

SECTION 515

END PRODUCT SPECIFICATION FOR HOT-IN-PLACE RECYCLED ASPHALT PAVEMENT

PART A - GENERAL

515.01 General – This Section describes the materials, equipment, professional standards and end product requirements for the construction of Hot In Place Recycled Asphalt Pavement.

End Product Specifications contain the acceptance and payment criteria based on the results of specified sampling and testing. Payment of the contract Unit Prices for the hot in place asphalt pavement product is subject to adjustments upward and downward in accordance to the provisions provided in End Product Specifications (EPS).

515.02 General Description Of Work - The Contractor will be responsible for the following work associated with the construction of hot in place asphalt pavement by EPS:

- Preparing a Quality Control Plan for evaluation before commencing the Work and providing at the production site a testing facility to provide the data needed to implement that plan.
- Supplying, screening, crushing, processing and improving aggregate to produce virgin asphalt mix aggregate.
- Supplying and delivering asphalt cement meeting the requirements of Section 952.
- Supplying and delivering rejuvenating agents meeting the requirements of Subsection 514.11 and Subsection 514.23.
- Heating the virgin asphalt mix aggregate and mixing it with asphalt cement to produce asphalt admix that meets the Job Mix Formula.
- Hauling, and adding the asphalt admix into the recycling process.
- Recycling the existing highway pavement by heating, milling, reprocessing, with or without the addition of rejuvenating agents or admix (virgin mix) as specified, re-mixing, replacing and compacting using a multi-stage, hot milling process and rollers.

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the contract. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice and those identified in Section 514. Payment is subject to adjustments based on quality assurance tests performed by the Ministry Representative.

The Ministry shall provide information pertaining to the gradation of the admix, asphalt content, addition rates for rejuvenating agents and the percentage of admix to be incorporated.

515.03 Definitions Relevant To End Product Specification

515.03.01 End Product Specification (EPS) - A specification whereby the Contractor is entirely responsible for quality control of the construction processes, and whereby the Ministry performs the specified quality assurance sampling and testing of the end product for the purpose of determining acceptance/rejection and payment.

515.03.02 Job Mix Formula - The Job Mix Formula, supplied by the Ministry, establishes the virgin aggregate proportions, gradation, the asphalt content and type of asphalt to be used for production of asphalt admix. The Job Mix Formula is based on an asphalt mix design, in accordance with Subsection 515.05.06, or on a variation in accordance with Subsection 515.05.07.

515.03.03 Asphalt Admix - The Asphalt Admix is virgin asphalt mix added to the recycled mix. The Asphalt Admix is project specific designed and is blended homogeneously within the recycling process. The Asphalt Admix becomes an integral component of the recycled pavement structure.

515.03.04 Asphalt Content - Asphalt Content means the quantity of asphalt cement in the virgin admix expressed as a percentage by weight of the total dry aggregate in the mix.

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

Approved Asphalt Content - The design asphalt content or subsequent adjustment to it, embodied in a Job Mix Formula or revised Job Mix Formula.

Actual Asphalt Content - Actual asphalt content is the amount of asphalt cement in the admix as determined by the Contractor's Quality Control Testing.

515.03.05 Smoothness - Smoothness is a measure of the longitudinal profile of the pavement surface. The unit for measurement is the International Roughness Index (IRI).

515.03.06 Sample Mean - The Sample Mean is the arithmetic mean of a set of test results constituting the sample.

515.03.07 Stratified Random Sample - A Stratified Random Sample is a set of test measurements taken one each from a number of separate (stratified) areas or Sub-Lots within a Lot in an unbiased way.

515.03.08 Lot - A Lot is a portion of the work being considered for acceptance and for the determination of payment. A Lot is defined as follows.

For the application of the contract requirements for:

- Density,

A Lot shall be one day's scheduled production of at least 7 hours of pavement recycling where no changes have occurred to criteria such as but not limited to:

- approved Job Mix Formula,
- the specific thickness to be processed,
- the required materials addition rate,
- change in the ratio of the components making up the Hot In Place Recycled Pavement.

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

One day's production of less than 7 hours will be dealt with as follows:

- the material will be added to the next Lot that has the same criteria, as described above, except that
- if a test indicates that this production is subject to a payment adjustment or to rejection, or if no further material will be produced with the same criteria, this production will be designated as a separate Lot,

A Lot shall be no more than two days total production even if the above criteria have not changed or been met.

For application of the contract requirements for:

- Smoothness,

A Lot shall be one kilometre length of recycled pavement for each driving lane.

515.03.09 Sub-Lots for Density and Smoothness - For the application of the contract requirements for:

- Density, each Lot shall be divided into three equal Sub-Lots.
- Smoothness, each Lot shall be divided into 100 metre Sub-Lots.

515.03.10 Driving Lane - A driving lane shall mean a single lane in any area of the pavement other than a shoulder or a barrier flare.

515.03.11 Surplus Aggregate - Surplus aggregate is aggregate surplus to the works, in split or un-split stockpiles which singly or combined will meet the virgin asphalt mix aggregate gradation. Surplus aggregate will be paid for as indicated in Subsection 515.32.01. There will be no payment for reject aggregate.

515.03.12 Hot In Place Recycled Pavement - Hot In Place Recycled Pavement shall be the result of the process where recycling, the addition of admix and/or rejuvenating agents, the spreading, compacting and finishing of the asphalt pavement have taken place to form a quality finished product. The Hot In Place Recycled Pavement may be comprised of the following components: existing asphalt pavement, admix, and/or rejuvenating agents.

515.04 Quality Control

515.04.01 General - Quality Control, by the Contractor, is the sum total of activities by the Contractor to ensure that a product meets contract specification requirements. Quality Control includes material handling and construction procedures, calibration and maintenance of equipment, production process control and any sampling, testing and inspection that is done for these purposes.

The Contractor is responsible for all Quality Control under this specification. The Ministry Representative will audit and monitor the Contractor's operations and the implementation of the Contractor's Quality Control Plan.

