforced concrete box culvert; including couplers, related junctions, fittings and appurtenances; will be included in the unit price bid per metre for the applicable types and sizes specified.

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5.17 SUPPLY OF POLYVINYL CHLORIDE PIPE**5.17.1 GENERAL**

The Work consists of supplying polyvinyl chloride pipe of the following types:

- Type PSM Polyvinyl Chloride Drainage Pipe
- Ribbed Polyvinyl Chloride Drainage Pipe
- Polyvinyl Chloride (PVC) Pipe for Culvert Liners

Nominal sizes include:

- 100, 150, 200, 250, 300, 375, 450, 525, 600, 675, 750 and 900 mm diameter.

5.17.2 APPLICABLE SPECIFICATIONS

All references to "Standards" or "Specifications" refer to the latest edition at the time of tender.

CSA B182.2	Large-diameter, Type PSM PVC Sewer Pipe and Fittings
CSA B182.4	Large-diameter, Ribbed PVC Sewer Pipe and Fittings
ASTM D883	Definition of Terms Relating to Plastics
ASTM D1784	Standard Specification for PVC and CPVC Compounds
ASTM D2122	Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2152	Standard Test Method for Quality of Extruded PVC Pipe by Acetone Immersion
ASTM D2412	Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
ASTM D2444	Standard Test Method for Impact Resistance of Thermo-plastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D3034	Standard Specification for Type PSM PVC Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F412	Definition of Terms Relating to Plastic Piping Systems
ASTM F477	Standard Specification for Elastomeric Seals for Joining Plastic Pipe
ASTM F794	Standard Specification for PVC Large-diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

5.17.3 MATERIALS

All pipe and fittings shall be made of virgin PVC plastic as defined in ASTM Standard D1784.

Elastomeric seals (gaskets) shall conform to the requirements of ASTM Standard F477.

5.17.4 REQUIREMENTS**5.17.4.1 Length**

Standard pipe length shall be 4 m or as requested by the Consultant. A tolerance of ± 25 mm on the nominal laying length will be permitted.

5.17.4.2 Dimensions for Type PSM, PVC Drainage Pipe

Nominal Pipe Size (mm)	Average Inside Diameter (mm)	Average Outside Diameter (mm)	Minimum Wall Thickness (mm)
100	100.94	107.06	3.06
150	150.29	159.39	4.55
200	201.16	213.36	6.10
250	251.46	266.70	7.62
300	299.36	317.50	9.07
375	366.42	388.62	11.10
450	447.87	475.01	13.57
525	527.99	559.99	16.0
600	594.00	630.00	18.0
675	669.42	710.00	20.29
750	766.36	812.80	23.22
900	917.22	972.80	27.79

5.17.4.3 Dimensions for Ribbed PVC Drainage Pipe

Nominal Pipe Size (mm)	Average Inside Diameter (mm)	Average Outside Diameter (mm) (over RIBS)	Minimum Wall Thickness (mm)
200	200	224	2.03
250	251	280	2.16
300	298	333	2.54
375	374.40	399.80	3.05
450	448.31	448.44	3.05
525	527.05	570.73	3.65
600	596.90	648.20	4.34
675	673.10	728.98	4.8
750	749.30	811.28	5.35
900	901.70	976.90	6.38

5.17.5 JOINTS

All sizes of pipe shall be supplied with elastomeric gasket joints providing a watertight seal meeting the requirements of the latest version of CSA B182.2 and ASTM F477. The joints shall be able to withstand 345 kPa hydrostatic pressure.

5.17.6 HYDRAULICS

The Manufacturer will provide the tested Manning's "n" value that will be used to calculate pipe flow capacity.

5.17.7 MARKINGS

All pipe supplied shall be clearly marked with the following information at intervals of not more than 1.5 m with 5 mm or larger letters.

- Manufacturer's name or trademark
- Nominal diameter
- Material designation and cell class
- The applicable specification designation
- Date of manufacture and plant designation

5.17.8 INSPECTION, SAMPLING AND TESTING

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Consultant at least 72 hours prior to shipping the materials to coordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Consultant deems necessary.

Any material found unacceptable by the Consultant shall be replaced with acceptable material by the Contractor at his expense.

5.17.9 MEASUREMENT AND PAYMENT

No separate payment will be made for the supply of polyvinyl chloride pipe. The cost for the supply and delivery of all materials, including gaskets and appurtenances, to the job site will be included in the unit price bid for the applicable installation.

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5.18 SUPPLY OF PERMANENT HIGHWAY SIGNS, POSTS AND BASES**5.18.1 GENERAL**

The Work shall consist of supplying concrete bases, steel breakaway posts as applicable, cluster frames, wooden posts and designated highway signs as indicated in the Special Provisions, as shown on the Drawings or as directed by the Consultant.

5.18.2 MATERIALS**5.18.2.1 General**

All materials shall be supplied by the Contractor.

The Contractor shall supply the Consultant with certification from the Supplier that the signs conform with the Specifications and shall only purchase signs that are certified by the Supplier to meet the Specifications of the sheeting Manufacturer.

5.18.2.2 Signs

All signs supplied by the Contractor shall be clearly marked with the following information:

- Manufacturer's Name or Trade Mark
- Date of manufacture
- Type of sheeting material

The information shall be provided on a weatherproof label, or some other form of permanent marking fixed to the back of the sign near the bottom right-hand corner. The label shall be smaller than 100 mm x 100 mm in size.

Sign patterns shall conform to the Uniform Traffic Control Devices of Canada Sign Pattern Manual or to the Alberta Transportation Sign Pattern Manual. All other signs shall be as specified by the Consultant.

All lettering on signs shall conform to the series Type Highway Font from the Standard Alphabet for Highway Signs, available from the Federal Highway Administration (CHTO-20), Washington, D.C., 20590, unless otherwise specified by the Uniform Traffic Control Devices of Canada Sign Pattern Manual or the Alberta Transportation Sign Pattern Manual.

When signs not included in the Schedule of Signs are required, the Consultant will provide the following information:

- Dimensions of the sign;
- Dimensions of the lettering;
- Colours of the sign;
- Material specifications.

5.18.2.3 Wooden Posts

Posts shall be pine or spruce structural framing no. 2 or better, as per NLGA 1980 Rules Par. 123 C. Posts are to be CCA (Copper, Chromate, Arsenate) pressure treated in accordance with CSA 080.14 and CSA 081.1. Material supplied shall be free from wane and shall be clean and dry.

Post sizes to be supplied shall be 100 mm x 100 mm, 100 mm x 150 mm and 150 mm x 200 mm dimension lumber, in lengths ranging from 365 cm to 610 cm.

5.18.2.4 Cluster Frames

The Contractor shall supply cluster frames suitable for the installation of multiple signs of up to 1.5 m² in accordance with Drawing TEB 1.71A, C-Cluster Frame. The frames shall be painted with rust resistant aluminum paint or a metal primer and aluminum paint suitable to the Consultant.

5.18.2.5 Concrete Bases

The Contractor shall supply bases in accordance with Drawing TEB 1.83. The Contractor shall provide the Consultant with the Manufacturer's certification indicating that the base has been manufactured to specified requirements.

The Contractor shall supply all material necessary to install the base, including suitable backfill material. Cementitious and organic materials are not acceptable backfill.

5.18.2.6 Breakaway Steel Sign Posts

The Contractor shall supply steel posts as shown on Drawing TEB 1.82.

The Contractor shall provide the Consultant with the material Manufacturer's certification that the material meets the Department's Specifications.

The Contractor shall supply zinc-rich paint (i.e. galvicon or equivalent) for repairs to any damaged galvanized surfaces.

5.18.2.7 Mounting Hardware

The Contractor shall supply all bolts and other hardware required to mount signs to posts or to frames and the frames to the posts. All bolts and hardware shall be galvanized.

5.18.2.8 Material Specifications

5.18.2.8.1 Reflective Sheeting

Reflective sheeting shall meet or exceed the minimum requirements as specified in ASTM-D4956, Performance Requirements Type III or Type IV, High Intensity Retroreflective Sheeting.

5.18.2.8.2 Reflective Sheeting for Specialized Application Permanent Highway Signs

The reflective sheeting supplied by the Contractor for the following signs shall meet or exceed the performance requirements specified in ASTM-D4956 for Type IX or Type XI Unmetallized Cube Corner Microprismatic Retroreflective Element Material. Products meeting these requirements are listed on the Alberta Transportation Products List under the "Specialized Applications" Category.

- RA-1 "Stop"
- RA-2 Yield
- RB-22 "Wrong Way"
- RB-23 Do Not Enter
- Overhead Guide Signs without sign illumination

The reflective sheeting supplied by the Contractor for the following signs shall meet or exceed the performance requirements specified in ASTM-D4956 for Type IX or Type XI fluorescent yellow sheeting. Products meeting these requirements are listed on the Alberta Transportation Products List under the "Warning Signs" Category.

- WA-1, WA-2, WA-3, WA-4, WA-5 and WA-6 Curve Signs (L & R)
- WA-9 Chevron
- WA-26 Low Clearance
- WA-27 Low Clearance
- WA-36 Hazard Marker - Centre
- WA-36-L Hazard Marker - Object On Left
- WA-36-R Hazard Marker - Object On Right
- WB-1 Stop Ahead
- WB-2 Yield Ahead
- WB-3 Two-Way Traffic Ahead
- WB-3-T "Two Way Traffic Ahead" Tab
- WB-4 Signals Ahead
- WB-5 Prepare to Stop
- WB-5A Prepare to Stop
- WB-5-T "Prepare to Stop" Tab
- WB-6 Railway Crossing Ahead
- WB-6A Railway Crossing Ahead
- WC-2-L Left Side Pedestrian Crossing Ahead
- WC-2-R Right Side Pedestrian Crossing Ahead
- WC-2-T "Pedestrian" Tab
- WC-2A "Watch For Pedestrians On Highway"
- WC-3 Playground Ahead
- WC-3-T "Playground" Tab
- WC-3A-T "30 km/h" Tab
- WC-9 School Bus Stop Ahead
- WC-9-T "School Bus Stop Ahead" Tab

5.18.2.8.3 Backing

Plywood - Sanded one side:

- ½" 100/100 or 120/120 Hi-Density
- ¾" 100/100 or 120/120 Hi-Density

Aluminum

- Extruded aluminum panels for major signs, shall be Alcan Shape #73247 with anodize treatment and shall conform to ASTM B221M, "Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes", Alloys 6061-T6 or 6063-T5.
- Aluminum for standard signs shall be a minimum of 2 mm flat sheet tension leveled, sign grade aluminum and shall conform to the requirements of ASTM B209M, "Specification for Aluminum and Aluminum-Alloy Sheet and Plate", Alloys 6061-T6 or 5052-H38.

5.18.3 MEASUREMENT AND PAYMENT**5.18.3.1 Wooden Posts**

No separate payment will be made for the supply of sign posts. The cost of supplying and delivering sign posts to the jobsite will be included in the applicable unit price bid for the sign post installation.

5.18.3.2 Cluster Frames

No separate payment will be made for the supply of cluster frames. The cost of supplying and delivering cluster frames to the jobsite will be included in the unit price bid for the cluster frame installation.

5.18.3.3 Concrete Bases

No separate payment will be made for the supply of concrete bases. The cost of supplying and delivering concrete bases to the jobsite will be included in the unit price bid for the concrete base installation.

5.18.3.4 Breakaway Steel Posts

No separate payment will be made for the supply of breakaway steel posts.

The cost of supplying and delivering breakaway steel posts to the jobsite will be included in the applicable unit price bid for the steel post installation.

5.18.3.5 Mounting Hardware

No separate payment will be made for the supply of bolts, nuts washers or any other hardware required for breakaway post assembly or the mounting of signs, cluster frames or other assemblies necessary to complete the Work.

5.18.3.6 Signs

Measurement for the supply of reflective sheeting and backing will be made in square metres of the actual surface area of each sign. The actual area calculations for the various types and sizes of signs are as shown in the Department's "Sign Catalogue and Images" found on the Department's web site.

Payment for signs will be made at the applicable unit price bid per square metre for "Supply of Signs, 1/2" Plywood ", "Supply of Signs, 3/4" Plywood", "Supply of Signs, Aluminum", or "Supply of Signs, Extruded Aluminum". This payment will be full compensation for the manufacture and supply of the signs to the worksite and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

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5.20 SUPPLY OF LINE PAINTING MATERIALS**5.20.1 GENERAL**

This specification applies to contracts that require the Contractor to supply line painting and pavement message marking materials.

5.20.2 MATERIALS

The Contractor shall choose the glass beads, paint, and durable paint materials to be supplied from the Alberta Transportation Proven Products List, found on the Department's website. The Contractor shall be responsible for ensuring that the quality of the paint and beads supplied meet the requirements specified.

The Contractor shall advise the Consultant of any change in paint formulation.

The Contractor shall provide the Consultant with the following information prior to commencing the Work:

- Names and mailing addresses of the Suppliers and Manufacturers;
- Formulation to be supplied;
- Written confirmation from the Manufacturer that the materials to be supplied meet all specified requirements.

The Contractor shall verify that all materials delivered and used in the Work are the type ordered.

5.20.3 SAMPLING AND TESTING

The Contractor shall supply the Consultant with quality assurance samples and the Manufacturer's quality control test results. Quality control results shall include a minimum of Specific Gravity, Hiding Power, Dry to Traffic and Viscosity results. A minimum of one quality assurance sample per batch shall be taken for glass beads as per TLT-601, Sampling Glass Beads. A minimum of one quality assurance sample per colour per batch shall be taken for paint as per TLT-636, Sampling Traffic Paint. The Consultant will forward the samples to the Department's designated quality assurance testing firm.

All materials shall be subject to further inspection and sampling by the Consultant, and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

Paint products shall be tested and shall meet the requirements as specified in the Special Provisions.

5.20.4 SUPPLY, HANDLING AND STORAGE

The Contractor shall make all arrangements for the supply and delivery of paint and glass beads and shall provide the Consultant with records of all materials received and/or returned, on a daily basis.

The Contractor shall provide, maintain and reclaim all material storage sites. Storage of materials at Department facilities will not be permitted.

No paint formulation shall be diluted or mixed with a different formulation or with any other material, without the specific approval of the Consultant.

The Contractor shall take all necessary steps to prevent contamination of the materials. Paint shall be protected from freezing.

The Contractor shall be responsible for the proper clean up of waste or spilled material, and the proper disposition of containers.

5.20.5 MEASUREMENT AND PAYMENT

Payment for the supply of all required materials including paint, glass beads and any cleaning solvents will be included in the applicable unit price bid for "Roadway Lines - Supplying Paint and Painting", "Intersection Lines - Supplying Paint and Painting" or "Interchange Lines - Supplying Paint and Painting", "Pavement Messages" and "Durable Pavement Messages".

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5.21 SUPPLY OF LIVESTOCK GUARDS**5.21.1 GENERAL****5.21.1.1 Description**

The Work consists of supplying livestock guards designed for safe passage of motor vehicles while safely prohibiting the passage of livestock.

5.21.1.2 Design Standards

The Contractor shall provide full shop drawings showing all materials, including specification and grade of steel, all material sizes and/or dimensions, and all connections, including grades and sizes of bolts and sizes of weld. Drawings shall be fully dimensioned in metric units.

Designs shall be certified by a Professional Engineer registered in the Province of Alberta, that they meet the specified load capacity for each type of livestock guard outlined herein.

In cases in which standards are quoted, such as the Canadian Standards Association (CSA) or the Canadian Welding Bureau (CWB), the latest edition shall be used.

The Contractor shall indicate patent information and ownership, if applicable. Ownership of the registered design will remain with the vendor.

CB-6 drawings referred to in this specification are found in the latest edition of the manual entitled "CB-6 Highway Standard Plates".

5.21.2 MATERIALS**5.21.2.1 General**

The Contractor shall supply all materials required to complete the Work to the standards shown on the Drawings. Livestock guards shall be fabricated using new or used quality material as specified, be painted with one coat of oil alkyd type primer, and shall meet the requirements of the Canadian General Standards Board (CGSB) Spec. 1-GP-166M. Weathering steel, which does not require paint, is also acceptable.

Finished products shall be identified with a trademark and the date of manufacture stamped or welded in an area of the guard that can be easily read after installation.

Fencing detail shown on the Drawings is for information only, and with the exception of the applicable fence post sleeves, shall not apply to this specification.

5.21.2.2 Types of Livestock Guard

The various types of livestock guards are as follows:

5.21.2.2.1 Standard Highway Type

Standard highway livestock guards are used on all paved and unpaved roads and are designed to carry legal highway vehicles at various speeds. Details are shown on Drawings CB6 2.13 M5, M6, M7 and M11.

5.21.2.2.2 Range Type

Range type livestock guards are designed to be used on lightly or seldom travelled roads with no more than standard farm or ranch vehicles. Details are shown on Drawing CB6 2.13 M4.

5.21.2.2.3 Off-Highway Type

Off-highway type guards are used on logging or mining access roads where the load of the vehicles can exceed the legal highway limit. There may also be frequent light or average truck/car traffic. These guards shall be constructed in accordance with the applicable drawing for the required size with the increased load ratings detailed herein.

