

SECTION 330

HOT MIX ASPHALT CONCRETE - GENERAL

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330.01 SCOPE

This specification covers the Department's requirements for all materials used in the production of hot mix, hot laid base course, surface course and leveling course asphalt concrete for pavement construction. This specification provides materials, equipment and general requirements that are common to both method and end product specification projects. Section 332 provides specifications specific to method projects, while Section 333 details the specifications for end product projects. Unless otherwise directed in the Contract Documents, projects shall follow the requirements of Section 332.

The base, surface and leveling course asphaltic concrete pavement shall consist of PGAC, coarse and fine mineral aggregates, blending sand, mineral filler if required and additives combined as hereinafter specified, placed and compacted on a prepared base in conformity with the lines, grades, dimensions and cross sections, as staked by the Owner's Representative.

Any project paving work (base, levelling and surface coarse) with a truck haul time to the laydown location exceeding 90 minutes will require a Warm Mix Asphalt (WMA) mix design in accordance with Section 337, for the entirety of the paving work. No additional payment will be made for this requirement.

The paving of bridge decks and approach slabs shall be in accordance with Section 922.

330.02 REFERENCES

Reference standards shall be the latest revision at the date of Tender closing. This specification refers to the following standards, specifications or publication:

- Asphalt Institute – Asphalt Mix Design Methods - MS-2
- AASHTO M320 “Standard Specification for Performance Graded Asphalt Binder”
- AASHTO T111 “Standard Method of Test for Mineral Matter or Ash in Asphalt Materials”
- AASHTO T283 “Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage”
- ASTM D140, “Standard Practice for Sampling Bituminous Materials”
- ASTM D242 “Standard Specification for Mineral Filler for Bituminous Paving Mixtures”
- ASTM D995 “Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures”

- ASTM D3625 “Standard Practice for the Effect of Water on Bituminous-Coated Aggregate Using Boiling Water”

330.03 DEFINITIONS

Hot Mix Asphalt (HMA): means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Performance Graded Asphalt Cement (PGAC): means an asphalt binder that is an asphalt-based cement produced from petroleum residue, either with or without the addition of non-particulate modifiers according to AASHTO M320.

Recycled Asphalt Pavement (RAP): Processed HMA material that is recovered by partial or full depth removal.

330.04 MATERIALS

330.04.01 Performance Graded Asphalt Cement (PGAC)

Unless otherwise specified, the asphalt cement (binder) shall conform to the latest edition of AASHTO M320, The PGAC shall be minimum grade of PG 58-28 and shall conform to the requirements of Table 1 in the AASHTO Specification. Other PGAC’s may be specified in individual contracts when warranted. Irrespective of the PGAC specified the ash content must be less than 0.50% tested in accordance with AASHTO T111.

The Contractor shall be responsible for ensuring the correct grade of PGAC is supplied.

All PGAC’s will be subject to testing for acceptance prior to and during use. Samples failing to meet the relevant performance grade will require classification and be subject to price adjustment based on the following formulation.

Temperature Deviation	Price Reduction (% of Asphalt Cement and Mix Prices)
Within 3 degrees of Specified Grade	NA
From 3 degrees to 6 degrees of Specified Grade	10%
From 6 degrees to 9 degrees of Specified Grade	20%
Greater than 9 degrees of Specified Grade	Rejection

Projects with only one PGAC sample collected and not meeting the specified grade will have price adjustments applied to all the unit prices of the entire quantity of HMA concrete. Projects with multiple samples of PGAC will have the price adjustment applied proportionally to the affected asphalt.

PGAC's with either higher than the maximum or lower than the minimum design temperature will be accepted at full price and no bonus will be applied.

Prior to the start of and throughout pavement production current copies of PGAC property certification shall be provided to the Department. Safety Data Sheets for the PGAC and any chemical additives must also be submitted.

Any PGAC other than that specified must be removed from the Contractor's tanks to prevent contamination. PGAC meeting the performance specifications but obtained from different sources cannot be stored in the same tank unless approved by the asphalt suppliers.

330.04.01.01 PGAC Sampling

The Contractor shall collect samples of PGAC as required by the Owner's Representative. At least one sample shall be collected per project and per additional 5000 tonnes of HMA produced. The Owner's Representative may opt to request one random sample per day. Samples shall be taken from the Contractor's storage tank in accordance with ASTM D140. The sample size shall be at least two litres placed in one litre containers. Collection of the PGAC sample shall be witnessed by the Owner's Representative. The sample shall be appropriately identified including the time and date of sampling, grade and type of cement, supplier, refinery and the name including proportions of any additives. The sample shall be immediately forwarded to the witnessing Owner's Representative.

The Department's will submit PGAC samples for quality assurance verification testing for price reduction purposes.

330.04.01.02 PGAC Temperature Viscosity Chart

The Contractor shall supply a temperature viscosity chart from the manufacturer/supplier for each source or type of PGAC provided. The Contractor shall also request of the manufacturer/supplier any information or recommendations regarding the production and handling of the mix relating to the PGAC. All such requested information shall be available in advance of the pre-paving meeting for discussion and review during the meeting.

During the HMA production the maximum mixing temperature shall be the lower of either; the high end temperature for recommended mixing from the temperature viscosity chart provided by manufacturer/supplier or 165°C. HMA exceeding a temperature of 165°C at any point of the operation shall be cause for rejection

330.04.02 Crushed Aggregates

Additional to all other requirements, the designated aggregates shall be split on the 4.75 millimetre screen during crushing operations, and each material shall be stockpiled separately such that intermixing of each size and type does not occur.

Where aggregates are processed from pits the naturally occurring fines shall be pre-screened prior to crushing, individually stockpiled and referenced as “naturally occurring fine aggregate”. No more than 5% naturally occurring fine aggregate passing the 4.75 millimetre screen shall be permitted with the retained naturally occurring screened coarse aggregate prior to crushing. Naturally occurring coarse aggregate must be stockpiled separately prior to crushing. Fine aggregate sizes generated during the crushing phase shall also be individually stockpiled and identified as “crushed fines”. In no cases shall the fine aggregate stockpiles be combined or mixed with other aggregate types. For all mixes the maximum percentage passing the 75 µm sieve is limited to 10% for naturally occurring fine aggregate.

