

**Material Specification for
Hot Mixed, Hot Laid Asphaltic Concrete**

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TS 1150.01 SCOPE

This specification covers the requirements for the materials, equipment and methods to be followed for proportioning and mixing hot mixed, hot laid asphaltic concrete for pavement construction and related uses.

TS 1150.02 REFERENCES

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

City of Toronto Standard Specifications

TS 310	Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
TS 1003	Material Specification for Aggregates – Hot Mixed, Hot Laid Asphaltic Concrete
TS 1101	Material Specification for Performance Graded Asphalt Cement and Performance Graded Asphalt Cement with Elastic Recovery

Ontario Provincial Standard Specifications, Construction

OPSS 102	General Specification for Weighing of Materials
OPSS 314	General Specification for Untreated Granular Sub base, Base, Surface Shoulder and Stockpiling

Ontario Provincial Standard Specifications, Material

OPSS 1001	Material Specification for Aggregates – General
OPSS 1103	Material Specification for Emulsified Asphalt

Ontario Ministry of Transportation, Designated Sources for Materials List

DSM#3.05.10	Antistripping Additives
DSM#3.05.25	Coarse Aggregates for HL-1, DFC and OFC and Fine Aggregates for DFC and OFC

Ontario Ministry of Transportation, Laboratory Testing Manual

LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-266	VMA in Compacted Bituminous Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-292	Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate from Bituminous Paving Mixtures

American Association of State Highway and Transportation Officials, Provisional Standards

MP2	Specification for Superpave Volumetric Mix Design
MP8	Standard Specification for Stone Matrix Asphalt (SMA)
PP6	Practice for Grading or Verifying the Performance Grade of an Asphalt Binder

American Society for Testing and Materials

D 5581	Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch diameter Specimen)
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Asphalt Institute

Manual Series

No. 2 (MS-2) Mix Design Methods

Ontario Hot Mix Producers Association

Environmental Practices Guide

TS 1150.03 DEFINITIONS

For the purpose of this specification, the definitions given in TS 310, TS 1003 and TS 1101, and the following definitions apply:

Advisory Clause means the information provided [Note:] to assist Contractors.

Blending Material means any coarse or fine aggregate added to the aggregates originally selected in order to obtain the physical requirements of a hot mix(es).

Commercial Aggregate Source means a source of aggregate meeting the requirements of TS 1003.

Crushed Material means particles of aggregate having at least two well-defined faces resulting from fracture and meeting the requirements of TS 1003.

Prolonged Storage means the storage of hot mix in storage bins for more than two hours, after batching.

TS 1150.04 DESIGN AND SUBMISSION REQUIREMENTS**TS 1150.04.01 Submissions**

Any required submissions shall be in writing. All information and test data forms must be legible. Faxed or e-mail copies are acceptable provided the original is submitted to the Contract Administrator within three Working Days following receipt of the fax or e-mail message.

TS 1150.04.02 Designation of the Mix(es)**TS 1150.04.02.01 *Mix Designs*****TS 1150.04.02.01.01 *General***

At least 15 Working Days prior to the commencement of the asphalt paving work, the Contractor shall notify the Contract Administrator as to:

- a) where the stockpiles of the various aggregates, which are representative of the materials to be used in the Work, are available for sampling;
- b) the dates upon which the production of the hot mix(es) is to commence;
- c) the sources asphalt cement suppliers of the Performance Graded Asphalt Cement (PGAC), Performance Graded Asphalt Cement with Elastic Recovery (PGAC-E), if any, and antistripping additives, to be used in the Work; and

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- d) factors, such as previous experience with the materials and hot mix designs, that will be of assistance to the Contract Administrator in having hot mix designs completed.

The Contract Administrator may waive the requirement for a mix design for those hot mix types, if any, that the Contractor has previously supplied to the City during the current asphalt paving season. These hot mix types must have incorporated the same aggregates (source and gradation) and PGAC or PGAC-E, and must have an approved satisfactory mix design and job-mix formula.

If the Superpave volumetric mix design method (AASHTO MP2) is to be used for any hot mix type, this will be indicated in the Contract Documents and covered by a special provision.