5.21.2.3 **Load Requirements**

In all load applications, the load shall be placed on the livestock guard in a location causing the greatest stress to the member in question.

5.21.2.3.1 Live Load Requirements

Range type and standard highway type livestock guards shall meet the live load capacity requirements of CSA bridge design code S6 for design truck: normal loading CS-600 truck (180 kN axle).

Off-highway livestock guards shall meet the live load capacity requirements of CSA bridge design code S6 for design truck: log haul loading CS-750 truck (225 kN axle).

5.21.2.3.2 Impact Loading

An impact load shall be applied concurrently with the live load. The impact load for all livestock guard types shall be:

- a vertical load equal to 40% of the live load, or
- a vertical load equal to 20% of the live load combined with a horizontal load equal to 20% of the live load.

5.21.3 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

5.21.4 CONSTRUCTION

5.21.4.1 **General**

All livestock guards shall be constructed in accordance with the applicable drawings.

Welding shall be performed by a company approved by the Canadian Welding Bureau to CSA Standard W47.1 with Work performed to CSA Standard W59.

5.21.4.2 **Sill and Frame Construction**

The frame shall be designed to allow even distribution of live loads to the sills. The ends of the frame which contact the road surfaces shall include a fill guard to prevent road material from falling between the deck and sills. The fill guard shall be welded to the side of the livestock guard.

No splices are permitted in supporting members.

5.21.4.3 Deck Construction

Deck construction shall consist of round structural tubing with dimensions as shown on the Drawings arranged perpendicular to traffic. A gusset reinforcement shall be used between each member. This reinforcement shall not permit the build-up of gravel or snow which may allow livestock to cross.

Fence post sleeves designed to accept a 60 mm outside diameter (O.D.) post shall be connected through the deck and attached to the frame at an outward 115-degree slant. The top of the sleeve shall not protrude above the deck.

Deck members shall be continuous over the length of the guard. Any splices shall develop the full strength of the member and shall be detailed on the Drawings.

5.21.5 INSPECTION, SAMPLING AND TESTING

The Contractor shall contact the Consultant for coordination of inspection during production. Inspection, sampling and testing of livestock guard materials may be carried out by the Consultant, in accordance with the latest editions of the applicable specifications and standards. In particular, acceptance shall be on the basis of load bearing tests, material tests and inspection of the completed product.

Where shop or plant inspections are made, the Contractor shall ensure the Consultant has free access to all parts of the shop or plant as involved in the manufacture or production of the material ordered, and shall furnish all such facilities as to provide a safe and adequate inspection of the production of the material. All materials which do not meet the Specifications shall be rejected. No rejected material, the defects of which have subsequently been corrected, shall be used unless approval in writing has been given by the Consultant. Stocked materials, even though accepted in delivery, shall be subject to testing and shall meet the Specifications at the time they are to be used in the Work.

The Contractor shall supply to the Consultant the material Manufacturer's certification that the material meets the Department's Specifications.

5.21.6 MEASUREMENT AND PAYMENT

Payment for the supply of livestock guards will be included in the unit price bid per livestock guard for the applicable type and size as supplied and installed.

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5.22 SUPPLY AND INSTALL SMOOTH WALL STEEL PIPES**5.22.1 GENERAL**

The Contractor shall supply and install smooth wall steel pipe culvert through the existing highway without disturbing the existing surfacing structure as shown on the Drawings and as directed by the Consultant.

Centerline steel pipe culvert installation shall consist of augering of the steel pipe through the existing highway embankment and installing the remainder of the steel pipe culvert by the trenched or open cut method as shown on the Drawings (CB6-2.4M19).

The abbreviation for Smooth Wall Steel Pipe when indicated on the plans or used in the Specifications is S.W.S.P.

5.22.2 MATERIALS**5.22.2.1 Culvert Material**

Smooth wall steel pipe (9.5 mm wall thickness) shall be supplied by the Contractor and shall meet ASTM Specification A252 Grade2. Any variation from the specified requirements for the smooth wall steel pipe shall be subject to the approval of the Consultant. The Consultant has the sole right to reject material that in his opinion will not adequately meet the expected longevity of this new culvert installation. The Contractor shall have no claim against the Department for all or part of material rejected and shall remove and dispose of rejected material at his own expense.

5.22.2.2 Material for Bedding, Backfill and Sealing

The Contractor shall either use approved native material or produce granular material for bedding and backfill in trenched areas in accordance with Specification 3.2, Aggregate Production and Stockpiling, for the Designation and Class of materials specified. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate.

The Contractor shall supply the required clay material for the clay seals at both ends of the installation.

5.22.3 CONSTRUCTION**5.22.3.1 Length of Pipe Required for Installation**

The Contractor shall determine the total length of smooth wall steel pipe required for both the coring and trenched or open cut installations based on the design cross-sections available from the Consultant.

Prior to commencing the installation, the Contractor shall liaise with the Consultant to determine the exact length of pipe required, depending on landowner requirements and onsite inspection.

5.22.3.2 Welding

Welding of smooth wall steel pipe shall only be performed by journeyman welders. All Welders' qualifications shall be current and shall be available for examination by the Consultant.

Smooth wall steel pipe sections shall be joined together with a full strength and continuous butt weld which forms a watertight seal in accordance with CSA standard W59, Welded Steel Construction. Welding procedures shall be prepared and stamped by a Professional Engineer and shall be submitted to the Consultant for review prior to welding.

When the ambient air temperature is between 0°C and 5°C the Contractor shall pre-heat the smooth wall steel pipe to a minimum of 100°C for a distance of 80 mm beyond the weld in each direction, and shall shelter the section being welded from the wind. When the ambient air temperature is below 0°C the Contractor shall provide suitable hoarding and heating of the sections being welded. The Consultant has the right to require the Contractor to modify or cease his welding operation if, in the opinion of the Consultant, adequate shelter and heating is not being provided during cold weather welding.

At the discretion of the Consultant, Non-Destructive Examinations such as Radiography and Ultrasonic testing may be required to verify quality and strength of the welds. Non-destructive examinations shall only be done by qualified technicians and the results shall be provided to the Consultant for review. The Contractor shall arrange and provide non-destructive testing when required by the Consultant. Any defects found by such testing shall be repaired at the Contractor's expense.

5.22.3.3 Coring and Pushing

The installation shall be carried out by coring and pushing a steel pipe through the highway embankment without disturbing the existing pavement structure and in a manner approved by the Consultant. The invert elevations, pipe length and pipe diameter shall be as shown on the Drawings or as determined in consultation with the project Consultant. The Contractor shall cut sections and join sections with a continuous butt weld to provide the necessary overall length as part of the coring and pushing operations.

The Contractor shall be responsible for correcting and repairing, at his own expense, any roadway slides or failures that occur as a result of activities associated with the coring operations.

The coring machine shall be capable of excavating to a diameter not greater than 25 mm of the outside diameter of the pipe.

In the event that adverse soil conditions are encountered during coring operations which necessitate a change in construction methods, the method of construction for the affected portion shall be approved by the Consultant prior to proceeding with further construction.

5.22.3.4 Coring

The Consultant will provide line and grade at each end of the pipe from which the Contractor shall accurately control the coring.

The Contractor shall block, shim or construct rails as required to ensure that the finished pipe meets the tolerance requirements for alignment and grade.

Line and grade shall be continuously checked by the Contractor using a laser. The laser must be sufficiently capable of shooting the entire length of each operation and have a beam deviation not greater than 6 mm. If the laser does not meet the requirements of the project, the Contractor shall replace it with a unit approved by the Consultant, at the expense of the Contractor.

The Consultant may also monitor the installation by performing quality assurance testing of the line and grade. The Contractor shall co-operate by making the workings available for checking at suitable intervals during regular working hours as required by the Consultant.

Discrepancies found by the Consultant shall be corrected by the Contractor immediately. The return to established line or grade shall be at a rate not exceeding 50 mm per 10 m.

Such checks or lack of them shall not relieve the Contractor of full responsibility for constructing the pipe to the line and grade as specified by the Consultant.

5.22.3.5 **Installation by Trench or Open Cut Method**

The pipe shall be installed on the prepared base, true to the designed lines and grades unless otherwise established by the Consultant. Separate sections shall be securely joined together with a continuous butt weld. The Contractor shall cut beveled end sections (3:1 or 4:1 slope as applicable) as directed by the Consultant.

The Contractor shall use due care when installing pipe to avoid damaging the pipe. Damaged pipe shall be removed and replaced by the Contractor at his own expense.

5.22.3.5.1 Bedding and Backfill

Bedding and backfill material shall be placed as shown on the Drawings and shall consist of approved suitable native material or imported select gravel or soil material as directed by the Consultant. All bedding and backfill material shall be free from frozen lumps and organic material. Backfill within 300 mm of the pipe wall shall be free from stones of diameter larger than 80 mm.

5.22.3.6 **Hand-Laid Riprap**

Immediately following completion of the pipe installation, hand-laid riprap shall be placed in accordance with Specification 2.5, Riprap.

5.22.3.7 **Cleanup**

After the installation has been completed, the Contractor shall cleanup the site to a condition similar to the surrounding area or as directed by the Consultant. This includes but is not limited to, removal and disposal of all discarded utility lines, tracks, coring equipment, and unused construction materials and debris from the pipe and construction area.

The Contractor shall leave the pipe in a clean reasonably dry condition suitable for inspection by the Consultant.

5.22.3.8 **Final Acceptance Inspection**

The final installation shall be subject to the Consultant's inspection. All damages such as bent or deformed edges or undulations of the pipe shall be corrected at the Contractor's expense.

The finished pipe culvert installation shall not deviate from grade and alignment by more than 50 mm.

Any pipe placed which does not comply with these requirements shall be corrected to the satisfaction of the Consultant, at the Contractor's expense.

5.22.4 MEASUREMENT AND PAYMENT

Measurement for the supply and installation of smooth wall steel pipes will be made in metres based on the total invert length of pipe installed including sloped end sections.

Payment will be made at the unit price bid per metre for "Smooth Wall Steel Pipe - Supply and Install" for the applicable size of pipe specified. This payment will be full compensation for supplying and installing the S.W.S.P. by coring and open trench methods, welding, preparing the culvert bed in the trenched sections, supplying and placing of bedding and backfill materials, supply and construction of clay seals and the supply and placement of hand-laid riprap, and all materials, labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

When the Contract contains a bid item for "Channel Excavation," excavation for the open cut of the trenched portion of the culvert installation as determined by the Consultant, will be paid for as "Channel Excavation" in accordance with Specification 2.3, Grading. When the Contract does not contain a bid item for "Channel Excavation", all excavation will be considered included in the unit price bid for "Smooth Wall Steel Pipe - Supply and Install."

Costs associated with non-destructive testing of welds, as directed by the Consultant, will be paid for as "Extra Work" in accordance with Specification 1.2, General. When the non-destructive testing determines a weld is defective, the initial non-destructive test for that weld will be considered incidental to the Work and no separate or additional payment will be made.

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5.23 SUPPLY OF CORRUGATED METAL PIPE AND PIPE ARCHES**5.23.1 GENERAL**

This specification covers the requirements for the supply of corrugated metal pipe and pipe arches up to 1400 mm equivalent diameter by the Contractor.

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

- C.S.P. - Corrugated Steel Pipe
- C.S.P. Arch - Corrugated Steel Pipe Arch
- C.A.P. - Corrugated Aluminum Pipe
- C.A.P. Arch - Corrugated Aluminum Pipe Arch

5.23.2 MATERIALS

The Contractor shall ensure that the supply and fabrication of all galvanized, polymer coated and aluminum coated corrugated steel pipe (CSP) and pipe arches including couplers and appurtenances are in accordance with the latest edition of Canadian Standards Association (CSA) G401 Specification, and the supply and fabrication of corrugated aluminum pipe (CAP) and pipe arches including couplers and appurtenances are in accordance with the latest edition of AASHTO Designation M196 and M197, with the following modifications:

Previously installed pipe shall not be used. All pipe supplied shall be clearly marked with the following information at intervals of not more than 3 m.

- Manufacturer's Name or Trade Mark
- Nominal Thickness and Type of Metal
- Plate/Metal Coating (for non-standard coating)
- Specification Designation
- Plant Designation Code
- Date of Manufacture

5.23.2.1 Sloped End Sections

Sloped end sections are required for each culvert. When 4:1 and 3:1 sloped end sections are specified, templates CB6-5.15M1 and CB6-5.15M2 will apply.

5.23.2.2 Cut Ends

All cut edges of a sloped or square end section shall be made smooth by grinding so that all of the burrs are removed. Any damaged protective coating shall be recoated with appropriate material in accordance with CSA G401.

5.23.2.3 Couplers

Annular corrugated couplers for pipe greater than 300 mm in diameter shall be of sufficient width to cover at least two outside crest corrugations on each recorrugated end.

5.23.2.4 Coupler Bands

Coupler bands for pipe greater than 800 mm in diameter shall have a minimum of three bolts.

5.23.2.5 Termination of Lock Seams

On pipes 1000 mm diameter or larger, lock seams terminating at the cut edges of sloped or square ended sections shall have a 75 mm length fillet weld run along the lock seam at each cut edge. The weld and surrounding area shall be recoated with the appropriate material in accordance with CSA G401.

5.23.2.6 Recorrugated Ends

Spirally corrugated metal pipe shall have ends recorrugated to provide annular corrugations for couplers.

5.23.2.7 Perforated Pipe

Perforated corrugated steel pipe shall be fabricated in accordance with the latest edition of CSA G401 (currently Section 4.1.6).

5.23.2.8 Polymer Coated C.S.P.

When Polymer Coated C.S.P. is specified, the polymer coating shall be applied to both sides of the galvanized sheet prior to corrugating in accordance with classification grade 250/250 as specified in CSA G401 section 3.5.4.

Any pinholes, blisters, cracks or lack of bond shall be cause for rejection.

5.23.3 INSPECTION, SAMPLING AND TESTING

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Consultant at least 72 hours prior to shipping the materials to coordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Consultant deems necessary.

Any material found unacceptable by the Consultant shall be replaced with acceptable material by the Contractor at his own expense.

5.23.4 MEASUREMENT AND PAYMENT

Payment for the supply of corrugated metal pipe and pipe arches including couplers and appurtenances will be included in the unit price bid per metre for "Culverts - Supply and Install" for the various types and sizes of culvert specified.

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5.24 SUPPLY OF POLYETHYLENE PIPE

5.24.1 GENERAL

This specification covers the requirements for the supply of polyethylene pipe by the Contractor.

The Work consists of supplying polyethylene pipe of the following types:

- Closed Profile Pipe: a pipe product that has an essentially smooth waterway braced circumferentially or spirally with corrugations that are joined integrally by an essentially smooth outer wall.
- Corrugated Pipe: a single walled pipe where the wall is formed into a series of alternating ridges and grooves.
- Open Profile Pipe: a pipe product that has an essentially smooth waterway braced circumferentially or spirally with outside corrugations.

5.24.2 APPLICABLE SPECIFICATIONS

All references to Standards or Specifications refer to the latest edition at the time of tender.

CAN/CSA B182.8 Corrugated Polyethylene (PE) Storm Sewer and Drainage Pipe and Fittings

ASTM F405 Corrugated Polyethylene (PE) Tubing and Fittings

ASTM F667 Large Diameter Corrugated Polyethylene Tubing and Fittings

ASTM F894 Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

ASTM D3350 Specification for Polyethylene Plastic Pipe and Fittings Materials

ASTM D4976 Specification for Polyethylene Plastics Moulding and Extrusion Materials

AASHTO M252 Corrugated Polyethylene Drainage Tubing

AASHTO M294 Corrugated Polyethylene Plastic Pipe

5.24.3 DEFINITIONS

Polyethylene Plastic: - plastic based on polymers made with ethylene as essentially the sole monomer.

Profile: - pipe wall construction that presents an essentially smooth surface in the waterway but includes ribs or other shapes, which can be either solid or hollow, that help brace the pipe against diametrical deformation.

5.24.4 MATERIALS

The moulding and extrusion material shall be polyethylene plastic according to the requirements of CAN/CSA B182.8, ASTM F405, ASTM F667, ASTM F894, ASTM D3350, ASTM D4976, AASHTO M252 or AASHTO M294 for the appropriate type of polyethylene plastic pipe.

Previously installed pipe shall not be used.

5.24.4.1 **Markings**

Markings for corrugated, and open-end, closed-profile, polyethylene plastic pipe, tubing and fittings shall be in accordance with the appropriate standard. All pipe supplied shall be clearly marked with the following information at intervals of not more than 3 m.

- Pipe Diameter
- Pipe Stiffness
- Standard Designation
- Manufacturer

5.24.4.2 **Certificate**

Upon request, the Contractor shall provide a certificate of compliance from the supplier indicating that the product was produced, tested and conforms to all of the requirements of the appropriate specification.

5.24.5 REQUIREMENTS

The pipe stiffness for polyethylene plastic pipe or fittings shall be no less than 210 kPa for corrugated pipe and 320 kPa for open profile pipe at 5% deflection. The closed profile pipe shall have a minimum ring stiffness coefficient of RSC100 or higher, depending on site loading conditions.

