

MATERIAL SPECIFICATION FOR MSCR GRADED ASPHALT CEMENT

Intended to replace OPSS.MUNI 1101 dated November 2013

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1101.01 SCOPE

This specification covers the requirements for the properties and use of MSCR (Multiple Stress Creep Recovery) graded asphalt cements. It is intended to replace OPSS.MUNI 1101 dated November 2013.

1101.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

1101.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner.

Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

1101.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

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

Ontario Provincial Standard Specifications

OPSS 310	Hot Mix Asphalt
OPSS 1150	Material Specification for Hot Mix Asphalt
OPSS.MUNI 1151	Superpave and Stone Mastic Asphalt Mixtures

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:

LS-227	Determination of Ash Content
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ASTM International

D 3665-12	Standard Practice for Random Sampling of Construction Materials
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American Association of State Highway and Transportation Officials (AASHTO)

M 320-10	Standard Specification for Performance Graded Asphalt Binder
R 29-08	Grading or Verifying the Performance Grade of an Asphalt Binder
T 40-02 (2006)	Sampling Bituminous Materials
TP 70	Multiple Stress Creep and Recovery (MSCR) of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

1101.03 DEFINITIONS

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

Asphalt Binder means modified or unmodified asphalt cement.

Hot Mix Asphalt (HMA) means as defined in OPSS 310.

Independent Laboratory means a third party laboratory that is not owned or corporately affiliated with the laboratory that prepared the mix design or with the Contractor.

Multiple Stress Creep Recovery Graded Asphalt Cement (MGAC or MG) means asphalt binder graded according to the Multiple Stress Creep Recovery (MSCR) procedure outline in AASHTO TP 70. Guidelines for the use of MGAC grading option are given in Tables A-1 and A-2 and in Appendix A.

Performance Graded Asphalt Cement (PGAC or PG) means an asphalt binder graded according to procedures outlined in AASHTO M 320.

Recompaction Temperature means the temperature to which plant produced mix is to 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 MGAC Test Documentation

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

- a) The MGAC supplier and the facility type and location that the product shall be supplied from.
- b) Applicable mixing and compaction temperatures for the product.
- c) Documentation of construction, storage and handling requirements, including the material safety data sheet, recompaction temperature, mix discharge temperature, and recommended extraction procedure.
- d) When the MGAC contains any polyphosphoric acid (PPA) and a liquid anti-stripping additive is incorporated into the MGAC at the MGAC supplier's depot:
 - i. Information on how much anti-stripping additive was added to the MGAC.
 - ii. Documentation from the MGAC supplier stating that the PPA modified MGAC with the liquid anti-stripping additive added at the MGAC supplier's depot shall meet all asphalt cement material requirements specified in the Contract Documents including AASHTO TP 70 for the MGAC grade specified.

1101.05 MATERIALS

MGAC shall be according to AASHTO TP 70 for the MSCR grades specified in the Contract Documents when tested using the methods designated in AASHTO R 29, section Test Procedure for Verifying the Nominal Grade of an Asphalt Binder.

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

MGAC 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 handled at all times in accordance with the manufacturer's specifications.

MGAC xxH-yy and xxV-yy 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 MGAC shall contain no more than 1.0% PPA. All grades of MGAC shall not contain any orthophosphoric acid.

MGAC grades shall meet the additional requirements shown in Tables 1 and 2.

1101.07 PRODUCTION

1101.07.01 Sampling and Testing

Sampling shall be as described in the Quality Assurance section.

1101.08 QUALITY ASSURANCE**1101.08.01 Basis of Acceptance**

Material acceptance of asphalt cement for performance grading and the properties and attributes shown in Tables 1 and 2 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.

The Contractor shall be provided with test results from all tests completed to determine if the material is according to the requirements of the Contract Documents.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified in the Contract Documents.

1101.08.01.01 Laboratory Requirements

The laboratory conducting MGAC testing shall have participated in the most recent AASHTO Materials Reference Laboratory proficiency sample correlation program for PGAC.