The Ministry will not take samples for quality control testing and will in no manner assist in any degree or in any aspect of the Contractor's operation in the production of asphalt pavement, beginning from the production of aggregate through the compaction of asphalt mix. The only exception shall be in accordance with the provisions of Subsection 515.05.07, where the Ministry shall have the ability to adjust the ratio of the components of the Hot In Place Recycled Pavement based upon the Contractor's Quality Control Results and visual inspections.

The Ministry Representative may issue a Stop Work Order to the Contractor if the Contractor fails to adhere to the Quality Control Plan. The Ministry Representative will not issue a Resume Work Order until the Contractor has given the Ministry Representative satisfactory assurance that it has in place adequate capacity to fulfil the requirements of the Quality Control Plan.

515.04.02 Quality Control Plan - The Contractor shall prepare a detailed, written Quality Control Plan, based on the guidelines as shown in Appendix 1 and functions integrally with any other Quality Management provisions of the Contract. The Contractor's Quality Control Plan shall be submitted to the Ministry Representative not less than five working days before starting the production of paving aggregate. The Ministry Representative will evaluate the Contractor's Quality Control plan and will respond, in writing, within five days. Any subsequent changes to the Contractor's Quality Control Plan must also be submitted to the Ministry Representative for evaluation.

The Contractor's Quality Control Plan shall include a description and schedule of the intended sampling, testing and reporting. The Quality Control Plan must also include a detailed description of the means by which the Contractor shall use the quality control test results to ensure that the asphalt materials, aggregate, mix production, recycling and pavement compaction processes will be controlled to keep the end product within the specified limits. The Quality Control Plan must clearly show the flow of information from the quality control laboratory to the individuals who shall make the actual adjustments to the processes and equipment to this control. The plan will show time allowance for each step, the names and positions of all the people involved, and a clear description of the responsibilities of each.

515.04.03 Quality Control Testing and Inspection - The Contractor shall provide and maintain equipment and qualified personnel to perform all laboratory testing, field testing and inspection necessary to determine and monitor the characteristics and properties of all the materials produced and incorporated into the work. They shall also monitor the workmanship of the final product in accordance with the Quality Control Plan as most recently submitted.

The Contractor shall use a qualified registered member of the Association of Professional Engineers and Geoscientists of British Columbia or a qualified, registered member of the Applied Science Technologists and Technicians of British Columbia. This person shall be designated as the Quality Control Manager for the purposes of these specifications. The Quality Control Manager shall be responsible for preparation and sign off of the Quality Control Plan, shall be responsible for all Quality Control testing and inspections and shall be responsible for the signing of all Quality Control testing and inspection records and submissions to the Ministry.

The Contractor shall provide a testing facility(s) that meets the requirements necessary to carry out all the test procedures listed within this Section. The facility(s) must have the equipment specified under the appropriate test designation to perform the tests.

All equipment and the laboratory shall be well maintained and in good working condition. All testing equipment shall be calibrated and evidence of the calibration shall be provided when requested by the Ministry Representative.

515.04.04 Quality Control Records - The results from quality control testing shall be reported on test logs and plotted on charts immediately after each test is completed.

These test results, reports and charts shall be available, within 24 hours of the end of each shift, to the Ministry Representative and at all times during the progress of the work.

For the purposes of confirming delivery of asphalt mix to the road and the calculation of material application rates, the Contractor shall prepare and provide to the Ministry Representative, a copy of the Road Checker's Summary and the weigh tickets for each load received at the recycling operation at the end of each shift. The Road Checker's Summary shall include, but not be limited to, the following information:

- a) Truck Number
- b) Weigh Ticket Number and Net Weight of load
- c) Time and location by station of delivery
- d) Admix and Rejuvenator Material Application Rate Calculations
- e) Processed Depth, Lengths and Widths
- f) Temperatures (behind screed, windrow, ambient and admix)
- g) Notes pertaining to the paving of any appurtenances (intersections, tapers, etc.)

515.04.05 Final Quality Control Testing Reports - Prior to the issuance of a Completion Certificate, the Contractor shall provide the Ministry Representative with:

- a summary of all virgin aggregate quality control test results;
- copies of all quality control test results for asphalt admix properties, Hot In Place Recycled Pavement and compaction; and
- copies of all quality control charts.

515.04.06 Minimum Acceptable Construction Practices - Good construction practices shall be considered as standard construction procedures to be followed and shall include but not be limited to the procedures described below.

Stockpiles – Stockpiles of different types of material shall be located and constructed in such a manner as to prevent intermingling of the types and segregation of material.

Haul Vehicles – Lubrication of the truck boxes with diesel fuel will not be permitted. All vehicles shall have adequately insulated truck boxes and shall be equipped with an insulating tarpaulin of such size as to completely protect the asphalt mix.

TABLE 515-A-1 STANDARD SAMPLING AND TESTING PROCEDURES FOR VIRGIN AGGREGATES

All virgin aggregate tests shall use the following sieve sizes:
37.5mm, 25mm, 19mm, 16mm, 12.5mm, 9.5mm, 4.75mm, 2.36mm, 1.18mm, 0.600mm, 0.300mm, 0.150mm, and 0.075mm.

Item	Procedure	Test Reference
1	Sieve Analysis of Fine And Coarse Aggregates	ASTM C-136
2	Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing	ASTM C 117
3	Specific Gravity and Absorption of Coarse Aggregate	ASTM C-127
4	Specific Gravity and Absorption of Fine Aggregate	ASTM C-128
5	Determining the Percentage of Fractured Particles in Coarse Aggregate	ASTM D-5821
6	Total Moisture Content of Aggregate by Drying	ASTM C-566

TABLE 515-A-2 STANDARD SAMPLING AND TESTING PROCEDURES FOR ASPHALT CEMENT

Item	Procedure	Test Reference.
1	Penetration of Bituminous Materials	ASTM D-5
2	Viscosity of Asphalt by Vacuum Capillary Viscometer	ASTM D-2171

TABLE 515-A-3 STANDARD SAMPLING AND TESTING PROCEDURES FOR VIRGIN ASPHALT ADMIX AND HOT IN PLACE RECYCLED PAVEMENT

Item	Procedure	Test Reference
1	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures	ASTM D-2726
2	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures	ASTM D-2041
3	Sampling Compacted Bituminous Mixtures for Laboratory Testing	ASTM D-5361
4	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	ASTM D-1559
5	Determining Asphalt Content by Ignition Methods for Admix.	ASTM D-6307

TABLE 515-A-4 TEST SAMPLE SOURCE LOCATIONS

Test	Sample Source:
Density	150mm diameter. road cores
Smoothness	Center of Lane

Existing Paved Surfaces – Existing paved surfaces shall be clean to avoid contamination of the recycled pavement. The existing surfaces shall be swept back at least 20cm wider than the area to be processed.

