The ABCs of PGAC

The Use of Performance Graded Asphalt Cements in Ontario

ONTARIO PGAC REQUIREMENTS

New Hot Mix or up to 20% RAP

Zone 1: 52-34	Zone 2: 58-34	Zone 3: 58-28
RAP > 20%:	per individual jobsite requirements	

ZONE BORDERS

Zone 1 and 2
from Georgian Bay, east along the French River, Lake Nipissing, Mattawa River to the Ottawa River

Zone 2 and 3
from Honey Harbour, south-easterly through Longford, Taylor Corners, Caven, Campbellford and Mallorytown

Note:
This bulletin (Issue 2.0) eliminates Zone 3 Optional

Asphalt pavement is used on over 95 percent of all Ontario roads. Performance Graded Asphalt Cements make it an even better choice today.

Why PGACs? Asphalt cement contributes up to one-third of a pavement's rutting resistance, over half of the fatigue crack resistance and almost 90% of low temperature cracking performance. Specifying the right asphalt cement is essential.

PGACs are also an essential component of Superpave™ and Superpave is now the guiding force in pavement design.

Superpave is the product of the Strategic Highway Research Program's 5-year, $150 million research program. To improve the performance and durability of pavements it integrates:

- PGAC selection and specification
- Volumetric mix design system
- Mix performance prediction system

Using PGACs is an important first step in Superpave implementation.

PGAC implementation has been endorsed by all the key industry organizations and associations including the Ontario Ministry of Transportation, Ontario Good Roads Association, Municipal Engineers Association, Consulting Engineers of Ontario, Canadian Council of Independent Laboratories, Ontario Road Builders Association, the Ontario Hot Mix Producers Association and the asphalt cement suppliers. The industry is geared up for full production of PGACs in 1998.

This guide provides key information on how to select, order and test PGACs and how to use them with Superpave design methods.

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SELECTING PGACs

PGACs are specified based on temperature conditions, traffic loading and whether or not recycled materials are used in the hot mix. These are performance based criteria designed to improve durability and in particular, to reduce thermal cracking.

Temperature – PGAC specifications are defined by temperature extremes.

The first number of the PG designation specifies the maximum design temperature; the second specifies the minimum design temperature.

A PG 58-28, for example, meets the average 7-day maximum pavement design temperature of 58°C and the minimum design temperature of -28°C.

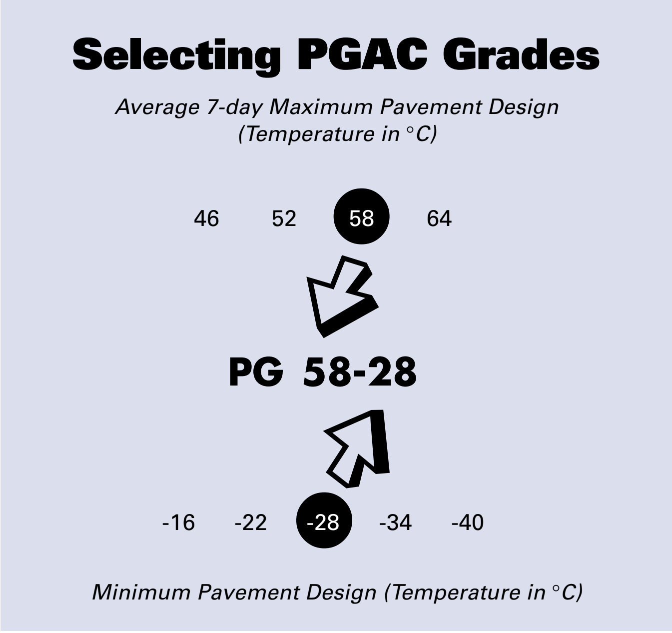
Design temperatures for PGACs are in increments of 6 degrees.

Reliability – Minimum and maximum temperatures are based on historical data provided by weather stations but how reliable is that data? What if temperatures exceed historical trends? PGAC specifications take that into account.

Design temperatures are based not just on historical data but also on the reliability of that data to predict future performance requirements. A 98% reliability, for example, means that over the design life of the pavement, there would be less than a 2% chance that temperatures could exceed the seven day average maximum or minimum temperature.

Ontario PGAC specifications are based on 98% reliability.

The Ontario Zones – The Ontario Ministry of Transportation in consultation with all the industry stakeholders has designated three Ontario zones each with its own specific grade of PGAC. These zones are based on the best available weather data and new Long Term Pavement Performance (LTPP) studies with due consideration for the practicalities of Ontario geography.



Recycling – Ontario's leadership in recycled pavements will continue with PGAC specifications that allow for and encourage recycling.

