MATERIAL SPECIFICATION FOR PERFORMANCE GRADED ASPHALT CEMENT

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1101.01 SCOPE

This specification covers the requirements for the properties, use, and payment of performance graded asphalt cements.

1101.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 313 Hot Mix Asphalt - End Result

Ontario Provincial Standard Specifications, Material

OPSS 1151 Superpave and Stone Mastic Asphalt Mixtures

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-100 Rounding-Off of Test Data and Other Numbers
LS-228 Accelerated Aging of Asphalt Cement Using Modified Pressure Aging Vessel Protocols

LS-299 Determination of Asphalt Cement's Resistance to Ductile Failure Using Double Edge Notched Tension Test (DENT)
LS-308 Determination of Performance Grade of Physically Aged Asphalt Cement Using Extended Bending Beam Rheometer (BBR) Method
LS-319 Determining the Cross-Over Temperature of Asphalt Cement
LS-320 Determining the Low Temperature Critical Spread of Asphalt Cement

American Association of State Highway and Transportation Officials (AASHTO)

M 320-17 Standard Specification for Performance Graded Asphalt Binder
R 29-15 (2019) Grading or Verifying the Performance Grade of an Asphalt Binder
R 66-16 Sampling Asphalt Materials
T 350-19 Standard Method of Test for Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

ASTM International

D7643 - 16 Standard Practice for Determining the Continuous Grading Temperatures and Continuous Grades for PG Graded Asphalt Binders
D8078 - 18 Standard Test Method for Ash Content of Asphalt and Emulsified Asphalt Residues

1101.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Asphalt Binder means modified or unmodified asphalt cement.

Asphalt Cement Anti-Stripping Treatment (AST-AC) means as defined in OPSS 1151.

High Temperature Performance Grade (XX) means the high temperature performance grade specified in the Contract Documents and also referred to as the XX specified for the PGAC where the PGAC grade specified is PG XX-YY, and the maximum design pavement temperature.

Hot Mix Asphalt (HMA) means as defined in OPSS 313.

Lot means as defined in OPSS 313.

Low Temperature Limiting Grade (LTLG) means the warmest of the Limiting Grades, T_L obtained for 1 hour, 24 hours, 72 hours and the two conditioning temperatures according to LS-308, and Form B of LS-308.

Low Temperature Performance Grade (-YY) means the low temperature performance grade specified in the Contract Documents and also referred to as the -YY specified for the PGAC where the PGAC grade specified is PG XX-YY, and the minimum design pavement temperature.

Performance Graded Asphalt Cement (PGAC) means an asphalt binder that is produced from petroleum residue, either with or without the addition of non-particulate modifiers, according to AASHTO M 320.

Quality Assurance (QA) means as defined in OPSS 313.

Recompaction Temperature means the temperature to which plant produced mix shall be reheated for testing purposes and shall be the same as the laboratory mix design compaction temperature.

1101.04 DESIGN AND SUBMISSION REQUIREMENTS

1101.04.01 Submission Requirements

1101.04.01.01 PGAC Product Documentation

For each grade of PGAC specified in the Contract Documents, the following items shall be supplied to the Contract Administrator at least 14 Days prior to the first use of each product:

a) The PGAC supplier, the facility type, and location that the product shall be supplied from.

b) Applicable mixing and compaction temperatures for the product.

c) The minimum temperature of the HMA immediately after spreading, recommended by the PGAC supplier. This information is required when paving on bridge decks only.

d) Documentation of construction, storage, and handling requirements, including the material safety data sheet, recompaction temperature, mix discharge temperature, and recommended extraction procedure.

e) When the PGAC contains any polyphosphoric acid (PPA) and a liquid AST-AC is incorporated into the PGAC at the PGAC supplier's depot:

   i. Information on how much AST-AC was added to the PGAC.
   ii. Documentation from the PGAC supplier stating that the PPA modified PGAC with the liquid AST-AC added at the PGAC supplier's depot shall meet all PGAC material requirements specified in the Contract Documents, including AASHTO M 320 for the PGAC grade specified.

1101.04.01.02 PGAC Supply Documentation

For each grade of PGAC specified in the Contract Documents, the following items shall be supplied to the Contract Administrator prior to the commencement of HMA production:

a) All PGAC documentation from the PGAC supplier in the form of bill of lading and certificate of analysis, confirming the grade of PGAC. The bill of lading and certificate of analysis shall also be supplied for each subsequent delivery of PGAC that will be used for the HMA production.

b) Documentation identifying the PGAC storage tank at the HMA plant that will be supplying the PGAC during production of HMA for this Contract. The Contract Administrator shall be notified and provided updated documentation prior to changing the storage tank that is being used to supply PGAC for the HMA production at the HMA plant.

