Superpave Technology

- The Superpave is the acronym for 'Superior Performing Asphalt Pavements' system
- It is the product of the Strategic Highway Research Program of USA
- It gives highway engineers and contractors the tools they need to design asphalt pavements that will perform better under extremes of temperature and heavy traffic loads

- Superpave includes a new mixture design and analysis system based on performance characteristics of the pavement.
- It is a multi-faceted system with a tried approach to designing asphalt mixtures based on desired performance.
- Using the Superpave system, materials and mixes can be designed to reliably perform under any conditions of load and environment.

- Superpave system primarily addresses three pavement distresses

1. Permanent deformation, which results from inadequate shear strength in the asphalt mix at high pavement temperatures
2. Fatigue cracking, which occurs mainly because of repeated traffic loads at intermediate pavement temperatures
3. Low temperature cracking, which is generated when an asphalt pavement shrinks and the tensile stress exceeds the tensile strength at low pavement temperatures

Benefits of Superpave

- Superpave technology offers significant potential for mitigating pavement performance problems such as extreme temperatures, environmental conditions, traffic impacts of transit operations, and frequent stopping and turning maneuvers
- Superpave improves the correlation between material properties and pavement performance
- It evaluates the binders' abilities in resisting rutting, fatigue and low temperature cracking based on their rheological properties at the anticipated pavement temperatures.

Technology

- The Superpave system consists of three interrelated elements :

1. Asphalt binder specification
2. Volumetric mixture design and analysis system
3. Mix analysis tests and a performance prediction system that includes computer software

Asphalt Binder Grading System

- The Asphalt binder grading system in Superpave is called the performance grading (PG) system.
- All PG Binders are characterized based upon fundamental engineering parameters.

1. It accounts for the impact of climatic factors on binder characteristics at both the hot and cold temperature regimes
2. In addition to climatic conditions, traffic and aging control the performance of the pavement.

Simulation of Conditions

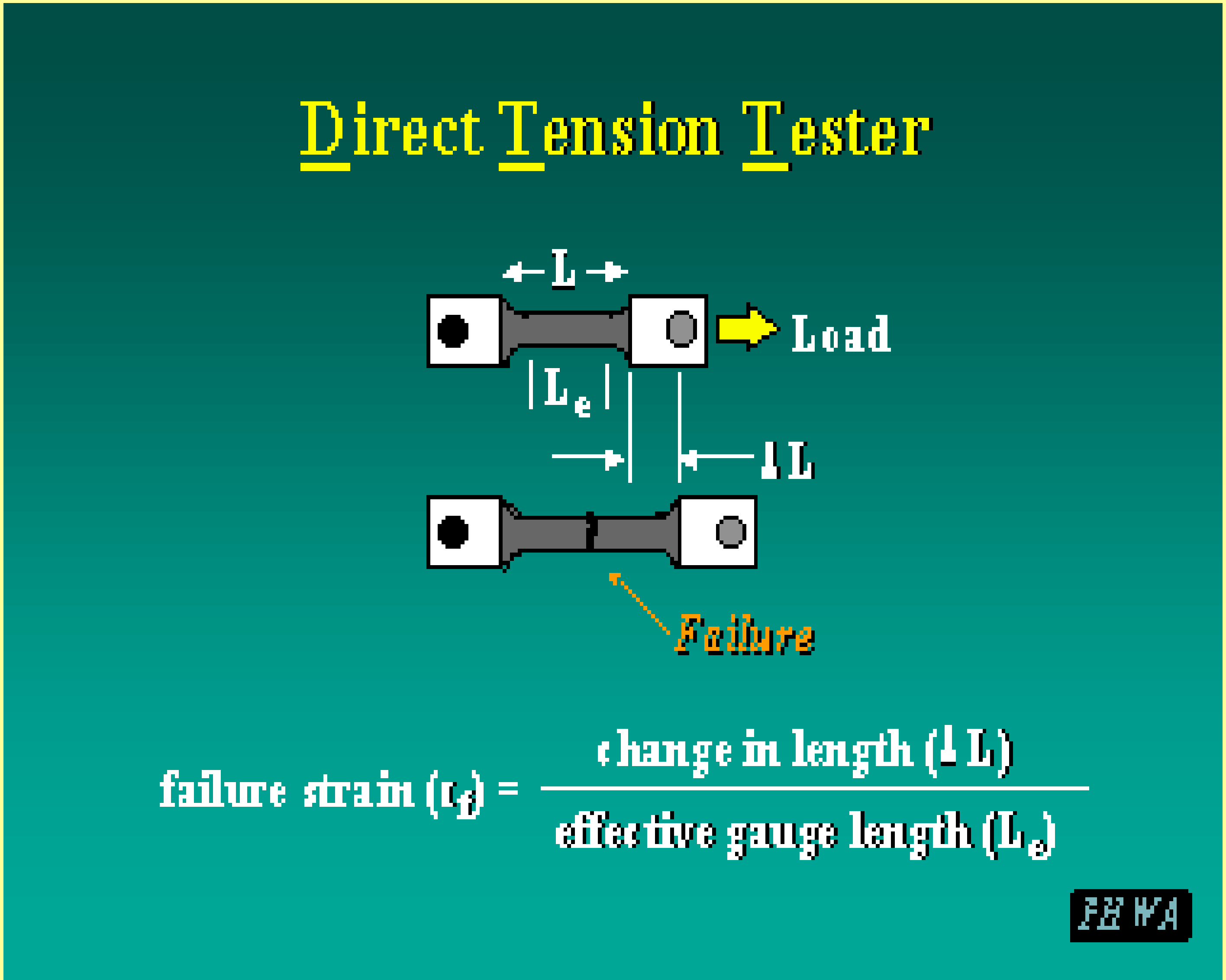
- To simulate climatic conditions, testing is conducted at three pavement temperatures: hot, Intermediate and cold pavement temperatures.
- To simulate traffic conditions, an average rate of loading was assumed for normal highway speeds. Heavy traffic conditions ma be addressed by selecting a binder corresponding to higher temperatures.
- To simulate binder aging, a new rolling thin film oven procedure is used which allows for rapid aging/oxidation of an asphalt binder.