TS 1150.04.02.01.02 *Mix Designs Supplied by the City*

For DFC, HL-1, SMA, HL-3 (HS), HL-8 (HS), HL-8 (HS, 10% RAP) and LSBC hot mix types as shown in Table 1, the Contract Administrator shall arrange for samples of each material—aggregates and PGAC or PGAC-E—to be taken and for mix design(s) to be completed in an asphalt laboratory with Canadian Council of Independent Laboratories (CCIL) Type A Certification. The mix design(s) shall be completed according to current MTO procedures using Asphalt Institute Manual Series No. 2. All mixes, with the exception of LSBC, will be designed using 75 blows with a manual compaction hammer, or the mechanical equivalent. LSBC will be designed using the ASTM large aggregate Marshall method procedure (ASTM D 5581), using 112 blows with a manual compaction hammer, or the mechanical equivalent. The Contractor will receive a copy of the full Marshall mix design.

At least 7 Days prior to the commencement of the asphalt paving work, the Contract Administrator will provide the Contractor with the preliminary design mix proportions and properties for each hot mix type to be used.

Table 1: Hot mix types

Hot mix type	Use levelling, binder or surface course	Source of acceptable coarse aggregate	Source of acceptable fine aggregate(s)	Coarse aggregate size, 100% passing
DFC ^{1,2}	surface (dense friction course)	trap rock, dolomitic sandstone, meta-arkose, diabase or gneiss from source on DSM #3.05.25 ⁴	trap rock, dolomitic sandstone, meta-arkose, diabase or gneiss from source on DSM #3.05.25	16.0 mm
HL-1 ¹	surface (high stability)	trap rock, dolomitic sandstone, meta-arkose, diabase, andesite or gneiss from source on DSM #3.05.25	100% crushed material and asphalt sand from commercial aggregate source(s)	16.0 mm
SMA ^{1,2,3}	surface (stone mastic asphalt)	trap rock, diabase, dolomitic sandstone or meta-arkose from source on DSM #3.05.25	trap rock, diabase, dolomitic sandstone or meta-arkose from source on DSM #3.05.25	13.2 mm
HL-2	padding or repair	not applicable	100% crushed material from commercial aggregate source	9.5 mm
HL-3 (HS) ⁵	levelling (high stability)	100% crushed material from commercial aggregate source	100% crushed material from commercial aggregate source	16.0 mm
HL-3	Surface	commercial aggregate source	commercial aggregate source	16.0 mm
HL-3 Mod	surface	commercial aggregate source	100% crushed material and asphalt sand from commercial aggregate source(s)	13.2 mm
HL-3 Fine	driveways and boulevards	same as HL-3	same as HL-3	13.2 mm
HL-8 (HS)	binder (high stability)	100% crushed material from commercial aggregate source	100% crushed material from commercial aggregate source	26.5 mm
HL-8	binder	commercial aggregate source	commercial aggregate source	26.5 mm
LSBC	binder (large stone binder course, high stability)	100% crushed material from commercial aggregate source	100% crushed material from commercial aggregate source	37.5 mm

Note 1: DFC, HL-1 and SMA – The aggregate combination used for the mix shall be one of those listed in Table 6 of TS 310.

Note 2: DFC and SMA – Coarse and fine aggregates shall be obtained from the same source.

Note 3: SMA – Incorporates filler and fibre.

Note 4: DSM #3.05.25 – MTO Designated Sources for Coarse Aggregates for HL-1, DFC and OFC and Fine Aggregates for DFC and OFC.

Note 5: HL 3 (HS) – Not intended for surface course use.

TS 1150.04.02.01.03 *Mix Designs Supplied by the Contractor*

For HL-2, HL-3, HL-3 Fine, HL-3 Mod, HL-8 and HL-8 with up to 20% RAP hot mix as shown in Table 1, the Contractor will provide the Contract Administrator with the job-mix gradation and asphalt cement content (job-mix formula) for each hot mix type to be used at least five Working Days prior to the commencement of the asphalt paving work. The mix design shall be carried out during the calendar year in which the asphalt paving work is performed. The mix proportions shall be corroborated by submission of a five point Marshall Mix design, completed and reported according to current MTO procedures, by a laboratory having Canadian Council of Independent Laboratories (CCIL) Type A Certification. The hot mix type(s) shall not be supplied to the Work until the mix proportions have been approved by the Contract Administrator.

