An Introduction to Modified Asphalt Binders

Presented by:

3 Hour Short Course 2019

Handling Modified Binders
Contractor's View

Presented By:
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Prepared for the Association of
Modified Asphalt Producers
Training Program

Handling Modified Asphalts

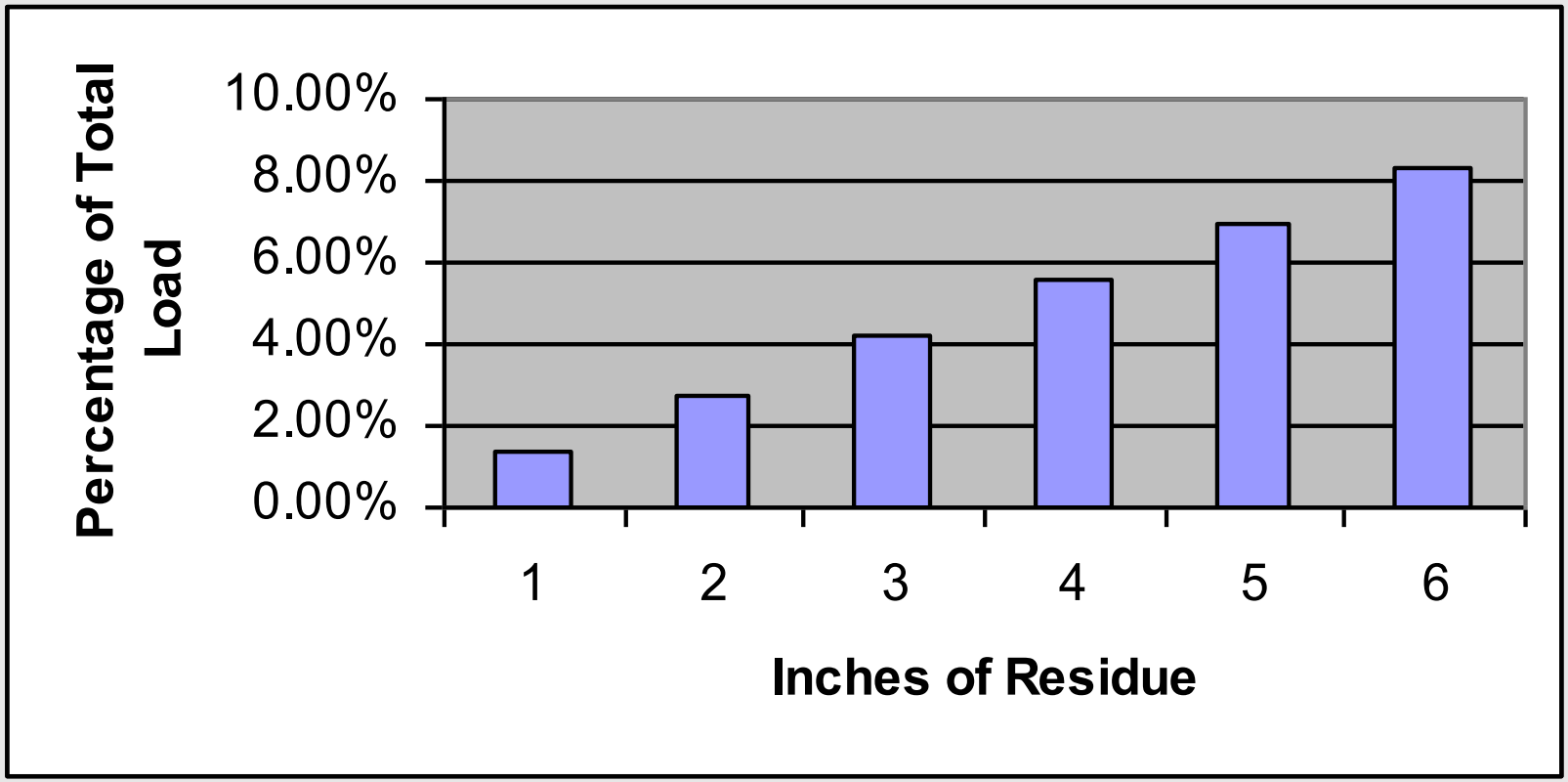
Handling Modified Asphalts

- Between 5-20% of all asphalts are currently modified
- Most modified binders are in the PG 64-28 to 76-22 range
- Be safe and follow manufacturer's recommendations