As an alternative to the above pre-screening on the 4.75 millimetre screen, where aggregates are processed from pits, contractors may choose to pre-screen with a 19 millimetre or larger screen size provided that no more than 10% of the retained material for aggregate production passes the 19 millimetre sieve. For this pre-screening operation a completely safe means of accessing the retained material for sampling is to be provided by the Contractor. The Department shall have full control over the time of sampling. If the Contractor chooses to pre-screen with a 19 millimetre or larger screen size, material passing the 19 millimetre or larger screen size can not be utilized as a naturally occurring fine aggregate.

330.04.02.01 Coarse Aggregate

Coarse Aggregate shall consist of hard, durable crushed stone or crushed gravel particles, uniform in quality and free of deleterious materials. The portion of material retained on the 4.75 millimetre sieve shall be known as coarse aggregate. The coarse aggregate stockpile shall contain no more than 10% passing the 4.75 millimetre screen.

Coarse Aggregates shall be washed if necessary to have clean surfaces free from coatings of foreign matter. Coarse Aggregates shall conform to the physical requirements shown in Table 1.

TABLE 1
Physical Requirements for Coarse Aggregates

TEST METHOD	TEST NO.	HIGHWAY CLASSIFICATION		
		RAU & RAD-100 RAU & RAD-90, RCU-80		RLU-60, RLU-70 RLU-80
		SURFACE	BASE	ALL COURSES
LOS ANGELES ABRASION - % MAXIMUM (A)	ASTM C131	35	35	35
ABSORPTION - % MAXIMUM	ASTM C127	1.75	2	2
MAGNESIUM SULPHATE - SOUNDNESS - 5 CYCLES - % MAXIMUM (B)	ASTM C88	12	12	12
PETROGRAPHIC NUMBER - MAXIMUM	CSA A23.2-15A	135	135	135
FREEZE-THAW TEST - 5 CYCLES - % MAXIMUM	CSA A23.2-24A	8	10	10
CRUSHED PARTICLES - % MINIMUM (C)	ASTM D5821	90	90	70
FLAT & ELONGATED PARTICLES - % MAXIMUM (D)	ASTM D 4791	20	20	20
LOSS BY WASHING - % MAXIMUM PASSING (E)	ASTM C117	1.75	1.75	1.75
MICRO DEVAL - % MAXIMUM (EXCLUDING LABRADOR)	ASTM D6928	18	20	20
MICRO DEVAL - % MAXIMUM (LABRADOR ONLY)	ASTM D6928	16	16	16
CLAY LUMPS - % MAXIMUM	CSA A23.2-3A	1	1	1
LOW DENSITY PARTICLES - % MAXIMUM	CSA A23.2-4A	1	1	1
FRIABLE OR SLATEY SILTSTONE - % MAXIMUM	CSA A23.2-15A	1	1	1

Notes:

- a) The ratio of the loss after 100 revolutions to the loss after 500 revolutions shall not exceed 0.265. This Physical Property is not applicable to projects in Labrador.
- b) Test to be conducted on basalt rich or highly absorptive (> 1.5%) aggregates.
- c) Pieces must have a minimum of two freshly fractured faces. Pieces with only small chips removed will not be considered as crushed.
- d) Flat and elongated pieces are those whose greatest dimension exceeds four times their least dimension.

- e) When only quarried rock is used as a source of coarse aggregate, a maximum of 2 percent passing the 75 µm sieve shall be permitted.

Irrespective of compliance with the physical requirements of Table 1, any coarse aggregate may be accepted or rejected on the basis of past field performance at the discretion of the Department.

The Contractor is responsible for ensuring the combination of aggregate for HMA conforms to the grading requirements of Table 3. The Contractor must meet all the requirements above, while the guidelines below are provided for information purposes.

Guidelines for Coarse Aggregate Gradation

Sieve Size	Surface Course & Levelling Course Type I	Base Course & Levelling Course Type II
22.0 mm	100	100
19.0 mm	100	85-100
12.5 mm	85-100	50-80
9.5 mm	45-75	25-60
4.75 mm	0-10	0-10

330.04.02.02 Fine Aggregate

Fine aggregate shall consist of clean, tough, rough-surfaced grains, free from clay, loam and other foreign matter. The fine aggregate stockpile shall contain no more than 20% retained on the 4.75 millimetre screen. Fine Aggregates shall conform to the physical requirements shown in Table 2.

TABLE 2
Physical Requirements for Fine Aggregates

TEST METHOD	TEST NO.	HIGHWAY CLASSIFICATION		
		RAU & RAD-100, RAU & RAD-90, RCU-80		RLU-60, RLU-70, RLU-80
		SURFACE	BASE	ALL COURSES
MICRO-DEVAL TEST FOR FINE AGGREGATE - % MAXIMUM (EXCLUDING LABRADOR)	ASTM D7428	18	20	20
MICRO-DEVAL TEST FOR FINE AGGREGATE - % MAXIMUM (LABRADOR ONLY)	ASTM D7428	17	17	17
PLASTICITY INDEX	ASTM D4318	0	0	0
SAND EQUIVALENT - % MINIMUM	ASTM D2419	50	50	50

TEST METHOD	TEST NO.	HIGHWAY CLASSIFICATION		
		RAU & RAD-100, RAU & RAD-90, RCU-80		RLU-60, RLU-70, RLU-80
		SURFACE	BASE	ALL COURSES
FINE AGGREGATE ANGULARITY - % MINIMUM (A)	ASTM C1252	45	45	45

Note:

- a) FAA tests shall be conducted on a representative sample of the total fine aggregate inclusive of all fine aggregate materials as indicated in the mix design including blending sand. The test will be conducted in accordance with Standard Graded Sample Method A

Irrespective of compliance with the physical requirements of Table 2 any fine aggregate may be accepted or rejected on the basis of past field performance at the discretion of the Department.

The Contractor is responsible for ensuring the combination of aggregate for HMA conforms to the grading requirements of Table 3. For all HMA mixes the fine aggregates maximum percentage passing the 75 µm sieve is limited to 8% prior to mix production at the asphalt plant. Contractors should also be aware of material breakdown after crusher production testing for the material being utilized and their plants capabilities in producing the mixture in accordance with Table 3.