1101.08.02 Anti-Stripping Additive

The Contractor may request that an allowance be made for the impact of the anti-stripping additive on a MGAC grade for QA or referee purposes provided that when production begins the Contractor submits to the Contract Administrator complete AASHTO TP 70 test results for the following:

- a) Asphalt cement with anti-stripping additive at the percentage identified in the mix design.
- b) Asphalt cement without the anti-stripping additive.

1101.08.03 Sampling

The Contract Administrator shall determine the frequency of sampling and testing based on the HMA tender quantity for each grade of MGAC.

All test samples shall be obtained at the plant according to AASHTO T 40 and ASTM D 3665 by the Contractor in the presence of the Contract Administrator. All sampling will be carried out in accordance with the Contractor's Health and Safety Plan. The Contract Administrator shall inform the Contractor when the MGAC is required to be sampled. The QA and referee sample shall be taken at the same time. Sample containers shall be supplied by the Contractor. Sample quantities, labelling, and delivery requirements shall be as shown in Table 3. Samples shall be delivered in a condition suitable for testing.

1101.08.03.01 Switching Performance Grade or Source of Supply

The Contract Administrator shall be advised in writing whenever there is a change in performance grade or source of supply.

1101.08.04 Quality Assurance Testing

When the Contract Administrator elects to carry out QA testing, one of the samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

Test results for samples that do not comply with the performance grading requirements shall be categorized as borderline or rejectable. MGAC shall be categorized based on its test result's deviation from the criteria given in Tables 1 and 2 as follows.

Borderline: The maximum J_{nr} values for MG xxS-yy shall be 4.50 kPa^{-1} . The maximum J_{nr} values for MG xxH-yy shall be 2.20 kPa^{-1} . The maximum J_{nr} values for MG xxV-yy shall be 1.10 kPa^{-1} . The maximum J_{nr} values for MG xxE-yy shall be 0.55 kPa^{-1} . The continuous low temperature grade shall not be warmer than 3°C above the specified grade.

Rejectable: The J_{nr} value for MG xxS-yy is greater than 4.50 kPa^{-1} . The J_{nr} value for MG xxH-yy is greater than 2.20 kPa^{-1} . The J_{nr} value for MG xxV-yy is greater than 1.10 kPa^{-1} . The J_{nr} value for MG xxE-yy is greater than 0.55 kPa^{-1} . A continuous low temperature grade greater than 3°C warmer than the specified grade.

When a sample does not comply with more than one property, attribute, and PG grading, acceptance of the HMA shall be dealt with using the property, attribute, or PG grading selected by the Owner.

1101.08.05 Disposition of HMA Produced with MGAC Not Conforming with the Requirements of the Contract Documents

The Owner shall review the test results and determine the disposition of the HMA produced using any MGAC that does not conform to all requirements of the Contract Documents. HMA produced using MGAC for which test results indicate that the product did not conform to the Contract Documents shall be dealt with as follows:

Borderline: The HMA shall be accepted at full payment.

Rejectable: The HMA shall not be accepted into the Work. The Contract Administrator shall notify the Contractor that in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the HMA from the Work and replacing it with acceptable HMA or invoking referee testing. The Contractor may request a reduced price in-lieu of removal of the HMA. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When test results indicate non-compliance with the Contract Documents, all costs to the Owner to establish the degree and extent of the non-compliance shall be the responsibility of the Contractor.

1101.08.06 Referee Testing

The Contractor and the Owner may send a maximum of two representatives each to observe the referee testing. The Contract Referee testing by an independent laboratory may be invoked by the Contractor for any sample of MGAC within 5 Days of receiving all the QA test results for the sample, provided the Contractor has taken and delivered all referee samples in a condition suitable for testing.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor within 3 Business Days following the Contractor's written notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator.

The referee testing shall determine the sample J_{nr} rounded to the nearest 0.01 and continuous low temperature grade, rounded to the nearest 0.5°C of the MGAC and the properties and attributes shown in Tables 1 and 2.

