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## *PG binders, Taking the mystery out of the numbers*

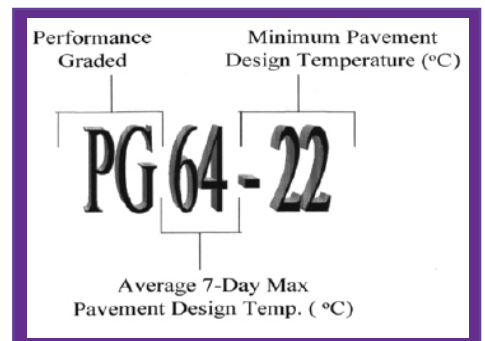
The Performance Graded (PG) system is a method of measuring asphalt binder performance. It was originally developed during the Strategic Highway Research Program (SHRP) in the early 1990's.

The Superpave™ performance grading (PG) specification classifies asphalt binders into performance grades that change at 6°C intervals according to the service climate. Examples of typical asphalt binder PG grades used may be PG 58-28, PG 58-34, PG 64-22, PG 64-28, PG 64-34, and PG 76-28. Specification parameter values used to determine the PG grade of an asphalt binder do not change with climate. However, measured value of specification parameters (higher/lower than the max/min specified parameter value) that result in PG grade change of less than 6°C do not change the PG grade. For example, an asphalt binder that has a true grade (also called continuous grade) anywhere in the range of PG 64.0-28.0 to PG 69.9-33.9 is classified as a PG 64-28.

### **WHAT DO THE NUMBERS MEAN?**

PG asphalt binders are selected to meet expected high temperature and low temperature extremes with a certain level of reliability. This increases the resistance to permanent deformation or rutting at high temperatures and increases the resistance to transverse thermal cracking at low temperatures.

An example of a performance graded binder is PG 64-22. PG indicates that it is a performance graded binder. The first number (64) indicates that the binder meets high temperature physical properties up to 64 degrees Celsius. The last number (-22) indicates the



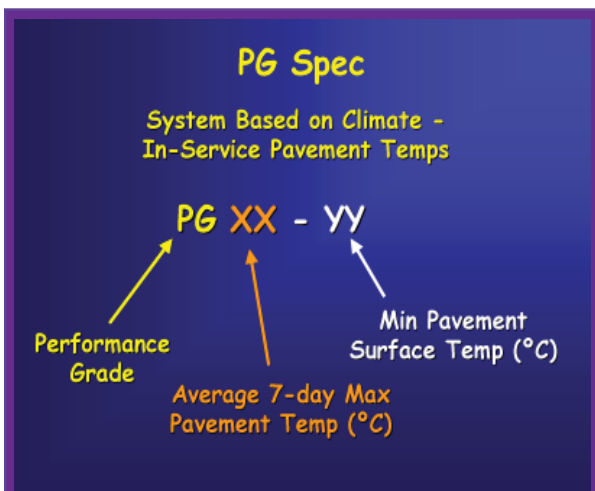
# The Asphalt RAP

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binder meets low temperature physical properties down to -22 degrees Celsius. A level of reliability can be determined for a binder selected for use in a particular area using temperature data from a weather station in the area. The level of reliability deemed necessary will need to be determined by the specifying agency. The main purpose of classifying and selecting asphalt binders using the PG system is to make certain that the binder has the correct properties for a given environment. Asphalt binders are most commonly characterized by their physical properties. An asphalt binder's physical properties directly relate to field performance. Although asphalt binder viscosity grading is still common, new binder tests and specifications have been developed to more accurately characterize temperature extremes which pavements in the field are expected to withstand. These tests and specifications are specifically designed to address three specific pavement distress modes: permanent deformation (rutting), fatigue cracking, and low temperature cracking. Performance grading is based on the concept that asphalt binder properties should be related to the conditions



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under which the binder is used. PG asphalt binders are selected to meet expected climatic conditions as well as traffic speed and volume adjustments. Therefore, the PG system uses a common set of tests to measure physical properties of the binder that can be directly related to field performance of the pavement at its service temperatures. For example, a binder identified as PG 64-22 must meet performance criteria at an average seven-day maximum pavement temperature of 64°C and also at a minimum pavement temperature of -22°C.