TS 1150.04.02.02 *Trial Batches and Job Mix Formula*

The Contractor shall make pre-asphalt paving plant trial batches from which hot mix samples will be taken by the Contract Administrator to ensure that each hot mix type meets the requirements as specified in the Contract Documents. Each trial batch shall be representative of consistent hot mix production and shall be a minimum of two pugmill batches of the size that will be used during hot mix production for batch plants, or a minimum of five tonnes for drum mixing plants. The remainder of the trial batches shall be disposed of by the Contractor. Such trial batches shall be produced until a complete laboratory mix compliance check indicates conformance with the design mix proportions and properties for each hot mix type to be used. Compliance checks will include Immersion Marshall testing for those mix types incorporating an antistripping additive. Up to two trial batches for each hot mix type will be paid for as shown in the Pricing Form. Should more than two trial batches be required for any hot mix type, the Contractor shall bear both the cost of the trial batches and laboratory mix compliance checks for such additional batches.

If the Contractor elects to use more than two hot mix plants for the production of a hot mix type, the Contractor shall bear the cost of all the trial batches and all the laboratory mix compliance checks for such additional plant(s). Contractors should note that only materials from the same sources may be used in a hot mix type produced in more than one plant.

All mix sampling and testing for the Contract shall be done by qualified technicians in an asphalt laboratory(ies) with Canadian Council of Independent Laboratories (CCIL) Type A Certification.

For those hot mix types indicated in TS 1150.04.02.01.02, herein, the Contract Administrator will provide the Contractor with the job-mix gradation and asphalt cement content (job-mix formula) for each mix to be used, based on the mix design proportions and properties, and trial batch mix compliance checks. The job-mix formula selection by the Contract Administrator is intended to produce the optimum mix for Contract use.

TS 1150.04.02.03 *Hot Mix Plant(s) and Process Control*

At least five Working Days prior to the commencement of the paving work, the Contractor shall notify the Contract Administrator as to the location, type, model, nominal hourly capacity, manufacturer's rated capacity of drier or drum in tonnes per hour of dried aggregate for various percentages of moisture in the combined aggregate feed and process control procedures for the hot mix plant(s).

Note: Contractors should note that a moisture content determination must be completed by the Contractor each morning and afternoon for each aggregate and RAP, if any, being used in a drum mixing plant, with these moisture contents reported to the Contract Administrator no later than the next working morning.

While the Contract Administrator will make the results of quality assurance (QA) testing available to the Contractor, the Contractor shall be responsible for the necessary process control testing during hot mix production, placement and compaction, and any necessary adjustments, to produce uniform, acceptable hot mix.

TS 1150.05 MATERIALS**TS 1150.05.01 Supply of Materials**

Prior to starting the work, the Contractor shall supply the Contract Administrator with material safety data sheets (MSDS) for all materials to be incorporated in the Work.

TS 1150.05.02 Grade of PGAC and PGAC-E

Each grade of performance graded asphalt cement (PGAC) and performance graded asphalt cement with elastic recovery (PGAC-E) required for the Contract shall be according to TS 1101.

TS 1150.05.03 Aggregates

All aggregates required for the Contract hot mix types shall be according to TS 1003.

TS 1150.05.04 Blending Materials

If required, blending material(s) shall be used in order that the hot mix(es) meet(s) the physical requirements of this specification. The blending material(s) shall according to TS 1003. All costs associated with the use of blending material(s) will be deemed to be included in the unit price(s) for hot mix in the Pricing Form.

TS 1150.05.05 Fillers and Additives

The filler incorporated in SMA shall be limestone dust (mineral filler) or dolomitic limestone dust (mineral filler) according to AASHTO MP8.

The fibre incorporated in SMA shall be cellulose fibre or mineral fibre according to AASHTO MP8.

When and where specified in the Contract, filler and/or additive requirements for other hot mix types shall be given by a special provision.

TS 1150.05.06 Silicones

Silicone oil, if added to the PGAC or PGAC-E, shall not be used with a concentration of more than three parts per million parts of PGAC or PGAC-E, and only with the written approval of the asphalt cement supplier(s). The use of silicone oil in a hot mix(es) shall be noted on the weigh ticket for the hot mix.

TS 1150.05.07 Composition and Properties of Hot Mix Types

TS 1150.05.07.01 *General*

The hot mix shall be of uniform consistency and consist of coarse and fine aggregates, as required for the hot mix type, mixed with PGAC or PGAC-E.

All testing of hot mix shall be in accordance with current MTO procedures.

TS 1150.05.07.02 *Gradation, Content Requirements for Hot Mix Types*

The aggregates and PGAC or PGAC-E shall be combined in such proportions as to produce a hot mix conforming with the gradation, and PGAC or PGAC-E content, requirements given in Table 2.