The Contractor must meet all the requirements above, while the guidelines below are provided for information purposes.

Guidelines for Fine Aggregate Gradation

Sieve Size	Percent Passing by Dry Weight	
	Surface Course & Levelling Course Type I	Base Course & Levelling Course Type II
9.5 mm	100	100
4.75 mm	90-100	85-100
2.00 mm	40-60	40-90
0.425 mm	15-30	20-55
0.150 mm	5-16	10-25
0.075 mm	2-6	2-7

330.04.02.03 Crushing Tolerances

After the Contractor starts crushing, an average grading will be determined and tolerances will be applied to subsequent production. The average grading will be determined by averaging at least six washed sieved results on a minimum of 1500 tonnes or 30% of the required amount.

The tolerances for subsequent production are as follows:

Tolerance for Production of Asphalt Aggregate

Aggregate Passing 25.0 mm to 9.5 mm sieves	± 6%
Aggregate Passing 4.75 mm sieve	± 5%
Aggregate Passing 2.00 mm sieve	± 4%
Aggregate Passing 425 µm sieve	± 4%
Aggregate Passing 150 µm sieve	± 3%
Aggregate Passing 75 µm sieve	± 2%

330.04.03 Blending Sand

Blending sand shall be supplied by the Contractor and consist of clean, tough, rough surfaced grains, free from clay, loam, or any other foreign matter. Blending sand is considered as a fine aggregate and thus must meet the requirements of Table 2. Blending sand may be either a naturally occurring screened sand or a manufactured sand added to the mix for the purposes of enhancing mix properties.

The gradation of the blending sand shall be such that when used in the asphalt mix, the resulting mix shall meet the requirements of Tables 3. In any case, the blending sand shall have 100% (by dry weight) passing the 9.5 millimetre sieve and at least 80% (by dry weight) passing the 4.75 millimetre sieve.

For RCU-80 and above highway classifications the maximum allowable percentage in total of all natural occurring fine aggregates plus blending sand in the total combined aggregate shall be 15% (by dry weight). For RLU-80 and below highway classifications the maximum allowable percentage in total of all natural occurring fine aggregates plus blending sand in the total combined aggregate shall be 20% (by dry weight).

330.04.04 Mineral Filler

Material Filler shall meet the requirements of ASTM D242. Where filler is required, it shall be supplied by the Contractor.

330.04.05 Anti-Stripping Additive

An approved anti-stripping additive shall be added to all HMA. The anti-stripping additive may be either an approved liquid anti-stripping additive or hydrated lime ($\text{Ca}(\text{OH})_2$) with each meeting the requirements outlined as follows.

If an approved liquid anti-stripping additive is utilized it shall be added to all HMA at a minimum application rate of 0.5% of additive by weight of PGAC or the recommended percentage as determined by AASHTO T283. Approved liquid anti-stripping additives include the following products:

AD-here LOF 6500 (ARR-MAZ Custom Chemicals)
AD-here 77-00 (ARR-MAZ Custom Chemicals)
Evotherm M1 (Meadwestvaco Corp.)
Evotherm P25 (Meadwestvaco Corp.)
Redicote C-3082 (Akzo Nobel Chemicals)
Rediset LQ-1102C (Akzo Nobel Chemicals)
Warmgrip N1(ARR-MAZ Custom Chemicals)

All other products must be approved by the Department's Materials Engineering Division.

Suppliers of PGAC and anti-stripping additives shall provide in writing all mixing requirements and proof of product compatibility. Treated asphalt PGAC's must meet the relevant performance grade specifications. Some of the additives noted above at various dosage rates are understood to lower the required mixing and compaction temperature of the asphalt mixture. All information in this regard shall be provided 10 working days prior to mix design. This information shall also be made available for proper production, laydown and field testing.

Contractors must inform the Owner's Representative and advise workers of the proper procedures, use of protective clothing and equipment when handling anti-stripping additives. HMA produced with liquid anti-strip additives are known to produce strong odours. Contractors must ensure the mix materials are used under proper environmental conditions to guarantee the safety and comfort of construction personnel and the public.

Modified Lottman tests in accordance with AASHTO T283 shall be completed within the mix design procedure to confirm if the minimum application rate is sufficient. An additional rate of anti-strip and/or an alternate anti-stripping additive will be required if any one of the following conditions occurs as determined by AASHTO T283:

- The tensile strength ratio of the HMA is less than 0.80

- There is visual evidence of stripping. Acceptable specimens shall have a visual stripping rating of 1.0 or lower based on a scale from 0 to 10 (with 0 being no visual stripping and 10 being fully stripped).
- The results of the mix utilizing neat HMA (or with no anti-stripping additive) significantly exceed the performance of the mix with the anti-stripping additive.

In addition to AASHTO T283 requirements, the HMA containing the anti-stripping additive shall pass a boiling water test in accordance with ASTM D3625 within the mix design procedure. The pass criterion for ASTM D3625 is 95% or greater retained bitumen coating of aggregate.

An additional rate of anti-strip and/or an alternate anti-stripping additive may be required if the aggregate is known to be prone to stripping from past performance and the minimum application rate was insufficient.

If additional or alternative anti-stripping additives are required, a further 10 working days will be required after the Contractor has advised the Department of its new anti-strip proposal and all materials have been received by the Materials Engineering Division. The Contractor and their supplier shall provide sample materials, any technical information and Manufacturer's recommended application rates.

AASHTO T283 and ASTM D3625 shall also be conducted on field produced samples of HMA. All field produced samples shall also pass the requirements above.

Where hydrated lime is used as an anti-strip additive the dosage requirement shall be the greater of 0.5% by mass of total dry aggregate, or the recommended percentage as determined from AASHTO T283 and ASTM D3625.

Where hydrated lime is utilized the hydrated lime shall be added to all aggregates by either of the following methods:

- a) Hydrated lime slurry shall be homogeneously mixed with the aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant (the hydrated lime slurry shall be produced at the approximate rate of 1 part lime to 3-4 parts water).
- b) Dry hydrated lime shall be homogeneously mixed with wetted aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant. The wetted aggregate shall have a minimum moisture content of 2% by weight for coarse aggregate and 3% by weight for fine aggregate.