- Superpave binders are designated with a "PG" (performance grade) rating.
- The first number in the rating indicates the high-temperature grade; the second indicates the low-temperature grade.
- For example, a binder classified PG58-28 would meet the required physical properties at pavement temperatures as high as 58 degrees C and as low as -28 degrees C.
- The mix designer selects a Superpave binder based on the climate in which the pavement will serve and the traffic it will bear.

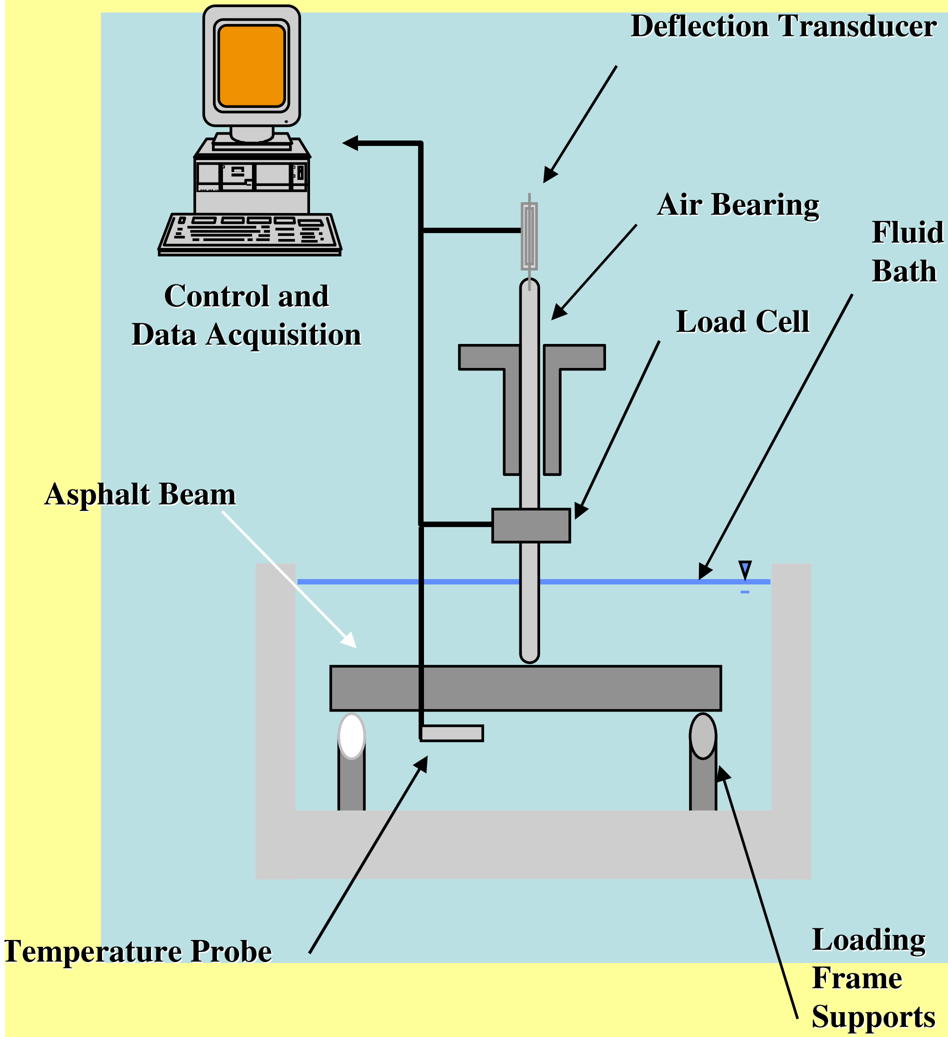
Tests for PG grading

- Direct tension test
  - Measures resistance of asphalt to thermal cracking
- Bending beam test
  - Measures critical stiffness at which the asphalt becomes brittle and susceptible to thermal cracking
- Pressurized Aging Vessel (PAV)
  - In order to simulate the most severe case, the thermal cracking analysis is conducted using the asphalt which has gone through the accelerated aging process using the PAV
- Dynamic shear test
  - Used for fatigue and rutting characterisation with shear modulus parameter (G*)
  - For fatigue characterisation, the binder is aged through PAV process
  - For rutting characterisation, the binder is aged through Rolling Thin Film Oven test