Table 2: Gradation and PGAC or PGAC-E content requirements for hot mix types ^{1,2,3}

MTO sieve designation	Percentage passing by dry mass										
	DFC	HL-1	SMA	HL-2	HL-3 (HS)	HL-3	HL-3 Fine	HL-3 Mod	HL-8 (HS)	HL-8	LSBC
37.5 mm											100
26.5 mm									100	100	67-90
19.0 mm									94-100	94-100	56-80
16.0 mm	100	100			100	100			77-95	77-95	- - -
13.2 mm	95-100	98-100	100		98-100	98-100	100	100	- - -	- - -	43-73
9.5 mm	80-95	75-90	75-90	100	75-90	75-90	85-94	85-94	48-75	48-78	37-60
4.75 mm	52-69	45-65	26-38	85-100	45-65	45-65	65-80	65-80	30-55	30-55	22-45
2.36 mm	35-55	35-56	20-30	70-90	35-56	36-64	52-80	52-80	20-46	21-54	14-35
1.18 mm	20-37	25-47	15-25	50-75	25-47	25-58	36-72	36-72	12-39	12-49	8-25
600 µm	12-24	15-35	12-20	30-55	15-34	16-45	23-56	23-56	6-26	6-38	6-18
300 µm	6-16	7-20	10-18	15-35	7-20	7-26	10-32	10-32	3-15	3-22	4-13
150 µm	2-11	1-8	9-15	5-16	1-8	3-10	3-12	3-12	1-7	1-9	3-9
75 µm	1-7	1-5	7-12	3-8	1-5	1-6	1-6	1-6	1-5	1-6	2-6
PGAC or PGAC-E content %	4.5 to 7.0	4.5 to 7.0	5.0 to 7.0	6.0 to 8.0	5.0 to 6.5	5.0 to 6.5	5.5 to 7.0	5.5 to 7.0	4.5 to 6.0	4.5 to 6.0	4.0 to 5.5

Note 1: DFC Mix shall contain 60% by volume of the total aggregate passing the 4.75 mm sieve.

Note 2: HL 1 Mix shall contain 55% by volume of the total aggregate passing the 4.75 mm sieve.

Note 3: The aggregate combination used for DFC, HL-1 and SMA hot mix shall be one of those listed in Table 6 of TS 310.

Note: The Contractor should note that these gradation, and PGAC or PGAC-E content, requirements are subject to tolerances on the job-mix formula during hot mix production.

TS 1150.05.07.03 *Physical Requirements for Hot Mix Types*

The hot mix shall be according to the physical requirements given in Table 3.

For DFC, HL-1 and HS (High Stability) mixes, the minimum Marshall stability requirement shall be satisfied for the PGAC or PGAC-E range of job mix formula ± 0.3 per cent.

Table 3: Physical requirements for hot mix types

Property of laboratory compacted mix	DFC	HL-1 ¹	SMA ³	HL-8 (HS)	HL-2	HL-3 Fine	HL-3 HL-3 Mod HL-8	LSBC
minimum Marshall stability: N at 60°C	Note 2	14000	7000	14000	9000	5000	7000	27000 ⁴
minimum Marshall flow: units of 0.25 mm at 3.5% air voids	8	8	8	8	8	9	9	8
maximum Marshall flow: units of 0.25 mm at 3.5% air voids	---	14	16	14	---	14	---	14
air voids: %	2.5 to 4.5	3 to 5	2 to 4	3 to 5	3 to 5	2.5 to 5	3 to 5	3 to 5
mix design desirable design air voids: %	3.5	4	3	4	4	3.5	4	4

Note 1: HL-1 – As a guide, HL-1 mix will contain 55% by volume of the total aggregate passing the 4.75 mm sieve and the percentage by mass of asphalt sand will be between 10 and 15%. Contractors should note that achieving the minimum Marshall stability for HL-1 may be difficult for some aggregate combinations and can limit the amount of asphalt sand incorporated.

Note 2: DFC – The Marshall stability requirements for DFC Mix shall be:

Coarse Aggregate/Fine Aggregate	Minimum Marshall Stability, N at 60°C
Trap Rock/Trap Rock	12000
All Other DFC Aggregates (Table 6 of TS 310)	14000

Note 3: SMA – As a guide, SMA Mix will incorporate about 8.0% filler by mass of aggregate/filler and 0.3% cellulosic or 0.4% mineral fibre addition by mass of total mix.

Note 4: LSBC – The minimum Marshall stability requirement is for 152.4 mm diameter briquettes (ASTM D 5581).