Handling Modified Asphalts

- Mixing PMA with other asphalts can cause the asphalt to fail to meet the PG grade requirements
- Reduce contamination at the terminal
  - Tanker truck empty before loading at terminal
  - Load from correct loading arm at terminal

Residue as % of Load



Handling PMA at the Plant

- Reduce contamination at the HMA plant
  - Pump into correct tank at HMA plant
  - Use dedicated tanks, if possible
  - If dedicated tank is not available
    - Empty tank as much as possible if previous material was different
    - Add 2 or 3 full loads of PMA before testing and/or using the material in the tank
- Diluted PMA may fail PG grade!!!

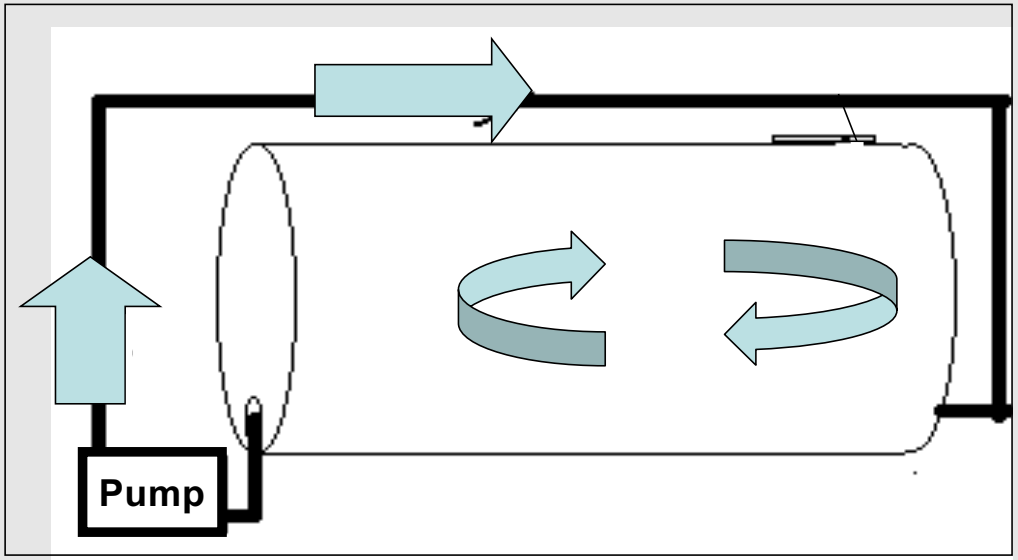
Handling PMA at the Plant

- Vertical tanks
  - Vertical tanks provide more efficient agitation
  - Very few PMAs requires agitation to prevent separation
  - Agitation is recommended for GTR modified asphalt
  - Check with supplier
- Check and maintain proper temperatures

Handling PMA at the Plant

- Horizontal Tanks
  - Horizontal tanks work fine for most PMAs
  - Circulate to achieve uniform temperatures above and below heating coils

Proper Circulation in Horizontal Tanks



- Suction and return lines at opposite ends of tank to completely circulate material
- Return line near bottom of tank to prevent oxidation