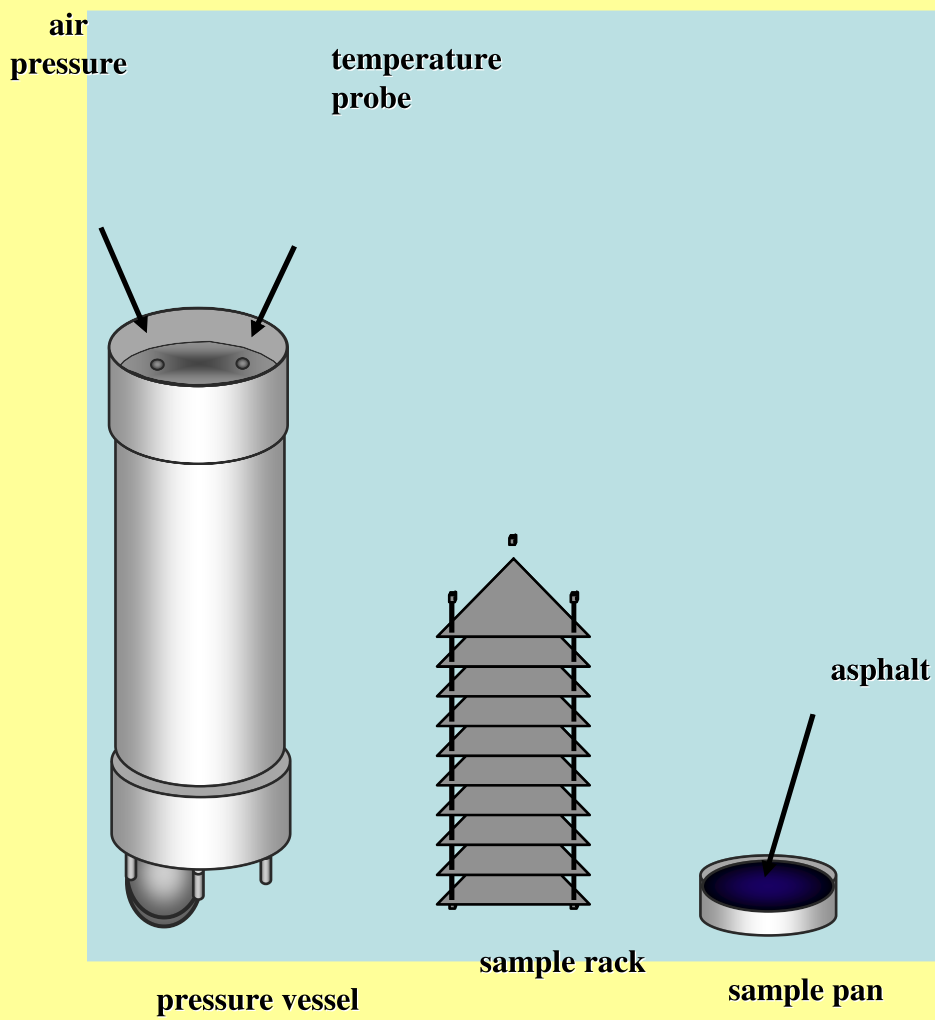
Direct Tension Tester



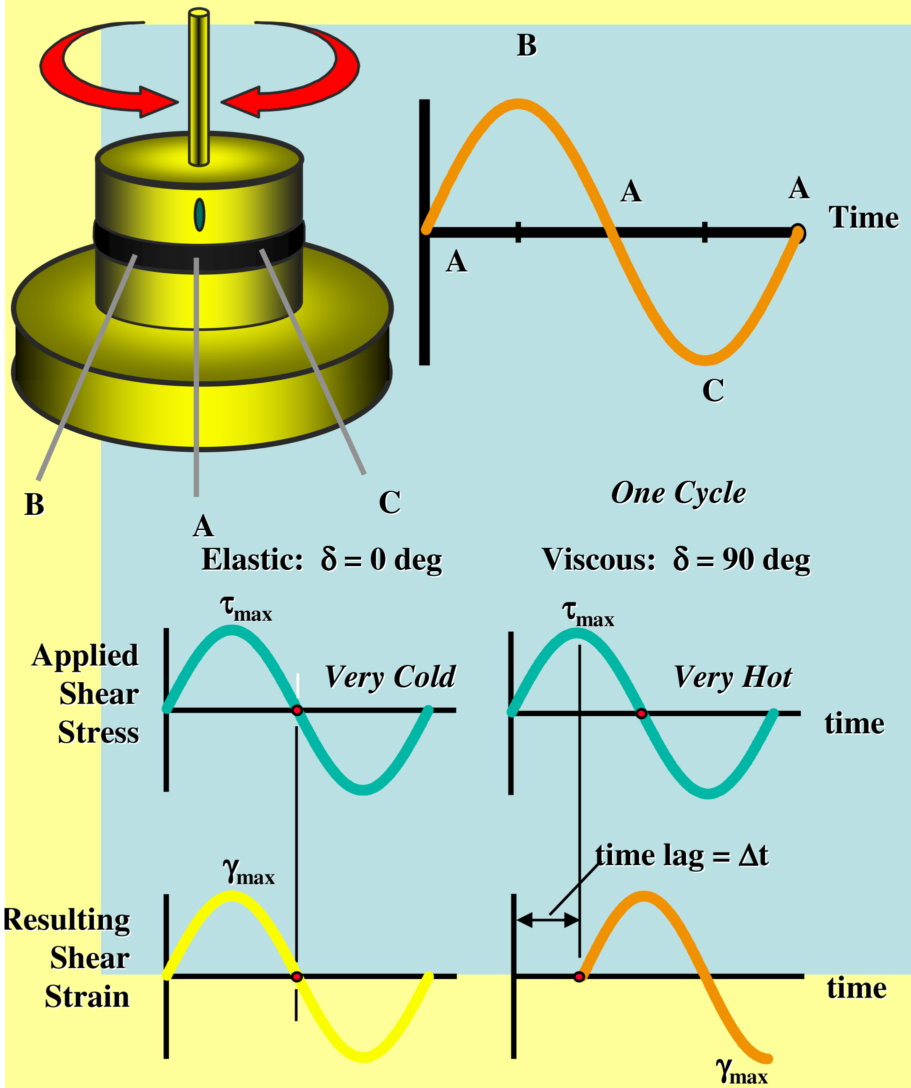