The percent voids in compacted mineral aggregate allowing for the volume of absorbed PGAC or PGAC-E (% VMA) for the hot mix, with the exception of DFC and SMA, shall be according to the requirements given in Table 4. Table 4 is based on the nominal maximum size of the total aggregate, which is the sieve size next larger than the largest designated sieve on which no less than 10 per cent of the total aggregate is accumulatively retained.

Table 4: Minimum per cent VMA for hot mix types

Pass 4.75 mm by mass %	Nominal maximum particle size							
	2.36 mm	4.75 mm	9.5 mm	13.2 mm	16.0 mm	19.0 mm	26.5 mm	37.5 mm
40				13.0	12.5	12.0	11.0	10.0
45				13.5	13.0	12.5	11.5	10.5
50				14.0	13.5	13.0	12.0	11.0
55				14.5	14.0	13.5	12.5	11.5
60				15.0	14.5	14.0	13.0	12.0
60 or more	21.0	18.0	16.0	15.5	15.0	14.5	13.5	12.5

TS 1150.06 EQUIPMENT**TS 1150.06.01 General Inspection Requirements**

All equipment shall be available for inspection, testing and approval before operations commence.

The Contract Administrator shall have access, at all working times, to any or all parts of the equipment, for all purposes pertaining to the Contract.

Note: Contractors should note the importance of adopting and following the OHMPA Environmental Practices Guide.

TS 1150.06.02 Requirements for all Hot Mix Plants**TS 1150.06.02.01 *Inspection Requirements***

Stairways to the mixer platform and to the PGAC or PGAC-E storage tank inspection openings, and ladders to other plant units, shall be placed at all points required for accessibility to all plant operations. Ample and unobstructed space shall be provided on the mixing platform. A platform shall be provided in the vicinity of the plant to permit inspection and sampling of the hot mix before delivery of the load.

TS 1150.06.02.02 *Equipment for Preparation*

Tanks for storage of PGAC and PGAC-E shall be capable of heating the PGAC and PGAC-E under effective and positive control at all times and maintaining it in a temperature range between 120°C and 165°C. The actual working temperature shall not vary by more than $\pm 5^\circ\text{C}$ when the amount of PGAC or PGAC-E added to the mix is measured volumetrically.

A circulating system of adequate size shall be provided for the PGAC and PGAC-E ensure proper and continuous circulation between working tank and mixer during the entire operating period. A sampling valve shall be included between the working tank and the mixer. There shall be a separate tank and recirculating line for each grade of PGAC or PGAC-E to be used in the work. Each tank shall have a calibrated dipstick to show the quantity of PGAC or PGAC-E remaining in it by reading from the inspection opening cover down.

Note: Contractors should note that the presence of residual PGAC or PGAC-E of a different source, grade or type can cause significant problems with the quality and testing of PGAC or PGAC-E.

TS 1150.06.02.03 *Cold Feed System*

Bin dimensions shall be such as to provide a free flow of aggregates at all times. An individual cold feed bin shall be provided for each size, type or gradation of aggregate. Each bin shall be equipped with individual gate controls so as to provide accurate and positive proportioning. Partitions of sufficient height to eliminate intermingling of the aggregate shall be provided between adjoining bins. If the cold feed bins are being fed with a front-end loader, the width of each bin must be at least 0.5 m wider than the width of the loader bucket.

Vibratory pan feeders will not be acceptable for proportioning fine aggregates. A variable speed control will be permitted only if properly designed to give total and proportional control of the cold feed system.

TS 1150.06.02.04 *Drier*

A rotary drier, of sufficient capacity to heat the aggregate to the required temperature, shall be provided for drying and heating the aggregate.

TS 1150.06.02.05 *Control Unit*

Satisfactory means shall be provided to incorporate the required quantity of PGAC or PGAC-E into the mix. All measuring devices shall be sensitive to a 0.5 per cent variation above or below the actual mass required.

TS 1150.06.02.06 *Thermometric Equipment*

Each PGAC and PGAC-E storage tank shall be equipped with a thermometer set just above the discharge pipe. The indicator dial, graduated from 100 to 200°C in 2°C increments, shall be mounted where it is clearly visible.

The plant shall be further equipped with a thermometric instrument so placed at the discharge chute of the drier as to register the temperature of the hot aggregate, except for drum mixers where the temperature of the hot mix shall be registered. The indicator dial of this measuring device shall be clearly visible to the plant operator at all times.