The requirements for corrugated polyethylene plastic pipe, tubing and fittings shall be according to ASTM F405, ASTM F667, AASHTO M252 or AASHTO M294.

The requirements for open and closed profile polyethylene plastic pipe and fittings shall be according to CAN/CSA B182.8 or ASTM F894.

5.24.6 JOINTS

Joining systems shall be Bell and Spigot (Gasketed Type), Bell and Spigot (Extrusion Weld Type), Heat Fusion, Plain End Extrusion Weld, Integral Connectors and shall meet the requirements of the latest version of ASTM F894 and CSA B182.8.

5.24.7 PERFORATED PIPE

Perforated corrugated polyethylene pipe shall be fabricated in accordance with the latest edition of ASTM F405 (currently Section 6.2.4).

5.24.8 HYDRAULICS

The manufacturer will provide the tested Mannings "n" value that will be used to calculate pipe flow capacity.

5.24.9 INSPECTION, SAMPLING AND TESTING

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall co-operate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Consultant at least 72 hours prior to shipping the materials to co-ordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Consultant deems necessary.

Any material found unacceptable by the Consultant shall be replaced with acceptable material by the Contractor at his own expense.

5.24.10 MEASUREMENT AND PAYMENT

Payment for the supply of polyethylene pipe including joining systems and appurtenances will be included in the unit price bid per metre for "Culverts – Supply and Install" for the applicable type and sizes of pipe specified.

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5.25 SUPPLY OF THRIE BEAM AND W-BEAM GUARDRAIL**5.25.1 GENERAL**

The Work shall consist of supplying Thrie Beam, Modified Thrie Beam or W-Beam guardrail, as specified, for use as hazard avoidance barriers.

5.25.2 STANDARDS OF REFERENCE**Alberta Transportation Drawings**

Alberta Transportation TEB and RDG Drawings are contained in the following Appendixes of the Roadside Design Guide (2007) and are listed on the Department's web site:

Appendix B1 Alberta Weak Post and Strong Post W-Beam Guardrail
Appendix B3 Weak Post Box Beam Guardrail
Appendix B4 Thrie Beam Guardrail

All materials supplied by the Contractor shall be in accordance with the following standards, specifications or publications. Previously installed materials may not be used.

Canadian Standards Association (CSA):

CSA G40.20 and G40.21-M87 - Structural Quality Steels
CSA G164-M - Hot Dip Galvanizing of Irregularly Shaped Articles
CSA W59-M - Welded Steel Construction (Metal Arc Welding)
CSA 080-M - Wood Preservation

American Society for Testing and Materials (ASTM):

ASTM A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM D4956 - Retroreflective Sheeting for Traffic Control
ASTM E316.3 - Magnetic gauge testing of galvanizing coating

American Association of State Highway and Transportation Officials (AASHTO):

AASHTO Standard Designation M-180 of the latest edition "Corrugated Sheet Steel Beams for Highway Guardrail"
Task Force 13 report "A Guide to Standardized Highway Barrier Hardware"

American Road and Transportation Builders Association (ARTBA):

ARTBA Technical Bulletin No. 268-B

National Lumber Grades Authority (NLGA):

NLGA Standard Grading Rules for Canadian Lumber

5.25.3 MATERIALS

The Contractor shall supply all materials necessary to complete the Work.

5.25.3.1 Rails and Terminal Elements

Guardrail shall consist of rail sections fabricated to develop continuous beam strength with the necessary safety end feature components.

All rail sections and other components shall match the design profiles and dimensions of the AASHTO/ARTBA hardware requirements for full interchangeability of similar components regardless of the manufacturer.

The name or trademark of the Manufacturer, the metal thickness and the year of production shall be clearly and permanently stamped on each component clear of the splicing overlap and on the face opposite the traffic side.

The rails and terminal elements shall be manufactured from open hearth, electric furnace or basic oxygen semi-spring steel sheet and hot dip galvanized after fabrication, all in general accordance with the AASHTO Standard Designation M180 of the latest Edition and shall conform to the relevant TEB and RDG Drawings.

Rails shall be punched for splice and post bolts in strict conformity with the AASHTO Standard to the designated number and centre-to-centre spacing of posts. No punching, cutting or welding will be permitted on site except for special details in unforeseen and exceptional cases with the prior approval of the Consultant.

If any guardrail installation requires curved W-beam rails, the Contractor shall form these to the radius specified by the Consultant.

The rails and terminal elements shall be manufactured according to the following standards:

- Metal properties of the base metal for the rails shall conform to the following requirements:
 - Minimum Yield Point: 345 MPa
 - Minimum Tensile Strength: 483 MPa
 - Minimum Elongation: 12% in 50 mm length
- Sheet Thickness shall be in accordance with Table 2 (Class A, Type 2) of AASHTO Standard M180 of the latest edition with a nominal base metal thickness of 2.8 mm (2.57 mm minimum).
- Sheet width for the W-beam rail shall be 483 mm, with a permissible tolerance of minus 3.2 mm.
- Sheet width for the thrie beam or modified thrie beam shall be 750 mm with a permissible tolerance of 3 mm.

Welding for the fabrication of terminal elements shall conform to the requirements of CSA-W59M. Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category may be permitted to perform weldments.

Rails and terminal elements shall be hot dip galvanized after fabrication, in accordance with CSA-G164M.

5.25.3.2 Bolts, Nuts and Washers

Bolts, nuts and washers shall conform to ASTM-A307, and shall be hot dip galvanized in accordance with CSA-G164M (Drawing TEB 3.06).

Hardware for barrier cable terminals shall conform to Task Force 13 report "A Guide to Standardized Highway Barrier Hardware" and the requirements of Drawings RDG - B1.2 and RDG - B1.3.

5.25.3.3 Posts

5.25.3.3.1 Wooden Posts

Posts and offset blocks shall be either douglas fir, hemlock, lodgepole pine or better and shall meet the requirement of the National Lumber Grades Authority (NLGA) for No. 1 Structural Posts and Timbers graded conforming to the NLGA Standard Grading Rules for Canadian Lumber.

Posts and blocks shall be rough sawn with holes drilled to the finished dimensions shown in drawing TEB 3.01. Unless otherwise specified in the Special Provisions, the standard length of posts shall be 1.52 m for weak post W-Beam installations and 1.83 m for strong post W-Beam installations.

Posts shall be date stamped at the top of either side of the post not used for rail attachment with the last two digits of the year of fabrication. The stamp shall be 50 mm x 50 mm and have an indentation of 3 mm.

Stamping and drilling shall be completed prior to treating posts. Blocks shall be pressure treated in accordance with the current requirements of CSA Standard 080, with water-borne preservative of chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) to 8 kilograms per cubic metre.

The penetration and retention of preservatives shall conform to the requirements of CSA Standard 080.14, Table 1, Minimum Retention of Preservatives in Pressure Treated Wood for Highway Construction, under the headings "Post-Guardrail, Guide, Sign and Sight" for posts, and "Bridge Hand Rails, Guard Rails and Posts" (not in contact with ground or water).

5.25.3.3.2 Plastic Posts

The Contractor has the option of supplying plastic guardrail posts in place of wooden posts except at the following locations:

- The transition area between a roadway guardrail system and a bridgerail system.
- As part of a proprietary end treatment such as a Breakaway Cable Terminal (BCT) or Cable Attenuator Terminal (CAT) which normally use wooden posts.
- In any cable barrier system.
- At any other installation specifically prohibited by the Consultant.

Plastic guardrail posts supplied by the Contractor shall be a product from the Alberta Transportation Products List as shown on the Department's web site.

Plastic posts shall be stamped at the top of the post on a surface not used for rail attachment with the following information:

- The identifying product number or code, and
- The year of manufacture.

These markings shall be legible throughout the normal service life of the post. The Contractor shall supply the Consultant with certification from the Supplier that the plastic posts conform to the applicable specifications.

5.25.3.4 **Guardrail Reflectors**

Solid guardrail reflectors shall be supplied for installation on guardrail posts. Reflectors shall have minimum dimensions of 108 mm x 76 mm. Reflective sheeting meeting the requirements of ASTM D4956 for Type IX or XI sheeting shall be installed on both sides of the reflector. The colour of the reflector shall be either white or fluorescent yellow to match the colour of the nearest painted roadway edge line.

5.25.4 ACCEPTANCE AND INSPECTION OF MATERIAL

5.25.4.1 **General**

Prior to installing any guardrail, the Contractor shall provide the Consultant with copies of the Manufacturer's certificates verifying that the supplied guardrail material conforms to Section 16 of CSA G40.20M for each of the mechanical and chemical tests; and the supplied reflective sheeting conforms to ASTM D4956 for Type IX or XI sheeting.

5.25.4.2 **Inspection of W-Beam Guardrail Material**

Hot dip galvanized coating shall be smooth, free of beading or sharp projections at edges. Coating adherence shall prevent the peeling of any portion of the zinc coating so as to expose the base metal by cutting or prying with a stout knife under considerable pressure (bond check). A magnetic gauge will be used for checking thickness in accordance with ASTM Standard E316.3(c).

Warped or otherwise deformed rails and terminal elements will be rejected, as will those with injurious defects or excessive roughness of the zinc coating. When the rail is laid on a flat surface, the warpage shall not be greater than 5 cm.

5.25.4.3 **Inspection of Wooden Posts and Blocks**

The Consultant may verify the penetration and retention of the preservative by the assay method.

Posts and blocks shall be subject to inspection by the Consultant when the bundles are opened immediately prior to use.

5.25.5 PAYMENT

Payment for the supply of guardrail; including all required hardware, posts and reflectors; shall be included in the unit price bid per metre for "Guardrail - Supply and Install" for the applicable type of guardrail to be installed, in accordance with Specification 2.19, Guardrail and Guide Posts. No separate or additional payment will be made.

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5.26 SUPPLY OF BOX BEAM GUARDRAIL AND POSTS**5.26.1 GENERAL**

The Work consists of supplying standard box beam or median box beam guardrail and posts for use as hazard avoidance barriers.

5.26.2 STANDARDS OF REFERENCE

All material supplied shall refer to the following standards, specifications or publications:

Society of Automotive Engineers:

SAE J403 - Sept. 80 - Chemical Composition of SAE Carbon Steels

Canadian Standard Association:

CAN/CSA G40.20-M87 - General Requirements for Rolled or Welded Structural Quality Steel
CAN/CSA G40.21-M87 - Structural Quality Steel
CSA W47.1-1983 - Certification of Companies for Fusion Welding of Steel Structures.
CSA W59-M1984 - Welded Steel Construction (Metal Arc Welding).
CSA G164-M1981 - Hot Dip Galvanizing of Irregularly Shaped Articles.

American Society for Testing and Materials:

ASTM A307-86a - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A325M-86 - High-Strength Bolts for Structural Steel Joints (Metric).

References made to TEB drawings in this Specification refer to drawings found in the manual entitled "Typical Barrier Drawings" which is published by Alberta Transportation and is available on the Department's web site.

5.26.3 MATERIALS

The Contractor shall supply all materials necessary to complete the Work. Previously installed material may not be used.

Prior to installing any guardrail, the Contractor shall supply the Consultant with the Manufacturer's certification that the material conforms to the Specifications.

All materials for standard box beam or median box beam installations shall be supplied in accordance with the Drawings contained in Appendix B3 of the Roadside Design Guide, available on the Department's web site.

5.26.3.1 Steel Box Beam Barriers**5.26.3.1.1 Rails**

Rails shall be welded or seamless structural tubing (350 WT grade) and either class C or H conforming to CAN/CSA G40.21M.

The steel shall conform to a minimum standard impact energy requirement of 14 Joules (10.5 ft-lbs) for a half-size test specimen tested at 0°C and shall contain a manganese/carbon ratio, computed based on heat analysis values, of at least 4.5.

The above requirements and the mechanical and chemical properties shall be verified by test results, certified as outlined in CAN/CSA G40.20M, and verified as outlined in the Quality Assurance Section of the Road Authority specification.

5.26.3.1.2 Posts, Ground Plates, Paddles, Brackets, Base Plates and Splice Plates.

Posts shall be American standard beam section. Posts, ground plates, paddles, brackets, and splice plates shall conform to CSA/CAN G40.21M, grade 230G.

5.26.3.1.3 Bolts, Nuts and Washers.

Bolts, nuts and washers shall conform to ASTM A307-86A. Self-drilling, self-tapping fasteners shall be #12-24-1.50 indented hex washer head, cadmium plated.

Bolts, nuts and washers used for terminal end anchorage treatment shall conform to ASTM A325M-86.

5.26.3.2 **Production**

5.26.3.2.1 General Requirements

Welding shall conform to CSA W59M and W47.1. No transverse welds are permitted on the rail sections.

All components and associated hardware except for self-drilling, self-tapping fasteners shall be hot dip galvanized after fabrication and shall conform to CSA G164M.

All dimensions are subject to manufacturing tolerances unless otherwise indicated. The individual components shall be capable of being assembled to conform to the finished structure as indicated on the Drawings.

5.26.3.2.2 Fabrication

Flame-cutting shall not be used to create the rounded ends of the slots for the post paddles. The slots may be fabricated in one of the following ways:

- Two holes each 40 mm in diameter shall be drilled at the two ends of the slot, and the material between may then be removed either by flame-cutting or saw-cutting; or
- The entire slot may be punched.

The distance from the end of the slot to the outside face of the nearest vertical side wall shall be no less than 13 mm, and cuts shall not extend past these rounded ends. Failure to comply with these requirements shall constitute grounds for rejection of the product. All slots are to be fabricated before hot dip galvanizing.

When indicated in the material requirements, an expansion joint shall be provided for at one end of the rails in accordance with Drawings TEB 3.30 and TEB 3.40.

5.26.3.2.3 Marking

The name, brand or trademark of the steel producer, the year of production, and the heat number shall be stamped so as to remain legible after galvanizing.

The stamped information shall appear on the underside of each rail.

5.26.4 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

5.26.5 MEASUREMENT AND PAYMENT

Payment for the supply of box beam guardrail including all required hardware and posts will be included in the unit price bid per metre for "Box Beam Guardrail - Supply and Install" in accordance with Specification 2.19, Guardrail and Guide Posts.

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5.27 SUPPLY OF CABLE BARRIER AND METAL POSTS**5.27.1 GENERAL**

The Work consists of supplying cable barrier and metal posts for use as hazard avoidance barriers.

5.27.2 STANDARDS OF REFERENCE

All material supplied shall refer to the following standards, specifications or publications:

Alberta Transportation, Traffic Control Standards Manual

TEB drawings referenced in this specification are found in the manual entitled "Typical Barrier Drawings", published by Alberta Transportation.

Society of Automotive Engineers:

SAE J403 - Sept. 80 - Chemical Composition of SAE Carbon Steels

Canadian Standards Association:

CAN/CSA G40.20-M87 - General Requirements for Rolled or Welded Structural Quality Steel
 CAN/CSA G40.21-M87 - Structural Quality Steel
 CSA/CAN 3-G12-M78 - Zinc-Coated Steel Wire Strand
 CSA W47.1-1983 - Certification of Companies for Fusion Welding of Steel Structures.
 CSA W59-M1984 - Welded Steel Construction (Metal Arc Welding).
 CSA G164-M1981 - Hot Dip Galvanizing of Irregularly Shaped Articles.

American National Standards Institute/American Society for Testing and Materials:

ASTM A307-86a - Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
 ASTM A325M-86 - High-Strength Bolts for Structural Steel Joints (Metric).
 ANSI/ASTM A536-84 - Ductile Iron Castings
 ASTM A47-M84 - Ferritic Malleable Iron Castings (Metric)
 ASTM B30-85a - Copper-Base Alloys in Ingot Form

5.27.3 MATERIALS

The Contractor shall supply all materials necessary to complete the Work. Previously installed material may not be used.

Prior to installing any cable barrier, the Contractor shall supply the Consultant with the material Manufacturer's certification that the material conforms with the Specifications.

The Contractor shall supply the following major components in accordance with the applicable drawings:

Posts c/w ground plates	TEB 3.42
Hook bolts c/w double hex nuts	TEB 3.43
Galvanized steel cables (305 m rolls)	TEB 3.43
Tension bolts and ferrous castings	TEB 3.44
End fittings	TEB 3.44

Slicers and wedges	TEB 3.44
Pressed ferrules and cable fittings	TEB 3.44
Fabricated steel sections for anchor blocks	TEB 3.45

5.27.3.1 Cables

The barrier cable and the cable used for pressed ferrule and cable fittings shall conform to CSA/CAN 3-G12M for grade 110 steel wire strand, hot zinc coated (galvanized) or Class A electro-zinc-coated and shall be supplied in a continuous length of 305 m on expendable reels.

The cable shall be a 13 mm diameter, 7-wire strand weighing approximately 228 kg per 300 m with a minimum breaking strength of 70 kN.

5.27.3.2 Fittings

Ferrous castings for the end fitting and splicer shall conform to ASTM A47M for malleable iron, grade 32510 or ASTM Designation A536 for ductile iron, type 60-45-10.

The tension bolt for the end fitting shall be SAE 1035 hot rolled fine grained steel, and the ferrule shall be SAE 1020 rolled steel, conforming to SAE J403. As an option, the tension bolt may contain a square or hex nut welded as shown on Drawing TEB 3.44, conforming to low hydrocarbon classification CSA W59M.