Existing Utility Structures – The Contractor shall ensure BC - MOT

all catch basins and manholes, which are within the operating area of the heating units are clear of any flammable liquids or otherwise hazardous fumes/gases.

Heating of Recycled Material – The recycled material shall not be heated over an average of 150°C in order to avoid excessive oxidation and hardening of the recycled Asphalt Cement.

Minimum Admix Temperature – Based on the most recent Temperature Viscosity Curve supplied by the Asphalt Cement Supplier. This information will be used to set minimum and maximum mixing temperatures.

Longitudinal Joints – Longitudinal joints in the top lift of

asphalt pavement will generally only be permitted where lane dividing lines are to be painted.

Longitudinal Edges – Are to be blended to conform in elevation with the adjacent pavement unless this surface is scheduled to be recycled.

Minimum Temperature – Minimum Temperature behind the paver screed of the recycled material shall not be less than 110°C.

Metering of Rejuvenating Agents – To accurately proportion the rejuvenating agent into the hot milled material, the equipment shall control the quantity of the rejuvenating agent to $\pm 0.05 \ell/m^2$ of surfaced reprocessed with an agent application range of $0.0 \ell/m^2$ to $1.0 \ell/m^2$. The measurement of the rejuvenating agent applied by means of a metering device shall be capable of recording accumulated litres to the accuracy of $\pm 2\%$, and be fully visible to both the operator and the Ministry Representative.

Outer Edges – The outer edge of each lane shall generally be tapered to a 12:1 slope.

Recycling Adjoining Mats – When recycling an adjoining parallel mat there shall be at least a 50-mm overlap onto the previously recycled surface. This overlap shall be properly “raked” to form a homogeneous bond between the two mats.

Raking – Any material that is raked from the joint shall not be placed on the new mat or placed on or in front of the paver. This material may be introduced at a point of the operation where the material shall be reheated and remixed with the Hot In Place Recycled Pavement.

Discontinued Paving - At locations where reprocessing operations begin and end, the Contractor shall ensure that the transition between the processed and unprocessed surface is smooth and without irregularities. If any irregularities occur resulting from the reprocessing operation, the Contractor shall repair these areas with fresh asphalt mix and/or additional reprocessing, at the Contractor’s own expense.

Pavement Drainage – The Contractor shall at all times ensure that the appropriate cross slopes for safety and positive pavement drainage are maintained.

Rollers – Rollers shall normally operate with the drive wheel nearest the paver and at a speed not in excess of 8 km/h. They shall not be allowed to park on the mat prior to complete cooling.

515.05 Supply Of Virgin Aggregates, Asphalt BC - MOT

Materials, Asphalt Admix Design And Job Mix Formula

515.05.01 Work in Ministry Pits or Quarries - When operating in a Ministry pit or quarry, the Contractor shall comply with all provisions of Subsection 145.26.

515.05.02 Supply of Virgin Aggregates, Aggregate Production and Characteristics - The Contractor shall not produce paving aggregate until the Contractor has received written notification that the Quality Control Plan is in accordance with Subsection 515.04.02, and has in place testing facilities for aggregate production that are in accordance with the Quality Control Plan.

For the production of virgin Asphalt Mix Aggregate, within Ministry pits, the Contractor shall provide crushing equipment that will permit all aggregate, that passes through 375 mm x 450 mm slotted openings, to be used for the production of crushed aggregate. Rocks, which will not pass through these openings, shall be stockpiled or disposed of as directed by the Ministry Representative. Crushing and screening equipment shall be provided with adequate facilities and capacity to be able to bleed off reject aggregate and remove any excess fine aggregate, dust or objectionable aggregate coatings, to make it acceptable for use. All products from crushing or screening plants, that can be used shall not be wasted, and shall be stockpiled or used as directed by the Ministry Representative.

Where the Ministry has available any test result information on the properties shown in Table 515-B, for a Ministry pit or other source, the Ministry Representative will upon request, provide that information to the Contractor. Otherwise, sampling and testing to determine and demonstrate the compliance of paving aggregate with the requirements of this Section shall be the responsibility of the Contractor.

Paving aggregates shall meet the following requirements:

- a) Virgin Coarse Aggregates;
 - i) shall be all mineral matter retained on the sieve designated in the test procedures for each individual test.
 - ii) shall consist of crushed stone, crushed gravel, or combination thereof, or materials naturally occurring in a fractured condition, or materials naturally occurring of highly angular nature or rough texture.
 - iii) shall be free from coating of clay, silt or other deleterious material, and shall meet the requirements listed in Table 515-B.

- b) Virgin Fine Aggregate
 - i) shall be clean, tough, durable, moderately sharp, and free from coatings of clay, silt, or other deleterious material, and shall contain no clay balls or other aggregations of fine material.
 - ii) shall have a maximum mass loss after five cycles of not more than 23% when tested in accordance with ASTM Test C-88.
 - iii) shall have a sand equivalent of not less than 40 when tested in accordance with ASTM Test D-2419
 - iv) shall have a minimum value of 45 when tested according the AASHTO Test T 304, Method "A", - Uncompacted Void Content of Fine Aggregate when determining Fine Aggregate Angularity.
- c) Virgin Mineral Filler and Mineral Dust
 - i) Mineral filler shall consist of all matter passing the 0.600-mm sieve and mineral dust shall consist of all mineral matter passing the 0.075-mm sieve.
 - ii) Mineral filler and mineral dust shall be free from organic matter.
 - iii) Mineral filler shall be non-plastic when tested in accordance with ASTM Test D-4318.