1101.05 MATERIALS

All PGAC shall be according to AASHTO M 320 for the performance grades specified in the Contract Documents when tested using the methods designated in AASHTO R 29, section Test Procedure for Grading an Unknown Asphalt Binder and continuous grading temperatures according to ASTM D7643 and reported continuous grading temperatures rounded to the nearest 0.1 °C.

When silicone oil is added to the PGAC, it shall be less than five parts per million of the PGAC.

The PGAC shall be homogeneous; free of water and any contamination; and shall not foam when heated to the temperatures specified by the manufacturer for the safe handling and use of the product. It shall be shipped, used, and always handled in accordance with the manufacturer's specifications.

All PGAC 70-28, 70-34, and 64-34 shall not contain more than 0.5% PPA and shall only be used as a catalyst for the purpose of modification with polymers. Other grades of PGAC shall contain no more than 1.0% PPA. All grades of PGAC shall not contain any orthophosphoric acid.

The PGAC shall meet the performance grading requirements shown in Table 1 and the additional testing requirements shown in Table 2.

1101.07 PRODUCTION

1101.07.01 Sampling and Testing

Sampling shall be as specified in the Quality Assurance section.

1101.08 QUALITY ASSURANCE

1101.08.01 Sampling

1101.08.01.01 General

The QA, referee, and other required samples for possible Owner testing shall be taken at the same time.

1101.08.01.02 Performance Graded Asphalt Cement

All PGAC test samples shall be obtained during the production of the HMA at the HMA plant from the storage tank which is directly feeding the production of the HMA according to AASHTO R 66 and the asphalt plant's Health and Safety Plan. The asphalt plant's Health and Safety Plan and procedure for sampling shall be discussed at the pre-pave meeting.

Notification from the Contract Administrator shall be provided when the PGAC is required to be sampled.

Sampling frequency, minimum quantities, and additional labelling shall be as shown in Table 3.

1101.08.02 Lot Size

The Contract Administrator shall determine the size and location of the lots for each grade of PGAC, after discussion with the Contractor and before HMA production for the HMA tender item starts.

For tonnage tender items, the quantity of PGAC incorporated into a maximum of 10,000 tonnes of HMA is considered one lot or as determined by the Contract Administrator.

For square metre tender items, the quantity of PGAC incorporated into a maximum of 80,000 m^2 of HMA for lift thicknesses in the order of 40 to 55 mm is considered one lot or as determined by the Contract Administrator. For lift thicknesses in the order of 60 to 100 mm, the lot size is adjusted to a maximum of 50,000 m^2 or as determined by the Contract Administrator.

All PGAC lot sizes shall be based on the HMA tender quantity for each grade of PGAC.

A lot shall be terminated when the source of PGAC is changed. A lot may be terminated at the Contract Administrator's option when HMA production for the Contract ceases for a period of 20 Days or more.

1101.08.02.01 Switching Performance Grades

When switching from the use of one performance grade to a different performance grade, a request may be made that the quantity of PGAC in the first tanker load be considered as a separate lot. This request shall be submitted in writing to the Contract Administrator. The Contract Administrator shall consider only one request for the duration of the Contract.

1101.08.03 Acceptance Testing

Material acceptance of PGAC for performance grading and for the additional testing specified in Tables 1 and 2, respectively, shall be based on QA test results conducted by the Owner's designated laboratory unless superseded by referee test results, subject to the conditions specified in the Contract Documents.

Test results from the tests completed to determine if the material complies with the requirements of the Contract Documents shall be provided by the Owner.

1101.08.04 Basis of Acceptance

Lots of PGAC are categorized for acceptance according to Tables 1 and 2.

When a PGAC lot is categorized with more than one category in Tables 1 and 2, acceptance of the HMA shall be dealt with using the category selected by the Owner.

1101.08.04.01 Asphalt Cement Anti-Stripping Treatment

At the discretion of the Owner, an allowance may be made for the impact of the asphalt cement anti-stripping treatment on a PGAC grade for QA or referee purposes provided that when production begins a request is submitted to the Owner with complete AASHTO M 320 test results for the following:

a) Asphalt cement with anti-stripping treatment at the percentage identified in the mix design.

b) Asphalt cement without the anti-stripping treatment.