TS 1150.06.02.07 *Dust Collector*

All plants shall be equipped with a primary, dry dust collection system and a wet or dry secondary dust collection system meeting current Ontario Ministry of the Environment requirements.

Normally, all dust collected shall be uniformly returned to the mix, except that dust collected in a secondary wet scrubber system shall be wasted. With the permission of the Contract Administrator, a portion of the dry dust can be wasted from the dust collection system, provided that the remainder shall be uniformly returned to the mix.

TS 1150.06.02.08 *Hot Mix Storage Bins*

If the Contractor elects to use a hot mix storage bin (silo), it shall be designed, constructed and operated so that there shall be no segregation of, or damage—hardening of PGAC or PGAC-E—to, the hot mix.

Prolonged storage, up to 20 hours, of hot mix in a storage bin (silo) is permitted, subject to the Contractor providing the Contract Administrator with a written certificate, with supporting technical data from the silo manufacturer and/or an asphalt laboratory with Canadian Council of Independent Laboratories (CCIL) Type A Certification, stating that the silo which is to be used is suitable for the intended purpose and will not damage the hot mix.

Regardless, prolonged storage of more than two hours for DFC and SMA is not permitted.

TS 1150.06.02.09 *Moisture Content of Hot Mix*

The moisture content of the hot mix, as discharged from the hot mix plant, shall be less than 0.2 per cent. The moisture content of the hot mix shall be determined according to MTO LS-282 or LS-292.

TS 1150.06.02.10 *Filler and Fibre Addition*

For SMA production, the hot mix plant shall be suitably equipped for the uniform, mechanical addition of filler and fibre, in the correct proportions.

Note: Contractors should note that practical experience indicates that satisfactory SMA production requires consistent and accurate introduction of the filler and fibre during SMA production.

TS 1150.06.02.11 *Acceptance and Uniformity*

The hot mix plant shall be designed, operated and coordinated so as to provide, as nearly as possible, continuous plant operation.

The Contract Administrator may discontinue the use of a hot mix plant(s) during the progress of the Work if the hot mix type is not produced uniformly and according to this specification. When the Contract Administrator discontinues the use of a hot mix plant(s), production will not be acceptable for City work until corrective measures, demonstrated satisfactorily to the Contract Administrator, are carried out at the Contractor's cost and location.

TS 1150.06.03 *Special Requirements for Batch Plants*

TS 1150.06.03.01 *Screens*

Screens capable of screening all aggregates to the sizes required for proportioning each type of hot mix, and having capacities in excess of the hourly capacity of the mixer, shall be provided. Screens shall have square openings and shall be kept clean. An intermediate screen shall be required for HL-8, HL-8 (HS) and LSBC mixes.

TS 1150.06.03.02 *Aggregate Storage Bins*

All plants shall have a combined hot aggregate storage bin capacity of not less than nine times the capacity of the mixer.

The plant shall contain a minimum of three hot aggregate storage bins arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each bin shall be equipped with an overflow chute to prevent any backing up of the aggregate into other bins. An oversize chute shall also be provided to prevent oversize aggregate from becoming incorporated into the mix.

Each bin shall be provided with a suitable device for obtaining test samples.

TS 1150.06.03.03 *Weigh Hopper*

The plant shall include a means for accurately weighing each bin size of aggregate in a weigh hopper suspended on scales and ample in size to hold a full batch without running over.

TS 1150.06.03.04 *Plant Scales*

Plant scales for weighing aggregates and PGAC or PGAC-E shall be of a standard make and design. Scales for weighing aggregates shall be accurate and sensitive to 0.5 per cent of the maximum load required, and shall have a positive means of balancing the tare mass of the hopper and asphalt bucket. The Contractor shall at least annually, at the Contractor's expense, verify the accuracy of the scales.

TS 1150.06.03.05 *Mixer Unit*

The plant shall include a batch mixer of an approved twin shaft pugmill type that shall be capable of producing a uniform mix within the tolerances required. The clearance of the blades from the inner surfaces of the pugmill liners shall not exceed 20 mm. The mixer shall be constructed to prevent leakage of the contents. The mixer shall be fitted with separate dry and wet mixing cycle timers and locking devices so that PGAC or PGAC-E cannot be discharged, and the pugmill gate cannot be opened, until the desired mixing times have elapsed.

TS 1150.06.04 *Special Requirements for Drum Mixing Plants*

TS 1150.06.04.01 *Aggregate Feed System*

A positive interlocked automatic shutoff shall be provided so that the plant shuts down automatically after a 15 second delay if there is any disruption in the flow of aggregate from any cold feed bin.