515.05.03 Supply of Asphalt Cement and Rejuvenating Agents - The Contractor shall supply the types and grades of asphalt cement and rejuvenating agents as specified in the Special Provisions. The supply of these materials includes, but is not limited to, ordering, scheduling delivery of, supply of Temperature Viscosity Curve information, receiving, handling, storing, heating, blending, sampling, and testing of the materials and other related work.

The Contractor shall supply the Ministry Representative with copies of the supplier's weigh-bill and records of all asphalt and rejuvenating materials received on a daily basis. The amount of asphalt cement used will be

calculated based on the Contractor's Quality Control testing results.

The supply of asphalt cement and rejuvenating agents shall be at the Unit Price bid for asphalt cement and rejuvenating materials.

515.05.04 Responsibility for Asphalt Admix Design - As the Ministry is responsible for all pre-engineering for the project, preparation of the asphalt admix design is the responsibility of the Ministry. The Ministry shall provide to the Contractor, pre-engineering information related to the Asphalt Admix. All costs incurred in admix design formulation are the responsibility of the Ministry.

515.05.05 Evaluation of Asphalt Admix Materials - The Ministry Representative will require up to 5 calendar days upon notification from the Contractor to evaluate the Contractor's Asphalt Admix materials.

515.05.06 Samples Required for Asphalt Admix Evaluation - At the discretion of the Ministry Representative, the Ministry may request samples of the Admix materials and Quality Control results and documentation for evaluation. Shipping costs for samples delivered to the Ministry Representative are the responsibility of the Contractor.

515.05.07 Field Adjustment of the Job Mix Formula and/or Recycled Pavement - During construction, the Ministry may require field adjustments to the job mix formula and/or recycled pavement. A field adjustment to the Job Mix Formula is defined as a change in the asphalt cement content of the admix, aggregate gradation, rejuvenating agent and/or proportioning of various aggregate sizes.

PART B - PAYMENT ADJUSTMENTS

515.11 Density

515.11.01 Coring - The Contractor shall be responsible for providing all core samples for quality assurance and

TABLE 515-B – REQUIREMENTS FOR VIRGIN COARSE AGGREGATES

Test Reference	Requirements	
ASTM C-127	Maximum Water Absorption: % by Mass	2
ASTM C-88	Soundness of Aggregate Maximum Loss After 5 Cycles	20
ASTM C-142	Maximum % by Mass of Clay Lumps and Friable Particles	1.5
BCH I - 9	Minimum Degradation Factor	35
ASTM D-5821	2 Fractured Faces: Minimum % by Mass Retained on the 4.75 mm sieve	85

payment adjustment purposes. The location of the cores shall be randomly selected and provided to the Contractor by the Ministry Representative. The Contractor shall provide 150 mm diameter cores for these purposes. The minimum core thickness shall be 37 mm. The Contractor shall prepare the cores prior to submission by removing all material not representative of the pavement lift to be tested. The Contractor shall deliver these cores to the Ministry Representative on site, within 24 hours of being provided the locations for the coring.

In the case of a core sample location falling in an obvious non representative area, such as a previously patched area, at the sole discretion of the Ministry Representative, a new random core location will be chosen for that sample.

All costs associated with obtaining the cores, including the filling and compaction of the core holes are considered incidental to the contract and are the responsibility of the Contractor.

515.11.02 Percent Density - One random core sample will be obtained from each Sub-Lot and tested. The test results for the three Sub-Lots will be averaged to determine the percent density for the Lot.

$$\text{\% Density} = \frac{\text{In Place Density of Sample}}{\text{Maximum Theoretical Density}} \times 100$$

(ASTM D-2041)

The Maximum Theoretical Density for the lot will be determined by combining the Sub-Lot cores. Prior to testing to determine the maximum theoretical density, the cores should be prepared in accordance with the procedure outlined in Appendix 3.

515.11.03 Payment Adjustments - The payment adjustment for percent density will be the amount shown in Table 515 C for the Sample Mean of the test results for the Lot.

515.11.04 Rejection Limit - The rejection limit for percent density is the limiting value of the Sample Mean as shown in Table 515 C.

If the test result for density of a Sub-lot is outside the acceptance limits, the Sub-lot is rejected automatically regardless of the values of other acceptance parameters. To minimize the cost of rejection to the Contractor, the Contractor shall isolate the area of low density within the Sub-lot and perform the necessary corrective measures to ensure specifications are met. The limits of the low density area must be verified and approved by the Ministry Representative before remedial work proceeds.

515.11.05 Payment for Rejected Work Made

Acceptable - The payment adjustment for density will be based on testing of the reprocessed, replaced, or overlaid material where applicable. Where replacement or overlay material does not cover the entire Lot or Sub-Lot, prior tests of the uncovered area will be averaged with new tests on the corrective work.

515.12 Smoothness

515.12.01 Determination of Pavement Smoothness -

The finished pavement surface shall be tested by the Ministry using a Class I precision rolling profile measuring instrument, to determine the longitudinal profile and compute the International Roughness Index (IRI) in each driving lane. Profiles shall be measured and the IRI calculated in the centre of the lane for each Sub-Lot. IRI values will be recorded to a precision of 0.01 m/km for each Sub-Lot. The Lot IRI value is the average of the IRI values calculated for the Sub-Lots within the Lot.

For any Sub-Lot between 50 m and 100 m in length, the IRI value shall be considered representative of a complete Sub-Lot. For any Sub-Lot less than 50 m in length, the IRI value will be combined with the proceeding Sub-Lot IRI value.

The profile shall be measured over the entire length of the pavement exclusive of structures and shoulder areas. Acceleration, deceleration and turning lanes are considered part of the driving lanes and shall be tested in accordance with this provision. For the measuring process, the Contractor shall provide the Ministry Representative a chalk guide line in the centre of the lane immediately prior to measurement.