1101.08.05 Referee Testing

Referee testing may be invoked for any lot of PGAC within five Business Days of receiving all the QA test results for the lot.

Referee testing costs as specified in the Contract Documents shall be borne by the Contractor, unless the referee testing confirms total conformance of the PGAC sample to the Contract Documents when the QA testing did not, in which case the costs shall be borne by the Owner.

Referee testing may only be invoked for a PGAC lot that is categorized as major borderline or rejectable.

The referee testing shall include all testing specified in Tables 1 and 2. Test results generated by the referee laboratory shall be used to re-evaluate the lot to determine whether the PGAC conforms to the Contract Documents and the disposition of the HMA. The referee test results are binding on both the Owner and the Contractor.

1101.08.06 Disposition of HMA Produced with Borderline and Rejectable Lots

The Owner shall review the test results and determine the disposition of the HMA produced using any PGAC that does not conform to all requirements of the Contract Documents. HMA for which PGAC test results indicate that the PGAC did not conform to the Contract Documents shall be dealt with as follows and a non-conformance report shall be issued:

Minor Borderline: HMA shall be accepted into the Work at full payment.

Major Borderline: HMA shall be accepted into the Work, provided that a payment reduction is accepted, calculated as follows:

PGAC Payment Reduction = 5% of HMA contract price x quantity of HMA in the PGAC lot.

The quantity of HMA shall be in tonnes or square metres as specified for the applicable HMA tender item.

This payment reduction is assessed independently of other payment adjustment provisions specified in the Contract Documents.

If the PGAC in a particular lot has been used for the production of more than one HMA type, the payment reduction shall be calculated using the actual quantities of the HMA types produced with the PGAC for the HMA type, within the PGAC lot.

Rejectable: HMA for which PGAC test results are rejectable shall be subject to repair or payment adjustment. The Contract Administrator shall determine if a rejectable lot may remain in the Work without repairs, with a payment adjustment accepted by the Owner.

When there are changes from one performance grade to a different performance grade and the request for the establishment of a separate lot has been accepted according to the Switching Performance Grades clause, HMA produced with this separate PGAC lot shall be administered as follows:

a) The HMA payment shall not be assessed a PGAC payment reduction for a major borderline disposition due to performance grading.

b) All HMA with PGAC that is rejectable shall be removed or its payment shall be adjusted at the discretion of the Contract Administrator.

TABLE 1
Performance Grading Requirements and Categories for PGAC

Category	Performance Grading Test Result Requirements (Notes 1 & 2)
Acceptable	Equal to or above XX and equal to or below -YY
Minor Borderline	≤ 0.5 °C below XX and ≤ 0.5 °C above -YY
Major Borderline	≤ 1.0 °C below XX and ≤ 1.0 °C above -YY
Rejectable	> 1.0 °C below XX or > 1.0 °C above -YY

Notes:
1. XX is the specified high temperature performance grade and design maximum pavement temperature. -YY is the specified low temperature performance grade and design minimum pavement temperature.
2. Performance grading test results shall be reported rounded to the nearest 0.1°C.

TABLE 2
Additional Testing Requirements and Categories for PGAC

PGAC Grade (Note 1)	Property and Attributes (Unit)	Test Method	Results Reported Rounded to Nearest (Note 2)	Category			
				Acceptable	Minor Borderline	Major Borderline	Rejectable
All PGAC Grades except PG58-28	Ash Content, % by mass of residue (%)	ASTM D8078	0.01	≤ 0.60	N/A	> 0.60 and ≤ 0.80	> 0.80
PG58-28				≤ 0.40	N/A	> 0.40 and ≤ 0.60	> 0.60
All PGAC Grades except PG58-28 and PG52-34	Non-recoverable creep compliance at 3.2 kPa, $J_{nr-3.2}$ (kPa^{-1})	AASHTO T 350 (Note 3)	0.01	< 4.50	N/A	N/A	≥ 4.50
	Average percent recovery at 3.2 kPa, $R_{3.2}$ (%)		0.1	> the lesser of 55.0 or [(29.371) $(J_{nr-3.2})^{-0.2633}$]	≤ the lesser of 55.0 or [(29.371) $(J_{nr-3.2})^{-0.2633}$] and > the lesser of 45.0 or [(29.371) $(J_{nr-3.2})^{-0.2633}$-10]	N/A	≤ the lesser of 45.0 or [(29.371) $(J_{nr-3.2})^{-0.2633}$-10]
	Percent difference in non-recoverable creep compliance between 0.1 kPa and 3.2 kPa, J_{nrdiff} (%)		0.1	Testing carried out for information purposes only.			
PG70-28, PG64-28	CTOD, δ_t (mm)	LS-299 (Note 4)	0.1	≥ 10.0	< 10.0 and ≥ 6.0	< 6.0 and ≥ 4.0	< 4.0
	LTLG (°C)	LS-308 (Note 4)	0.1	≤ -28.0	> -28.0 and ≤ -25.0	> -25.0 and ≤ -22.0	> -22.0
	Grade Loss (°C)	LS-308 (Note 4)	0.1	≤ 6.0	N/A	> 6.0 and ≤ 8.0	> 8.0