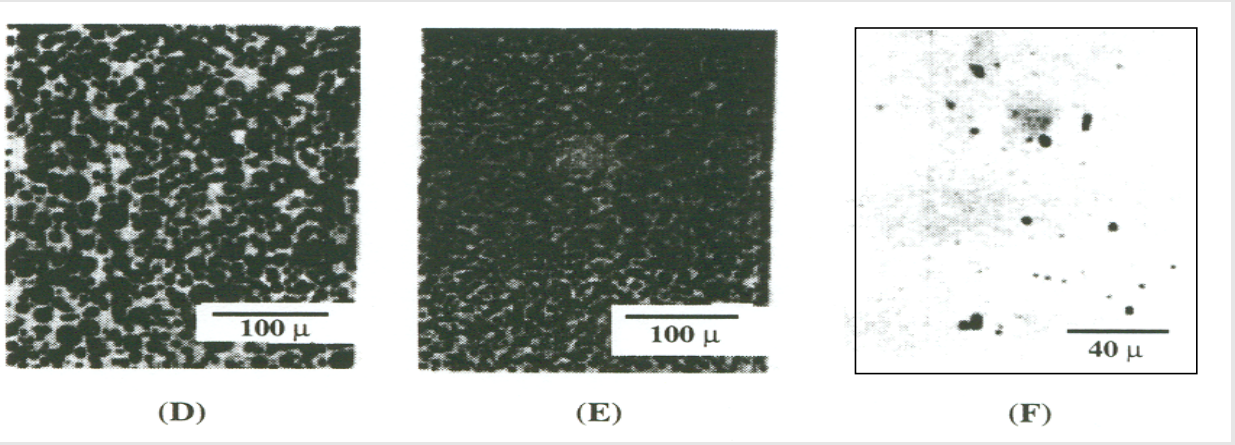
Handling PMA at the Plant

- **BEWARE OF MIXING MODIFIED ASPHALTS FROM DIFFERENT SUPPLIERS!!!**
  - Different suppliers may use different polymer technologies
  - Differing technologies may not be compatible
  - Polymer separation may occur

Handling PMA at the Plant

- **BEWARE OF USING DIRECT-FIRE HEATERS WITH MODIFIED ASPHALTS!!!**
  - Direct-fire heat tubes may develop hot spots
  - Hot spots will immediately destroy the polymer network in the asphalt