The ferrous castings, tension bolt and ferrule shall be hot dip galvanized conforming to CSA G164M. The ferrule shall be galvanized after it has been pressed onto the cable.

Wedges shall be bronze conforming to ASTM B30 for alloy suitable for sand casting.

All fittings shall be so designed and be of such section as to develop the full strength of a single cable or cable assemblies, as the case may be.

Single cable assembly (minimum tensile strength of 100 kN)

Three cable assembly (minimum tensile strength of 300 kN)

5.27.3.3 Posts and Fabricated Steel Sections for Anchor Blocks

Posts shall be American Standard Beam Section. Posts, ground plates, brackets, and splice plates shall conform to CSA/CAN G40.21M, grade 230G.

5.27.3.4 Hook Bolts and Nuts

Hook bolts and nuts shall conform to ASTM A307-86a.

Self-drilling, self-tapping fasteners shall be #12-24-1.50 indented hex washer head, cadmium plated.

5.27.3.5 Production

5.27.3.5.1 General Requirements

Welding shall conform to CSA W59M and W47.1.

All components and associated hardware except for self-drilling, self-tapping fasteners shall be hot dip galvanized after fabrication and shall conform to CSA G164M.

All dimensions are subject to manufacturing tolerances unless otherwise indicated. The individual components shall be capable of being assembled to conform to the finished structure as indicated on the Drawings.

5.27.3.5.2 Pressed Ferrule and Cable Fitting

The ferrules supplied are for use at the end of the fitting cable and shall be pressed onto the end of the fitting cable.

The ferrule shall not slip from the cable when tested under a tensile static load to the limit of cable breakage.

5.27.3.5.3 Marking

Coils and reels of the guardrail cable shall be identified by an attached, durable tag on which the following information is indelibly recorded:

Galvanized steel wire strand
Manufacturer's name
Nominal diameter of strand
Grade
Length of strand in metres
Weight of strand in kilograms per coil

5.27.4 EQUIPMENT

The Contractor shall supply all equipment necessary to complete the Work.

5.27.5 MEASUREMENT AND PAYMENT

Payment for the supply of cable barrier including all required hardware and posts will be included in the unit price bid per metre for "Cable Barrier - Supply and Install" in accordance with Specification 2.19, Guardrail and Guide Posts.

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Supply of Flexible Guide Post Traffic Delineators

5.28 SUPPLY OF FLEXIBLE GUIDE POST TRAFFIC DELINEATORS**5.28.1 GENERAL**

The Work consists of the supply of flexible guide post traffic delineators.

5.28.2 MATERIALS

The Contractor shall supply flexible guide posts which return to upright positions following repeated impacts and passages of vehicles over them. Such collisions shall not cause serious damage to the post or vehicle. Failure to conform to the requirements specified herein shall be cause for rejection.

5.28.2.1 General

The posts shall be of uniform high quality and workmanship and be free from defects.

Prior to installation, the Contractor shall provide a complete report of the physical properties of the post to the Consultant. This report shall include properties such as low temperature impact resistance, after-impact recoverability and weather resistance.

5.28.2.2 Specifications - Dimensions, Colour and Construction

The round posts shall have a minimum outer diameter of 90 mm and an overall length of 1.67 m. The semi-flat fiberglass posts shall have a minimum width of 90 mm and an overall length of 1.67 m.

The top 250 mm of the post length shall be black and the remainder shall be white.

The post shall be straight. Straight is defined as having no point along the length of the post any more than 6 mm removed from a perfectly straight edge placed parallel to any side of the post.

Round posts shall be open at the top and bottom.

The surface of the post shall be smooth and free from irregularities or defects. The surface of the post shall not be affected by cleaning using scrapers, detergent and water, or solvent.

Reflective sheeting shall be securely fastened to the black portion of the post with three stainless steel staples inserted through the overlapped portion of the reflective strip.

If one piece construction is not used, then the connections between the pieces shall be at least as strong as if constructed of a single piece. The strength shall exist at temperatures ranging from -50°C to 50°C.

The reflective portion of round posts shall be visible from all directions and shall be of sufficient size so as to be recognizable in the dark as a guide post reflector. The reflective portion of semi-flat posts shall be visible to traffic.

5.28.2.3 Weather Resistance and Durability

The post shall not be seriously affected by ozone, exhaust fumes, asphalt or road oils, dirt, vegetation, deicing salts or any other types of air contamination or materials likely to be encountered after installation.

Supply of Flexible Guide Post Traffic Delineators

The post shall withstand without serious damage all elements likely to be encountered after installation including hot (50°C) or cold (-50°C) temperatures, rain, snow, hail, abrasion and physical abuse.

5.28.2.4 Strength And Flexibility

The posts shall resist, without breaking, tearing, shattering or other serious damage, one highway vehicle impact at a speed of 100 km/h at a test temperature of -33°C.

The post shall not bend, warp or distort when installed at temperatures up to 50°C or installed in wind velocities up to 120 km/h.

5.28.2.5 Reflective Sheeting

The reflective sheeting material shall be super-high intensity retroreflective sheeting meeting the minimum requirements as specified in ASTM D4956 for a Type X sheeting with Class I pressure sensitive adhesive backing.

Each post shall have a 100 mm wide x 330 mm long strip of reflective sheeting fastened onto the black portion of the post. The reflective sheeting shall be centered in such a manner that 75 mm of the black portion is exposed both above and below the attached reflective strip.

Generally, the colour of the reflective strip shall be either white or fluorescent yellow to match the colour of the nearest painted roadway edge line. When marking the edges of approaches located on curves or other concealed access points as directed by the Consultant, the colour of the reflective sheet shall be green. When green reflective sheeting is required, white sheeting shall be screen printed green using a process recommended by the sheeting Manufacturer.

5.28.3 MEASUREMENT AND PAYMENT

Payment for the supply of guide posts will be included in the unit price bid per post for "Flexible Guide Post/Delineators - Round - Supply and Install" or "Flexible Guide Post/Delineators -Semi Flat - Supply and Install", in accordance with Specification 2.19, Guardrail and Guide Posts.

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5.29 SUPPLY OF REINFORCEMENT**5.29.1 GENERAL**

This specification is for the supply, fabrication, handling and placing of reinforcing steel. Reinforcement bars shall be supplied in the lengths and shapes, and installed as shown on the Drawings.

5.29.2 MATERIALS

All materials shall be supplied by the Contractor. Reinforcing steel shall conform to the requirements of the CSA Standard G30.18M Grade 400. All hooks and bends shall be bent using the pin diameters and dimensions as recommended in The Reinforcing Steel Institute of Canada, (RSIC), Manual of Standard Practice, 1 Sparks Ave, Willowdale, Ontario M2H 2W1, Phone: 416-499-4000, unless specified otherwise. Reinforcing bars shall conform accurately to the dimensions shown on the Drawings and within the fabricating tolerance as shown in the RSIC, Manual of Standard Practice.

Epoxy coated reinforcing steel shall be prepared and coated according to the requirements of ASTM A775 and the Ontario Provincial Standard Specification OPSS 1442, Material Specification for Epoxy Coated Steel Reinforcement for Concrete. Film thickness of the coating, after curing, shall be 175 µm to 300 µm (7 to 12 mils). The epoxy coating material shall conform to the requirements of OPSS 1443, Material Specification for Organic Coatings for Steel Reinforcement.

Mesh reinforcement shall be supplied in flat sheets only.

5.29.3 HANDLING AND STORAGE

The Contractor shall handle and store the reinforcement in a manner that ensures it is not damaged or contaminated with dirt or other materials.

Special care shall be taken when handling epoxy-coated reinforcing steel so that damage to the coating is minimized. Epoxy-coated reinforcing bars shall not be dropped or dragged, and shall be lifted with non-metallic slings. Bar-to-bar abrasion and excessive sagging of bundles must be prevented, and bundles shall be handled with spreaders and non-metallic slings.

On site storage of the epoxy coated reinforcing steel shall not exceed 120 days, and exposure to daylight shall not exceed 30 days. If the exposure time exceeds or is expected to exceed 30 days, the reinforcing steel shall be protected by covering with opaque polyethylene sheeting or equivalent protective material.

The Contractor shall repair all damages to the epoxy coating using epoxy patching material. If damaged areas rust before being repaired, the rust shall be completely removed before the areas are repaired.

5.29.4 PLACING AND FASTENING

All steel reinforcement shall be accurately placed in the positions shown on the Drawings, and firmly tied and chaired before placing the concrete. When placed in the Work it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material. Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction, when alternate intersections shall be tied.

Distances from the forms shall be maintained by means of stays, spacers, ties, hangers, or other approved supports. Spacers for holding reinforcement from contact with the forms shall be precast mortar blocks, or chairs of plastic or galvanized metal, of approved shape and dimensions. Any metal chairs protruding through the surface of the hardened concrete shall be cut back at least 25 mm, and the holes filled in accordance with Section 4.26(1), unless otherwise approved by the Consultant. Metal chairs shall not be used to support reinforcement on surfaces which are to be exposed or are to be finished; where possible, this reinforcement is to be supported entirely from above. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe, and wooden blocks, will not be permitted. Unless otherwise shown on the Drawings, the minimum distance between bars shall be 40 mm.

All chairs or bar supports for epoxy-coated reinforcement shall be non-metallic, or epoxy coated and be approved by the Consultant. Tie-wire for the coated reinforcement shall be plastic-coated.

Where field cutting of epoxy-coated reinforcing steel is necessary, and is approved by the Consultant, it shall be cut by methods other than torch-cutting. All cut ends shall be patched with epoxy patching material.

5.29.5 SPLICING

Splicing of bars, unless shown on the Drawings, is prohibited except with the written approval of the Consultant. Splices, where possible, shall be staggered.

For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete. In general, suitable lap lengths will be achieved by the placing of bars of the lengths as detailed. Where the lap length cannot be determined, a minimum of 35 bar diameters lap length shall be provided.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

5.29.6 MEASUREMENT AND PAYMENT

The supply of plain reinforcing steel, the supply of epoxy coated reinforcing steel and the supply of mesh reinforcement will not be paid for separately but will be included in the unit price bid for the applicable structure containing the reinforcing materials.

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5.30 SUPPLY OF METAL BIN RETAINING WALL**5.30.1 GENERAL**

This specification covers the supply of galvanized metal (cellular) bin retaining wall of various sizes depending on the retaining wall design.

5.30.2 APPLICABLE SPECIFICATIONS

CSA G164 Hot Dip Galvanizing of Irregularly Shaped Articles.

ASTM A525M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip process.

ASTM B695 Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

ASTM A568M Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot Rolled and Cold-Rolled, General Requirements.

ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

ASTM A526M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

5.30.3 MATERIALS

Metal bin retaining wall shall be fabricated from steel galvanized sheets to the requirements of the latest edition of American Society for Testing and Materials (ASTM) A525M and A526M Specification. The steel components shall be manufactured in accordance with the latest edition of ASTM A568M Specification and hot dipped galvanized to the latest edition of Canadian Standards Association (CSA) G164 with a minimum zinc coating designation of Z600.

Fasteners (bolts & nuts) shall be manufactured in accordance with ASTM A325M and shall be mechanically galvanized to ASTM B695 GR 50 or hot dipped galvanized to CSA G164 Class 5.

Vertical connectors shall be fabricated from a minimum 5.0 mm thick grade 250W steel and hot-dip galvanized after fabrication to CSA G164 Specification.

5.30.4 REQUIREMENTS

All steel members shall be carefully formed to the required structural shape and punched accurately in the Manufacturer's plant, and shall be straight and true. All members of the same type, thickness and length shall be interchangeable.

Minor damage to the galvanized coating shall be repaired as specified in the latest edition ASTM A780 Specification.

The Manufacturer shall provide drawings (shop drawings) that complement the Consultant's drawings. Any exclusions to the Consultant's drawings shall be noted and made very clear on the Manufacturer's shop drawings. The Manufacturer's drawings shall clearly show the height and depth of all bins, thickness of all stringers and spacers and any special details.

5.30.5 MARKING

Each sheet, or each 600-1500 mm length of steel coil or strip, shall be mill-stenciled with the following information with 5 mm or larger letters.

- Manufacturer's name or trademark.
- Material designation and cell class.
- Nominal thickness of steel sheet in millimetres.
- The applicable specification designation.
- Date of manufacture and plant designation.

5.30.6 INSPECTION, SAMPLING AND TESTING

All materials shall be subject to inspection, sampling and quality assurance testing by the Consultant and the Contractor shall provide safe, convenient access, acceptable to the Consultant, for inspection and sampling of the materials, and shall cooperate in the inspection and sampling process when requested to do so.

The Contractor shall contact the Consultant at least 72 hours prior to shipping the materials to coordinate any inspection, sampling or testing at the manufacturing location and the delivery site that the Consultant deems necessary.

Any material found unacceptable by the Consultant shall be replaced with acceptable material by the Contractor at his own expense.

5.30.7 MEASUREMENT AND PAYMENT

Payment for the supply of metal bin retaining wall including all necessary hardware and appurtenances will be included in the unit price bid per square metre for metal retaining wall installation for the various design types of retaining wall installed.

When more than one design of retaining wall is specified, the designs will be shown by letter suffixes following the pay item.

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5.31 GEOTEXTILE**5.31.1 GENERAL**

The Work includes the supply and installation of both non-woven and woven geotextile at locations shown on the Drawings, described in the Special Provisions or as directed by the Consultant.

5.31.2 MATERIALS**5.31.2.1 Non-Woven Geotextile**

Non-woven geotextile includes:

- continuous monofilaments or staple fibers.
- random fibers that are physically entangled by punching with needles.
- random fibers that are pressed and melted together at the contact points.

The non-woven geotextile fabric shall meet the following requirements:

Property	ASTM Test	Material Specification ¹ Average Roll Value		
		Type A ⁽²⁾	Type B ⁽³⁾	Type C ⁽⁴⁾
Grab Tensile Strength (N)	D4632	400 min	650 min	875 min
Grab Tensile Elongation (%)	D4632	50 % min	50 % min	50 % min
Mullen Burst (MPa)	D3786	1.2 min	2.1 min	2.7 min
Puncture (N)	D4833	240 min	275 min	550 min
Trapezoid Tear (N)	D4533	180 min	250 min	350 min
Ultraviolet Stability (% Retained Strength)	D4355	70 % @ 150 hr.	70 % @ 150 hr	70 % @ 150 hr
Apparent Opening Size (mm)	D4751	0.2 max	0.2 max	0.2 max
Permittivity (per sec)	D4491	2.1 min	1.5 min	1.2 min
Flow Rate (l/sec/m ²)	D4491	102 min	102 min	102 min
Minimum fabric lap shall be 300 mm				

Note 1: All numeric values except A.O.S. represent minimum average roll value as measured in the weaker principal direction;

2: Typically used with perforated pipe and similar applications;

3: Typically used in medium duty situations such as under Class 1M, 1 & 2 riprap;

4: Typically used in heavy duty applications such as under Class 3 riprap.

5.31.2.2 Woven Geotextile

Woven geotextile consists of continuous monofilaments, staple fibres, multi-filament yarns, or slit films that are woven into a fabric.

Woven geotextile shall have the following material properties:

Property	ASTM Test	Material Specification ¹ Average Roll Value		
		Class 1	Class 2	Class 3
Elongation (%)	D 4632	<50 min	<50 min	<50 min
Grab Strength (N)	D 4632	1 400 min.	1 100 min.	800 min.
Sewn seam strength (N)	D 4632	1 260 min.	990 min.	720 min.
Tear Strength (N)	D 4533	500 min. ²	400 min. ²	250 min.
Puncture Strength (N)	D 4833	500 min.	400 min.	300 min.
Permittivity (per sec)	D 4491	0.05 min. ³	0.02 min. ³	0.02 min. ³
Apparent Opening Size (mm)	D 4751	0.43 max.	0.60 max.	0.60 max.
Ultraviolet stability (% retained strength)	D 4355	50% after 500 hrs of exposure	50% after 500 hrs of exposure	50% after 500 hrs of exposure

Note 1: All numeric values except A.O.S. represent minimum average roll value as measured in the weaker principal direction

Note 2: For woven monofilament geotextile, the required minimum average roll value for tear strength is 250 N.

Note 3: Default value. Permittivity of the geotextile should be greater than that of the soil. The Consultant may also require the permeability of the geotextile to be greater than that of the soil.

5.31.3 CONSTRUCTION

Unless otherwise directed in the applicable specification, the placement of geotextile shall be in accordance with the following:

- The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material. The geotextile fabric shall be installed free from tensile stresses, folds, wrinkles, or creases.
- If more than one width of geotextile fabric is used, the Contractor shall either overlap the joints by a minimum of 400 mm with no stitching, or overlap the joint by 200 mm and provide two rows of stitching at each joint.
- The geotextile fabric shall be protected all times during construction. Wheeled or tracked vehicles shall not be allowed to travel directly on the geotextile fabric. Any geotextile fabric damaged during installation or during placement of granular material shall be replaced by the Contractor at his own expense.