PGAC Grade (Note 1)	Property and Attributes (Unit)	Test Method	Results Reported Rounded to Nearest (Note 2)	Category			
				Acceptable	Minor Borderline	Major Borderline	Rejectable
PG58-28	CTOD, δ_t (mm)	LS-299 (Note 4)	0.1	≥ 6.0	< 6.0 and ≥ 4.0	N/A	< 4.0
	LTLG (°C)	LS-308 (Note 4)	0.1	≤ -24.0	N/A	> -24.0 and ≤ -22.0	> -22.0
	Grade Loss (°C)	LS-308 (Note 4)	0.1	≤ 6.0	N/A	N/A	> 6.0
PG70-34, PG64-34, PG58-34, PG52-34	CTOD, δ_t (mm)	LS-299 (Note 4)	0.1	≥ 14.0	< 14.0 and ≥ 10.0	< 10.0 and ≥ 8.0	< 8.0
	LTLG (°C)	LS-308 (Note 4)	0.1	≤ -34.0	> -34.0 and ≤ -31.0	> -31.0 and ≤ -28.0	> -28.0
	Grade Loss (°C)	LS-308 (Note 4)	0.1	≤ 6.0	N/A	> 6.0 and ≤ 8.0	> 8.0
PG58-40, PG52-40	CTOD, δ_t (mm)	LS-299 (Note 4)	0.1	≥ 18.0	< 18.0 and ≥ 14.0	< 14.0 and ≥ 12.0	< 12.0
	LTLG (°C)	LS-308 (Note 4)	0.1	≤ -37.0	N/A	> -37.0 and ≤ -34.0	> -34.0
	Grade Loss (°C)	LS-308 (Note 4)	0.1	≤ 6.0	N/A	> 6.0 and ≤ 8.0	> 8.0
ALL PGAC grades	CTOD, δ_t (mm)	LS-299 (Note 5)	0.1	Testing carried out for information purposes only.			
	Cross-Over Temperature, Tδ45 (°C)	LS-319 (Note 4)	0.1	Testing carried out for information purposes only.			
	Cross-Over Temperature, Tδ45 (°C)	LS-319 (Note 5)	0.1	Testing carried out for information purposes only.			
	Low Temperature Critical Spread, ΔT_C (°C)	LS-320 (Note 4)	0.1	Testing carried out for information purposes only.			
	Low Temperature Critical Spread, ΔT_C (°C)	LS-320 (Note 5)	0.1	Testing carried out for information purposes only.			

Notes:
1. PGAC grades are as specified in the Contract Documents.
2. The rounding-off procedure, for all values, shall be according to LS-100.
3. Conducted at 52°C for Contracts located north of the boundary formed by the French River, Lake Nipissing, and the Mattawa River, excluding Manitoulin Island (also referred to as PGAC Zone 1). Conducted at 58°C for locations South of PGAC Zone 1 in Ontario, including Manitoulin Island (also referred to as PGAC Zones 2 and 3).
4. Conducted on PAV residue LS-228 Method A.
5. Conducted on PAV residue LS-228 Method C.

TABLE 3
PGAC Sampling Requirements

Samples	**Frequency**	**Minimum Sample Quantity**	**Labelling**
Owner Samples (includes QA and Referee)	Each Lot	6 litres (Note 1)	Label shall include: - Grade - Supplier
Notes: 1. Six litres shall be provided in 6 suitable one litre containers or 3 containers able to hold a minimum of 2 litres each.			