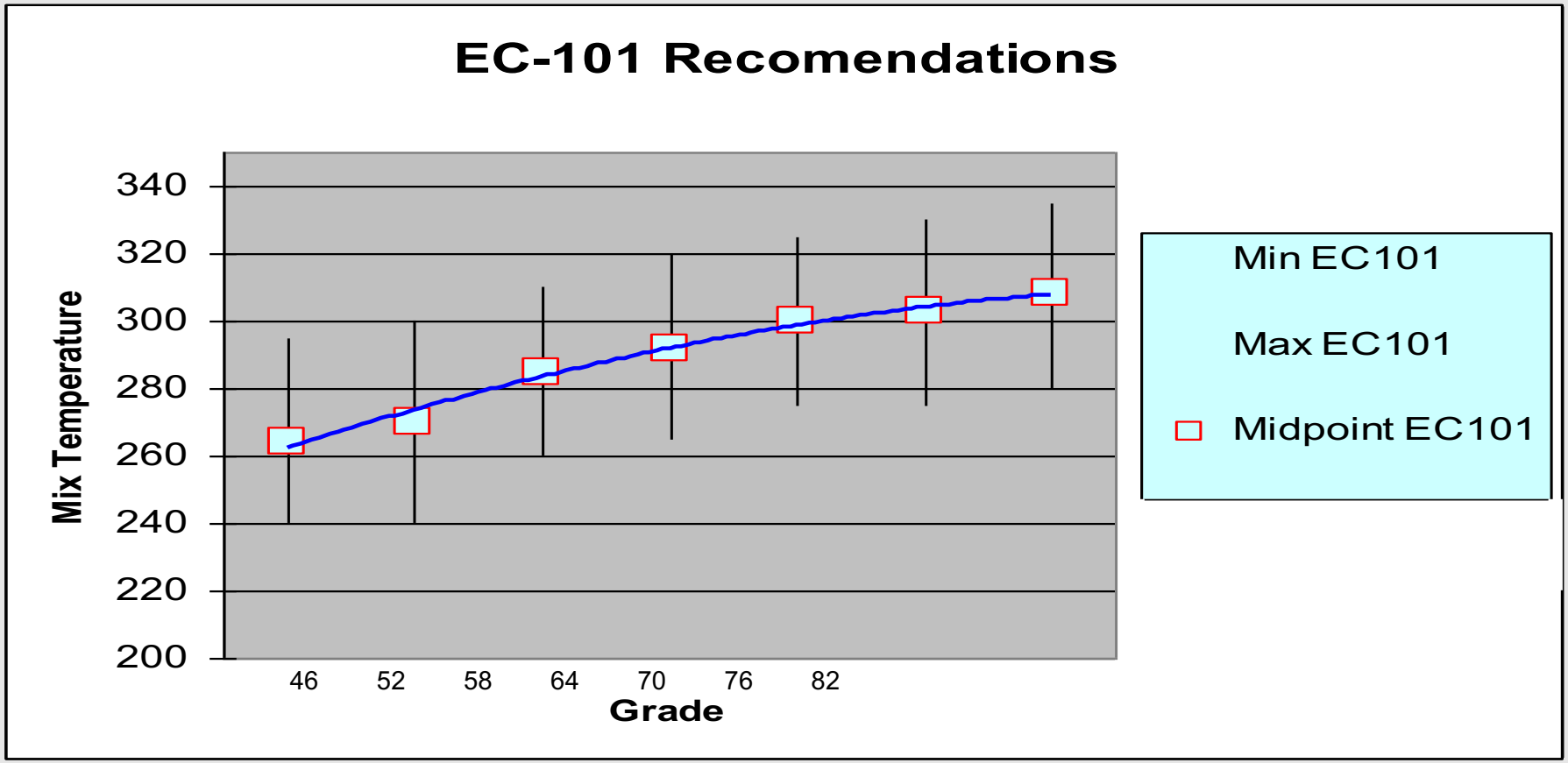
Effect of Mixing Time and Temperature



Fluorescence micrographs showing the effect of time and temperature on the compatibility of a 10% SBS/ 10% Aromatic Oil/ 80% asphalt binder
(D) 430 °F 1 hour
(E) 430 °F 4 hours
(F) 430 °F 7 hours

Ref: B Brule, Y Brion and A. Tanguy, Asphalt Paving Technology 60, 43 (1991)

EC-101 Recommendations



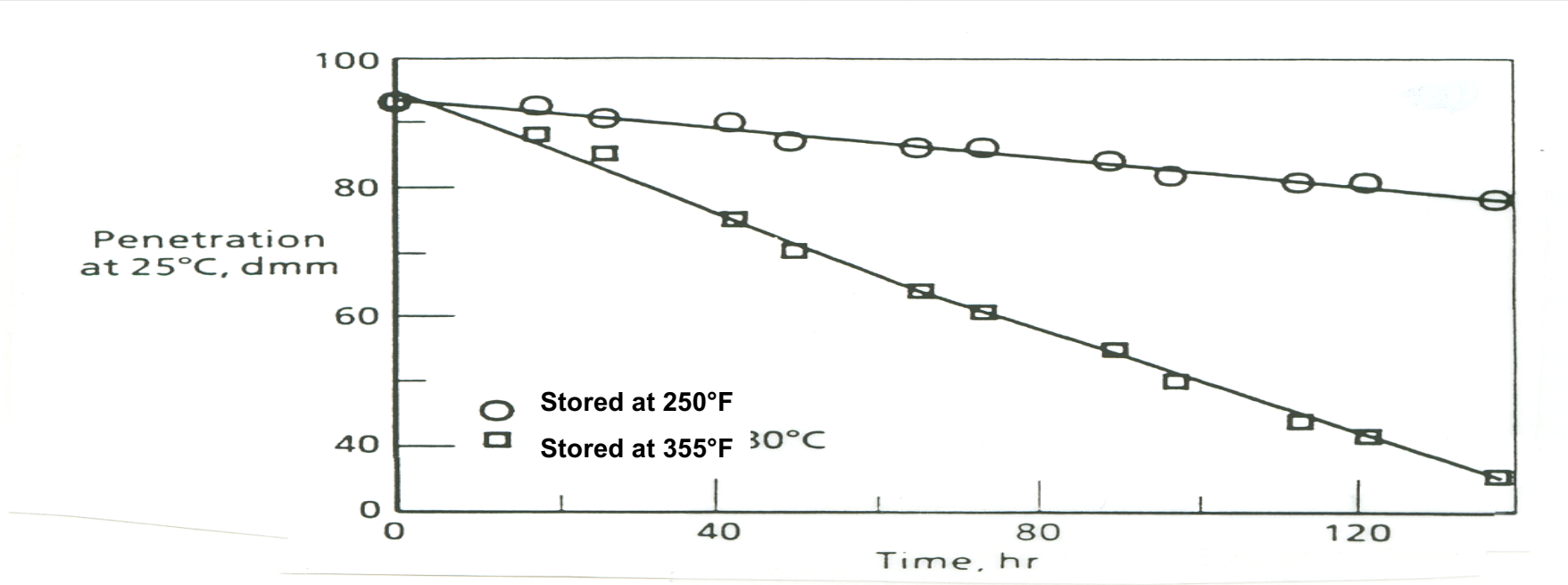
General Guidelines for Storage and Mixing Temperatures