Hydrated lime shall be mixed with the aggregate at least 4 hours prior to entering the asphalt plant. Aggregate treated with hydrated lime shall be used within the same construction season. Treatment shall include both coarse and fine aggregate components of the asphalt aggregate.

Where hydrated lime is to be utilized, the Contractor shall provide the Department with complete information on how the hydrated lime is to be used in the treatment of aggregates. HMA produced containing hydrated lime, shall conform to all requirements of the contract before acceptance. The design amount of hydrated lime will be added as a percentage of the total dry aggregate weight.

The cost of all anti-stripping additives (including hydrated lime) will be borne by the Contractor no separate or additional payment will be made.

330.04.06 Recycled Asphalt Pavement (RAP)

If the Contractor wishes, RAP may be permitted in levelling or base course asphalt. The amount of RAP in the pavement mixture will be limited to 20% and subject to the following conditions:

Preparation and submission of a Marshall Asphalt Design Mix Formula (including all supporting documentation) for the asphalt mixture containing RAP, to be submitted to the Materials Engineering Division for review, is the responsibility of the Contractor. The Contractor shall engage professional engineering services and a CCIL or AASHTO certified testing laboratory, to assess the aggregate materials, asphalt binders, blending sands, mineral fillers, anti-stripping agents and PGAC rejuvenation agents proposed for use and to carry out the design of the asphalt concrete mix. No compensation will be provided to the Contractor, for the production of the asphalt design mix formula for the asphalt mixture containing RAP.

The asphalt mixture containing RAP shall be designed in accordance with the Ontario Ministry of Transportation, Design Procedure for Recycled Hot Mix Asphalt, latest edition, except that all test methods referred to shall be replaced with the appropriate ASTM Standards.

RAP percentages may require the use of a rejuvenation agents to ensure the overall PGAC characteristics meet the specified requirements. Testing to confirm the rheological characteristics of the combined PGAC and the RAP asphalt cement shall be supplied as part of the Marshall Mix Design. In all cases the PGAC shall meet the project specifications.

RAP shall be comprised of asphalt millings and be free of uncoated particles. The use of non-milled reclaimed asphalt pavement is subject to the Department’s discretion.

The quality of the aggregate in the RAP and the quality of the final pavement mixture shall meet all requirements set forth in this specification.

Where RAP is included in base or levelling course mixes the following process will be followed:

- RAP shall be fractionated into a minimum of three separate sizes.
- The gradation of the individual fractionated RAP shall be:
 - 9.5 millimetres and above
 - 4.75 millimetres to 9.5 millimetres
 - minus 4.75 millimetres
- The asphalt plant must be equipped with a metering system that allows the fractionated RAP to be added in a controlled manner acceptable to the Department.

The Contractor shall provide the Department with a minimum 30 day notice of their intention to use RAP. The Department reserves the right to accept or reject any particular source of RAP, irrespective of its quality.

330.04.07 Composition of Pavement Mixture

330.04.07.01 General Requirements for Pavement Mixture

The mixture shall consist of suitably graded fine and coarse aggregate thoroughly mixed with PGAC as specified. Blending sand, filler and chemical additives shall be added when required.

Unless otherwise specified, the aggregates shall be combined to produce a mixture conforming to the grading requirements of Table 3.

**TABLE 3
 Asphalt Aggregate Mixtures**

Sieve Sizes	Percent Passing by Dry Weight			
	Surface Course RCU 80 and above	Surface Course RLU 80 and below	Levelling Course Type I**	Base & Levelling Course Type II***
22.0 mm	100	100	100	100
19.0 mm	100	100	100	90-100
12.5 mm	93-100	93-100	75-100	75-90

Sieve Sizes	Percent Passing by Dry Weight			
	Surface Course RCU 80 and above	Surface Course RLU 80 and below	Levelling Course Type I**	Base & Levelling Course Type II***
9.5 mm	75-92	75-92	63-95	63-84
4.75 mm	45-60	50-65	35-78	35-55
2.00 mm	32-55	32-55	20-55	20-42
0.425 mm	16-25	16-25	10-25	10-25
0.150 mm	5-12	5-12	5-12	5-12
0.075 mm	2-5*	2-5*	2-5*	2-6*
Asphalt Cement (% By Weight of Total Mixture)	4.5 – 7.0	4.5 – 7.0	4.5 – 7.0	4.5 – 7.0

Notes:

- * The dust/effective asphalt ratio of all mixtures shall be between 0.6 and 1.2. Dust is defined as material passing the 0.075 millimetre sieve. For surface course mixtures on roads of less than 500 vehicles per day the upper gradation limit on the 0.075 millimetre sieve can be increased to 6% passing by dry weight. Commercial truck traffic will also be considered in identifying the roadways applicable to the modification of the gradation limit on the 0.075 millimetre sieve. Road sections will be identified in the project tender documents with the surface courses applicable to the modification of the gradation limit on the 0.075 millimetre sieve.
- ** Levelling Course Type I to be used where thickness of compacted lift is to be less than or equal to 30 millimetres.
- *** Levelling Course Type II to be used where thickness of compacted lift is to be greater than 30 millimetres.

Once a mix design has been designated or recognized by the Materials Engineering Division, the Contractor shall be required to produce a HMA mixture conforming to the following mix control tolerances. The mix must still fall inside the gradation envelopes of Table 3.

Individual Sample Tolerance for Production of Combined HMA

Aggregate Passing 19.0 mm sieve	± 5%
Aggregate Passing 12.5 mm sieve	± 5%
Aggregate Passing 9.5 mm sieve	± 5%
Aggregate Passing 4.75 mm sieve	± 5%
Aggregate Passing 2.00 mm sieve	± 4%
Aggregate Passing 425 µm sieve	± 3%
Aggregate Passing 150 µm sieve	± 2%
Aggregate Passing 75 µm sieve	± 1%

330.04.07.02 Physical Requirements for Mixture

The aggregates and the PGAC shall be mixed in such proportions as to satisfy the criteria contained in Table 4. These criteria are based on the Standard Marshall Test Procedures using a compactive effort of 75 blows on each face of the specimen.