515.12.02 Auxiliary Lanes - For smoothness testing,

TABLE 515 C PAYMENT ADJUSTMENTS FOR DENSITY

% MAXIMUM THEORETICAL DENSITY LOT AVERAGE	PAYMENT ADJUSTMENT (\$ PER m²) FOR DESIGN LOT
95.6 Plus	+ \$0.25
95.0 – 95.5	+ \$0.15
94.0 – 94.9	+ \$0.10
93.0 – 93.9	0.00
92.6 – 92.9	- \$0.10
92.0 – 92.5	- \$0.25
91.9 or less	Reject

sections of the driving lanes that do not fall within the continuous through lanes, such as acceleration lanes, deceleration lanes and turning lanes, and lanes which are less than 1 km in length, shall be treated as follows. The ratio of the section length to the standard Lot length of 1 km shall be determined and the payment adjustment shall be pro-rated on this basis as in the following example:

$$\text{Length of segment, } = \frac{0.565 \text{ times the Standard Lot}}{\text{i.e. } 565 \text{ metres}} \text{ Length of } 1000\text{m.}$$

Hence the applicable payment adjustment is 0.565 times the payment adjustment for a 1-km Lot as determined from Table 515-D.

515.12.03 Acceptance Limits - The acceptance limit for smoothness is the limiting value as shown in Table 515-D, beyond which corrective work is required. Payment adjustments are shown in Table 515-D. The International Roughness Index (IRI) value, calculated for each Sub-Lot, will be used to determine if the Lot will be accepted, and if so whether it will be subject to any payment adjustment.

515.12.04 Payment Adjustments for Full or Increased Payment - Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects as per Subsection 515.22 and in the case of top lift pavement only, the pavement smoothness, as reported by the International Roughness Index (IRI) meets the following requirements:

- All Sub-Lots shall have an IRI value ≤ 2.0

TABLE 515-D – LOT ASSESSMENT AND PAYMENT ADJUSTMENTS FOR SMOOTHNESS

For the final surface course only, the following payment adjustments shall apply to each Lot.

<u>Lot IRI (m/km)</u>	<u>Payment Adjustment</u>
≤1.00	+\$2,000
>1.00 and ≤1.10	+\$1,000
>1.10 and ≤1.20	+\$500
>1.20 and ≤1.30	+\$250
>1.30 and ≤1.40	0
>1.40 and ≤1.60	-\$300
>1.60 and ≤1.80	-\$750
>1.80 and ≤1.90	-\$1,500
>1.90 and ≤2.00	-\$2,500
>2.00	REJECT

515.12.05 Rejection Limit - If a Sub-Lot has an IRI >2.0, the Sub-Lot is rejected.

515.12.06 Remedial Work - If the test results on a Sub-Lot of pavement indicate a payment reduction or rejection because of smoothness, the Contractor may propose remedial work to improve the smoothness. Such proposals are subject to the approval of the Ministry Representative, but such approval does not imply that the proposed remedy will be successful, and does not reduce the Contractor’s responsibility for meeting the acceptance requirements. Reprocessing may be acceptable, but cold milling and repaving may be required. Only one attempt may be made to improve smoothness, and this must be completed within ten (10) calendar days from the time the Contractor receives notification from the Ministry Representative of the original smoothness test results for that Sub-Lot.

Following any attempt to improve the smoothness of a Sub-Lot or Sub-Lots, the Ministry Representative will retest the Sub-Lot or Sub-Lots, and the new results will replace the previous data for the purposes of determining acceptance and payment.

No payment will be made for any material, equipment or manpower used to improve, or attempt to improve, smoothness.

515.12.07 Smoothness Deficiency Repairs - Smoothness deficiencies (bumps and dips) less than 8 mm over 3 m will not have a fix or remedial work requirement. Individual Smoothness deficiencies between 8 mm and 12 mm over 3 m will result in a \$200.00 penalty per deficiency and Smoothness deficiencies over 12 mm over 3 m will require remedial work. (see Subsection 515.22).

PART C - ACCEPTANCE AND REJECTION

515.21 Acceptance At Reduced Or Adjusted Payment - Acceptance of any Lot at reduced payment will occur if it contains no obvious defects as per Subsection 515.22, and if:

- the test results for acceptance parameters are such that the Lot or Sub-Lot meets the requirements for acceptance at a reduced payment; and
- the Lot or Sub-Lot is approved in respect of all other requirements; and if
- the Contractor has not notified the Ministry Representative in writing that it will exercise its option to either repair or remove and replace the work, at its own cost, with work meeting the requirements for acceptance at full or increased payment.

515.22 Rejection For Workmanship Defects - The finished surface of any lift shall have a uniform "closed" texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Ministry

Representative such as, but not limited to the following, will be cause for automatic rejection of asphalt pavement regardless of the values of any other acceptance parameter:

- individual bumps and dips that exceed 12 mm over 3 m.;
- areas of excess or insufficient asphalt;
- improper matching of longitudinal and transverse joints;
- roller marks;
- tire marks; or
- cracking or tearing.

When asphalt pavement is rejected by reason of obvious defects, the minimum area of rejection will be the actual length of the defect for the full width of the driving lane in which the defect exists.

Rejected work shall be promptly repaired, remedied, or removed and replaced in a manner acceptable to the Ministry Representative. The Contractor shall be responsible for all costs including materials.

No payment will be made for work in any Lot or Sub-Lot, which has been rejected, until the defects have been remedied.

515.23 Appeal Testing

515.23.01 Density - The Contractor may appeal the results of acceptance testing for density for any lot only once. Appeals will only be considered if quality control results can be presented to support the appeal.

Quality control test results for density which are provided to the Ministry Representative subsequent to the Contractor's receipt of the quality assurance test results for that Lot will not be considered (when evaluating evidence) for an appeal. The appeal shall be for all tests within the Lots, and there will be no appeal allowed for single tests within the Lot.

The following procedures will apply for the appeal:

- The Ministry Representative will arrange for an independent testing laboratory to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality control testing on the project will not be used for appeal testing.
- The original quality assurance results will not be considered in the appeal. The Contractor will sample the pavement at locations randomly re-selected by the Ministry within three site occupancy days following receipt of the appeal such that a total of (5) new core specimens are extracted throughout the Lot. The Ministry Representative will observe

the sampling process. The procedures used to determine the test results shall be consistent with the original acceptance testing methods.

515.23.02 Smoothness - The Contractor may appeal smoothness acceptance test results of any rejected or penalised Lot, once. The appeal shall be in writing and submitted within the next three site occupancy days following receipt of the test results.