PG Binder	Storage Temperature (°F)	Mixing Temperature (°F)
64-22	285-315	265-320
70-22	300-325	280-330
76-22	315-340	285-335

Extended Storage <275 °F

Source: EC-101

Effect of Time and Temperature on Asphalt Properties



J H Collins and M Bouldin, Rubber World, 206(5) 32, (1992).

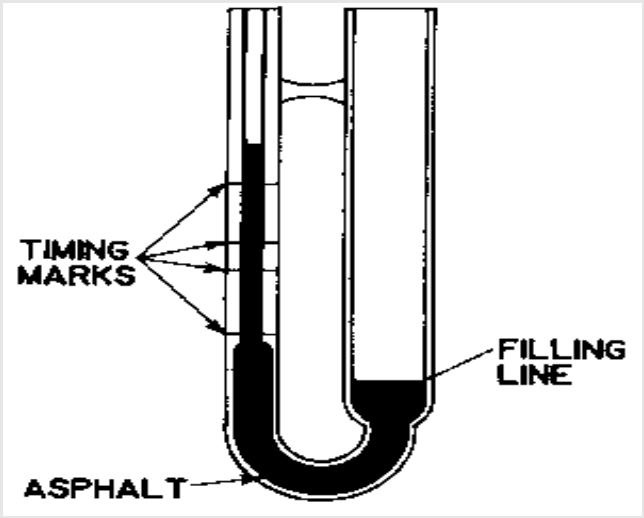
Long Term Storage of Modified Binders

- If storing PMA for longer than 60 days, turn heat down or off
- Lower temperatures minimize danger of damaging the PMA

Long Term Storage of Modified Binders

- Re-heating PMA binders
  - Bring temperature up slowly
  - If material has been held over the winter, heat incrementally 20 degrees increase at a time
  - Allow 3 or 4 days to get material up to circulation temperature
- As a precaution, you may want to test before using after winter shutdown

Mixing and Compaction Temperature Guidance



- Asphalt Institute developed procedure in 1970's for determining laboratory mixing and compaction temperatures (MS-2)
- Equiviscous laboratory mixing and compaction temperatures
  - Viscosity at 135ºC and 165ºC
  - Lab mixing range of 150-190 centistokes
  - Lab compaction range of 250-310 centistokes
- *NOT FOR FIELD TEMPERATURES!!!*