The grade of PGAC is determined by the recycled asphalt pavement (RAP) content of the mix and the design temperature required. Grade changes are not required if up to a maximum of 20% RAP is used in the mix.

Traffic – PGAC specifications also take traffic conditions into account. The PGAC designations for the three Ontario zones shown on the map are for normal traffic conditions on roads other than expressways and freeways.

For superior rutting resistance, the maximum design temperature (the first number) for slow moving traffic or extraordinarily high numbers of heavy loads increases by one grade.

An asphalt cement in London, for example, increases by the 6 degree increment from PG 58-28 for normal traffic to PG 64-28 under slow moving traffic conditions. Because of the high number of heavy loads, this same adjustment also applies to Highway 401 in the London area.

For roadways with a high percentage of heavy truck traffic at slow speeds and frequent stops and starts, increasing by two grades should be considered.

Grade Equivalency – Ontario PGAC grades replace the penetration grading system and this is specifically to improve the performance of pavements.

For simple comparative purposes, 85/100 is similar to PG 58-22; 150/200 to PG 52-28; 200/300 to PG 52-34; and 300/400 to PG 46-34.

SPECIFYING PGACs

For MTO projects, specification requirements for the properties and use of the various grades of PGAC are given in the MTO Non-Standard Special Provision Amendment to OPSS 1101 "Performance Graded Asphalt Cement (PGAC)". Suppliers of PGAC must be listed as an asphalt cement supplier in the MTO's Designated Sources for Materials Manual (DSM).

Municipalities should:

- Specify the PGAC grade required
- Include a clause stating that the PGAC will "conform with the MTO Non-Standard Special Provision Amendment to OPSS 1101" for the specified grade.

This will ensure that the specified grade of PGAC is obtained from a supplier on the MTO's DSM for PGACs.

SUPERPAVE ASPHALT CEMENT TESTS

Test	Properties
Rolling Thin Film Oven Test (RTFOT) Pressure Aging Vessel (PAV)	Aging in hot mix production and in-service oxidation
Dynamic Shear Rheometer (DSR)	Intermediate and high temperature tests for permanent deformation and fatigue cracking
Rotational Viscometer (RV)	High temperature handling, pumping and mixing
Bending Beam Rheometer (BBR) Direct Tension Test (DTT)*	Low temperature crack resistance

**DTT is not routinely used in Ontario*

Performance Graded Asphalt Binder Specifications and Testing Superpave Series #1 (SP-1), Asphalt Institute, 1994

TESTING PGACs

PGACs are evaluated by comparing performance-based test results to limits outlined in AASHTO Provisional Standard Specification MP1, *Performance Graded Asphalt Binder.*

SUPPLIER QUALITY CONTROL

To be listed in the MTO's Designated Sources for Materials Manual, suppliers of PGAC must meet the provisions detailed in MTO's *Requirements and Procedures Related to the Supply of Performance Graded Asphalt Cements.*

Each supplier must have a quality control program in-place describing the methods and frequency of testing, details on reporting and documentation and plans for dealing with non-conforming materials.

QUALITY ASSURANCE

Quality control and quality assurance testing of PGACs on MTO contracts is conducted in accordance with a Non-Standard Special Provision. The provision stipulates the basis for product acceptance, lot size, sample size and laboratory proficiency requirements.

Quality control testing is contract-specific and is in addition to the supplier's own QC testing. A minimum of one complete compliance test per lot is required. Acceptance is based on test results provided by the contractor.

Quality assurance testing is at MTO's discretion but, if required, will likely be at a reduced frequency (e.g. one test for every two QC tests).

Lot Size – For MTO contracts, the number of QC tests and samples required are based on the total quantity of hot mix. The hot mix contract quantity is divided into lots of 10,000 tonnes each. Each lot has two sub-lots of 5,000 tonne increments.

A separate QC test must be provided for each lot. Three samples are taken from each sub-lot. On MTO contracts, each sub-lot requires a separate one-litre sample for QC, QA and referee testing if required.

Additional QC tests are not required for different mix types as long as the same PGAC grade is used throughout the contract.

On municipal contracts, usually supplier QC testing and inclusion on the MTO's DSM will be sufficient. If the municipality does quality assurance testing, typically one sample per week on larger contracts will be sufficient.

Note that regardless of these guidelines, for MTO and municipal projects, specific contract requirements prevail.

SUPERPAVE MATERIAL SELECTION

SHRP's Superpave system has three interrelated parts:

- PGAC selection and specification
- Volumetric mix design system
- Mix performance prediction system

While fatigue cracking and low temperature cracking are more a function of asphalt cement properties, there is general agreement that aggregate properties play the central role in overcoming asphalt pavement permanent deformation or rutting.

