Tests to Assess the Potential for Moisture Damage in Asphalt Mixtures

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Asphalt Institute Spring 2002 Meeting

Houston, TX

Moisture Damage Tests

- Pre-SHRP
  - Immersion-Compression Test
  - Boil Test
  - Texas Freeze-Thaw Pedestal Test
  - Swell Test (Hveem)
  - Lottman Test
  - Root-Tunnicliff Test

Moisture Damage Tests

- Post-SHRP
  - Environmental Conditioning System
  - Modified Lottman Test
  - Root-Tunnicliff Test
  - Hamburg Wheel Tracking Test

Modified Lottman Test

- Standard Procedure
  - AASHTO T-283
- Specimen Size
  - 4-inch (100-mm) diameter; 2.5-inch (63-mm) height
  - 6-inch (150-mm) diameter; 3.75-inch (95-mm) height ?
- Percentage of Air Voids
  - Construction air voids
    - 7.0 ± 1.0%

Modified Lottman Test

- Aging
  - Loose Mix
    - 16 hours at 60C in forced draft oven
  - Compacted Specimen
    - 72-96 hours at ambient temperature (20-25C)

Modified Lottman Test

- Specimen Conditioning (Conditioned Subset)
  - Partial Vacuum Saturation
    - After compacted specimen aging
    - Initial saturation of 55-80%

Modified Lottman Test

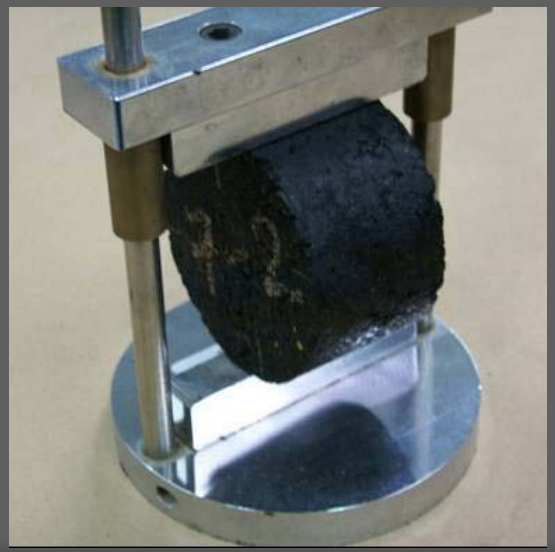
- Specimen Conditioning (continued)
  - Freeze Cycle
    - 15 hours at -18C
  - Thaw Cycle
    - 24 hours at 60C

Modified Lottman Test

- Specimen Conditioning (All Specimens)
  - Temperature Equilibration
    - 2 hours at 25C (water bath)

Modified Lottman Test

- Mechanical Test
  - Indirect Tensile Strength
    - 50 mm/min. displacement rate
    - Peak Load at Failure



Modified Lottman Test

- Test Result
  - Tensile Strength Ratio
    - Average Indirect Tensile Strength of Conditioned Specimens ($S_{t,wet}$)
    - Average Indirect Tensile Strength of Conditioned Specimens ($S_{t,dry}$)

$$TSR = \frac{S_{t,wet}}{S_{t,dry}}$$

Modified Lottman Test

- Interpreting the Results
  - TSR $\geq$ 0.80
    - Acceptable resistance to moisture damage
  - Some agencies use TSR $\geq$ 0.70 as criterion
- Mix Adjustments for Poor TSR
  - Liquid anti-stripping additives
  - Hydrated Lime
  - Change of aggregate/mix design

Root-Tunnicliff Test

- Standard Procedure
  - ASTM D4867
- Specimen Size
  - 4-inch (100-mm) diameter; 2.5-inch (63-mm) height
  - 6-inch (150-mm) diameter; 3.75-inch (95-mm) height ?
- Percentage of Air Voids
  - Construction air voids
    - 7.0 ± 1.0%

Root-Tunnicliff Test

- Aging
  - Loose Mix
    - None required
  - Compacted Specimen
    - None required (cool)
- Specimen Conditioning (Conditioned Subset)
  - Partial Vacuum Saturation
    - Initial saturation of 55-80%

Root-Tunnicliff Test

- Specimen Conditioning (continued)
  - Freeze Cycle
    - 15 hours at -18C (OPTIONAL)
  - Thaw Cycle
    - 24 hours at 60C
- Specimen Conditioning (All Specimens)
  - Temperature Equilibration
    - 2 hours at 25C (water bath)

