MATERIAL SPECIFICATION FOR AGGREGATES HOT MIXED, HOT LAID ASPHALTIC CONCRETE

INDEX

TS 1003.01 SCOPE

This specification covers the requirements for aggregates for use in hot mixed, hot laid asphaltic concrete.

TS 1003.02 REFERENCES

This specification refers to the following specifications and publications:

City of Toronto Specifications

TS 310 – Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving

TS 1150 – Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete

Ontario Provincial Standard Specifications (OPSS), Materials

OPSS 1001 – Aggregates – General

Ontario Ministry of Transportation (MTO), Special Provisions

Special Provision No. 110F12 – Aggregates for Hot Mixed, Hot Laid, Asphaltic Concrete (Amendment to OPSS 1003)

Ontario Ministry of Transportation (MTO), Designated Sources for Materials (DSM) List

DSM #3.05.25 – Aggregates, Coarse for HL 1, DFC and OFC and Fine Aggregates for DFC and OFC.

Ontario Ministry of Transportation (MTO), Form

PH-CC-449 – Asphalt Aggregate Test Data

Ontario Ministry of Transportation (MTO) Laboratory Testing Manual (Tests)

LS-601 – Material Finer than 75 μm Sieve in Mineral Aggregates by Washing
LS-602 – Sieve Analysis of Aggregates
LS-604 – Relative Density and Absorption of Coarse Aggregate
LS-606 – Soundness of Aggregate by Use of Magnesium Sulphate
LS-607 – Percent Crushed Particles in Processed Coarse Aggregate
LS-608 – Percent Flat and Elongated Particles in Coarse Aggregate
LS-609 – Petrographic Analysis of Coarse Aggregate
LS-613 – Determination of Insoluble Residue of Carbonate Aggregates
LS-614 – Freezing and Thawing of Coarse Aggregates
LS-617 – Determination of Percent Particles with Two or More Crushed Faces and Uncrushed Particles in Processed Coarse Aggregate

LS-618 – Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619 – Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-624 – Guidelines for the Use of Control Charts for Construction Aggregates
LS-625 – Guidelines for Sampling of Granular Materials
LS-704 – Plastic Limit and Plasticity Index of Soils

Aggregate Producer's Association of Ontario (APAO)

Commercial Aggregate Source Book and Membership Directory

TS 1003.03 DEFINITIONS

For the purpose of this Specification, the definitions given in Toronto Works and Emergency Services Specifications TS 310 and TS 1150, and the following definitions apply:

Control Chart: means a graphical method used to monitor the central tendency and the variability of a material characteristic in order to control production.

Mean: means the arithmetic average of a set of data.

Physical Property: means an inherent attribute or feature of an aggregate material. Tests are carried out to determine a material's resistance to weathering and/or degradation. Physical properties are generally not affected by aggregate production processes.

Quality Assurance, QA: means a system or series of activities carried out by the City to ensure that materials received from the Contractor meet the specified requirements.

Quality Control, QC: means a system or series of activities carried out by the Contractor to ensure that materials supplied to the Contract meet the specified requirements.

TS 1003.04 SUBMISSION REQUIREMENTS

TS 1003.04.01 Submissions

Any required submissions shall be in writing. All information and test data forms must be legible. Faxed copies are acceptable provided the original is submitted to the City within three business days following receipt of the fax.

TS 1003.04.02 Source(s) of Aggregates

At least ten business days prior to the commencement of the asphalt paving work, the Contractor shall notify the City as to the Commercial Aggregate Source(s) for the aggregates to be used in the asphalt mix types for the Contract.

TS 1003.04.03 Test Data

At least ten business days prior to the commencement of the asphalt paving work, the Contractor shall provide the City with test results, from a quality control (QC) laboratory meeting the requirements of Subsection TS 1003.06.02, demonstrating conformance of the aggregates with the requirements of this Specification. Test results shall be submitted using MTO Form PH-CC-449 (suitably modified for the Contract) or equivalent, for either the stockpile method or control chart method as appropriate, in accordance with MTO Special Provision No. 110F12.

TS 1003.05 MATERIALS

TS 1003.05.01 General

The requirements of OPSS 1001 shall apply to the Contract. Materials shall conform to this Specification when tested according to the MTO Laboratory Testing Manual "LS" test number identified in following Subsections.

Aggregates shall only be obtained from Commercial Aggregate Sources that comply with the MTO Special Provision No. 110F12 requirements for aggregate processing, handling, stockpiling and quality control (stockpile and/or control chart method).