Test results generated by the referee laboratory shall be used to re-evaluate the lot to determine whether the product conforms to the Contract Documents and the disposition of the HMA.

Referee testing shall be carried out in the presence of the Contract Administrator. The Contractor may observe the testing at no cost to the Owner.

Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance.

Comments on the nonconformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When referee test results show that the MGAC is rejectable, the HMA represented by the test results shall not be accepted. The Contractor shall remove the HMA from the Work at no cost to the Owner. The Contractor may request a reduced price in-lieu of removal of HMA produced with MGAC with rejectable test results. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results confirm total conformance of the MGAC sample to the Contract Documents. Otherwise, the Contractor shall be responsible for the cost.

Table 1—MSCR Graded Asphalt Binder Specification

MSCR Grade	52		58	
	-34	-40	-28	-34
Original Binder				
Flash point, T 48: temp, min °C	230			
Viscosity ^a , T 316 ^c : test temp, °C (max 3 Pa*s)	135			
Dynamic shear ^b , T 315: @ 10 rad/s, test temp °C ($G^*/\sin\delta$ ^c , min 1.00 kPa)	52		58	
Rolling Thin-Film Oven Residue (T 240)				
Mass change ^d : max, percent	1.00			
MSCR, TP 70: test temp for MG xxS-yy, °C ($J_{nr3.2}$, max 4.5 kPa ⁻¹ ; J_{nrdiff} , max 75%)	52		58	
MSCR, TP 70: test temp for MG xxH-yy, °C ($J_{nr3.2}$, max 2.0 kPa ⁻¹ ; J_{nrdiff} , max 75%)	52		58	
MSCR, TP 70: test temp for MG xxV-yy, °C ($J_{nr3.2}$, max 1.0 kPa ⁻¹ ; J_{nrdiff} , max 75%)	52		58	
MSCR, TP 70: test temp for MG xxE-yy, °C ($J_{nr3.2}$, max 0.5 kPa ⁻¹ ; J_{nrdiff} , max 75%)	52		58	
Pressurized Aging Vessel Residue (R 28)				
PAV: aging temp, °C	90		100	
Dynamic shear, T 315: @ 10 rad/s, test temp for MG xxS-yy, °C ($G^* \sin\delta$ c, max 5000 kPa)	13	10	19	16
Dynamic shear, T 315: @ 10 rad/s, test temp for MG xxH-yy, xxV-yy and xxE-yy, °C ($G^* \sin\delta$ c, max 6000 kPa)	13	10	19	16
Creep stiffness, T 313: test temp @ 60 s, °C (S, max 300 MPa; m-value, min 0.300)	-24	-34	-18	-24

Notes:

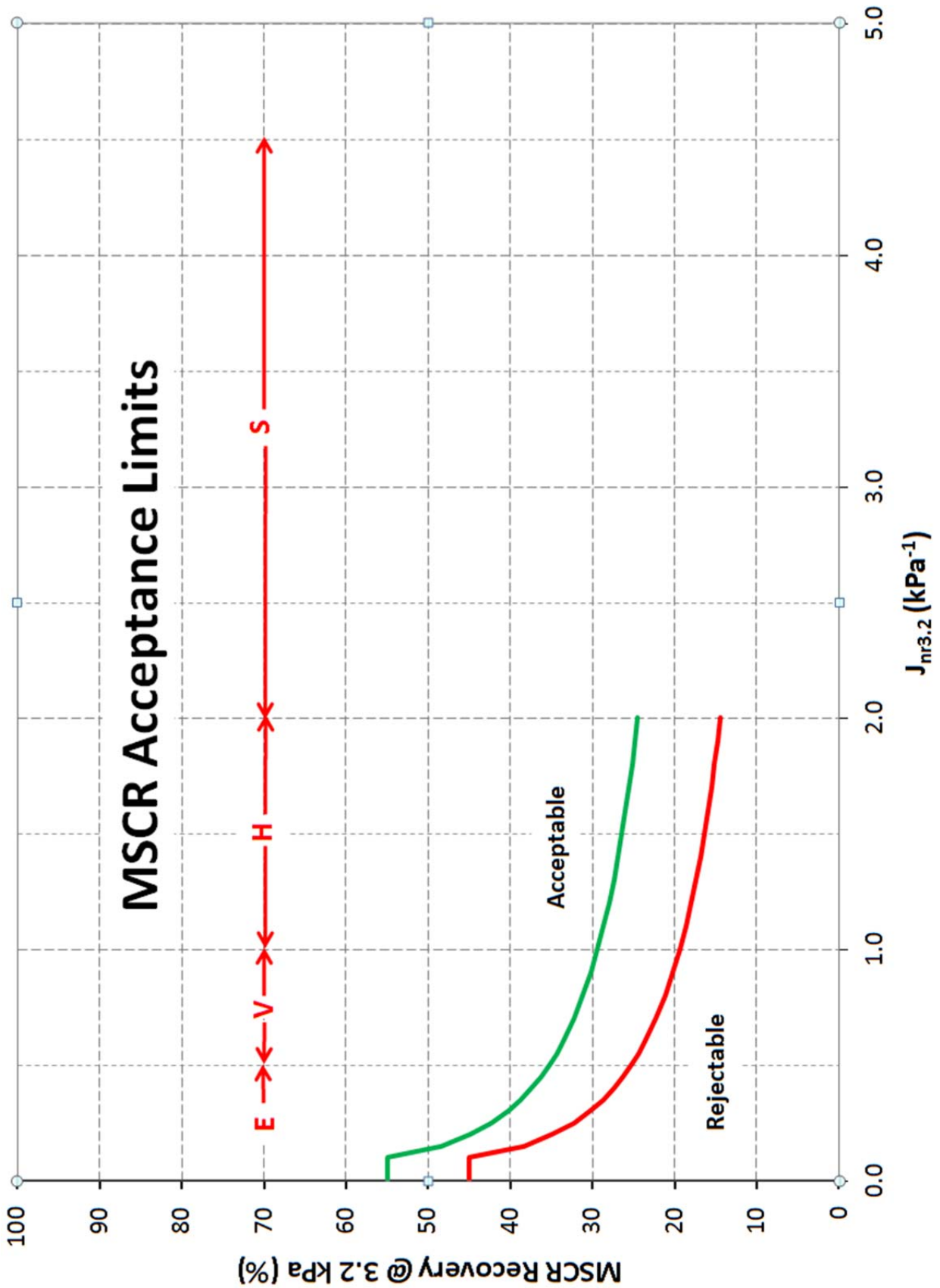
- This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be used to supplement dynamic shear measurements of $G^*/\sin\delta$ at test temperatures where the asphalt is a Newtonian fluid.
- $G^*/\sin\delta$ = high temperature stiffness and $G^* \sin\delta$ = intermediate temperature stiffness.
- The mass change shall be less than 1.00 percent for either a positive (mass gain) or a negative (mass loss) change.

Table 2
Additional Testing Requirements and Acceptance Criteria for MGAC

Property and Attributes (Unit)	Test Method	Results Reported Rounded to the Nearest	Acceptance Criteria	Rejectable
Ash Content, by mass of residue (%)	LS-227	0.1	Less than or equal to 1.0	Greater than 1.0
For MG xxH-yy, MG xxV-yy and MG xxE-yy, Average recovery at 3.2 kPa (R _{3.2}) (%)	MSCR testing according to AASHTO TP 70 testing conducted at a high temp for the grade as specified in Table 1	0.1	Greater than or equal to the lesser of $[(29.371) (J_{nr-3.2})^{-0.2633}]$ or 55.0	Less than the lesser of $[(29.371) (J_{nr-3.2})^{-0.2633} - 10]$ or 45.0

Table 3
Sampling Requirements

Samples	Minimum Sample Quantity	Labelling	Delivery
QA	2 litres (Note 1)	Label shall include: <ul style="list-style-type: none"> • Contract number • Date (yyyy-mm-dd) and time of sampling (hh:mm) • MGAC grade for the asphalt cement • Supplier's name 	<ul style="list-style-type: none"> • Samples shall be delivered as specified in the Contract Documents. • Samples shall be delivered at the same time.
Referee	2 litres (Note 1)		
Notes: 1. Two litres shall be provided in 2 suitable one litre containers or a container able to hold a minimum of two litres.			