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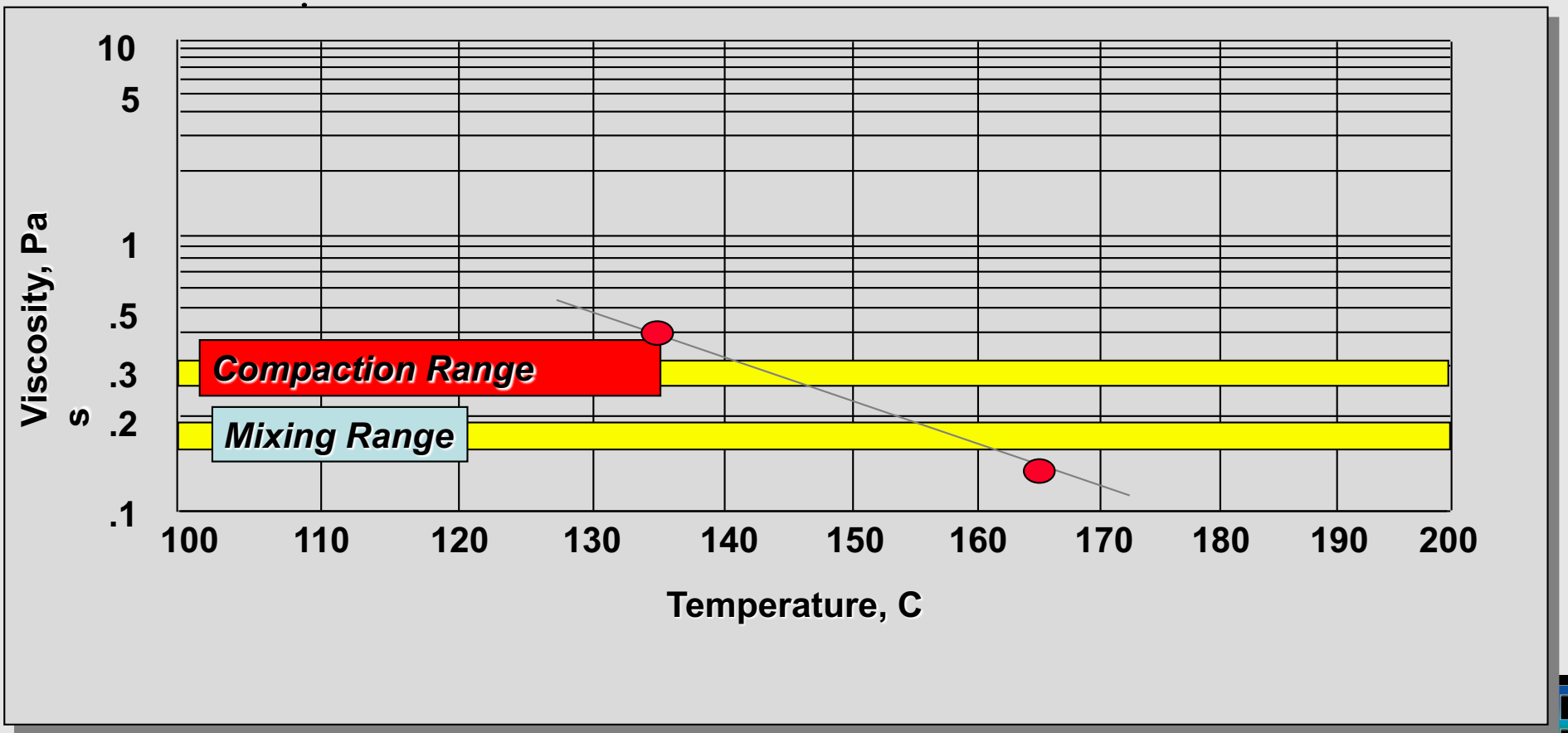
Laboratory Mixing and Compaction Temperatures



Mixing and Compaction Temperature Guidance

- Superpave adopted AI procedure using rotational viscometer
- Equiviscous laboratory mixing and compaction temperatures
- Does not work for PMA
  - Yields extremely high temperatures
  - Use suppliers' recommendations
- *Not For Field Temperatures for Unmodified or Modified Asphalts!!!*