All test procedures utilized shall be the latest versions of ASTM or AASHTO standards.

All parameters must not exceed minimum or maximum values as outlined in Table 4 during HMA production. At the discretion of the Owner's Representative, production may be delayed and the Contractor will be required to make changes and provide testing results that HMA production meets the requirements outlined.

TABLE 4
Physical Requirements for Asphaltic Concrete Mixture (All Courses)

	Minimum	Maximum
MARSHALL STABILITY N. AT 60°C (I) FOR HIGHWAY CLASSIFICATIONS RLU-60, RLU-70, RLU-80 (II) FOR HIGHWAY CLASSIFICATIONS RAU & RAD-100, RAU & RAD-90, RCU-80	5 400 8 000	--- ---
MARSHALL FLOW INDEX MM	2.5	4.25
% AIR VOIDS (A) (I) FOR ALL HIGHWAY CLASSIFICATIONS RLU-60, RLU-70, RLU-80, RAU & RAD-100, RAU & RAD-90, RCU-80	2.5	4.5
% VOIDS IN COMPACTED MINERAL AGGREGATES (I) LEVELING & BASE COURSE (II) SURFACE COURSE	14.0 15.0	--- ---
MODIFIED LOTMAN AASHTO T283 - TENSILE STRENGTH RATIO (PLUS VISUAL) 330.02.01.05	0.8	---
% RETAINED COATING OF AGGREGATE - BOILING WATER TEST ASTM D3625	95	---
MOISTURE CONTENT OF HOT MIX ASPHALT BY OVEN METHOD, AASHTO T329 AS PERCENT OF HMA	---	0.3

330.05 END OF PAVING SEASON

The season for laying asphaltic surface course nominally ends on the 30th of September each year.

Placement of asphaltic surface course is permitted after September 30th if the placement conditions as outlined in 332.06.04 and 333.06.02 are met and there has been discussion and agreement with the Owner's Representative that asphalt may be placed. Contractors will only be permitted to open areas for asphaltic surface course that can reasonably be paved, as mutually agreed upon with the Department, based on projected forecasts and recent project performance.

330.06 USE OF PITS, QUARRIES AND STOCKPILES

The use of pits and quarries for the production of the aggregates, together with the requirements for the stockpiling of the aggregates shall be in compliance with the provisions of Section 310.

330.07 EQUIPMENT

All manufacturing of asphalt concrete shall be conducted using batch, drum or continuous mixing plants. All plants shall conform to the requirements of ASTM D995 and as specified herein.

330.07.01 Mixing Plants

330.07.01.01 General Requirements and Equipment for Storage of PGAC

Tanks for storage of PGAC shall be capable of heating and maintaining the temperature at a constant temperature range between 120°C and 160°C. The actual working temperature shall not vary by more than $\pm 5^\circ\text{C}$ when the amount of PGAC added to the mixture is measured volumetrically. Heating shall be by steam or oil coils, electricity, or other means such that no flame shall contact the heating tank.

A circulating system for the PGAC shall be of adequate capacity to thoroughly mix and provide continuous circulation between the storage tank and proportioning units during the entire operation period. All pipe lines and fittings shall be steam or oil jacketed and properly insulated to prevent heat loss.

Storage tank capacity shall be such as to ensure continuous operation of the plant and uniform temperature of the PGAC when it is introduced into the mixing unit. Tanks shall be accessible for measuring the volume of PGAC at any time.

A sampling outlet shall be provided in the PGAC feed lines connecting the plant storage tanks to the weighing system or spray bar. The outlet shall consist of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return

line discharge in a location that is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

330.07.01.02 Cold Bins

All plant types shall be equipped with operational cold bins capable of being calibrated. Cold bins shall be divided into not less than three compartments, each to be equipped with individual gate controls, so as to enable accurate and positive proportioning of each aggregate size. Partitions of sufficient height to prevent intermingling of the aggregate shall be provided between adjoining bins, if the bins are being fed with a front-end loader the width of each bin must be at least 500 millimetres wider than the width of the loader bucket.

330.07.01.03 Dryer

A rotary dryer, of satisfactory design, for drying and heating the aggregate shall be provided. Dryer units shall be of sufficient capacity to uniformly heat the aggregate and reduce the moisture content to the specified level. Upon request the asphalt Contractor shall make available to the Owner's Representative the following information:

- The specified rate of production in tonnes per hour versus aggregate moisture content.
- Within drum plants the specified location and length of the of the PGAC delivery pipe.

330.07.01.04 Screens

Plant screens on batch and continuous mix plants shall have adequate capacity and size range to properly separate all of the aggregate into the sizes required for proportioning so that they may be recombined consistently within the specification limits.

All screens shall have square openings and be free any rips or holes. Screen decks shall be stacked in such a manner that cross contamination of aggregates is prevented.

330.07.01.05 Hot Aggregate Storage Bins

Batch and continuous mix plants shall have hot bin storage of sufficient capacity to ensure uniform and continuous operation. Bins shall be divided into compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each compartment shall be provided with an overflow pipe of such size and at such a location to prevent any backing up of material into other bins or into contact with the screen. Adequate and convenient facilities shall be provided for obtaining aggregate samples from each hot bin.

330.07.01.06 PGAC Control Unit

Satisfactory means, either by weight, metering or volumetric measurements, shall be provided to obtain the proper amount of PGAC. All measuring devices shall prove accurate to within $\pm 2.0\%$ when tested for accuracy.

330.07.01.07 Thermometric Equipment

An armoured thermometer of suitable range shall be fixed in the PGAC feed line at a convenient location near the discharge of the mixer unit. The plant shall be further equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the dryer and in the hot fines bin to register and record automatically the temperature of the heated aggregate.

330.07.01.08 Dust Collectors

Dust collectors shall be provided where required under the provisions of Section 330.08.01. Provision shall be made to waste the material collected, or to return all or any part uniformly to the aggregate mixture.

330.07.01.09 Safety Requirements

Adequate and safe stairways to the mixer platform shall be provided, and guarded ladders to other plant units shall be located where requested.