Although more expensive than unmodified binder, using polymer modified binder in hot mix asphalt (HMA) can provide improved performance and durability for sensitive climate and traffic conditions. While unmodified binder is adequate for most

Colorado		
1996	Unmodified	Modified
	>64-22	>64-28
	>58-28	>70-34
	>58-22	>76-28
		>58-40
.....		
Currently	>64-22	>64-28
	>58-28	>76-28
	>58-34	>58-34

*PG 58-34 may or may not be modified depending on the supplier and crude stock used during manufacturing*



applications, improved resistance to rutting, thermal cracking, fatigue damage, stripping, and temperature susceptibility have led polymer modified binders to be specified for some applications.

## How do we determine what PG binder to use?

In Colorado, there is the need for 15 different binders based on climatic conditions. Manufacturing 15 different binders is impractical at best. The available binders in Colorado has been narrowed down to the five most common binders (see table previous page).

## Using an Alternative PG binder:

If you are contemplating the need to change a PG binder for a particular project, several issues should be considered regarding pavement performance. The designer should evaluate the engineering alternatives and determine ways to compensate for using a different PG binder.

## Risk of distress:

**Rutting** – Permanent deformation (or rutting) of asphalt pavements has been virtually eliminated in Colorado through the use of Superpave mixes and PG asphalt binders. Mix selection is a primary contributing factor to rutting resistance. The use of a higher gradation mix (100 gradation) and more stringent aggregate and mixture requirements can compensate for using an unmodified asphalt binder in lieu of a modified asphalt to resist rutting.

**Oxidation, weathering, raveling** – Surface durability is primarily a function of mix selection and mixture design as compared to PG binder grade selection. In Colorado, finer graded mixes with higher asphalt binder contents provide an increased ability to withstand surface deterioration related to oxidation, weathering, and raveling.

**Transverse cracking** – Proper PG binder selection is critical to withstand low temperature (thermal) cracking. The PG asphalt binder is the primary mix component to withstand transverse cracking. If a different grade of PG asphalt binder is selected, the result could be an increased occurrence of transverse cracking and the need for crack filling and sealing.

No matter what the goal it will be imperative the designer understand what the specifier needs and the importance of the items discussed as not all of them can be achieved.

In the event the grade of binder which will give the designer a 98% reliability level is not available, the next grade will most likely give at least a 50% or better reliability level based on the PG system which changes grades on 6 degree Celsius increments.



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## What are the risks in placing HMA using a binder which has a temperature number different than recommended?

The HMA may crack or deform prematurely requiring maintenance earlier than otherwise planned. Knowing this, the risk is most likely less than leaving a surface without a structural course for an extended period of time allowing for fatigue of the pavement section to take place.

## Are there ways to mitigate the impacts of a PG binder grade change? YES!

As previously discussed, using sound engineering and design practices. The designer must look at all aspects of materials used, structure of the HMA and understand the binder grade which will be utilized in the design.

A binder with a moderate number for the high or low temperature will perform relatively well if the structure of the HMA is designed knowing the binder may be one grade low for the high temperature, or one grade high for the low temperature. The issues will be how much deformation from high temperatures or what amount of cracking from low temperature will be acceptable to the owner?

Generally one of the PG Binder properties can be met when choosing a PG Binder, and the designer will only have to deal with adjusting the properties to resist one of the two properties, in most cases the issue will be adjusting for low temperature cracking.

## How do we engineer and design the HMA pavement?

The longevity of an HMA pavement is directly related to the engineering and design principles used, I.E. aggregate selection, traffic levels, maintenance, and design parameters, in addition to what binder is selected to be a part of the pavement.

The information in this publication was Authored by Tom Clayton, SET, Director of Training, and Tom Peterson, P.E., Executive Director, Colorado Asphalt Pavement Association and compiled from several sources including the FHWA, Colorado Department of Transportation, CalTrans, Asphalt Institute, Colorado Asphalt Pavement Association, and National Asphalt Pavement Association.