5.31.4 MEASUREMENT AND PAYMENT

Supply and installation of geotextile will not be paid separately when the applicable specification states that the cost of supplying and installing geotextile is considered incidental to the Work, or included in the unit price bid for the Work for which the geotextile is being utilized.

In Contracts where the Specification states the supply and installation of geotextile will be paid separately, geotextile will be measured in square metres of ground covered, excluding the area associated with laps or stitching.

Payment for:

- “Non-Woven Geotextile, Supply and Install” for the type specified;
- “Geotextile for Stabilization, Supply and Install” for the class specified ;
- “Geotextile for Materials Separation, Supply and Install” for the class specified;

will be made at the unit price bid per square metre. The price bid will be considered full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

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Permanent Environmental Protection Devices

6.5 PERMANENT ENVIRONMENTAL PROTECTION DEVICES**6.5.1 GENERAL**

This specification covers the installation of permanent environmental protection devices, as defined in Subsection 1.2.50.3 , Permanent Environmental Protection Devices or Procedures, of the General Specifications, including silt fences, synthetic permeable barriers, erosion control soil covering, rock check dams and straw bale barriers.

The Work shall be in accordance with the Best Management Practices for the various structures as shown in the Design Guidelines for Erosion and Sediment Control for Highways, and as specified herein.

The location, spacing, and the estimated quantities of permanent environmental protection devices will be provided in the Special Provisions or will be as shown on the Contract Drawings.

6.5.2 ABBREVIATIONS AND DEFINITIONS

B.M.P.	Best Management Practice
E.C.B.	Erosion Control Barrier (Silt Fence)
R.E.C.P.	Rolled Erosion Control Products
R.C.D.	Rock Check Dam
S.B.B.	Straw Bale Barrier
S.B.C.D.	Straw Bale Check Dam
S.P.B.	Synthetic Permeable (Ditch) Barrier

6.5.3 MATERIALS**6.5.3.1 Commercially Available Products**

Silt fences, synthetic permeable barriers and rolled erosion control products supplied by the Contractor shall be one of the Proven Products from the Alberta Transportation Products List found on the Department's web page. Alternative products that meet or exceed the material and performance properties shown on the Products List will be accepted subject to the Consultant's review.

6.5.3.2 Pins

Pins shall be made, in either a T or U shape, from 4 mm diameter (minimum) ungalvanized wire. T-shaped pins shall be made from a single length of wire to a height of 200 mm after bending. The bar of the T shall be 100 mm wide and the free end of the wire shall be bent downward approximately 20 mm. U-shaped pins shall have 200 mm long parallel legs spaced 25 mm apart at the crown.

The Contractor shall have the option of supplying biodegradable plastic or wooden pins, compatible with the proven product, as an alternative to ungalvanized wire pins.

For synthetic permeable barriers, the pins shall be in accordance with the Manufacturer's recommendations.

6.5.3.3 Rock

Rock shall meet the requirements of Class 1M Riprap in accordance with Specification 2.5, Riprap.

6.5.3.4 Stakes

Stakes used for silt fence and straw bale check dams and barriers shall be new, construction grade or better spruce wood cut from sound timber, and shall be free from any form of decay. The stake dimensions shall be in accordance with best management practice. Broken or split ended stakes will not be acceptable. Stakes cut from other types of wood may be used subject to the prior approval of the Consultant.

6.5.3.5 Straw Bales

Straw bales shall be less than 1-year old and shall show no signs of weathering. Bales shall be comprised of weed-free cereal crop straw such as wheat, oats, rye, or barley. Straw bales shall be machine-made, tightly compacted and bound with two rows of wire or synthetic string, and shall be rectangular in plan and cross-section.

6.5.4 CONSTRUCTION**6.5.4.1 Erosion Control Barrier (Silt Fence)**

Silt fence barriers shall be constructed as early as practicable to maximize the entrapment of silt, and shall be placed along the contour of the fill slopes at the elevation specified or as directed by the Consultant. The terminal ends of the barrier shall be at a marginally higher elevation to prevent water from bypassing them.

The geotextile used in the fence construction shall be self-edged at the top and shall be buried at the lower end in a shallow trench on the upstream side of the fence line as shown in the B.M.P..

6.5.4.2 Rolled Erosion Control Products

Soil covering shall be placed immediately following seeding and fertilizing operations. The Contractor shall ensure that the ground surface is free from stones, or other debris, which would interfere with the uniform contact of the covering within the soil.

Soil coverings shall be unrolled in the direction of expected water flow and shall be applied without stretching so that they loosely, but smoothly, contact the soil surface. The top end of any ditch or slope installation shall be stapled and buried in a narrow trench that is at least 150 mm deep. The soil backfill in the trench shall be firmly tamped in place.

Longitudinal laps in covering installation shall be achieved by excavating a check slot of 150 mm minimum depth, at the location of the lap, and burying the upper end of the downslope blanket in the slot. The upslope covering shall then overlap the downslope one by a minimum of 150 mm. Coverings lying side by side shall be lapped a minimum of 100 mm.

Additional check slots shall be provided at a spacing of 15 m along slopes and 10 m along ditches measured parallel to the ground slope. The covering shall be folded to contact the cross-section of the slot and stapled in place. The trench shall then be firmly tamped.

Pinning of R.E.C.P. shall be as shown in the B.M.P.. A common row of pins shall be used for all laps.

6.5.4.3 Rock Check Dams

The rock check dam shall be constructed in a 0.15 m deep key trench as shown in the B.M.P..

Typically, the weir crest shall be 0.5 m above the ditch bed elevation unless otherwise directed by the Consultant.

6.5.4.4 Straw Bale Check Dams and Barriers

Straw Bale Check Dams and Straw Bale Barriers shall be constructed in accordance with B.M.P. No. 11 and No. 12.

Bales shall be placed in an open trench excavated in the ditch to accommodate the dimensions of the barrier as shown on the B.M.P drawing. The bales shall butt tightly against each other and shall be pinned to the ground with wooden stakes as shown in the B.M.P.. The joint between bales shall be caulked using loosing straw.

At the junctions where the sideslopes and backslope meet the ditch bottom, one end face of the bales meeting at these junctions shall be distorted, or otherwise modified, so as to permit a snug fit with the adjacent bale. The joint at these junctions shall also be caulked with loose straw.

6.5.4.5 Synthetic Permeable (Ditch) Barrier

The Contractor shall integrate barrier installation with the installation of erosion control soil covering within ditch areas.

Synthetic permeable barriers shall be shall be installed in accordance with the Manufacturer's recommendations unless otherwise specified in the B.M.P. No. 10.

6.5.5 MAINTENANCE

All permanent environmental protection devices shall be maintained by the Contractor until the issuance of the Construction Completion Certificate. At no time shall silt or debris build-up be allowed to exceed more than one-half of the above ground vertical height of the structure.

Damage to the permanent environmental protection devices, for whatever reason, shall be immediately repaired by the Contractor to the satisfaction of the Consultant.

The Contractor shall assume ownership of all silt and debris trapped by the permanent environmental protection devices and shall dispose of this material to the satisfaction of the Consultant.

6.5.6 MEASUREMENT AND PAYMENT**6.5.6.1 Excavation and Backfilling**

Excavation and backfilling required for the installation of the permanent environmental protection devices will be considered incidental to the Work and no separate or additional payment will be made.

6.5.6.2 Erosion Control Barrier (Silt Fence)

Erosion control barrier will be measured in metres based on the length of the structure in-place.

Payment will be made at the unit price bid for "Erosion Control Barrier (Silt Fence)" and will be full compensation for all materials, equipment, labour, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

6.5.6.3 Rolled Erosion Control Products

Erosion control soil covering will be measured in square metres, based on the surface area of the ground covered by the installation. No allowances will be made for the burying or lapping of material.

Payment will be made at the unit price bid per square metre for "Erosion Control Soil Covering", for the type installed. This payment will be full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

6.5.6.4 Rock Check Dams

Rock Check Dams will be measured by the volume of rocks present in each structure calculated to the nearest 0.1 cubic metre in-place.

Payment will be made at the bid price per cubic metre for "Rock Check Dam". This payment will be full compensation for supplying the riprap, and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

6.5.6.5 Straw Bale Check Dams and Barriers

Each row of bales in the structure will be measured in lineal metres. If the structure contains multiple rows of bales, the length paid will be the sum of the lengths of each row.

Payment shall be made at the unit bid price per metre for "Straw Bale Check Dam" or Straw Bale Barrier as applicable. This payment will be full compensation for all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

6.5.6.6 Synthetic Permeable (Ditch) Barrier

Each of the single rows of permeable ditch barriers will be measured to the nearest metre. The quantity paid for will be the sum of the lengths of barriers in each row.

Payment will be made at the unit price bid for "Synthetic Permeable Ditch Barrier", and will be full compensation for the supply of all materials, equipment, labour, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Erosion control soil covering will be measured and paid at the applicable unit price bid.

6.5.6.7 Maintenance

Maintaining permanent environmental protection devices will be considered incidental to the Work and no separate or additional payment will be made. The removal and disposal of silt and debris trapped by the permanent environmental protection devices will be paid for as "Extra Work", in accordance with Specification 1.2, General.

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6.10 GABIONS AND GABION MATTRESSES**6.10.1 GENERAL**

This specification covers the preparation of the ground surface to receive gabions, the placement of geotextile and the construction of the gabion structures in place, complete with rock filling in accordance with these specifications at locations shown on the Drawings or described in the Special Provisions and in accordance with B.M.P. No. 2a-c of the Design Guidelines for Erosion and Sediment Control for Highways..

6.10.2 MATERIALS

All materials shall be supplied by the Contractor.

6.10.2.1 Geotextile

When specified, geotextile fabric shall be Type 'B' non-woven, in accordance with Specification 5.31, Geotextile.

6.10.2.2 Rock

Rock used for gabion structures shall consist of clean, sound durable stones that are resistant to weathering and water action. Shale or other soft rock may not be used.

The stones shall be angular in shape with a height and width dimension of at least one third the length. The gradation of the mixture shall be such that at least 80 percent (by weight) of the stones, have a minimum dimension of at least 100 mm. The maximum dimension of a stone shall be the lesser of 300 mm or the gabion structure thickness.

6.10.2.3 Gabions and Gabion Mattress

The gabion materials supplied shall be a Proven Product selected from the Alberta Transportation Products list. Albertnative products meeting the properties listed below will be accepted pending review and acceptance by the Consultant

Gabion units shall be manufactured from wire in accordance with Federal Specification QQ-W-461G, "Wire Steel, Carbon (Round, Bare and Coated)" and shall be soft tempered. Additional requirements of the wire for gabion units are given in Table 1.

Table 1
Wire Requirements for Gabion Units

Property ¹	Type		
	Galvanized Basket	Galvanized and PVC Coated Basket	Galvanized and PVC Coated Mattress
Netting Wire dia. (mm)	2.90	2.65	2.20
Self-edge Wire dia. (mm)	3.85	3.40	2.65
Binding Wire dia. (mm) ²	2.20	2.20	2.20
Zinc coating (gm/m ²)	245	245	245
PVC coating (mm)	--	0.42	0.42

Note (1): The allowable tolerance on all properties is $\pm 3\%$

Note (2): Galvanized clips with a wire diameter of 2.90 mm may be used with galvanized baskets.

Mattresses and baskets shall be cubical in shape and shall be assembled from independent rectangular faces laced or clipped together. Each face shall be a non-raveling wire mesh woven with a double twist into regular hexagonal openings measuring approximately 75 mm X 100 mm. The edges of each face shall be self-edged by weaving the mesh around a reinforcing wire in a manner designed to prevent slippage. The self-edging shall be secure at all points so that joints formed by tying adjacent faces along the self-edges shall be at least as strong as the internal mesh.

Gabion basket and mattress shall be supplied, complete with diaphragms and dividers from among the various sizes listed in Tables 2 and 3.

Table 2
Gabion Basket Sizes and Dimensions

Dimensions and Volumes					
Size No.	Number of Diaphragms	Length (m)	Width (m)	Depth (m)	Capacity (m³)
1	1	2	1	0.3	0.6
2	1	2	1	0.5	1
3	1	2	1	1	2
4	2	3	1	0.3	0.9
5	2	3	1	0.5	1.5
6	2	3	1	1	3
7	3	4	1	0.3	1.2
8	3	4	1	0.5	2
9	3	4	1	1	4

Table 3
Gabion Mattress Sizes and Dimensions

Dimensions and Areas						
Size No.	No. of Dividers	No. of Diaphragm	Length (m)	Width (m)	Depth (mm)	Plan Area (m²)
10	1	18	30	2	230	60
11	2	27	30	3	230	90

6.10.3 CONSTRUCTION

All stumps, roots, debris and rocks shall be removed and disposed of as directed by the Consultant, prior to placing gabions. Excavation to accommodate gabion installation shall be carried out to the lines and levels as shown on the Drawings or as directed by the Consultant.

Geotextile shall be laid free from wrinkles onto the prepared ground surface. Laps in geotextile shall be a minimum of 500 mm with the upslope portion on top. The edges of the geotextile shall be neatly trimmed or buried in the ground whichever is specified.

Individual gabion units shall form the component parts of a gabion structure.

Gabion cages shall be assembled by tying the appropriate faces together along the selfedges with binding wire. The binding wire shall be tightly looped around every other mesh opening to form a spiral with single and double loops alternating. Diaphragms and dividers shall be affixed in position by similarly binding them to the mesh of the assembled cage. Free ends of binding wire shall not be made to project from exposed faces of gabion structures.

When assembled, gabion baskets shall be divided by the diaphragms into compartments having a plan dimension of one metre square. Gabion mattress shall be separated lengthwise by the dividers into 1 m wide strips. The diaphragms shall further subdivide the mattress into compartments that have a plan dimension of 1 m x 3 m.

Gabion units, grouped together to form a gabion structure, shall be securely bound to each other along all contacting selfedges in the same manner as the faces are bound in the assembly of the cages.

Irregular shapes in any structure shall be achieved by overlapping and bending the rectangular components. Cutting of the mesh shall be minimized to avoid damage to the galvanized wire.

Rocks shall be infilled in the assembled cage units either by machine or by hand. When machine is used, minor rock repositioning shall be done by hand to fill the voids between larger rocks and thereby achieve a dense structure. Rocks along visible faces shall be selected and placed by hand from among the larger sizes with a flat face toward the exterior to produce a semblance of a masonry structure and a neat and workmanlike appearance.

Undue distortion in gabion units shall be avoided. Rock filing shall be carried out in stages with the difference in rock level between any two adjacent compartments limited to 250 mm. Further, distortion of gabion baskets shall also be prevented by tying with binding wire, the opposite faces of a compartment at the surface level of the rocks when the depth of fill has reached designated levels. These levels shall be 300 mm and 600 mm for 1 m deep baskets and 250 mm for 0.5 m deep baskets. Cross ties are not required for 0.3 m deep baskets.

The exposed faces of a gabion structure shall be maintained true to vertical and horizontal alignment by stretching taut with a standard fence stretcher, or other approved method, before placing rocks within the baskets. No such stretching is required for gabion mattress installation.

Following the filling of each gabion unit, the lid shall be affixed in position so that the selfedges coincide with the perimeter of the filled gabion unit. The selfedges shall then be laced together in the same manner as described above.

6.10.4 MEASUREMENT AND PAYMENT

6.10.4.1 **Excavation**

Where excavation for gabions does not overlap with excavation for other work, excavation will be classified and paid as "Channel Excavation" in accordance with Specification 2.3, Grading.

Where the excavation for gabion overlaps excavation for other work, only the excavation for other work will be measured and paid, as if no separate excavation for gabions took place.

The removal and disposal of debris, stumps, roots, etc. will be considered incidental to the Work and no separate or additional payment will be made.

6.10.4.2 Geotextile

Geotextile will be measured by the square metre, based on the surface area covered by the material, with no allowance made for laps. Payment will be at the price bid for "Geotextile Installation - Gabions". This payment shall be compensation in full for the supply of all labour, materials, equipment, tools and incidentals necessary to complete the Work.

6.10.4.3 Gabion

Gabion baskets will be measured in cubic metres based on the nominal dimensions of the baskets installed.

Payment for gabion baskets will be made at the price bid per cubic metre for "Gabion Basket". This payment shall be compensation in full for the supply of all materials including rock, and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

6.10.4.4 Gabion Mattress

Gabion mattress will be measured in square metres based on surface area of the mattress in place.

Payment for gabion mattress will be made at the price bid per square metre for "Gabion Mattress". This payment shall be compensation in full for the supply of all materials including rock, and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

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7.1 TRAFFIC ACCOMMODATION AND TEMPORARY SIGNING

7.1.1 GENERAL

This specification details the requirements for traffic accommodation including the preparation of the Traffic Accommodation Strategy and the supply, installation, maintenance and removal of temporary construction signing and traffic control devices which are specifically related to construction, repair or emergency situations and which are generally removed when the Work is completed or the situation returns to normal.

Permanent signing requirements for normal use of the roadway are detailed in Specification 7.7, Permanent Highway Signing.