All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly protected. Ample unobstructed passage shall be maintained at all times in and around the truck-loading space. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be located at the truck-loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks.

A suitable sampling platform with stairs or ramp access including railing shall be provided for sampling material in the truck bed. The height of the platform shall be adequate to prevent the personnel from having to climb up on to the truck in order to obtain a sample. The platform shall be constructed such that the truck is able to park on either side. If it is not possible for the platform to be constructed in such a manner, then two separate platforms shall be provided or the truck will be required to reverse direction so that a sample may be obtained. Overhead protection shall be provided where necessary.

330.07.01.09.01 Capacity

Unless indicated otherwise asphalt mixing plants must have a minimum rated capacity of 120 tonnes per hour delivered to the spreader, with a production history to support this requirement.

330.07.02 Special Requirements for Batching Plants

330.07.02.01 Weigh Box or Hopper

The equipment shall include a means for weighing each bin size of aggregate into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch without running over. The weigh box or hopper shall be supported on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment. Gates both on the bins and the hopper shall be constructed to prevent leakage when closed.

330.07.02.02 Plant Scales

Scales shall be of the dial or digital type and of a standard make and design. Scales for weighing aggregates shall be accurate and sensitive to 0.5% of the maximum loading required. All scales shall provide a positive means of balancing the tare weight of the hopper or asphalt bucket. After each plant set-up and prior to batching any materials, and whenever deemed necessary by the Owner's Representative, the Contractor shall, at their own expense, have the plant scales tested to the satisfaction of the Owner's Representative.

330.07.02.03 Mixer Unit

The plant shall include a batch mixer of an approved twin shaft pug mill type capable of producing a uniform mixture within the permissible job mix tolerances. The clearance between the mixer blades and liner plates shall not exceed 20 millimetres. The mixer shall be constructed to prevent leakage of the contents. Mixer discharge shall not cause appreciable segregation. The mixer shall be fitted with separate dry and wet mixing cycle timers and locking devices so that PGAC cannot be discharged and the pug mill gate cannot be opened until the desired mixing times have elapsed.

330.07.03 Special Requirements for Continuous Mixer Plants

330.07.03.01 Gradation Control Unit

The plant shall include means for accurately proportioning by volumetric measurement the aggregate discharged from each hot bin. The unit shall include a feeder, mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The orifice shall be rectangular with dimension adjustable by positive

mechanical means. Indicators shall be provided on each gate to show the gate opening in millimetres. Each gate will be provided with a lock.

330.07.03.02 Weight Calibration of Material Feed

The plant shall include a means for calibration of gate openings by weighted test samples. The equipment shall include a method of obtaining hot aggregates from the bins fully representative of the flow from the specific gate openings. It shall also include platform scales capable of accurately weighing test samples of aggregates and PGAC.

All calibration equipment, including revolution counters, shall be kept in good operating order at all times and records shall be available whenever required.

330.07.03.03 Synchronization of Aggregate and Asphalt Feed

In order to ensure the correct flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning sources, satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning sources. In order to ensure the correct flow of PGAC to the mixer at all times, the plant shall be equipped with means of maintaining a constant head of PGAC to the metering device. A satisfactory pressure gauge shall be installed on the asphalt line between the metering device and the spray bar.

330.07.03.04 Mixer Unit

The plant shall include a continuous mixer of an approved twin shaft pug mill type that shall be capable of producing a uniform mixture within the specified tolerances. The clearance of the blades from the inner surfaces of the pug mill liners shall not exceed 20 millimetres. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mixture. The mixer shall be equipped with an adjustable dam gate at the discharge end to control the level of the material. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at several heights.

Unless otherwise required, determination of mixing time shall be by weight method under the following formula. The weights shall be determined for the job by tests made by the Owner's Representative.

$$\text{Mixing time in seconds} = \frac{\text{Pug mill capacity in kilograms}}{\text{Pug mill output in kilograms per second}}$$

330.07.03.05 Discharge Hopper

All continuous mix plants shall be equipped with a controlled discharge storage hopper. The minimum capacity of the hopper in tonnes shall be equal to 1.5% of the hourly production rate of the plant but shall not be less than one tonne. This hopper shall be kept in satisfactory operating condition at all times and operated to prevent segregation of the mixture.

330.07.03.06 Material Level Indicators

Material level indicators shall be installed in each hot aggregate bin at the one-third full level and at the two-thirds full level and they shall be connected to remote high-low indicator lights mounted at the operator's station. Operation of the mixer shall not be permitted when the low-level indicator shows any bin to be less than one-third full.

330.07.04 Special Requirements for Drum Mixer Plants

330.07.04.01 Aggregate Feed

Aggregates shall be fed to the dryer drum by means of a multi bin (minimum 3 or 4 bins) cold feed unit and shall be blended to meet the design mix proportions by adjustment of variable speed feed belts and gates on each bin. There shall be no overflow from one bin to another.

A reliable moisture probe shall be installed in the fine aggregate cold feed bin with a meter mounted in the plant control panel.

The total flow of aggregate shall be metered by an electronic weigh belt system with an indicator that can be monitored by the plant operator and which is interlocked with a variable speed asphalt pump so that the proportions of aggregate and PGAC entering the mixer remain constant.

Cold feed calibration and PGAC pump calibration shall be performed at the start of each contract and whenever deemed necessary by the Owner's Representative. The calibration shall be done in the presence of the plant inspector. The cold feed shall be recalibrated whenever the weighing conveyor is moved.

A positive interlocked automatic shut off shall be provided so that the plant shuts down automatically if there is any disruption in the flow of aggregate or PGAC.

A vibrating screen of adequate capacity shall be provided to remove oversize from the combined cold feed.

An aggregate sampling device shall be provided which will divert a representative combined aggregate sample of adequate size into a container or hopper for the purposes of gradation testing. The sampling device shall be located after the cold feed aggregates have passed through the vibrating screen and prior to mixing with PGAC.

330.07.04.02 PGAC Feed

The PGAC feed system shall be equipped with a calibration system which will enable approximately 200 litres of PGAC to be by-passed into a container which can be weighed. Adequate scales shall be provided by the Contractor.