Bending Beam Rheometer



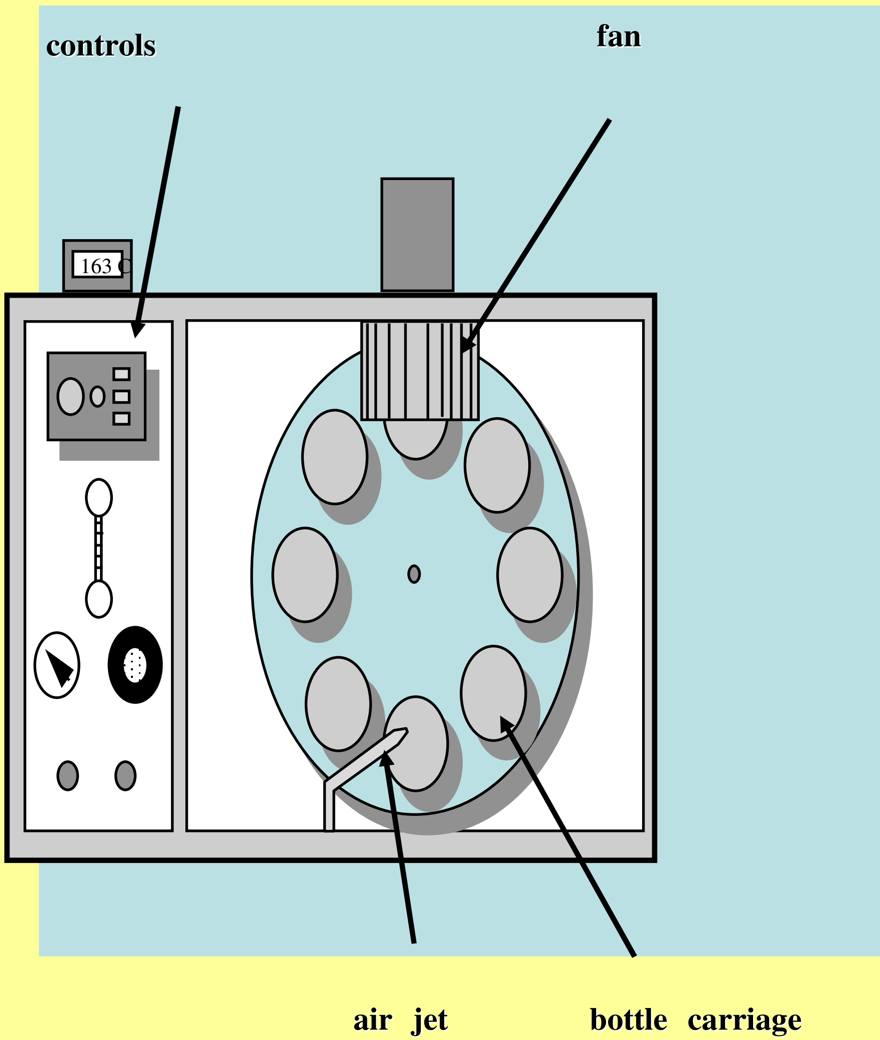
Pressure Aging Vessel (PAV)