Contractors should note that the APAO publishes a Commercial Aggregate Source Book and Membership Directory.

Aggregates may be gravels, quarried rock, or from reclaimed asphalt pavement (RAP), provided the source is of such a nature and extent as to ensure acceptable processed aggregates of a consistent gradation and quality. Coarse aggregates for HL 3 (HS), HL 3 Mod, HL 8 (HS) and LSBC asphalt mixes shall be either 100 percent crushed particles produced by crushing bedrock material or shall be crushed from gravel, cobbles or boulders retained on the 50 mm sieve size (75 mm sieve size for LSBC), including washing and classification if necessary. Fine aggregates (manufactured sands) for HL 1 (100 percent crushed component), HL 3 (HS), HL 3 Mod (100 percent crushed component), HL 2, HL 8 (HS) and LSBC shall be either 100 percent crushed particles produced by crushing bedrock material or shall be crushed from gravel, cobbles or boulders retained on the 9.5 mm sieve size, including washing and classification if necessary.

Contractors should note that washed screenings may not meet the gradation and/or physical requirements for 100 percent crushed fine aggregates (manufactured sand).

When reclaimed asphalt pavement (RAP) is used in hot mix, it shall be processed for such use, and shall be obtained solely from removed asphalt concrete, consisting of aggregates and asphalt cement, and shall not contain any steel slag material.

Steel slags, iron blast furnace slags, nickel slags and copper slags are not acceptable for use in hot mix.

Irrespective of compliance with the physical requirements of this Specification, aggregates may be accepted or rejected on the basis of field performance.

TS 1003.05.02 Fine Aggregate

TS 1003.05.02.01 Gradation Requirements

Fine aggregate shall be consistently graded, meeting the requirements of Table 1. The difference between the amount retained between any two consecutive sieves, excluding the 75 μm sieve, shall not be less than 5 percent.

TS 1003.05.02.02 Physical Requirements

Each fine aggregate shall be composed of clean, hard, durable particles meeting the physical requirements of Table 2. DFC and SMA fine aggregates must be obtained from Commercial Aggregate Sources listed on the MTO DSM #3.05.25 list. The DFC fine aggregate and coarse aggregate must be obtained from the same Commercial Aggregate Source. The SMA fine aggregate and coarse aggregate must be obtained from the same Commercial Aggregate Source.

TS 1003.05.03 Coarse Aggregate

TS 1003.05.03.01 Gradation Requirements

Coarse aggregates shall be consistently graded, meeting the requirements of Table 3. The gradation shall not be subject to the extreme limits of the grading envelope specified.

TS 1003.05.03.02 Physical Requirements

Each coarse aggregate shall be composed of clean, hard, durable particles meeting the physical requirements of Table 4. DFC, SMA and HL 1 coarse aggregates must be obtained from Commercial Aggregate Sources listed on the MTO DSM #3.05.25 list meeting the requirements for frictional properties.

TABLE 1
GRADATION REQUIREMENTS (LS-602) FOR FINE AGGREGATE (Note 1)

MTO Sieve Designation	Percent Passing by Mass				
	DFC SMA	HL 1 HL 3 HL 3 Fine HL 3 Mod	HL 2	HL 8	HL 3 (HS) HL 8 (HS) LSBC
9.5 mm	100	100	100	100	100
4.75 mm	85-100	90-100	85-100	85-100	95-100
2.36 mm	65-95	70-100	70-90	60-100	80-100
1.18 mm	48-80	50-90	50-75	34-90	50-90
600 μm	25-60	30-70	30-55	17-70	28-70
300 μm	10-35	15-40	15-35	9-40	10-40
150 μm	5-15	5-15	5-15	3-15	5-15
75 μm	0-6	0-5	3-8	0-7	0-5

Note 1: When using two or more fine aggregates, the combined gradation shall meet the requirements of this table. Each fine aggregate shall meet the physical requirements of Table 2.

TABLE 2
PHYSICAL REQUIREMENTS FOR FINE AGGREGATES

Laboratory Test	MTO Test Number	DFC SMA	HL 1	HL 3 (HS) HL 3 HL 3 Fine HL 3 Mod	HL 2 HL 8 LSBC	HL 8 (HS)
Micro-Deval Abrasion Loss, % maximum	LS-619	15	20	20	25	25
Plasticity Index	LS-704	0	0	0	0	0
Flat and Elongated Particles, % maximum	(Note 1)	10	10	-	-	15

Note 1: Weighted average, 4 to 1 aspect ratio, LS-608; +4.75 mm, -4.75 mm/+2.36 mm and – 2.36 mm/+1.18 mm size fractions.