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

The Ministry Representative will perform, and the Contractor will be given the opportunity to witness, the appeal testing and the new results will be binding on the Contractor and the Ministry.

515.23.03 Application of Appeal Testing Results - For density appeals, the original test will be discarded. A new Sample Mean for the five new test results will be determined and used for acceptance and payment adjustment.

The new values, thus determined, in all cases, will be binding on the Contractor and the Ministry.

515.23.04 Payment for Appeal Testing - If the new results indicate a change in the payment adjustment in the Contractor's favour, then sampling and testing costs incurred during the appeal procedures for that Lot will be borne by the Ministry.

If the new results verify that any payment reduction or rejection remains valid for that Lot, then the costs of sampling and testing (plus 10% mark-up) incurred during the appeal procedure will be charged to the Contractor.

515.23.05 Time Limits for Appeals of Test Results - All appeals shall be in writing and submitted within the next three site occupancy days of receipt of the test results.

515.24 Cold Milling And Re-Paving As A Corrective Measure - If cold milling and re-paving is used as a corrective measure on a defective Lot or Sub-Lot, the thickness will be subject to the approval of the Ministry Representative, but shall not be less than 40mm. In all other respects, the re-paving will be subject to the same specifications as the pavement being replaced.

Whether the cold milling and re-paving is applied as a corrective measure, acceptability and payment will be determined as follows:

- acceptability, and eligibility for either positive or negative payment adjustment, will be determined entirely on the results of testing and observations conducted on the re-paving, regardless of test results that have been obtained on the hot-in-place recycled pavement;
- the payment quantity, for application of the Unit Prices for asphalt pavement, and the quantity, to which any payment adjustment is to be applied, will be derived from the square meters of recycled pavement affected by the re-paving.

PART D - PAYMENT

515.31 General - Payment at Unit Prices for the supply of virgin aggregates, the supply of asphalt cement, the supply of rejuvenating agents, the supply of virgin asphalt mix and the Hot In Place recycling construction of asphalt pavement, shall be full compensation for completing the supply and installation of Hot In Place asphalt pavement on prepared surfaces in accordance with the contract requirements. Applicable payment adjustments (Additions or subtractions as applicable) shall be applied in accordance with Part B of this Section

The first 4,000 m2 of hot in place asphalt pavement recycling production will not be subject to bonus/penalty payment adjustments but will be required to meet minimum Specification requirements for quality and workmanship.

515.31.01 Rejuvenating Agent and Asphalt Cement -

Rejuvenating Agent - Payment to Supply Rejuvenating Agent shall be at the Unit Price per litre for the quantity of material actually metered into the recycling process.

Such payment shall be full compensation for supplying, handling, storing, heating, sampling, testing and blending the material and all other related work.

Asphalt Cement - Payment for Supply of Asphalt Cement for admix shall be at the Unit Price per tonne for the payment quantity determined from:

$$\text{Payment Quantity of Asphalt Cement} = \frac{\text{Av. Actual Asphalt Content} \times \text{Payment Quantity of Asphalt Admix}}{\text{Average Actual Asphalt Content} + 100}$$

- Where: **-Payment Quantity of Asphalt Admix** is the quantity determined in accordance with Subsection 515.31.03,
-Actual Asphalt Content is as defined in Subsection 515.03.04,

The actual asphalt content shall be determined on a Lot by BC - MOT

Lot basis by averaging the values obtained from the Quality Control tests from each Lot. This average will be used to determine the tonnage of Asphalt Cement used for payment purposes for the Asphalt Cement for the Lot.

The quantity of asphalt cement so determined shall be used for payment purposes regardless of any discrepancy that may be noted between it and any quantity calculated using delivery quantities, tank dips, or other data. No payment will be made for asphalt cement used in reject mix.

Such payment shall be full compensation for supplying the material to the project, handling, storing, heating, sampling, and testing of the material, and other related work.

515.31.02 Paving Aggregate into Stockpile – EPS - Payment for Paving Aggregate into Stockpile - EPS shall be at the Unit Price per tonne for the quantity of paving aggregate placed into stockpile accordance with the following:

- The paving aggregate quantity will be identical to (100%) of the asphalt admixture quantity. As the aggregate is crushed into stockpile, progress payments will be made against the bid item, up to the quantity shown in the “Approximate Quantity” column of the Schedule of Approximate Quantities and Unit Prices. At contract completion, the final payment quantity for asphalt admix aggregate in accordance with the following calculation:

$$\frac{\text{Tonnes of Asphalt Admix}}{\text{Aggregate}} = \frac{\text{'tonnes of mix} \times 100'}{100 + \text{actual calculated asphalt content as per Subsection 515.03.04}}$$

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

515.31.03 Asphalt Admix – EPS - Payment for Asphalt Admix - EPS constructed in place shall be at the Unit Price per tonne for the quantity of admix placed in accordance with the Contract requirements.

Subject to the exception noted below, only acceptable asphalt admix will be included in the payment quantity.

Where cold milling and re-paving is used as a corrective measure, in accordance with Subsection 515.24;

- the overlay quantity will not be included in the admix payment quantity, but
- the admix used in quantity of recycled pavement removed by the cold milling and re-paving will be included in the admix payment quantity, whether or

not it was acceptable.

Such payment shall be compensation in full for all work including but not limited to: loading the aggregate into the feeders, drying the aggregate, metering and adding the asphalt cement, mixing, loading, weighing, hauling, dumping, spreading, compacting and finishing the asphalt pavement, and shall also include all costs of quality control.

515.31.04 Hot In Place Recycled Asphalt Pavement – EPS - Payment for Hot In Place Recycled Asphalt Pavement - EPS constructed in place shall be at the Unit Price per square meter for the quantity of recycled pavement in accordance with the Contract requirements.

Subject to the exception noted below, only acceptable recycled asphalt pavement will be included in the payment quantity.

Where cold milling and re-paving is used as a corrective measure, in accordance with Subsection 515.24;

- the overlay quantity will not be included in the admix payment quantity, but
- the admix used in quantity of recycled pavement removed by the cold milling and re-paving will be included in the admix payment quantity, whether or not it was acceptable.