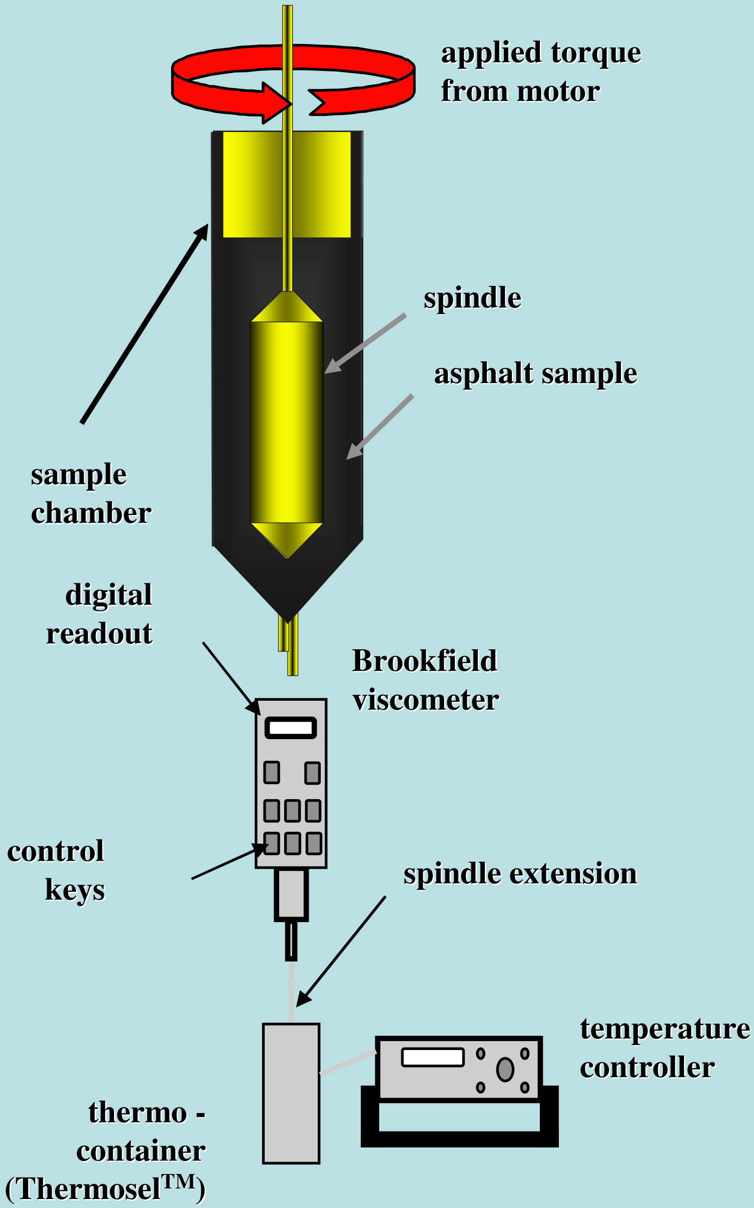
Dynamic Shear Rheometer



Rolling Thin Film Oven (RTFO)



Rotational Viscometer (RV)



Equipment	Purpose	Performance Parameter	Testing Procedure	Price Range (Rs)
Rolling Thin Film Oven (RTFO)	Simulate binder aging during HMA production and construction	Resistance to aging during construction	AASHTO T240 ASTM D2872	4,00,000 - 4,50,000
Pressure Aging Vessel (PAV)	Simulate binder aging during HMA service life	Resistance to aging during service life (5- 10 years)	AASHTO PP1	6,00,000 – 7,50,000
Rotational Viscometer (RV)	Measure binder properties at high construction temperatures	Handling and pumping	ASTM D4402 AASHTO TP48	2,50,000 – 2,75,500
Dynamic Shear Rheometer (DSR)	Measure binder properties at high and intermediate temperatures	Resistance to permanent deformation (rutting) and fatigue cracking	AASHTO TP5	15,00,000 – 17,50,000 (Specification Version)
Bending Beam Rheometer (BBR)	Measure binder properties at low service temperatures	Resistance to thermal cracking	AASHTO TP1	10,00,000 – 12,50,000
Direct Tension Tester (DTT)	Measure binder properties at low service temperatures	Resistance to thermal cracking	AASHTO TP3	25,00,000 -27,25,000

Specifications for Binders

Superpave Specification limits for Rutting
Superpave Binder Specification