TABLE 3
GRADATION REQUIREMENTS (LS-602) FOR COARSE AGGREGATE (Note 1)

MTO Sieve Designation	Percent Passing By Mass			
	DFC HL 1 HL 3(HS) HL 3	SMA HL 3 Mod HL 3 Fine	HL 8 (HS) HL 8	LSBC
37.5 mm	-	-	-	100
26.5 mm	-	-	100	55-80
19.0 mm	-	-	90-100	40-65
16.0 mm	100	-	65-90	-
13.2 mm	96-100	100	-	20-50
9.5 mm	50-73	50-75	20-55	10-30
4.75 mm	0-10	0-10	0-10	0-10

Note 1: When using two or more coarse aggregates, the combined gradation shall meet the requirements of this table. Each coarse aggregate shall meet the physical requirements of Table 4.

Contractors should note that practical experience indicates meta-arkose aggregates and gneiss aggregates are brittle and subject to breakdown, so that care is required with their handling.

TS 1003.05.04 Filler

Filler shall consist of baghouse dust, mineral filler, fly ash, hydrated lime, Portland cement or other fine material as designated and currently approved by the City for use in hot mix. Mineral filler shall consist of thoroughly dry dust produced from rock sources acceptable for coarse aggregates meeting the physical requirements listed in Table 4, and shall meet the following gradation requirements:

Passing 600 μm sieve size – 100%, and
Passing 75 μm sieve size – not less than 80%.

TS 1003.06 LABORATORY TESTING

TS 1003.06.01 General

The Contractor shall be responsible for all aggregates quality control (QC) testing and associated costs. The City will designate an aggregate quality assurance (QA) laboratory and will be responsible for all costs associated with QA testing unless otherwise indicated.

TS 1003.06.02 Laboratory Requirements

The aggregates QC and QA testing laboratories shall hold CCIL/APAO, Type C or Type D Certification for the applicable test methods.

TABLE 4
PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE

Laboratory Test	MTO Test Number	DFC, HL 1 and SMA						HL 3 (HS) HL 3 Mod	HL 3 HL 3 Fine	HL 8 (HS) LSBC	HL 8
		Material Type									
		Gravel (HL 1 only)	Andesite (HL 1 only)	Dolomitic Sandstone	Traprock Diabase	Meta-Arkose	Gneiss (DFC and HL 1 only)				
Loss by Washing, Pass 75µm Sieve, % maximum	LS-601	1.0 (Note 1)	1.0 (Note 1)	1.0 (Note 1)	1.0 (Note 1)	1.0 (Note 1)	1.0 (Note 1)	1.3 (Note 2)	1.3 (Note 2)	1.3 (Note 2)	1.3 (Note 2)
Absorption by Mass, % maximum	LS-604	1.0	1.0	1.0	1.0	1.0	1.0	1.75	1.75	2.0	2.0
Magnesium Sulphate Soundness, % maximum loss (Note 3)	LS-606	-	-	-	-	-	-	12	12	15	15
Percent Crushed Particles, % minimum	LS-607	-	100	100	100	100	100	100	80	100	80
Particles with 2 Faces Crushed, % minimum	LS-617	80	-	-	-	-	-	95 (Note 4)	-	95 (Note 4)	-
Flat and Elongated Particles, % maximum	LS-608	15	15	15	15	15	15	20	20	15	20
Petrographic Number (HL), maximum	LS-609	120	120	145	120	145	145	-	-	-	-
Insoluble Residue, Retained 75µm Sieve, % minimum	LS-613	-	-	45	-	-	-	-	-	-	-
Freezing and Thawing, % loss maximum	LS-614	6	6	6	6	6	6	6 (Note 5)	6 (Note 5)	15 (Note 5)	15 (Note 5)
Micro-Deval Abrasion Loss, % maximum	LS-618	5	10	15	10	15	15	17	17	21	21

Note 1: When control charts (LS-624, n>20) are used for LS-601, the average value shall not exceed the specification maximum (1.0%), with no single value greater than 1.4%.

Note 2: When control charts (LS-624, n>20) are used for LS-601, the average value shall not exceed the specification maximum (1.3%), with no single value greater than 1.7%. When quarried rock is used as a source of coarse aggregate, a maximum of 2.0 percent passing the 75µm sieve shall be permitted. When control charts (n>20) are used for LS-601 for quarried rock, the average value shall not exceed the specification maximum (2.0%), with no single value greater than 2.4%.