Root-Tunnicliff Test

- Mechanical Test
  - Indirect Tensile Strength
    - 50 mm/min. displacement rate
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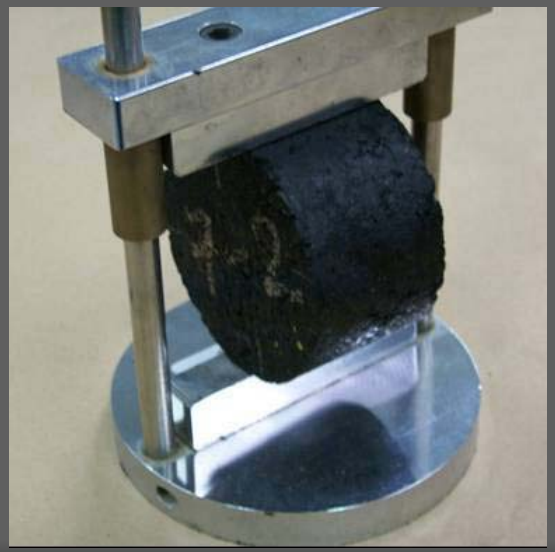

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Root-Tunnicliff Test

- Interpreting the Results
  - TSR $\geq$ 0.80
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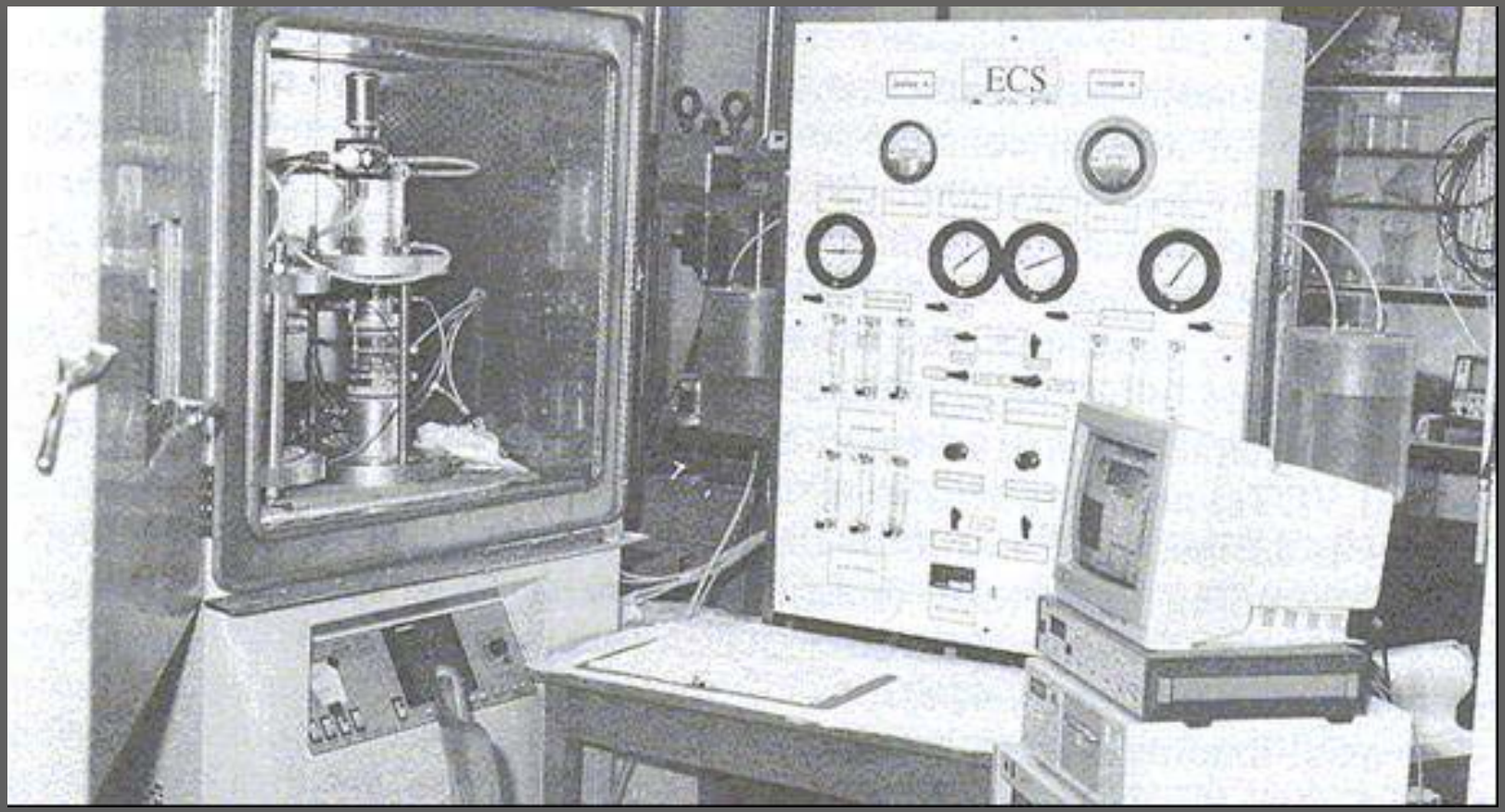
- Mix Adjustments for Poor TSR
  - Liquid anti-stripping additives
  - Hydrated Lime
  - Change of aggregate/mix design