Such payment shall be compensation in full for all work including but not limited to: recycling, metering adding the rejuvenating agent, adding, spreading, compacting and finishing the asphalt pavement, and shall also include all costs of quality control.

515.31.05 Payment for Acceptable Work - The following end product properties of recycled asphalt pavement will be measured for acceptance:

- Density
- Smoothness

515.31.06 Payment for Rejected Work Made Acceptable - When defects have been remedied in Lots or Sub-Lots which had been rejected, payment for the original quantity of material in those Lots or Sub-Lots will be made subject to payment adjustments and penalty assessments and subject to Subsection 515.24.

No payment will be made for any material used to replace, repair or overlay rejected work and all corrective work shall be performed entirely at the Contractor's expense.

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

1. For each Lot paid for by the square metre (m²), the applicable payment adjustment derived from Table 515-C (Density), in dollars per square metre will be expressed as positive in the case of increases and negative in the case of decreases. The algebraic sum of these unit adjustments will then be applied to the payment quantity for the Lot. The resulting amount, in dollars, will be the net payment adjustment, positive or negative, for that Lot.

The algebraic sum of the net payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for density for the current progress payment.

2. For each Lot, the applicable payment adjustment derived from Table 515-D (Smoothness), in dollars per Lot, will be expressed as positive in the case of increases and negative in the case of decreases, and will be the payment adjustment, positive or negative, for that Lot.

The algebraic sum of the payment adjustments for all such Lots for which payment is authorized on the current progress payment, computed in dollars, shall be the total payment adjustment for smoothness for the current progress payment.

3. The algebraic sum of the total payment adjustments for density and smoothness, derived in accordance with 1 and 2 above, shall be the total payment adjustment, positive or negative, in dollars, for all attributes for the current progress payment. This amount shall be added, if positive, or subtracted, if negative, by a single entry in computing the current progress payment.

4. The process set out in 1 to 3 above will be used in computing each progress payment to which it is applicable.

515.32 Surplus Aggregate In Stockpile - At the discretion of the Ministry Representative, the Ministry may or may not purchase surplus aggregate in stockpile in a private pit. Generally the Ministry will provide payment for the processing costs of surplus aggregate in stockpile in Ministry Pits only, and only to a limited quantity. However, should the Contractor produce surplus aggregate in a private pit, and the Ministry intends to purchase these surplus aggregates, the Contractor shall be required to provide a written agreement with the owner of the property. This document shall indicate that the Ministry will have free access to and use of the surplus aggregate in stockpile for a period of 12 months after the completion of the contract work. If the Contractor undertakes private

work from within the private pit, measurements for surplus aggregate in stockpile will not be taken until the completion of the private work, ensuring that the Ministry does not pay for aggregate used on private works.

All surplus aggregate shall be properly stockpiled.

515.32.01 Ministry Purchase of Surplus Aggregate - Should the Ministry proceed with the purchase of surplus aggregate, upon completion of the contract, the Ministry will purchase surplus paving mix aggregate as indicated herein. Surplus crushed base and/or shoulder aggregates shall be paid for according to Section 501.

If the quantity of Asphalt Pavement actually incorporated into the works is less than the estimated quantity, as stated

in the Schedule of Approximate Quantities and Unit Prices, the Ministry will purchase surplus aggregate up to 100% of the quantity required by the contract. The surplus aggregate must, when singly or combined, meet the gradation requirements set out in the Job Mix Formula. The maximum total surplus aggregate to be purchased will be the quantity of aggregate required to produce the quantity of mix as stated in the Schedule of Approximate Quantities and Unit Prices minus the quantity of aggregate actually incorporated in the works.

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

APPENDIX 1

QUALITY CONTROL REQUIREMENTS AND GUIDELINES

1.01 GENERAL

The Contractor's responsibilities for preparing, submitting and adhering to a Quality Control Plan are specified in Subsection 515.04. This Appendix provides requirements and guidelines for the Contractor's Quality Control Plan, in addition to those set out in Subsection 515.04.

1.02 QUALITY CONTROL PLAN

As a requirement, the Contractor shall prepare and submit a Quality Control Plan for evaluation. The Plan may be operated wholly, or in part by a qualified Subcontractor or an independent organization/agency. However, the Quality Control Plan, including compliance with the Plan and its modifications, is the responsibility of the Contractor.

The Plan shall address all elements that affect the quality of the hot in place recycled asphalt pavement, including but not limited to the following:

- Supply of Asphalt Materials
- Supply of rejuvenating agents
- Identification of source and proof of quality of virgin aggregates to be supplied;
- Virgin aggregate production and its gradation control;
- Quality of virgin aggregate components;
- Stockpile management;
- Asphalt plant calibration and proportioning of aggregate components;
- Mixing including asphalt cement content control;
- Process temperature controls;
- Admix Material and Rejuvenating Agent application rates and processed dimensions, placing and finishing;
- Joints;
- Density;
- Smoothness;
- Segregation;

The plan shall also include the following:

- The name of the Quality Control testing agency and its proven capability to provide the specific services required for the project.
- The list of dedicated technical staff, if available, (including names, qualifications and relevant experience) and their proposed roles.

The list of testing equipment available for project work.

The Quality Control Plan shall include the designation of specific personnel responsible for specific quality control duties.

- There shall be a designated Quality Control Manager, as per Subsection 515.04.03. The Quality Control Manager shall be qualified as per Subsection 515.04.03. The Quality Control Manager shall be responsible for the preparation and sign off of the Quality Control Plan, responsible for all Quality Control testing, and inspections, responsible for the sign off of all quality control testing and inspection records and responsible for all quality control submissions to the Ministry. The individual shall be identified and named in the Quality Control Plan submission. If the Contractor requests a change in the Quality Control Manager, then a formal request to the Ministry Representative shall be made and the Ministry will review the request for approval.
- There may be a designated Process Control Technician (PCT) who would be responsible to ensure that laboratory test results and other quality control practices are used to control the quality of aggregates and other mix components and to adjust and control mix proportions to meet the mix design(s). The PCT is responsible for ensuring that testing equipment, utilized for proportioning and mixing are calibrated and in good working order. The Plan may describe how the PCT's duties, including sampling methods and responsibilities are to be accomplished and documented. The Plan should also describe the criteria to be used by the PCT to correct or reject unsatisfactory materials.
- There may also be a Pavement Quality Control Technician (PQT) who would be responsible to ensure that delivered materials meet the requirements of the specifications. In addition, the PQT shall be responsible for periodically inspecting all equipment used in recycling, placing, finishing, and compacting to assure its proper operating condition and to assure that recycling, placing, application rate, finishing, joint construction, and compaction is in conformance with this specification and the contract requirements.