Note 3: The requirements will be waived by the City when the aggregate meets the alternative unconfined freeze-thaw requirements, LS-614, of this Table.

Note 4: This only applies to HL 3 (HS), HL 3 Mod, HL 8 (HS) and LSBC coarse aggregate crushed from gravel sources.

Note 5: Alternative requirements to Magnesium Sulphate Soundness, LS-604.

TS 1003.07 PRODUCTION

TS 1003.07.01 Aggregate Processing, Handling and Stockpiling

The Commercial Aggregate Source(s) shall comply with the aggregate processing, handling and stockpiling requirements of MTO Special Provision No. 110F12.

TS 1003.07.02 Quality Control

The Commercial Aggregate Source(s) shall comply with the quality control requirements of MTO Special Provision No. 110F12.

TS 1003.08 QUALITY ASSURANCE

TS 1003.08.01 General

Quality assurance (QA) testing may be carried out by the City for purpose of ensuring that the aggregates used in the Contract asphalt mix type(s) conform with the gradation and/or physical requirements of this Specification.

TS 1003.08.02 Sampling

Aggregate samples for QA will be taken by the City at the asphalt plant, or in the absence of a stockpile(s) at the asphalt plant, from a stockpile(s) at the Commercial Aggregate Source(s). The Contractor shall assist the City, at no cost to the City, in obtaining the QA aggregate samples.

TS 1003.08.03 Testing and Retention of Samples

Aggregate testing will be carried out at the City's QA laboratory to ensure that the aggregates conform to the requirements of this Specification. Following the preparation of the test samples, the QA laboratory shall retain all remaining aggregates for possible referee testing.

TS 1003.08.04 Acceptance

The Contractor's submission of test data, Subsection TS 1003.04.03, will be used to accept aggregates in the work, except where aggregates QA testing or referee testing has been carried out.

When QA test results show that the aggregate(s) meets the requirements of this Specification, the aggregate(s) will be accepted.

When QA test results show that the aggregate(s) does not meet the requirements of this Specification, the City will notify the Contractor that material(s) from the Commercial Aggregate Source(s), including material(s) in existing stockpiles or in the Work, will not be accepted. The Contractor then has the option of either removing the material(s) from the Work or requesting referee testing as outlined in Subsection TS 1003.08.05.

TS 1003.08.05 Referee Testing

When aggregate samples tested by the City do not meet the requirements of this Specification, the Contractor has the option of selecting a new Commercial Aggregate Source(s) or invoking referee testing. The Contractor shall notify the City of the selected option within two business days following notification.

When referee testing is selected, the City will select a referee laboratory, meeting the requirements of Subsection TS 1003.06.02, within three business days following notification of the intent to use a referee. Retained referee materials will be delivered to the referee laboratory from the QA laboratory by the City. If referee materials are not available, the City will be responsible for obtaining (LS-625) and submitting new aggregate samples to the referee laboratory, from a location to be decided by the City. The Contractor shall be present to witness the sampling.

Referee testing will be carried out in the presence of the City. Where applicable, the referee laboratory will also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the City. Comments on any nonconformity in the test methods must be made and corrected at the time of referee testing. Referee test results will be binding on both the City and the Contractor.

TS 1003.08.06 Disposition of Aggregate(s) Not Accepted

When referee test results show that the aggregate(s) meets the requirements of this Specification, the material will be accepted.

When the referee test results show that the aggregate(s) does not meet the requirements of this Specification, the material from the Commercial Aggregate Source(s), including materials in existing stockpiles or in the Work, will not be accepted. The Contractor shall remove the material from the Work at no cost to the City.

At the City's option, the Contractor may negotiate a reduced price payment in lieu of removal provided that: the referee test values do not exceed the requirement for Magnesium Sulphate Soundness (LS-606) or Unconfined Freeze-Thaw (LS-614) value by more than 25% of the specified value; or exceed the requirement for the Micro-Deval Abrasion (LS-618) value by more than 10% of the specified value. (For example, where the Magnesium Sulphate requirement value is 12, a reduced payment may be negotiated provided the referee test value does not exceed 15.) The minimum price reduction will be ten percent of the tender price for the applicable asphalt mix type(s) in the Form of Tender. This price reduction will be assessed independently of any other price adjustment provisions for the Contract.

The cost of referee testing shall be borne by the Contractor unless the testing confirms aggregate(s) conformance with this Specification, in which case the costs will be borne by the City.