APPENDIX A

March 2014

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should be aware that in this specification asphalt binder means asphalt cement. The former term is used in the AASHTO references cited, while the latter continues to be used in OPS specifications.

The designer should be aware that for the purpose of MGAC grade designation, Ontario has been divided into three zones as follows:

- Zone 1: The area north of the boundary formed by the French River, Lake Nipissing, and the Mattawa River.
- Zone 2: The area south of Zone 1, and north of a line from Honey Harbour, to Longford, Taylor Corners, Cavan, Campbellford, and Mallorytown.
- Zone 3: The area south of Zone 2.

For design purposes, the designer shall ensure:

- a) Towns located along a zone boundary line are to be included in the zone south of the boundary line.
- b) Projects located within 10 km of zone boundary lines may be included in either zone at the discretion of the designer so that they may be considered within one zone only.

The designer shall consider the following when selecting MGAC grades: the location of the Contract (i.e., the geographical zone in which it is located, noting that some discretion is allowed); new mixes vs mixes with recycled content (see Table A-1); and, upgrades for heavy commercial traffic, frequent starts and stops, and vehicle speeds (see Table A-2).

Appendix Table A-1 provides the basic performance grades for each Ontario zone. Two basic MGAC grades are specified for each zone, one for new hot mix or mix containing up to 20% recycled asphalt pavement (RAP), and the other for mixes containing 21 to 40% RAP. Recycling ratios in excess of 40% should be addressed on a Contract specific basis.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Table A-1
Grade Selection for Ontario MGAC Zones

MGAC Zone (Note 1)	Zone 1	Zone 2	Zone 3
HMA with up to 20% RAP	MG 52L – 34	MG 58L - 34	MG 58L - 28
HMA with 21 to 40% RAP	MG 52L – 40	MG 52L - 40	MG 52L - 34
Notes: 1. Zones are defined in Appendix A. 2. In the above table, the value for “L” represents the letter designation given in Table A-2. 3. MG xxS-yy refers to Standard Traffic 4. MG xxH-yy refers to Heavy Traffic 5. MG xxV-yy refers to Very Heavy Traffic 6. MG xxE-yy refers to Extremely Heavy Traffic 7. The adjusted letter grade (“L”) remains unchanged for higher RAP substitution (i.e. in Zone 1 where MG 52H-34 is specified according to Table A-2, the grade shall be change to MG 52H-40 if more than 20% RAP is used in the mix).			

Table A-2
OPSS.MUNI 1101 - Guidelines for the Adjustment of MGAC Traffic

Based on Roadway Classification and Traffic Conditions Highway Type	Increase from Standard MG xxS-yy	Optional Additional Grade Increase ^(Note 2)
Extremely Heavy Traffic ^(Note 3)	Upgrade to MG xxE-yy	N/A
Urban Freeway	Upgrade to MG xxV-yy	N/A
Rural Freeway Urban Arterial	Upgrade to MG xxH-yy	Upgrade to MG xxV-yy
Rural Arterial Urban Collector	Consider increasing to MG xxH-yy if heavy truck traffic is greater than 20% of AADT	Upgrade to MG xxV-yy
Rural Collector Rural Local Urban/Suburban Collector	Zone 1: MG 52S-34 Zone 2: MG 58S-34 Zone 3: MG 58S-28	Upgrade to MG xxH-yy or MG xxV-yy
Notes: 1. Upgrading is recommended for use in both surface and top binder courses (i.e., top 80 to 100 mm of hot mix). 2. Consideration should be given to an increase in grade for roadways which experience a high percentage of heavy truck or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting (i.e. truck climbing lanes, etc.). 3. Extreme Heavy Traffic typically refers to airports, dedicated transitways or truck marshalling yards.		