7.1.2 TRAFFIC ACCOMMODATION STRATEGY

The Contractor shall prepare a Traffic Accommodation Strategy detailing his proposed methods for accommodating traffic throughout the Work Zone. The minimum requirements are specified in the Department manual entitled "Traffic Accommodation in Work Zones 2008 (1st Edition)". Any project specific requirements, in excess of the minimum requirements, will be identified in the Special Provisions.

The Traffic Accommodation Strategy shall consist of drawings detailing the configuration of temporary construction signs and other traffic control devices in the work area(s) and, written confirmation of the methods or procedures being used by the Contractor to address specific traffic safety related issues or situations at the work zone.

When localized detours are required, the Contractor's Traffic Accommodation Strategy shall include detailed drawings of proposed traffic accommodation measures, signed and stamped by a Professional Engineer registered in the Province of Alberta. The detour plans shall be drawn to scale and shall include the proposed vertical and horizontal alignments. Detours shall meet or exceed the requirements of the following Department manuals:

- Traffic Accommodation in Work Zones 2008 (1st Edition), and;
- Section B7 of the Highway Geometric Design Guide, 1999.

Unless otherwise specified, the Contractor shall submit the Traffic Accommodation Strategy to the Consultant a minimum of 14 days prior to the pre-construction meeting for the project. The Consultant will review the Traffic Accommodation Strategy and communicate any concerns to the Contractor within 7 days of the pre-construction meeting. Any issues or concerns regarding the Contractor's proposed Traffic Accommodation Strategy shall be addressed to the mutual satisfaction of the Contractor and the Consultant prior to the commencement of the Work.

The Contractor shall have no claim against the Department resulting from the Consultant's failure to accept the Contractor's Traffic Accommodation Strategy submission, nor any costs incurred by the Contractor to address concerns raised by either the Consultant or the Department during the review of the Contractor's Traffic Accommodation Strategy submission.

7.1.2.1 Requirements for Traffic Accommodation and Temporary Signing

Unless otherwise specified, the Contractor shall accommodate Public traffic through the Work Zone on a 24-hour per day basis using any means at the Contractor's discretion, subject to the minimum requirements of the Traffic Accommodation in Work Zones manual and the following:

The Contractor shall:

- Make suitable provisions, including the use of detours, to accommodate all vehicular and pedestrian traffic safely and with a minimum of inconvenience through or around the Work.
- Provide, install, maintain and protect traffic control devices such as signs, barriers, fences and lights at his own expense and in accordance with Section 7.1.4, Temporary Construction Signing.
- Install, maintain and protect at his expense, any additional traffic control devices that the Department chooses to provide.
- Provide the required number of flag persons, during all periods of active equipment operations which may affect normal traffic operations.
- Control his operations to ensure normal school bus operations are not interfered with.
- Ensure uninterrupted access to developments along the project.
- Obtain approval from the Consultant prior to changing or disrupting existing accesses and road crossings.
- Carry out construction operations in one continuous operation at road crossings, intersections and entrances for each phase of the Work.
- When working in large cut or fill areas, stage construction as shown on Standard Drawing CB6-2.3M30, and as approved by the Consultant.
- Provide and use such other methods or equipment necessary to accommodate traffic safely through the work site.
- Include provision in his Traffic Accommodation Strategy for Standard Drawing "TCS-B-8.1 for Double Fines when Passing Workers in the active work area". The Contractor is advised that the signing sequence shown on this drawing is provided as general guidance only. The Contractor shall adjust his Traffic Accommodation Strategy and construction zone signing as required based on site conditions.

If the Contractor's operations are such that the active work area exceeds 5 km in length, the Contractor shall install interim "speed limit" and "ID-503" signs at the approximate mid-point of the active work area.

If the Contractor maintains separate active work areas where the cumulative length of the active work area plus any gaps exceeds 5 km, the Contractor shall sign each active work area separately in general accordance with Standard Drawing "TCS-B-8.1".

The Contractor shall promptly make any modifications to the traffic accommodation operations deemed necessary by the Consultant. Where, in the opinion of Consultant, the Contractor fails to adequately provide for the safety of the public, for recurring safety issues and/ or when the Contractor fails to comply with orders issued by the Consultant regarding traffic accommodation operations, the Consultant may suspend Work in accordance with Subsection 1.2.17.1, Authority to Suspend Work, of Specification 1.2, General.

The Contractor shall remove or cover all traffic control devices when not essential for the safe accommodation of traffic, in order to eliminate unnecessary inconvenience to the traffic.

The Contractor shall coordinate his traffic accommodation measures with those of other forces that may be working at or adjacent to the Work, as required, to accommodate traffic safely and conveniently. This shall not relieve the Contractor of his responsibility for the safe accommodation of traffic over the whole of the Work.

7.1.3 TYPICAL DRAWINGS

Drawings detailing minimum requirements for temporary signing and other traffic control devices for typical rural and urban highway situations are contained in Sections II and III, respectively, of the Department manual entitled Traffic Accommodation in Work Zones 2008 (1st Edition).

Any drawings necessary to address non-typical rural or urban highway situations shall be developed by the Contractor and included in the Traffic Accommodation Strategy.

7.1.4 TEMPORARY CONSTRUCTION SIGNING

7.1.4.1 **Materials**

The Contractor shall supply all signing materials including sign posts, weighted stands, brackets and any required mounting hardware and miscellaneous materials required for the erection of temporary construction signs.

All signs, barricades and other traffic control devices shall conform to the requirements for shape, colour and size specified in Section V of the Traffic Accommodation in Work Zones manual. The orange portion of all signs, barricades and other traffic control devices shall be fully reflectorized using high brightness, retro-reflective, non-metallized, prismatic sheeting material which incorporates durable, transparent, fluorescent pigment and meets the brightness requirements as specified in ASTM D4956 for Type VIII sheeting. Unless otherwise approved by the Consultant, the orange coloured reflective sheeting supplied by the Contractor shall be one of the Proven Products for "Temporary Orange Work Zone/Construction Signs" shown on the Alberta Transportation Products List.

All other colours of sheeting material shall be Type III or Type IV high intensity retro-reflective sheeting meeting or exceeding the minimum requirements as specified in ASTM-D4956.

Larger construction signs or oversized signs may be used where conditions require greater visibility in order to be effective. They shall be used in special circumstances where more than average attention value is required from the sign.

7.1.4.2 **Equipment**

The Contractor shall supply all equipment required to complete the Work.

7.1.4.3 **Erection of Signs**

Work on the project shall not commence until all necessary temporary construction signs and all other traffic control devices as proposed in the traffic accommodation strategy are in place.

When signs require frequent moves, portable type signs, mounted on weighted stands, may be used. Portable signs shall be placed on the shoulder of the road such that the face of the sign is fully visible to oncoming traffic and the bottom of the sign is not less than 0.3 m above the

road surface. The stands shall be securely weighted and erected to ensure against being blown over by prevailing winds or gusts from passing vehicles.

Non-portable signs shall be conspicuously posted, and erected at right angles to the roadway, with the bottom of the sign at a height of 1.5 m above the roadway surface, and not less than 2.0 m nor more than 6.0 m from the nearest traffic lane.

Traffic signs and devices shall be moved and kept as close to the Work Area as practical as construction progresses.

Objects within or immediately adjacent to the roadway which constitute a hazard to traffic shall be marked with alternating black and orange stripes attached directly to the object or erected immediately in front of it.

The use of signs shall be held to a minimum to prevent confusion.

"STOP" signs shall be installed on all subsidiary roads (local, district, municipal, service or approach) intersecting a primary highway detour route.

Speed zones, where required, shall be posted as indicated on the applicable drawing contained in the Traffic Accommodation in Work Zones manual or as shown in the Special Provisions.

7.1.4.4 Maintenance and Removal of Signs

Poorly maintained, defaced, damaged and/or dirty construction signs shall be replaced, repaired or cleaned without delay. Special care shall be taken to ensure that construction materials and dust are not allowed to obscure the face of a sign.

Signs not in effect shall be covered or removed; and all construction signs shall be removed after the project has been completed.

7.1.4.5 Modifications to Temporary Construction Signing

The Contractor shall be responsible for the supply and proper placement of temporary construction signs. However, in the case of potential danger to the travelling public or other circumstances where the Consultant determines that signing is inadequate, the Consultant may direct that changes to the Contractor's operations be implemented to remedy the situation. These changes may involve the use of different types and/or sizes of signs, modifying the number or locations of signs, and/or any other modifications or additions required to protect the safety of the travelling public.

7.1.4.6 Daily Recording of Temporary Construction Signing

Each day and as the work area changes, the Contractor shall record the location of all temporary construction signs and any other traffic control devices used at the work areas. The Contractor shall record this information on a form suitable to the Consultant and shall submit it to the Consultant on a weekly basis or when requested.

7.1.5 REMOVAL OF EXISTING SIGNS AND GUIDEPOSTS

Unless otherwise specified, all existing signs which must be removed in the prosecution of the Work shall be carefully salvaged by the Contractor. Guideposts which must be removed shall be disposed of. Critical signs necessary for the protection of traffic such as railroad crossing signs or stop signs shall be maintained.

Payment for the removal and salvage of existing signs will be made at the applicable unit prices bid in accordance with Specification 7.7, Permanent Highway Signing. All costs associated with the maintenance of existing signs and the removal and disposal of guideposts will be considered incidental to the Work, and no separate or additional payment will be made.

7.1.6 SEQUENTIAL ARROWBOARDS AND VARIABLE MESSAGE BOARDS

7.1.6.1 **General**

When specified in the Special Provisions, the Specifications, or as directed by the Consultant, the Contractor shall use sequential arrowboards for the accommodation of traffic. The Contractor shall have the option of supplying either stationary arrowboards or truck-mounted mobile arrowboards.

When specified in the Special Provisions, the Specifications, or as directed by the Consultant, the Contractor shall supply and operate an electronic variable message board in advance of the sequential arrowboard.

7.1.6.2 **Stationary Arrowboards**

Stationary arrowboards shall meet the following requirements:

- (i) Minimum size of 1.22 m x 2.44 m (4 ft x 8 ft),
- (ii) Minimum of 25 lamps that are legible at a minimum distance of 1 200 m,
- (iii) Fully adjustable light intensity on all arrowboard lights,
- (iv) Operating modes which include:
 - (a) sequential left arrow or chevron
 - (b) sequential right arrow or chevron
 - (c) sequential double arrow or chevron
 - (d) horizontal bar
 - (e) all four lamps in the extreme corners of the panel shall be flashing

7.1.6.3 **Truck-Mounted Mobile Arrowboards**

Truck-mounted mobile arrowboards shall meet the following requirements:

- (i) Minimum size of 0.75 m x 1.52 m (2.5 ft x 5 ft),
- (ii) Minimum of 25 lamps are legible at a minimum distance of 1 200 m,
- (iii) Fully adjustable light intensity on all arrowboard lights,
- (iv) Operating modes which include:
 - (a) sequential left arrow or chevron
 - (b) sequential right arrow or chevron
 - (c) sequential double arrow or chevron
 - (d) horizontal bar
 - (e) all four lamps in the extreme corners of the panel shall be flashing

7.1.7 FLAGPERSONS

7.1.7.1 **General**

When construction operations or Work Zone conditions cause interruption, delay or hazard to the traveling public or anyone on the worksite, and necessitates the use of flag persons; the

Contractor shall provide and equip responsible flag persons for the direction and control of traffic. The Contractor shall ensure that flag persons are instructed in and use proper traffic control procedures appropriate for the prevailing conditions.

Flag persons shall have proof of certification from a recognized training program on traffic control procedures through construction zones. The Department will recognize traffic control programs administered by the Alberta Construction Safety Association, however the Department reserves the right to accept or reject certification from any other institute.

7.1.7.2 Safety Apparel

7.1.7.2.1 Coveralls

Flag persons shall be dressed in coveralls which meet the Class 3 Level 2 requirements of CSA Z96-02, High Visibility Safety Apparel. Each pair of coveralls shall have a permanent label affixed certifying compliance with Class 3 Level 2 of CSA Z96-02.

The colour of the coveralls shall be fluorescent yellow-green with silver retro-reflective striping. The retro-reflective striping shall be a minimum of 50 mm wide, and shall be sewn onto a 100 mm wide fluorescent red-orange background material. Flag person safety apparel shall be kept clean and in good condition at all times. Faded, torn and/or dirty coveralls, or coveralls without CSA certification labels will not be acceptable and shall be replaced by the Contractor.

7.1.7.2.2 Headgear

Prior to commencement of the Work, the Contractor shall identify and assess existing and potential hazards at the project site. Where there is a foreseeable risk of injury to a worker's head, flag person's shall wear fluorescent orange protective hardhats meeting the requirements of CSA Standard Z94.1-92.

Where no foreseeable risk of head injury exists, flag persons will be permitted to wear any type of fluorescent orange headgear.

7.1.7.3 Night Time Operations

During hours of darkness, flag persons shall be equipped with hand held red traffic signal wands of sufficient brightness to be clearly visible to approaching traffic. In addition, flagging stations shall be illuminated by overhead lighting; and signs indicating hazardous conditions and/or signs requiring increased attention shall be marked with flashers.

7.1.8 DETOURS

Unless otherwise indicated in the Special Provisions or shown on the Drawings, the Contractor shall have the option of constructing temporary localized detours, or utilizing local roads for the accommodation of public traffic around major phases of the Work.

7.1.8.1 Localized Detour within or adjacent to the Right-of-Way

Subject to review by the Consultant, localized detours within or adjacent to the right-of-way may be utilized by the Contractor to carry traffic around the Work.

If the Consultant directs the construction of a localized detour; the Consultant will obtain any required Environmental Authorizations and/or right-of-way easements; and will arrange for the temporary relocation of utilities.

When the Consultant directs that a localized detour be constructed, payment for the construction and removal of the detour, including gravel surfacing, will be made at the applicable unit prices bid for the types of work incorporated.

If the Contractor elects to accommodate traffic using localized detours, the Contractor shall be responsible for the design, construction and removal of the localized detour. In addition, the Contractor shall be responsible for obtaining any required Environmental Authorizations and/or right-of-way easements, the temporary relocation of any utilities, and the reclamation of disturbed areas to a condition similar to that which existed prior to the disturbance. Prior to the commencement of any construction, the Contractor shall provide a copy of the Authorizations and easement agreements to the Consultant for review.

When the Contractor elects to construct a localized detour, all associated costs including, but not limited to, design, construction, maintenance, and removal of the detour will be considered incidental to the Work, and no separate or additional payment will be made.

7.1.8.2 Local Road Detour

When traffic is diverted entirely off the right-of-way via local roads, the Contractor shall establish and maintain local road detour signing, complete with signs at every intersection, in accordance with the Plans and Specifications.

The Contractor shall initially condition, maintain and restore roads used as local road detours to the satisfaction of the agency having jurisdiction, and in the case of provincially owned or controlled roads, to the satisfaction of the Consultant. The Contractor shall maintain the local roads, including dust abatement as required, and, following completion of construction operations, restore the roads to a condition comparable to that which existed prior to the commencement of the Work.

If the Contractor elects to use local roads to accommodate Public traffic, the Contractor shall be solely responsible for obtaining authority to utilize the local road detour from the Agency having jurisdiction. In situations where the Consultant directs the use of a local road detour, the Consultant will obtain the necessary approvals from the local road authority.

Unless otherwise stated in the Special Provisions, all costs associated with local road detours including, but not limited to, local road signing, initial road conditioning, maintenance, dust abatement, gravel surfacing, and local road restoration, will be considered the incidental to the Work, and no separate or additional payment will be made.

7.1.9 ROADWAY MAINTENANCE AND GRAVEL SURFACING

When the Work requires disturbance of the surface of an existing roadway that is carrying public traffic, the Contractor shall, at his own expense keep the disturbed areas of the travelled lanes well graded, free of potholes and of sufficient width for the required number of travel lanes.

When, in the opinion of the Consultant, surfacing gravel is required for traffic accommodation on areas disturbed by the Contractor prior to the completion of the Work on these areas, the Contractor shall supply and place surfacing gravel to the satisfaction of the Consultant.

For detours, payment for the supply and placement of surfacing gravel will be made in accordance with Subsections 7.1.8.1, Localized Detour within or adjacent to the Right-of-Way, and/or 7.1.8.2, Local Road Detours, as applicable.

For haul roads from gravel pits, payment for the supply and placement of surfacing gravel will be in accordance with Specification 4.5, Hauling.

For roads other than detours and haul roads from gravel pits, the supply and placement of surfacing gravel shall be at the Contractor's expense, except that the Department will pay for the truck haul of the gravel at the rate specified in Subsection 3.2.4.2, Interim Crushing, Hauling and Stockpiling, of Specification 3.2, Aggregate Production and Stockpiling. If the Contract contains a Department source option for the supply of aggregate, the Contractor may obtain the pit-run material necessary for gravel surfacing from the Department source at no cost.

If the Contractor fails to promptly carry out maintenance and/or the application of surfacing gravel when directed by the Consultant, the Department may make other arrangements to have the Work done and deduct the cost thereof from any money owing to the Contractor.

The Contractor will not be responsible for maintenance of those areas of an existing roadway which are to be constructed or reconstructed, but which have not yet been disturbed by the Contractor's construction or hauling activities.