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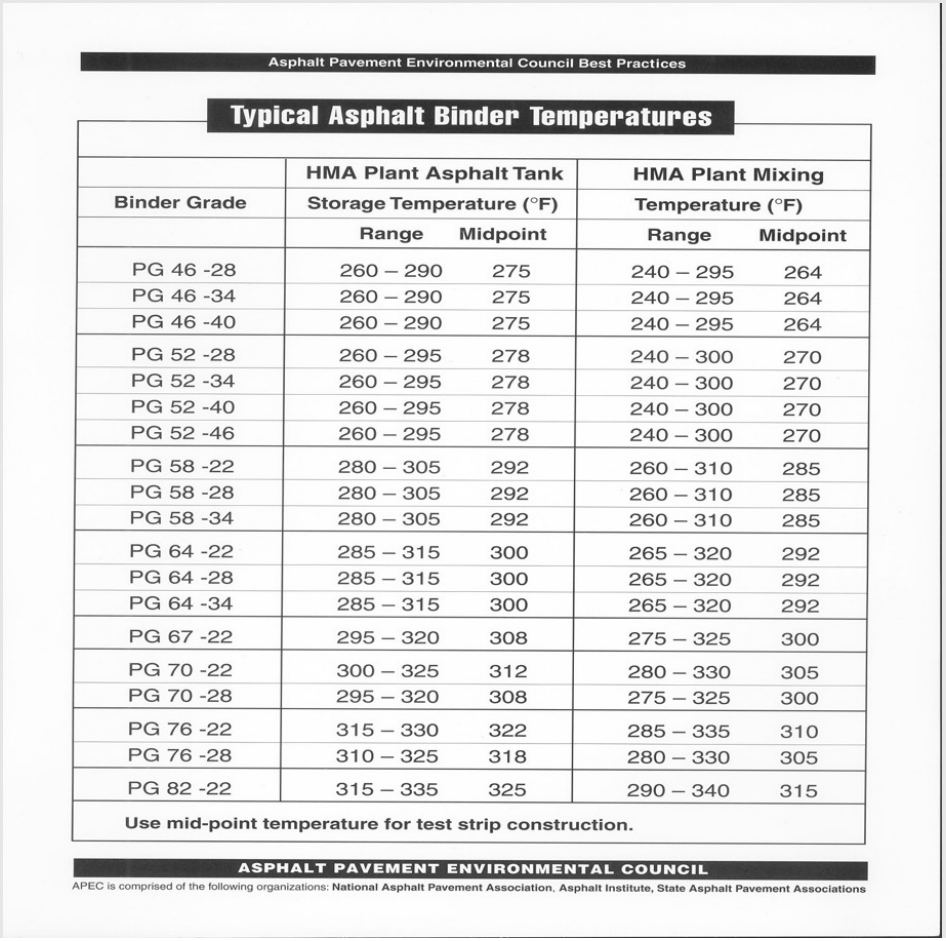
Field Mixing and Compaction Temperature Guidance



Asphalt Pavement Environmental Council Best Practices

Typical Asphalt Binder Temperatures

Binder Grade	HMA Plant Asphalt Tank Storage Temperature (°F)		HMA Plant Mixing Temperature (°F)	
	Range	Midpoint	Range	Midpoint
PG 46 -28	260 – 290	275	240 – 295	264
PG 46 -34	260 – 290	275	240 – 295	264
PG 46 -40	260 – 290	275	240 – 295	264
PG 52 -28	260 – 295	278	240 – 300	270
PG 52 -34	260 – 295	278	240 – 300	270
PG 52 -40	260 – 295	278	240 – 300	270
PG 52 -46	260 – 295	278	240 – 300	270
PG 58 -22	280 – 305	292	260 – 310	285
PG 58 -28	280 – 305	292	260 – 310	285
PG 58 -34	280 – 305	292	260 – 310	285
PG 64 -22	285 – 315	300	265 – 320	292
PG 64 -28	285 – 315	300	265 – 320	292
PG 64 -34	285 – 315	300	265 – 320	292
PG 67 -22	295 – 320	308	275 – 325	300
PG 70 -22	300 – 325	312	280 – 330	305
PG 70 -28	295 – 320	308	275 – 325	300
PG 76 -22	315 – 330	322	285 – 335	310
PG 76 -28	310 – 325	318	280 – 330	305
PG 82 -22	315 – 335	325	290 – 340	315

Use mid-point temperature for test strip construction.