A vibrating screen of adequate capacity shall be provided to remove oversize aggregate and any deleterious materials from the combined cold feed.

TS 1150.06.04.02 *Control Unit*

A flow switch shall be installed in the delivery system that will automatically stop the plant if an interruption occurs in the PGAC or PGAC-E.

A PGAC and PGAC-E metering system shall be provided that will deliver the desired mass of PGAC or PGAC-E to the mixer regardless of variations in material temperature or specific gravity.

TS 1150.06.04.03 *Calibration*

The plant should be equipped with a suitable device to permit the flow of aggregates to be completely and safely diverted into a suitable hopper or directly into a bucket of a front end loader from which samples can be obtained for gradation testing. The PGAC and PGAC-E feed system shall be equipped with a calibration system that will enable the PGAC or PGAC-E to be bypassed into a container that can be weighed. Adequate scales for this purpose shall be provided by the Contractor.

The belt scale on the cold feed conveyor shall be calibrated to the scale manufacturer's tolerance at the start of the Work.

The plant shall not be operated outside the production range within which the belt scale manufacturer guarantees the accuracy of the scale.

TS 1150.06.04.04 *Mix Discharge Control*

The moisture content of the mix, as discharged from the drum, shall be according to clause TS 1150.06.02.09, herein.

The temperature of the mix, as discharged from the drum, shall be continuously recorded.

The system used to transfer the mix from the drum mixer to the hot mix storage bin or trucks or both shall be designed, constructed and operated so that there shall be no segregation of, or damage—hardening of PGAC or PGAC-E—to, the mix.

A system for wasting unacceptable mix shall be provided between the drum mixer discharge and hot mix storage bin or trucks or both.

TS 1150.07 **PRODUCTION**

TS 1150.07.01 **Preparation of the Hot Mix**

TS 1150.07.01.01 *Aggregate Stockpile Requirements*****

Before any production of a hot mix type is started, stockpiles of each size and gradation of aggregate involved shall be provided at the asphalt plant site, each sufficient for two full days' production, or the total amount, of the hot mix type involved, whichever is the lesser. After asphalt paving operations have commenced, there shall be sufficient aggregates in stockpiles before each day's asphalt paving begins for all of that day's production. The stockpiles shall be free draining and developed so as to prevent the mixing of the various aggregates.

TS 1150.07.01.02 *Handling, Feeding and Drying of Aggregates*

Feeding of material directly from any aggregate processing plant to the hot mix plant cold storage bins shall not be permitted. Aggregates shall be loaded into the cold feed bins so as to prevent the mixing of separated sizes of aggregates. Mixing of aggregates by clam, or loading of more than one type of material into a single bin, shall not be permitted. The feeding of the aggregate from the stockpile to the cold feed bin by means of a dragline shall not be permitted.

For batch plants, the aggregates shall be dried and heated in the drier and separated by screening into hot storage bins. When fed to the plant mixer, aggregates shall be at a temperature consistent with proper mixing and placing.

Surfaces of dried aggregate shall be free of carbon or unburnt fuel oil. The aggregate shall be sufficiently dried as evidenced by the lack of noticeable steaming, slumping, bubbling, or foaming of the hot mix, and the absence of any visible free water on the tailgate of truck boxes. Regardless, the hot mix shall meet the maximum allowable moisture content requirement of TS 1150.06.02.09, herein.

TS 1150.07.01.03 *Proportioning, Mixing and Temperature*

TS 1150.07.01.03.01 *General*

The proportioning and mixing of aggregates and PGAC or PGAC-E shall be of a sufficient accuracy and time to produce a uniform homogeneous mix in which all aggregate particles are thoroughly and uniformly coated.

The temperature of the mix as discharged from the hot mix plant shall be controlled to ensure that the hot mix is not overheated and will meet the compaction temperature requirement at the paver screed based on the PGAC or PGAC-E viscosity temperature relationship and/or asphalt cement supplier's recommendations.

A mix which does not comply with this specification or as specified in the Contract Documents, and a mix which cannot be incorporated in the work according to this specification or as specified in the Contract Documents shall be rejected.

TS 1150.07.01.03.02 *Requirements for DFC and SMA Mixes*

The hot mix plant shall be dedicated to DFC or SMA mix production during DFC or SMA paving operations and shall not be used to produce other hot mix types during this asphalt paving. The prolonged storage of DFC and SMA mixes in hot mix storage bins (silos) shall not be permitted.