7.1.10 PROLONGED SHUT-DOWN

Prior to any prolonged shut-down of construction, the Contractor shall ensure that any disturbed roadway surface is restored to a condition suitable for traffic operations and acceptable to the Consultant. The Contractor will not be responsible for normal winter snow and ice control for traffic accommodation during the prolonged shut-down.

Prior to commencing any prolonged shut-down of the Work, the Contractor shall host a meeting between the Contractor, the Consultant, the Project Sponsor, and the Regional Maintenance Contractor. The purpose of the meeting shall be to develop a "Shutdown Plan" based on the specific needs and requirements of the project. The "Shutdown Plan" shall outline the Contractor's methods and procedures for monitoring and maintaining the project during the winter shutdown period, and will outline any responsibilities of the other parties.

Notwithstanding the above, no component of the shut-down plan will negate the Contractor's responsibilities for the project, except for snow and ice control.

7.1.11 DUST ABATEMENT

The Contractor shall maintain detours and disturbed roadways that carry traffic within the project limits free of excessive dust. In this case, "disturbed roadways" shall mean sections of roadway under construction and/or sections of roadway being used by the contractor for hauling of equipment or materials. The Contractor shall supply and apply all dust abatement materials at his expense.

If the Contractor fails to promptly undertake dust abatement measures, the Department may make other arrangements to have the Work done, and deduct the cost thereof from any money owing to the Contractor.

Dust abatement requirements for haul roads are detailed in Specification 4.5, Hauling.

7.1.12 TRAFFIC ACCOMMODATION FOR BRIDGE CONSTRUCTION

In addition to the requirements stated herein, the following requirements are required for work involving bridges and/or bridge culverts.

Detailed traffic control plans taking into account site specific conditions that may impact the Work shall be provided for each bridge site.

Traffic control shall be in place only during the time it is applicable to the Work on the bridge site.

Traffic control signals, if required, shall be adjusted to the traffic demands encountered.

The Contractor shall minimize inconvenience to traffic as much as possible, and shall provide the widest traffic roadway width practicable. The minimum traffic roadway width, as shown or specified, shall be maintained and be available to public traffic at all times.

The Contractor shall anticipate and as practical accommodate wide load vehicles that may enter the Work Zone.

On stand-alone bridge projects, the tender documents may contain a bid item for "Traffic Accommodation for Bridge Construction". Generally, this bid item will be included only on projects where traffic accommodation is required by localized detour or staged construction and the tender documents do not include separate bid items for the detour construction Work; or when other specialized requirements are detailed in the Special Provisions.

When a lump sum bid item for "Traffic Accommodation for Bridge Construction" is included, payment will be considered full compensation for all costs associated with the accommodation of public traffic through the site by the use of a localized detour, staged construction, the implementation of other measures described in the Special Provisions, or any combination thereof; including the supply, installation, monitoring, maintenance and removal of all required temporary traffic control measures, barriers, signs and devices; and all labour, materials, equipment, tools and incidentals necessary to carry out the Work to the satisfaction of the Consultant.

Payment will be made as follows:

- When the Contractor accommodates traffic using a localized detour, 60% of the lump sum price bid will be paid once the detour is in-place and fully operational. The remaining 40% of the lump sum price bid will be paid once the detour and all temporary traffic control measures have been removed; the site is opened to the unrestricted flow of public traffic; all associated clean-up has been completed and the area has been restored to a condition satisfactory to the Consultant.
- When the Contractor accommodates traffic using staged construction, 40% of the lump sum price bid will be paid once the initial stage is in-place and fully operational. The second 40% of the lump sum price bid will be paid once the traffic is switched to the second stage. The remaining 20% of the lump sum price bid will be paid once all temporary traffic control measures have been removed; the site is opened to the unrestricted flow of public traffic; and all associated clean-up has been completed to the satisfaction of the Consultant.
- When the Contractor accommodates traffic through the implementation of methods described in the Special Provisions other than the use of a localized detour or staged construction, 60% of the lump sum price bid will be paid upon acceptance of the initial installation of temporary traffic accommodation measures. The remaining 40% of the lump sum price bid will be paid when construction has been completed; all temporary traffic control measures have been removed; the site is opened to the unrestricted flow of public traffic; and all associated clean-up has been completed to the satisfaction of the Consultant.

7.1.13 MONITORING TRAFFIC ACCOMMODATION AT THE WORK ZONE

To ensure the traffic accommodation strategy is performing as intended, the Contractor shall monitor and maintain traffic accommodation at the work zone on a regular basis. The Contractor shall designate a specific individual or individuals to perform this function to ensure any issues arising are addressed in a consistent and timely manner.

Designated personnel shall be qualified, trained and experienced in traffic control and shall be knowledgeable in the operation of the traffic control devices and other related equipment. These workers shall be provided vehicles equipped with revolving warning lights and suitable communication devices to contact others for assistance if and when required. The Contractor shall identify those workers who will be responsible for monitoring and maintaining the traffic control devices at the pre-construction meeting.

The Contractor shall monitor all traffic control devices, temporary signing and roadway conditions during periods of inactivity. The frequency of inspection shall be commensurate with the traffic volumes on the highway. For all localized detours on roadway and bridge projects, and for staged construction on bridge projects, under no circumstances shall consecutive inspections be more than six hours apart, unless otherwise agreed by the Consultant. All site inspections shall be documented by the Contractor and available for the Consultant's review upon request.

The Contractor's traffic accommodation measures will be monitored by the Department and the Consultant. If, in the opinion of the Consultant, traffic is being unduly hindered, the Contractor may be required to modify his traffic accommodation measures.

7.1.14 COMPLIANCE

In cases where the Contractor is not in compliance with the specifications and, in the opinion of the Consultant there is imminent danger to the travelling public, the Consultant has the authority to order the immediate suspension of work. Such orders will be made in writing.

In other cases where the Contractor is not in compliance with the specifications but, in the opinion of the Consultant, the infraction is not causing imminent danger to the travelling public, the Consultant will use the following escalating process to address the situation:

- (i) Issue verbal instructions requiring the Contractor to correct the infraction.
- (ii) Issue a written warning instructing the Contractor to correct the infraction.
- (iii) Issue a written order instructing the Contractor to suspend work until the infraction is corrected to the satisfaction of the Consultant.

7.1.15 PAYMENT

7.1.15.1 **General**

Traffic accommodation and temporary construction signing is the sole responsibility of the Contractor. Unless otherwise stated, all costs including, but not limited to, the preparation and implementation of the Traffic Accommodation Strategy; the supply installation, maintenance and removal of all traffic control devices and temporary construction signing; the daily recording of temporary construction signing; the provision of flag persons; gravel surfacing; detour design, construction, dust abatement, maintenance, and removal; local road detour preparation, maintenance and restoration, dust abatement; and all labour, materials, equipment, tools, and

incidentals necessary to complete the Work to the satisfaction of the Consultant will be considered incidental to the Work and no separate or additional payment will be made.

7.1.15.2 Bonus and Penalty Assessment

The Contractor will be assessed a \$250.00 penalty for each written warning to correct an infraction issued by the Consultant. (Stage 2 of escalation process)

The Contractor will be assessed a \$1,000.00 penalty for each written order to suspend Work issued by the Consultant. (Stage 3 of escalation process or in cases of immediate suspension of Work due to imminent danger)

If neither of the following has occurred prior to the issuance of the Construction Completion Certificate:

- Written orders to suspend Work or written warnings issued by the Consultant .
- Written orders to suspend Work issued by the Department.

the Contractor will receive a lump sum \$2,000.00 payment.

Bonus and penalty assessments and written orders will not be administered separately for separate and distinct projects within the Contract or for distinct work phases on any given project within the Contract, but will be administered as a single process for the entire Work regardless of the number of separate and distinct projects or the number of distinct work phases on any given project.

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7.2 PAINTED ROADWAY LINES

7.2.1 GENERAL

7.2.1.1 **Description**

This specification covers the painting and removal of roadway lines including edge lines, lane lines, continuity lines and directional dividing lines as shown on the Drawings.

7.2.1.2 **Contractor Quality Control Inspection Plan**

The Contractor shall be totally responsible for quality control inspection throughout every stage of the Work to ensure that materials and workmanship comply with the requirements of this specification.

The Contractor shall develop and submit in writing to the Consultant a Quality Control Inspection Program (QCIP) that addresses all the elements that affect the quality of the line painting including but not limited to:

- Paint Application Rates,
- Glass Bead Application Rates,
- Pavement Surface and Atmospheric Conditions,
- Line Widths, Line Lengths and Space Lengths.

The Contractor shall maintain records of QCIP data, complaints from the public, and other details relevant to the Work and shall provide these records to the Consultant daily.

7.2.2 MATERIALS

The Contractor shall supply all paint and glass beads in accordance with Specification 5.20, Supply of Line Painting Materials.

7.2.3 EQUIPMENT

7.2.3.1 **General**

The Contractor shall provide all equipment necessary for completion of the Work including but not limited to the painting truck, a pilot truck, a crash attenuator vehicle and all ancillary equipment such as fork lifts, hoists, pumps and transport vehicles required to load, unload and transport the paint and glass beads.

7.2.3.2 **Painting Truck**

The painting truck shall be self-propelled and equipped to meet or exceed the following requirements:

- (a) Two paint tanks each having a minimum capacity of 270 litres feeding three lines for a simultaneous two-colour application (two yellow directional dividing lines and one white edgeline).
- (b) Painting controls capable of adjusting the paint application for the length of dashed line required. Each spray gun shall have independent controls and adjustment mechanisms, and shall be operated from the operator's compartment.

- (c) The compressor shall have a minimum rated capacity of 4.25 cubic metres per minute.
- (d) Bead dispensers shall be electrically controlled, air operated, gravity fed with controls to adjust the bead flow. The bead dispensers shall be fed from tanks capable of holding a minimum of 45 kilograms of beads.
- (e) A television vehicle guidance, or a vehicle guidance system mounted on a retractable A-frame with a guide wheel and pointer system, to assist the truck driver in maintaining alignment on the existing lines.
- (f) A minimum of five spray guns and five bead dispensers mounted in the following configuration:
 - (i) Three spray guns and three bead dispensers mounted on an independently-controlled boom located on the left side of the truck to paint the directional dividing lines. The outer two spray guns and bead dispensers shall be in a configuration that will produce two lines of equal width with the distance between the two lines equal to the width of one line (100 mm). The inner spray gun and bead dispenser shall operate independently and shall be used to apply the directional dividing line where only a single directional dividing line is required. When a 200 mm wide line is required, 2 guns shall be used simultaneously.
 - (ii) Two spray guns and two bead dispensers mounted on an independently controlled boom on the right side of the truck to apply the right edge line. When a 200 mm wide line is required, 2 guns shall be used simultaneously.
- (g) Equipped to apply white or yellow paint from the three spray guns mounted on the left hand side of the paint truck and to switch from one colour to the other during operation.
- (h) Control of both independent booms, all spray guns, bead dispensers and painting controls from the operator's compartment(s).

7.2.3.3 Companion Vehicles

The painting vehicle shall be immediately followed by a vehicle equipped with a crash attenuator which meets National Cooperative Highway Research Program, Report 350 Test Criteria, Test Level 3 for 100 km/hour work zones. The weight of the crash attenuator vehicle including ballast, flashing arrow board and truck mounted crash attenuator shall be 6 300 to 12 000 kg.

The crash attenuator vehicle shall be followed by a ½ ton or larger truck acting as a pilot vehicle.

7.2.3.4 Safety Equipment

The painting truck and both companion vehicles shall be equipped with the following:

- (a) A two-way radio for voice communication.
- (b) An overhead revolving beacon with an amber lens a minimum of 180 mm high and 180 mm wide. The beacon shall be mounted on the top of the vehicle fully visible to traffic approaching from both front and rear.

- (c) A sequential arrowboard meeting the requirements as described in Specification 1.2, General.
 - (i) The arrowboard shall be controlled from a console located in the vehicle cab.
 - (ii) The arrowboard display shall be visible to traffic approaching the rear of the trucks.
- (d) A "slow moving vehicle" sign. The sign shall be mounted at the rear of the vehicle and be visible to the public only when the painting truck is applying paint.
- (e) A warning sign, mounted at the rear of the truck, stating "wet paint keep off". The sign shall have standard warning colours with letters having a minimum height of 150 mm and shall be visible to the public only when the truck is applying paint.

7.2.4 HIGHWAY OPERATIONS

7.2.4.1 **General**

All painting shall be carried out during hours of daylight between ½ hour after sunrise and ½ hour before sunset. Generally, the Contractor may paint lines during any day of the week but is cautioned that traffic volumes are usually higher on all highways on Friday, Saturday and Sunday. Line painting on highways with relatively high traffic volumes shall be performed between Monday and Thursday inclusive if so directed by the Consultant.

Operation of the painting truck against the flow of traffic will not be permitted.

Loading glass beads or paint onto the painting truck is not permitted on a roadway surface.

7.2.4.2 **Operation of Companion Vehicles**

The Contractor shall operate both companion vehicles in conjunction with the painting truck during the painting of all longitudinal lines. Companion vehicle operators shall not attempt to control traffic from inside the vehicle.

The actual operating parameters of the companion vehicles will be determined by the Contractor to safely accommodate traffic and will be based on site specific conditions such as sight distances, highway geometrics and traffic patterns and volumes. Typical operating parameters are as follows:

7.2.4.2.1 Crash Attenuator Vehicle

The crash attenuator vehicle shall follow behind the painting truck at a distance of 50 to 400 m. Typically, on 4 Lane highways the crash attenuator vehicle should closely follow the paint truck to encourage traffic to maintain the passing lane and not pull in behind the paint vehicle. On 2 Lane roadways, traffic should still be encouraged to pass both vehicles in one pass, however actual conditions may dictate that the crash attenuator vehicle give way to allow safe passing.

On Single Lane Roads (for example on interchange ramps) the crash attenuator vehicle shall be driven in the travel lane to keep traffic from passing the painting truck.

7.2.4.2.2 Pilot Vehicle

On 2 lane and 4 Lane Highways the pilot vehicle shall be operated as follows:

- (i) On a 4 Lane Highway, the pilot truck shall be driven in the same travel lane as the paint machine, following it at a constant distance of approximately two kilometres.
- (ii) On a 2 Lane Highway with a minimum 3 m shoulder, the pilot truck shall be driven along the right shoulder, not straddling the right edge line and following the painting truck at a constant distance of approximately two kilometres.
- (iii) On a 2 Lane Highway with less than a 3 m shoulder, the pilot truck shall travel from approach road to approach road and stop until the paint machine has cleared the next approach road. Approach road in this context includes local roads, farm entrances, field entrances, etc. The pilot truck, when stopped in an approach road, shall sit parallel to the highway in order that the signs and arrowboard are fully visible to traffic approaching from the rear.

7.2.4.3 **Arrowboard Message**

The crash attenuator vehicle, pilot truck and the painting truck are to display the same message at all times. The message shall be one of the following:

- (a) On 2 Lane Highway - a bar (6 horizontal lights flashing) is preferred but if a bar cannot be shown on the type of arrowboard used, the 4 corner lights flashing is an acceptable alternative.
- (b) On a 4 Lane Highway - a right arrow when operating in the left lane and a left arrow when operating in the right lane.
- (c) On a Single Lane Road (for example the exit leg of an interchange) - four flashing corner lights or a bar.

7.2.5 PAINTING ROADWAY LINES7.2.5.1 **Areas to be Painted**

The Contractor shall paint lane lines, continuity lines, edge lines and directional dividing lines on the highway sections, interchanges or intersections specified, as well as the lines through towns, at truck turnouts, rest areas, points of interest and weigh scale turnouts. At intersections, edge lines shall be painted to the right-of-way limit or the point where the pavement ends whichever occurs first.

On pavement overlay projects, the Contractor shall ensure that the start and finish of "No-Passing Zones" are consistent with those on the underlying pavement, unless otherwise directed by the Consultant.

On new construction, the start and finish of "No-Passing Zones" will be determined and laid out by the Consultant.

7.2.5.2 Pavement Surface and Atmospheric Conditions

Painting shall not be performed during the following conditions:

- (i) When the temperature is below 0°C for alkyd paints and 10°C for waterborne paints.
- (ii) When wind conditions cause overspray.
- (iii) When the visibility is less than 700 m.
- (iv) During periods of rainfall.

Areas to be painted shall be clean and dry during the application of paint.

Areas to be painted shall be inspected by the Contractor to ensure they are clean, free of sand and debris, and suitable for painting. Sweeping, when required, shall be completed by the Contractor.

7.2.5.3 Paint and Bead Application

All painted lines shall be uniformly applied at a minimum rate of not less than 38 l/km of solid 100 mm wide line. Glass beads shall be applied immediately following the paint application at a uniform minimum application rate of not less than 600 g/l of paint.

The Contractor may heat alkyd paint to a maximum temperature of 65°C prior to application to the roadway surface to reduce drying time. The Contractor shall use due care in heating the paint because of its volatile nature. Waterborne paints shall not be heated.

7.2.5.4 Acceptance Criteria

All painted lines shall not exceed a dimensional width of 110 mm for specified 100 mm wide line. No tolerance below 100 mm is allowed for the specified 100 mm wide line.