A temperature gauge, showing the temperature of the PGAC at the metering pump, shall be provided in the control trailer. The gauge shall be graduated to cover at least the range 100°C to 200°C with increments of not more than 2.5°C.

A temperature compensating system shall be installed in the PGAC metering system designed to provide a volume of PGAC which will be constant when referenced to 15°C regardless of variations in the temperature of the PGAC from the storage tank.

330.07.04.03 PGAC Mixing

The heating, coating and mixing of the HMA shall be accomplished in an approved parallel flow dryer-mixer. The aggregate and PGAC shall enter the drum at the burner end and travel parallel to the flame and exhaust gas stream. Heating shall be controlled to prevent fracture of the aggregate or excessive oxidization of the HMA. The system shall be equipped with automatic burner controls and shall provide for continuous temperature sensing of the bituminous mixture of discharge, with a printing recorder that can be monitored by the plant operator. The printed record of mix temperatures shall be available to the Department for inspection.

The method used to transfer the mixture from the drum mixer to the haulage units shall be designed, constructed and operated so that there shall be no segregation of, or damage to, the HMA.

A system for wasting unacceptable asphalt aggregate mixture shall be provided between the drum mixer discharge and holding bin.

The plant shall not be operated below 50% of the rated capacity of the belt scale.

330.07.05 Truck Weigh Scales

The scales shall be in accordance with Section 501.

330.07.06 Haulage Equipment

Trucks for hauling HMA shall be of the metal box type in good working order and their use shall be authorized by the Owner's Representative. The metal box shall be in smooth condition with no rust scales or foreign materials. Where ever possible trucks shall be loaded such that the front and back of the truck body are loaded prior to placement of asphalt in the middle section.

Vehicles shall be equipped with tarpaulins of water repellent material (no open mesh types) of sufficient size to completely cover the truck box and overhang the box on all sides by a minimum of 150 millimetres. The tarpaulins shall have sufficient tie-down points so that they can be properly secured, and shall be in good condition and be free of holes and tears. They shall be securely tied down as an effective barrier against rain infiltration and air flow over the HMA mixture.

Tarpaulins are to be used at all times for protection of the load of HMA Tarpaulins shall be rolled back to uncover the hot mix for inspection immediately prior to dumping the load into the paver. Trucks will stop ahead of the paver and allow the paver to smoothly pick up the truck.

The use of hydrocarbon fuels or solvents to lubricate the truck bodies or to clean tools or equipment, will not be permitted. A biodegradable release agent shall be supplied by the Contractor to clean or lubricate tools, equipment and truck bodies.

330.07.07 Spreading Equipment

Mechanical self-powered pavers shall be used which are capable of spreading the mixture true to line, grade and crown as specified and as directed by the Owner's Representative.

Pavers shall be equipped with hoppers and reversing distributing screws to place the mixture evenly in front of the screed. The distributor screws shall always be kept 1/3 to 2/3 covered.

Asphalt concrete shall be dumped into the middle of the paver hopper. The hopper shall not be emptied to less than 25% of its capacity when moving except when the spreading operation is suspended. All cold or segregated asphalt must be shovelled out and wasted. In no case shall cold asphalt be allowed in the pavement mix.

Pavers shall be equipped with heated vibrating screeds and shall be capable of spreading the mixture, without segregation, in thickness from 10 millimetres to 200 millimetres and

in widths of from 2500 millimetres to the greater of the maximum width of the project travel lane and paved shoulder combined or 4000 millimetres, in increments of 150 millimetres.

There should be no allowance for pavers with non- vibratory screeds. All mechanical apparatus designed to aid compaction of the mixture shall have such devices operating continuously when the mixture is being placed unless otherwise directed by the Owner's Representative. Where screed extensions are used, such extensions shall be designed so that the tamping or vibratory action of the screed is effectively transferred to the extensions in such manner as to provide a uniform degree of initial compaction across the full width of the freshly laid mat.

To ensure continuous operation of the pavers, they shall operate at whatever speed necessary to match the output of the plant provided that a consistent and satisfactory mat is being laid. However, in no case shall the speed of the paver exceed 0.7 kilometres per hour.

The Contractor shall provide on each paver a 3 metre straight edge with a level recessed in its upper surface parallel to the lower face and capable of detecting a variation from the horizontal of 3 millimetres in 1000 millimetres.

The term "screed" shall mean any strike-off device operated by cutting, crowding, or other practical action which is effective on the mixture and which produces a finished surface of the evenness and texture required. The screed shall have an approved vibratory application and be adjustable as to level and crown and shall be heated in an approved manner.

Pavers shall be equipped with automatic screed controls, as recommended by the paver manufacturer, for the control of longitudinal grade and transverse slope. The longitudinal grade control shall be equipped to operate from a joint matching shoe except when a spreader with ski is required by the specifications. Longitudinal joints shall be matched by the spreader with ski where ever a spreader with ski is required or specified. The transverse slope control shall be capable of operating from either side of the paver.

A paver with a ski shall be required for paving base course and surface course on the Trans Canada Highway. On other projects, a paver with a ski will also be required where the contract item description includes the phrase "Spreader with Ski".

The paver with a ski shall be equipped with an authorized 12 metre ski. Where such a ski is a flexible unit, it shall be equipped with a spring tensioned wire extending between

brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

When two or more pavers are in echelon in order to match longitudinal joints, pavers following the lead paver shall use joint matching shoes, or a satisfactory 12 metre ski as per the contract requirements, designed for the purpose, which shall ride on the previously placed undisturbed mat. Pavers are considered to be paving in echelon when the lead paver is not more than 60 metres in advance of an adjacent succeeding paver.

330.07.08 Rollers

All rollers shall be of the types specifically designed for asphalt compaction.

All rollers shall be in good condition and capable of reversing without backlash. They should be operated at all times by competent and experienced operators.

All rollers shall be weighed in the presence of the Owner's Representative and ballasted, if required, immediately before commencing work and whenever subsequently required by the Owner's Representative. There shall be no additional cost to the Department for meeting these requirements.