**1.03 CONTRACTOR'S RECORD OF QUALITY
CONTROL TESTING**

Test results shall be made on specified forms or charts immediately after completion of each test. These test results are to be made available to the Ministry Representative upon request.

Records of gradation control, both during aggregate production and also during the asphalt mixing operation, should be kept on the form H-295 - Mechanical Analysis of Aggregates.

1.04 MATERIALS APPLICATION RATE

The Contractor shall control the Material Application Rate by monitoring the amount of asphalt admix delivered to the road against the area covered by checking the application rate every five loads.

The Contractor shall monitor the addition of rejuvenating agents by calculating the application rate, through comparing the metered amount with the total area processed every one-half hour.

The Contractor is to advise the Ministry Representative on an ongoing basis of the application rates.

1.05 DENSITY

The Contractor shall take core samples to determine actual pavement density. At the start of paving, the Contractor may take a minimum of two pavement cores from each Sub-Lot. The Contractor may employ a nuclear densometer to ensure intermediate density control.

1.06 OTHER QUALITY CONTROL PROCEDURES

The Contractor may initiate other Quality Control procedures as necessary for ensuring production of a quality product and include them in the Quality Control Plan. Procedures may also be introduced after the start of work as necessary as amendments to the Quality Control Plan.

**1.07 QUALITY CONTROL TESTING FREQUENCY
GUIDELINES**

Test frequency guidelines for Quality Control are described in TABLE 1:

TABLE 1 –TEST FREQUENCY GUIDELINES

	Test	Minimum Frequency
Tests During Crushing (Virgin Aggregate)	ASTM C-136, Dry Sieve Analysis of Aggregate	Split Stockpiles: One for each stockpile for every 2 hours of production. One main stockpile: for every 300 tonnes. Blend Sand: One for every 100 tonnes during stockpiling. Natural filler: One for every 50 tonnes during stockpiling.
	ASTM D-5821 Determining the Percentage of Fractured Particles in Coarse Aggregate	Every second coarse aggregate sieve test.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	One per day on reduced sample obtained from combined samples from the crusher
Tests During Asphalt Plant Mixing (Admix)	ASTM C-136, Dry Sieve Analysis of Aggregate	One of combined aggregate every 100 tonnes.
	ASTM C-566 & D-2216, Moisture Content	Aggregate: 2 tests/Lot Asphalt mix: 1 on first Sub-Lot and every second day.
	ASTM C-117 Sieve Analysis of Aggregates by Washing (Field Lab)	One per shift on reduced sample obtained from combined samples from the plant cold feed
	Asphalt Extraction Test ASTM D-6307 Ignition Method	One per Lot.
	Penetration of Bituminous Materials ASTM D-5	One per Manufacturer's Batch
	Viscosity ASTM D-2171	Contractor's Option
Rejuvenating Agents Tests	Rejuvenating Agent	Contractor's option.
Test During Asphalt Paving for Density Testing (Hot In Place Recycled Pavement)	ASTM D-1559, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus	Contractor's Option
	ASTM D-2726 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures (Briquette or Cores)	One per Sub-lot
	ASTM D-2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures	One (see Appendix 3 for Combining Cores)
	Core Samples	One core for each Sub-Lot. All cores to be 150mm diameter.

APPENDIX 2

REQUIREMENT FOR PRODUCTION OF ADMIX AGGREGATES

2.01 GRADATION MAXIMUM PERMISSIBLE VARIATION LIMITS:

Sieve Size	
19.0 mm or 16.0 mm	0%
12.5 mm	+/-3.5%
9.5 mm	+/-3.5%
4.75 mm	+/-3.0%
2.36 mm	+/-3.0%
1.18 mm	+/-2.0%
0.600 mm	+/-2.0%
0.300 mm	+/-1.5%
0.150 mm	+/-1.0%
0.075 mm	+/-0.75%

The variation limits, when applied to the Ministry specified design Admix gradation, shall not result in a gradation that is outside of the limits as specified by the Ministry.

APPENDIX 3

METHOD TO COMBINE ROAD CORES INTO A SINGLE COMBINED SAMPLE FOR THE
DETERMINATION OF MAXIMUM THEORETICAL DENSITY.**3.01 INTRODUCTION**

After the individual Density for each core has been determined, the Sub-lot road cores shall be combined into one single sample for the determination of maximum theoretical density.

3.02 SAMPLE PREPARATION

The upper re-cycled portion of the cores shall be separated from other pavement layers by sawing or other effective methods.

The minimum combined sample size required shall be 2000 grams and 2500 grams for 19.0 mm and 25.0 mm maximum aggregate size respectively.

Select a core trimmer to ensure that the minimum sample size is obtained depending on the thickness of the samples. 100 mm, 114 mm, or 127 mm core trimmers may be used.

Place the core samples in a pan and heat to $130^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for about 20 minutes to allow the specimens to be easily trimmed. Do not overheat. The cores can be stacked on top

of each other and trimmed together or individually.

Select a core trimmer to attain the minimum combined sample size. Heat the base of the trimmer by placing on a burner for a few minutes.

Centre the heated trimmer on the heated cores (allow equal clearance on all sides of the core).

Hold the trimmer vertically by its handle, then press it down through the core until it reaches the bottom of the pan. Apply a slight twist if the heated cores(s) are difficult to penetrate.

Remove the outside cut rock mix by means of a spatula spoon and discard.

Thoroughly mix the resultant combined sample prior to testing to ensure uniform aggregate coating.

The complete combined sample must be tested. If the resultant sample size exceeds the available capacity of the container used for vacuum saturation, it may be tested a portion at a time.