All painted lines shall not exceed a dimensional width of 210 mm for specified 200 mm wide line. No tolerance below 200 mm is allowed for the specified 200 mm wide line.

All painted direction dividing, lane dividing or continuity lines shall not exceed a maximum dimensional length deviation of +/- 100 mm for specified 3 m length of line.

All spaces between painted direction dividing, lane dividing or continuity lines shall not exceed a maximum dimensional length deviation of +/- 100 mm for specified 6 m or 3 m length of space.

All paint shall be applied at the proper locations in accordance with the Drawings or as directed by the Consultant.

All paint and glass beads shall be uniformly applied.

All painted lines shall be uniform in thickness and free of tire tracking, with no splatter, excessive overspray or other defects.

7.2.5.5 Removal, Repair or Replacement of Unacceptable Painted Lines

All painted lines that do not meet the requirements of this specification shall be removed and correctly applied or repaired by the Contractor.

In cases where the paint is "tracked" by vehicles tires, the lines may be repaired by reapplying paint and glass beads to the damaged areas.

In cases where incorrectly painted lines need to be removed, the Contractor shall use methods and equipment that will totally eliminate the pattern of the lines without damaging the integrity of the pavement surface. The methods and equipment used for such work shall be reviewed and accepted by the Consultant prior to their use. Obliterating incorrectly painted lines through the sole use of paint, liquid asphalt, slurry seal or other similar materials will not be permitted.

7.2.5.6 Painting of Temporary Roadway Lines for Seasonal Shutdown

When the Contract is carried over from one season to the next, all newly constructed asphalt pavement or asphalt stabilized surfaces shall be provided with temporary roadway lines as directed by the Consultant. All temporary roadway lines shall be painted in conformance with all of the requirements of this specification.

7.2.5.7 Removal of Existing Painted Lines

Removal of existing painted lines shall be carried out as described in Subsection 7.2.5.5, Removal, Repair or Replacement of Unacceptable Painted Lines.

7.2.6 MEASUREMENT AND PAYMENT**7.2.6.1 Painting Roadway Lines**

Measurement of painted roadway lines will be made in kilometres along the centreline of the roadway for the length of road painted, including the length of road through intersections. Intersections and interchanges will be counted separately and will include all roadway lines which would not be covered by the standard painting operation. Only those intersections or interchanges specified in the Contract or identified by the Consultant will be counted separately for payment. At locations such as truck turnouts and points of interest turnouts where additional lines are required beyond normal limits, individual lines will be measured separately and paid for under the applicable bid item.

Payment for painting roadway lines will be made at the unit price or prices bid for "Roadway Lines – Supplying Paint and Painting" for the type of line painted.

Payment for painting intersection and interchange lines will be made at the unit prices bid for "Intersection Lines - Supplying Paint and Painting" or "Interchange Lines - Supplying Paint and Painting", as applicable.

These payments will be full compensation for inspecting the areas to be painted; sweeping and cleaning the surfaces to be painted; supplying and applying the paint and glass beads; traffic accommodation; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

7.2.6.2 Temporary Roadway Line Painting

When the Contractor is required to paint roadway, intersection and/or interchange lines as a temporary measure at the end of a construction season, payment will be made in accordance with this section.

7.2.6.3 Removal of Existing Painted Lines

Measurement for removal of existing painted lines will be made in metres or kilometres of line removed, whichever is specified.

Payment will be made at the unit price bid for "Removal of Existing Painted Lines", and will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

The repair or removal of incorrectly painted roadway lines shall be carried out by the Contractor at his expense.

7.2.7 WARRANTY

Contrary to Section 1.2.53, Contractor's Warranty and Final Acceptance, the warranty period for painted roadway lines will be 60 days.

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7.3 PAVEMENT MESSAGES

7.3.1 GENERAL

The Work shall consist of applying pavement messages such as crosswalk, stop ahead, turning arrows and stop bar lines, to the dimensions specified; at the locations shown on the Drawings or as designated by the Consultant.

7.3.2 MATERIALS

7.3.2.1 **Templates**

The Contractor shall supply templates to the dimensions shown on the applicable Drawings. The dimensions shown are in millimetres unless otherwise indicated.

7.3.2.2 **Marking Materials**

The Contractor shall supply paint, glass beads and durable message materials in accordance with Specification 5.20, Supply of Line Painting Materials.

7.3.3 SCHEDULING OF THE WORK

Pavement message application shall be carried out during hours of daylight between ½ hour after sunrise and ½ hour before sunset. Generally, the Contractor may apply messages during any day of the week but is cautioned that traffic volumes are usually higher on all highways on Friday, Saturday and Sunday. Message application on highways with relatively high traffic volumes shall be performed between Monday and Thursday inclusive if so directed by the Consultant.

Scheduling of the Work shall be subject to the approval of the Consultant. Prior to commencement of the message application work, the Contractor shall submit his schedule to the Consultant for review and acceptance.

7.3.4 APPLICATION OF PAVEMENT MESSAGES

7.3.4.1 **Pavement Surface and Atmospheric Conditions**

Message application shall not be performed during the following conditions:

- When the temperature is below 0°C.
- When wind conditions cause overspray.
- When the visibility is less than 700 m.
- During periods of rainfall.

Areas where messages are to be applied shall be clean and dry during the application of materials.

Application areas shall be inspected by the Contractor to ensure they are clean, free of sand and debris, and suitable for message application. Any required sweeping or other cleaning shall be carried out by the Contractor and shall be completed to the satisfaction of the Consultant.

7.3.4.2 Paint and Bead Application for Painted Messages

Messages shall be painted using the templates. Each message shall be painted once unless otherwise specified in the Special Provisions or directed by the Consultant.

Paint shall be applied at the rate of 0.4 l/m² of actual painted area. Glass beads shall be applied immediately following the paint application at a uniform application rate of 600 g/l of paint. Aircraft Patrol Zone markings do not require glass bead application. Messages initially applied at less than the specified rate, as determined by the Consultant, shall be repainted at the expense of the Contractor.

All painted messages shall be uniform in thickness; with no splatter, excessive overspray or other defects.

Traffic shall be kept off newly painted messages until the paint has dried sufficiently to prevent tracking.

7.3.4.3 Durable Pavement Messages

The application of durable pavement messages shall be carried out in accordance with the applicable sections of this specification and the Manufacturer's recommended procedures. In cases of conflict the more stringent requirements shall apply.

7.3.4.4 Removal, Repair or Replacement of Unacceptable Pavement Messages

Pavement messages that do not meet the requirements of this specification shall be repaired or removed and correctly re-applied by the Contractor.

In cases where painted messages have been "tracked" by vehicles tires, the affected messages may be repaired by reapplying paint and glass beads to the damaged areas.

In cases where incorrectly painted messages require removal, the Contractor shall use methods and equipment that will totally eliminate the pattern of the messages without damaging the integrity of the pavement surface. The methods and equipment used for such work shall be approved by the Consultant prior to use. Obliterating incorrectly painted messages through the sole use of paint, liquid asphalt, slurry seal or other similar materials will not be permitted.

7.3.5 MEASUREMENT AND PAYMENT**7.3.5.1 Pavement Message Application**

Painted pavement messages and durable pavement messages will be measured on a per message basis for each message applied to the roadway surface. When the Consultant directs a second application of paint to any message, measurement will be based on each application of paint.

Payment will be made at the applicable unit price bid for "Painted Pavement Message" or "Durable Pavement Message" for the specified message type, and will be full compensation for inspecting the message application area; sweeping if required; supplying the templates, paint and glass beads or durable message materials; applying the pavement message; traffic accommodation; and all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

7.3.5.2 Removal of Existing Pavement Messages

When the removal of existing pavement messages is required, the removal of existing messages will be measured on a per message basis.

Payment will be made at the applicable unit price bid for "Removal of Existing Painted Pavement Message" or "Removal of Existing Durable Pavement Message", and will be full compensation for all labour, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

7.3.5.3 Removal of Incorrectly Applied Pavement Messages

The repair or removal of incorrectly applied pavement messages shall be carried out by the Contractor at his expense.

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7.7 PERMANENT HIGHWAY SIGNING**7.7.1 GENERAL**

The Work consists of the removal and reinstallation or disposal of existing signs and the installation of new signs, and includes traffic control signing, guide signing and facility signing for the normal use of the roadway. Signing for construction, repair or emergency situations is specified in Specification 7.1, Traffic Accommodation and Temporary Signing.

7.7.2 MATERIALS

The Contractor shall supply all materials required for the installation of permanent signs including frames for cluster signs, concrete bases, steel breakaway posts, wooden posts and all bolts and required mounting hardware, in accordance with Specification 5.18, Supply of Permanent Highway Signs, Posts and Bases.

When the Work necessitates the removal, salvage and reinstallation of signs, only materials from the existing installations shall be used. Contractor stockpiles of used material from other sources will not be considered acceptable.

7.7.3 CONSTRUCTION**7.7.3.1 Removal of Existing Signs**

Existing signs which must be removed in the prosecution of the Work shall be carefully salvaged and reinstalled. New wooden posts shall be used if the existing posts cannot be salvaged. Critical signs necessary for the protection of traffic such as railroad crossing signs or stop signs shall be maintained.

Existing signs designated for removal and disposal shall become the property of the Contractor.

7.7.3.2 Removal of Concrete Bases and Breakaway Posts

The Contractor shall remove the sign and breakaway posts from the existing concrete base and salvage for reinstallation or dispose of as directed by the Consultant.

When required, the existing base shall be removed, salvaged, and moved to the new installation site.

Where a base cannot be totally removed, the tops of the base shall be removed to below ground level and the excavation backfilled to the adjacent ground level. This will be considered incidental to the Work and will not be paid for separately.

7.7.3.3 General Installation and Layout

The Consultant will provide plan layout information in the form of a base line for the installation of the permanent signs. The Contractor shall establish the height and elevation of the sign and install it in accordance with the Drawings or as directed by the Consultant.

It is the Contractor's responsibility to have all sign locations checked for utilities prior to digging holes for posts. Any adjustments to the locations of signs will be subject to the approval of the Consultant.

The soil at the bottom of holes shall be thoroughly compacted to provide a firm bearing. Posts shall be set vertically and backfilled with material free of organics. All backfill shall be placed in thin layers and thoroughly compacted for the full depth. Cementitious materials shall not be used as backfill.

The disturbed area around installations shall be restored to the original contours.

The signs shall be fixed securely to the post(s) in accordance with the Drawings.

7.7.3.4 Installation of Concrete Bases

Concrete bases shall be installed as shown on Drawings TEB 1.82 and TEB 1.83. The Contractor shall excavate holes to a minimum of 300 mm larger than the base and the base shall be installed in the centre of the excavation. The backfill around the base shall be placed in thin layers and shall be thoroughly compacted for the full depth.

7.7.3.5 Installation of Breakaway Steel Posts

All installations shall conform to Drawing TEB 1.82. The installed post shall be within 1.5 degrees of vertical.

When salvaged materials are used, the sign and breakaway steel posts shall be reassembled and installed on the base at the new site. When new posts are required, the size of steel I-Beam post will be as shown on the Drawing or specified by the Consultant or in the case of a replacement, it will be the same size as the post being replaced.

The Contractor shall saw cut the flange and web; and cut, drill, weld and shim the flanges for the base joint as required to ensure an unstressed installation.

Damage to galvanized surfaces shall be repaired by treating the damaged areas with zinc rich paint.

7.7.3.6 Installation of Wooden Posts

Posts shall be installed in accordance with Drawing TEB 1.70 and shall be within 1.5 degree of vertical.

When a post is removed and replacement is not requested, the Contractor shall backfill the hole in thin compacted lifts.

Posts with rectangular cross-sections shall be installed such that the longer dimension is orientated parallel to the direction of the highway.

Unless otherwise directed by the Consultant, posts with a nominal cross-section larger than 100 mm x 100 mm shall be weakened as shown on Drawing TEB 1.81. All costs associated with weakening of wooden posts will be considered incidental to the Work, and no separate or additional payment will be made.

7.7.3.7 Installation of Cluster Frames

The new frames shall be installed perpendicular to and facing the approaching traffic lane and shall be securely fastened to the post in accordance with Drawing TEB 1.69.

7.7.3.8 Installation of Signs

Signs shall be mounted in accordance with Drawings TEB 1.69, TEB 1.71, TEB 1.72, TEB 1.75, TEB 1.82 and TEB 1.95.

The installed sign shall be clean and not bent or twisted. The reflectorized surface shall be free of scratches and marks and must be securely fastened to the post or frame.

Signs on utility posts shall be mounted by a procedure approved by the utility owner.

7.7.4 ACCEPTANCE OF WORK AND WARRANTY

Prior to the final acceptance of the Work, all damage or deficiencies from any cause in signs and posts installed under this Contract shall be rectified by the Contractor at his own expense.

In addition to the warranty requirements specified in Specification 1.2, General, the Contractor shall, during the warranty period, straighten and recompact or reinstall as required, all posts which are more than 50 mm from vertical in a 2 m length of post.

7.7.5 MEASUREMENT AND PAYMENT

7.7.5.1 General

All unit prices shall include traffic accommodation and temporary, construction signing; and all labour, materials, equipment, tools and incidentals necessary to complete the Work.

Because the condition of subsurface materials designed for salvage and reuse is unknown, this Contract may contain contingency bid items for units of work which may not be required. The Contractor shall have no claim against the Department for the deletion of any bid items during construction.

7.7.5.2 Removal of Existing Signs

Measurement will be made of the number of sign installations removed.

Payment will be made at the applicable unit price bid per sign for "Removal and Reinstallation or Disposal of Existing Signs - One Post", or "Removal and Reinstallation or Disposal of Existing Signs - Two Posts". Payment will be full compensation for removing, salvaging and reinstalling the wooden posts and signs, or removing and disposing of the existing wooden posts and signs.

If the Consultant determines that the removed post is not suitable for reinstallation and the existing sign is reinstalled, payment will be made for "Removal and Reinstallation or Disposal of Existing Signs" plus "Supply and Install - Wooden Post" for the applicable cross section of post installed.

7.7.5.3 Breakaway Steel Posts

Measurement will be made of the number of steel posts removed and disposed of, and the number of steel posts removed, salvaged and reinstalled.

Measurement of the supply and installation of new Breakaway Steel Posts will be measured on a per post basis.

Payment for supplying and installing new post will be made at the applicable unit price bid per post for:

- "Supply and Install Breakaway Steel Posts - W150 x 14"
- "Supply and Install Breakaway Steel Posts - W200 x 15"
- "Supply and Install Breakaway Steel Posts - W150 x 22"
- "Supply and Install Breakaway Steel Posts - W200 x 27"

This payment will be full compensation for supplying and installing the applicable post and all labour, materials, equipment, tools and incidentals necessary to complete the Work to the satisfaction of the Consultant.

Payment for removal and reinstallation of existing breakaway posts will be made at the unit price bid per steel post for "Remove and Reinstall Breakaway Steel Posts". This payment will be full compensation for removing and salvaging the steel post and sign; hauling salvaged material to the new site; and reassembling and installing the steel post and sign.

Payment for removal and disposal of existing breakaway posts will be made at the unit price bid per steel post for "Remove and Dispose - Breakaway Steel Posts". This payment will be full compensation for removing and disposing of the steel post and sign.

7.7.5.4 Concrete Bases

Measurement will be made separately of the number of bases supplied and installed; bases removed, salvaged and reinstalled; and bases removed and disposed of.

Payment for removing, salvaging and installing existing bases will be made at the unit price bid per concrete base for "Concrete Base - Remove and Reinstall". This payment will be full compensation for removing and salvaging of the existing base, moving the salvaged concrete base to the new site and installing the salvaged concrete base.

Payment for removing and disposing of concrete bases will be made at the unit price bid per base for "Concrete Base - Remove and Dispose". This payment will be full compensation for removing and disposing of the base; and placing and compacting backfill material in the hole.

Payment for supplying and installing new concrete bases will be made at the unit price bid per base for "Concrete Base - Supply and Install". This payment will be full compensation for supplying the base to the installation location, excavating, installing the new concrete base and backfilling and compacting around the base.

7.7.5.5 Wooden Posts

Measurement will be made of the number of posts of a particular cross-section supplied and installed.

Payment will be made at the unit price bid per post for "Supply and Install – 100 mm x 100 mm" or "Supply and Install Post - 100 mm x 150 mm" or "Supply and Install Post – 150 mm x 200 mm", regardless of the length of the post. This payment will be full compensation for supplying and installing and maintaining the post.

7.7.5.6 Cluster Frames

Measurement will be made of the number of cluster frames supplied and installed.

Payment will be made at the unit price bid per frame for "Cluster Frames - Supply and Install". This payment will be full compensation for the supply and installation of the new cluster frames.

7.7.5.7 Signs

Measurement will be made of the number of signs within a particular size range, based on surface area.

Payment will be made at the applicable unit price bid per sign for "Install Sign - less than 1 m²" or "Install Sign - 1 m² to 3 m²" or "Install Sign - over 3 m²". Separate payment will be made for each sign on a single post. This payment will be full compensation for installing and maintaining the signs.