The hot mix plant shall be cleaned out, and brought to a uniform DFC or SMA mix production, within specification, before any DFC or SMA mix is incorporated into the asphalt paving.

Note: Contractors should note that control of fine aggregate and dust at the hot mix plant is particularly important to satisfactory DFC and SMA mix production.

TS 1150.08 **QUALITY ASSURANCE**

TS 1150.08.01 **Aggregate Gradation Requirements**

Gradation test results for hot mix samples, completed by the Contract Administrator (MTO LS-282 or LS-292), shall meet the job-mix formula tolerance requirements given in Table 5.

Table 5: Tolerances on the full job-mix formula aggregate gradation

Hot mix type	Sieve size						
	37.5 – 4.75 mm	2.36 mm	1.18 mm	600 µm	300 µm	150 µm	75 µm
surface course mixes							
acceptable – up to, % :	±5.0	±4.5	±4.0	±3.5	±3.0	±2.5	±2.0
borderline							
rejectable – beyond, % :	±7.5	±7.0	±6.0	±5.5	±4.5	±4.0	±3.0
binder and levelling course mixes							
acceptable – up to, %:	±7.0	±6.0	±5.5	±4.5	±4.0	±3.0	±2.0
borderline							
rejectable – beyond, % :	±10.0	±9.0	±7.5	±6.5	±5.5	±4.0	±3.0

TS 1150.08.02 PGAC and PGAC-E Content Requirement

PGAC and PGAC-E content test results for hot mix samples, completed by the Contract Administrator (MTO LS-282 or LS-292), shall meet the job-mix formula tolerance requirements given in Table 6.

Table 6: Tolerances on the job-mix formula PGAC or PGAC-E content

all mixes, all types	acceptable – up to, %:	±0.30
	borderline rejectable – beyond, %:	±0.50

TS 1150.08.03 PGAC and PGAC-E Content, and Aggregate Gradation, Acceptance/Rejection

If the hot mix is borderline for PGAC or PGAC-E content (Table 6) or gradation (Table 5), the Contractor shall be warned by the Contract Administrator, and shall take immediate corrective action through process control at the hot mix plant. Contractors should note that a significant change in aggregate(s) gradation or properties may require a job-mix formula modification, which the Contract Administrator will, upon written request, develop and provide at the Contractor's cost.

If the hot mix is rejectable for PGAC or PGAC-E content (Table 6), or gradation for the 4.75 mm, 600 µm or 75 µm sieve sizes (Table 5), the mix represented by the test shall be removed and replaced by the Contractor with acceptable hot mix of the same type and compacted to the satisfaction of the Contract Administrator, at no extra cost to the City.

In the case of dispute, the Contractor may request, in writing with technical reasons, the Contract Administrator to undertake a coring and testing program to check the hot mix. If the rejectable hot mix is confirmed, the Contractor shall be responsible for the cost of the coring and testing program.

TS 1150.08.04 Physical Properties Requirements

TS 1150.08.04.01 *General*

Marshall compliance test results for hot mix samples, completed by the Contract Administrator (based on current MTO testing procedures, LS-263, LS-265 and LS-266), shall meet the requirements of Table 3.

Hot mix samples, incorporating an antistripping additive, shall have a minimum retained stability of 70 per cent, as determined by an immersion Marshall compliance test LS-283.

TS 1150.08.04.02 *Acceptance/Rejection*

If the hot mix physical properties do not meet the requirements of Table 3, but the air voids are within ± 1.0 per cent unit of the range given in Table 3, the Contractor shall be warned by the Contract Administrator, and shall take immediate corrective action.

If the air voids are outside ± 1.0 per cent unit of the range given in Table 3, the mix represented by the test shall be removed and replaced by the Contractor with acceptable hot mix of the same type and compacted to the satisfaction of the Contract Administrator, at no extra cost to the City. Disputes will be handled according to subsection TS 1150.08.03, herein.

TS 1150.08.05 Overheating of Hot Mix

The Contract Administrator will monitor the hot mix plant operations and hot mix temperatures to check for any potential overheating of the hot mix that may harden the PGAC or PGAC-E. The Contract Administrator may use AASHTO PP6 bending beam rheometer testing of recovered PGAC or PGAC-E to assist in this monitoring procedure. The Contractor shall immediately correct any overheating of hot mix when notified by the Contract Administrator.

TS 1150.09 OWNER PURCHASE OF MATERIAL – Not Used