Average 7 day Maximum pavement design Temperature,^{0}C
Minimum Pavement design Temperature, ^{0}C
Flash Point Temperature, T48:minimum, ^{0}C
Viscosity, ASTM D 4402: Max, 3-pa-s(3000cp).Test Temp ^{0}C
Dynamic Shear, TP5 Minimum, 1 kPa Test Temp@10rad/s
Rolling Thin Film Oven (T240)
Mass Loss, Maximum, %
Dynamic Shear, TP5 Minimum, 2.2 kPa Test Temp @10rad/s

Superpave Specification limits for Fatigue Cracking
Superpave Binder Specifications
PAV Aging Temp, ^0C
Dynamic Shear, TP5 Maximum, 5000 kPa Test Temp@10rad/s, ^0C
Physical Hardening
Creep Stiffness TP1: S, Maximum, 300 Mpa M-value, minimum, 0.300 Test Temp@60 sec, ^0C
Direct Tension, TP3: Failure Strain, min 1% Test Temp@1 mm/min, ^0C

Superpave Specification Limits for Thermal Cracking

Superpave Binder Specifications
PAV Aging Temp, ^{0}C
Dynamic Shear, TP5 Maximum, 5000 kPa Test Temp@10rad/s, ^{0}C
Physical Hardening
Creep Stiffness TP1: S, Maximum, 300 Mpa M-value, minimum, 0.300 Test Temp@60 sec, ^{0}C
Direct Tension, TP3: Failure Strain, min 1% Test Temp@1 mm/min, ^{0}C

Superpave Asphalt Binder Grades

High Temp Grades	Low Temp Grades
46	-34,-40,-46
52	-10,-16,-22,-28,-34,-40
58	-16,-22,-28,-34,-40
64	-10,-16,-22-28,-34,-40
70	-10,-16,-22-28,-34,-40
76	-10,-16,-22-28,-34
80	-10,-16,-22-28,-34

Hot Temp   Cold Temp