Steel drum rollers shall be equipped with satisfactory means to supply sufficient water to the drum to prevent adhesion of asphalt mixture. The rear wheels of combination rollers shall each be not less than 450 millimetres in width, drums of tandem rollers shall each be not less than 1250 millimetres in width. Steel drum rollers shall weigh at least 12 tonnes and shall exert a load on the compression roll of at least 6 tonnes per metre of wheel width. All pneumatic tired rollers shall be self-propelled and shall have not less than nine wheels revolving on two axles. The tires on the front and rear axles shall be staggered to cover the entire area over which the roller travels with a minimum overlap of 15 millimetres. Under working conditions, the roller shall exert a load of not less than 5 tonnes per metre of tire width on the asphalt surface. The tires shall be inflated to an air pressure of not less than 400 kPa. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the bituminous mixture from accumulating on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet, and which will have a capacity that will provide not less than two hours continuous operations without refilling.

330.07.09 Material Transfer Device/Vehicle

Unless otherwise noted within the tender documents for all highway classifications, a Material Transfer Device/Vehicle shall be used at no extra cost to transfer the project's top lift of asphalt mixture (base, leveling or surface material) from the transport vehicles

to the asphalt spreader. The purpose of the Materials Transfer Device is to minimize segregation during placement of the asphalt pavement and to increase the smoothness of the pavement surface by reducing the number of stops and starts during the placement of the asphalt pavement. The Material Transfer Device shall be utilized in conjunction with a hopper insert in the asphalt spreader. The hopper insert on the asphalt paver shall be kept full at all times. Cycling the hopper wings of the asphalt paver shall be kept to a minimum.

When required to pave on granulars, a self-propelled transfer vehicle is required.

Prior to being utilized the Material Transfer Device/Vehicle shall be authorized for use by the Owner's Representative.

Locations where it is deemed by the Owner's Representative that it is not practical to maneuver and/or safe to utilize a Material Transfer Device/Vehicle shall be identified within the tender documents. For such pre-identified locations no price adjustments to the various hot mix asphalt unit prices will be applied. However, if a Contractor still chooses to proceed with the use of their Material Transfer equipment in a safe manner no additional or other compensation will be applied.

Locations as noted by the Contractor and subsequently agreed with by the Owner's Representative as not practical to maneuver and/or safe to utilize a Material Transfer Device/Vehicle and which were not pre-identified within the tender documents shall have a 5% unit price reduction applied. The price reduction will apply to the various hot mix asphalt unit prices of the material quantities where the Material Transfer Device/Vehicle was not utilized.

The Contractor will be responsible for all surface defects or any other pavement defect irrespective of the utilization or not of a Material Transfer Device/Vehicle.

330.08 ENVIRONMENTAL PROVISIONS

Pits and quarries shall be stripped, worked and at the completion of the work restored, all in compliance with the provisions of Section 310.

The Contractor shall ensure that an insurance policy is in place in accordance with the Tender insurance policy requirements.

Out of specification asphalt shall be disposed of in accordance with Division 8.

330.08.01 Environmental Requirements for Asphalt Mixing Plants

Any asphalt plant being operated within a radius of 1.5 kilometres of a regularly used building, either residential or commercial, or an organized recreational area, must control their dust emissions such that compliance is obtained with the air standards enforced by the Department of Environment, Climate Change and Municipalities. In order to comply, the efficient operations of either a bag house dust collector or a water scrubber on the dryer emissions would be necessary.

These controls may be waived in an area where there are three or less regularly used buildings if the Contractor makes satisfactory arrangements with the owners and occupiers of all buildings. Under such circumstances, a written agreement between the Contractor and owner/occupier, signed by both parties, must be submitted to both the Department of Transportation and Infrastructure and the Department of Environment, Climate Change and Municipalities.

Contractors are referred to the "Environmental Code of Practice for Asphalt Plant Operations" prepared by the Department of Environment, Climate Change and Municipalities (Latest Edition). The link can be found here: <https://www.gov.nl.ca/dgsnl/licenses/env-protection/asphalt/>. Hydrocarbon storage shall be in accordance with Section 820. The Contractor shall follow the procedure for spill reporting.

All sections of the asphalt plant which could contribute to air or water pollution must be maintained in efficient operating condition.

Where a water scrubber is used, the scrubber effluent must be given retention time in suitably sized artificial settling ponds. Such ponds must be sufficiently impermeable to enable seepage water to meet the Environment Control (water and sewage) Regulations, 2003.

All storage tanks for fuel must be drained within one week after production has been completed. Fuel oil must not remain in tanks over the winter.

330.08.02 Environmental Approval

Contractors wishing to set up an asphalt mixing plant at a site must first obtain environmental approval before proceeding.

Contractors must apply in writing to the Digital Government and Service NL for a Ministerial Approval as required under the Environmental Protection Act SNL 2002. The following information must be supplied with the application:

1. Location of the proposed site and description of its surroundings within a radius of 1.5 kilometres.
2. Soil type and particulars of protective dyking near storage tanks.
3. Sieve analysis of cold feed aggregate or at least the percentage of minus 75 µm sieve.
4. Description of the plant and associated equipment to reduce air contaminants (plans if available).
5. Capacity of plant in tonnes per hour.
6. Source of heat (and sulphur content if it is oil).
7. Rate of air flow through the dryer at operating conditions and diameter of the dryer.
8. Relevant operation details of air pollution control equipment (ie. Pressure drop across cyclones or scrubbers).
9. Air to cloth ratio if baghouse filter is used.
10. Height of exhaust stacks.
11. Temperature and velocity of exhaust gases from dryer and/or stack.
12. Expected dates of operation of the plant including:
 - Proposed starting date
 - hours in operation per day
 - proposed completion date
 - total days in operation
13. If using a water scrubber, the rate of use of water (litres per second), the number and dimensions of settling ponds and the method of lining of the ponds.

For inspection purposes, the Contractor shall notify the Department of Environment, Climate Change and Municipalities at least 5 days prior to site closure.

Should the Contractor wish to leave their equipment at the site beyond the completion of their work for the Department, or beyond the proposed completion date as stated in their application, the Contractor shall state in writing their commitment to undertake the clean-up and restoration requirements of this section and those of Section 310, and also state the updated proposed completion date. Copies of this letter shall be sent to both the Department of Transportation and Infrastructure and the Department of Environment, Climate Change and Municipalities.