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

APEC is comprised of the following organizations: National Asphalt Pavement Association, Asphalt Institute, State Asphalt Pavement Associations

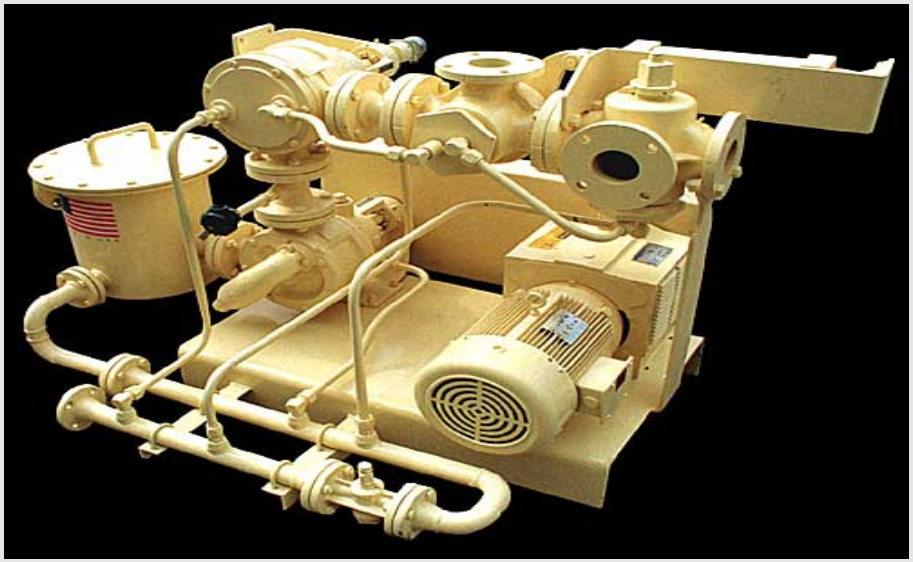
EC-101

The Association of Modified Asphalt Producers

HMA Plant Asphalt Pump

- Adequately sized AC pump
  - PMA will cause higher amperage draw
- AC pump in good condition
- Calibrated
- Strainer
  - Larger than standard holes – ¼”
  - Clean

HMA Plant Asphalt Pump Operation



- Circulate unmodified asphalt first before start-up
- Switch to PMA and circulate before start-up
- Switch to unmodified asphalt and circulate through pump after shutdown at end of shift
- Unmodified asphalt in AC pump, meter and strainer until next shift

HMA Plant Slat Conveyor

- Properly sized
- Good condition
- PMA will increase amperage draw on conveyor
  - Start at reduced tonnage rate
  - Start on unmodified mix to heat conveyor

Modified HMA Storage

- DO NOT STORE OVERNIGHT!!!

Transporting Modified HMA to Paver

- Clean, smooth truck beds
- Release agent
  - Type
  - Amount
  - Powdered Tide detergent
- Tarps

Placing Modified HMA

- No modifications to equipment
- Handwork is more difficult
- Attention to detail
- Weather Conditions – 50 °F minimum

Compacting Modified HMA

- Compaction Equipment
  - Number - 3 or 4
  - Type – high frequency
  - Size
- Mix temperature
  - Only high enough to allow proper compaction
  - Extra 10 ˚F doubles fumes
  - High temperatures can damage PMA
- Roller pattern
  - Front roller close to paver
- Field monitoring
  - Temp
  - Density

Compacting Modified HMA

- Compacting mixes with PMA may actually be easier than un-modified asphalt mixes
  - Compaction requires confinement
  - PMA may eliminate tender zone

Contractor QC Plan

- Contractors need to establish QC plan to prevent PG asphalt contamination and failing test results
  - Identify all hardware – label or number
    - Tanks
    - Pumps
    - Piping
    - Valves
    - Sample points
    - Heat system
  - Establish standard procedures and hardware settings for asphalt flow into storage and into HMA plant

Summary

- PMA improves the performance of HMA pavements
- Understand the product you are using and treat it with respect
  - Follow suppliers recommendations
  - Best Practices