Pavement experts agree that certain aggregate characteristics are critical to hot-mix asphalt performance. These characteristics, called "consensus properties", include gradation, coarse aggregate angularity, fine aggregate angularity; flat and elongated particles; and plasticity (clay fines). Criteria for these consensus properties are based on traffic level and position within the asphalt pavement structure. Appropriate aggregate consensus properties and tests are still being refined.

Aggregate characteristics that are source specific, called "source properties", include toughness, soundness and deleterious materials. Specific values are recommended and established by agency experience. These properties are relevant during the mix design process and may be used for aggregate source acceptance control. There has been considerable work completed in Ontario to provide aggregates meeting SHRP requirements.

As well as the consensus and source properties that SHRP researchers identified, they also developed a new way of specifying aggregate gradation. The 'design aggregate structure' ensures particle to particle contact and interaction.

The gyratory compactor is also a key component of the Superpave mix design method. It densifies the hot-mix asphalt mixture using a kneading action to simulate compaction equipment and traffic effects at the job site.

SUPERPAVE VOLUMETRIC MIX DESIGN

The Superpave volumetric mix design system for hot-mix asphalt is at the early evaluation stage in Ontario (MTO, Frontenac County and Toronto Transportation have already completed field trials).

Superpave volumetric mix design requirements are still being refined. Performance testing and analytical requirements for rutting, fatigue cracking and thermal cracking resistance are to be finalized.

It will be several years before Superpave volumetric mix design replaces the well-known Marshall method of mix design. However, Ontario's vast practical experience with the Marshall method and with satisfactory mixes will be a key supplement to the new system once it is introduced.

INTRODUCING PGACs IN ONTARIO

Longer lasting, better performing and more durable roads benefit everyone. As an essential component of Superpave, Performance Graded Asphalt Cements are a major advance in road design and performance in Ontario.

Achieving consensus in any industry is not always easy. For PGACs, however, implementation has been endorsed by all the key industry organizations and associations including the Ontario Ministry of Transportation, Ontario Good Roads Association, Municipal Engineers Association, Consulting Engineers of Ontario, Canadian Council of Independent Laboratories, Ontario Road Builders Association, Ontario Hot Mix Producers Association and the asphalt cement suppliers.

The Ontario asphalt industry geared up and fully converted to PGAC production for 1998. Every asphalt specifier in Ontario should take advantage of the considerable benefits both PGAC and Superpave offer.

It's for the good of our roads. It's for the good of our industry.

This information bulletin is provided by the Ontario Hot Mix Producers Association on behalf of the industry's Hot Mix PGAC Education Committee.

We have made every effort to ensure that the information is complete and accurate. However, this is for information only and all contract and design requirements for specific jobs should be verified by qualified personnel.

Any questions, comments or suggestions, please contact us at 905-507-3707.

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Superpave Mix Design System Schematic

1. Material Selection

1.1 Aggregates

Consensus Properties
- Gradation
- Coarse aggregate angularity
- Fine aggregate angularity
- Flat and elongated particles
- Clay content

Source Properties
- Specific gravity
- Toughness
- Soundness
- Deleterious properties
- Other

1.2 Performance Grade Asphalt Cement

PGAC is selected according to high/low pavement design temperatures and traffic
example: PGAC 58-28

58 indicates avg. 7-day high temperature (°C) at 20mm depth

-28 indicates 1-day minimum temperature (°C) at surface

2. Selection of Design Aggregate Gradation

Establish Trial Blends
1. Develop three blends (gradation) meeting the requirements for gradation, nominal sieve size, control points and restricted zone plotted on the FHWA chart

Gyratory Compactor
2. Compact mixture and determine the height of the specimen versus number of gyrations
3. Determine air voids, voids in mineral aggregate, voids filled with asphalt and dust proportion at 4% air voids
4. Compare properties to Superpave criteria and select most promising aggregate blend

3. Selection of Design PGAC Content
1. Compact selected aggregate blend in gyratory compactor for a range of PGAC contents (at estimated optimum PGAC, -0.5%, +0.5% and +1.0%)
2. Determine air voids, voids in mineral aggregate, voids filled with asphalt
3. Plot mixture properties versus PGAC content and determine PGAC content at 4% air voids
4. Compare mixture properties to Superpave criteria at 4% air voids

4. Evaluate Moisture Sensitivity *(Stripping Resistance)*

Superpave Mix Design Series #2 (SP-2), Asphalt Institute, 1996