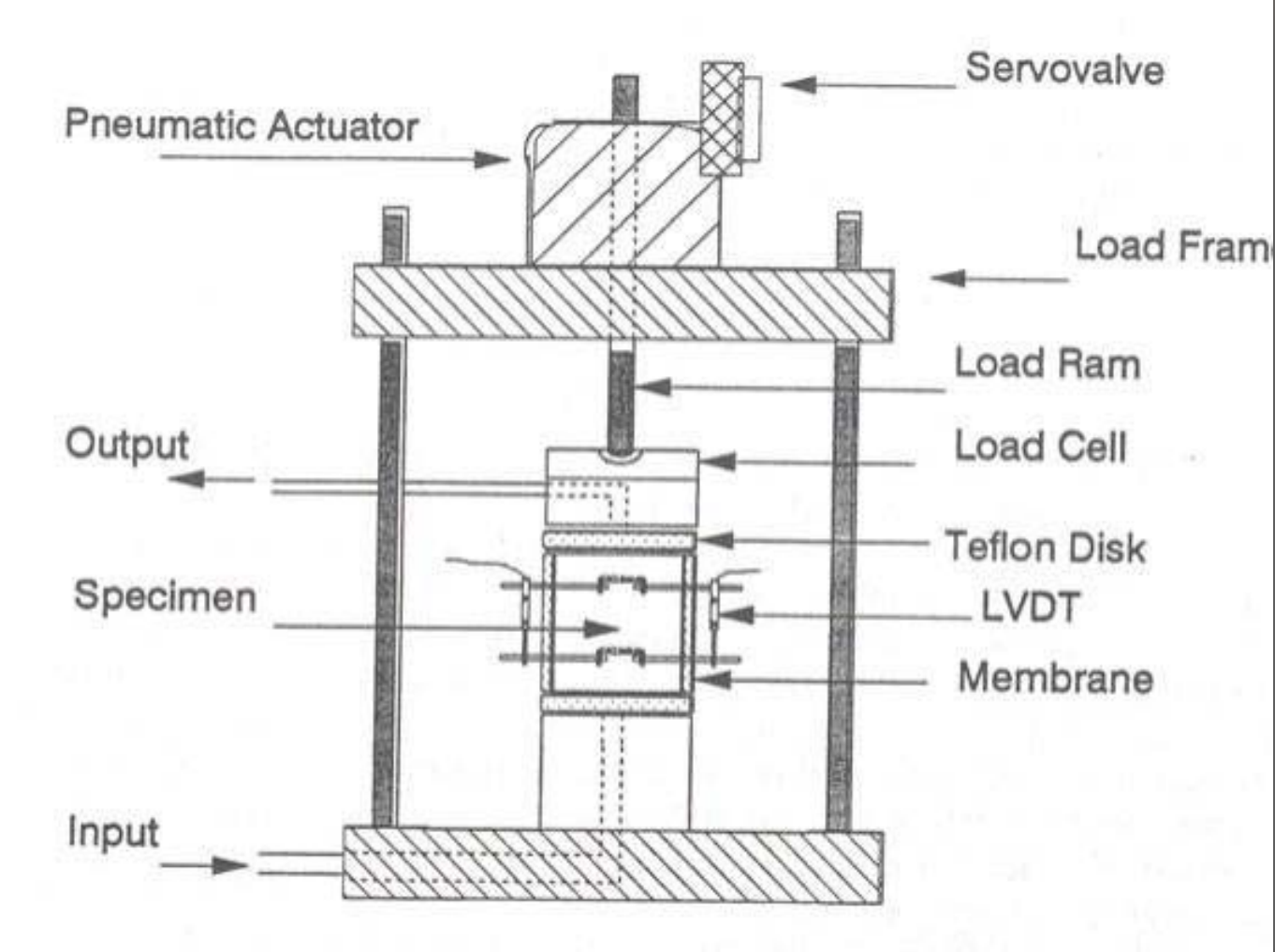
Environmental Conditioning System (ECS)

- Standard Procedure
  - SHRP-developed (A-003A)
  - Oregon State University (Terrel et. Al.)
- Specimen Size
  - 4-inch (100-mm) diameter; 4-inch (100-mm) height
- Percentage of Air Voids
  - Construction air voids

ECS



ECS


Servovalve
Pneumatic Actuator
Load Fram
Load Ram
Output
Load Cell
Teflon Disk
Specimen
LVDT
Membrane
Input

ECS

- Aging
  - Loose Mix
    - 4 hours at 135C
  - Compacted Specimen
    - None required (cool)

ECS

- Specimen Conditioning and Testing
  - Initial Resilient Modulus (uniaxial)
  - Thawing Cycles (1+)
    - 60C
    - Repeated loading, Mr
  - Freeze Cycle
    - Optional
    - Repeated Loading, Mr

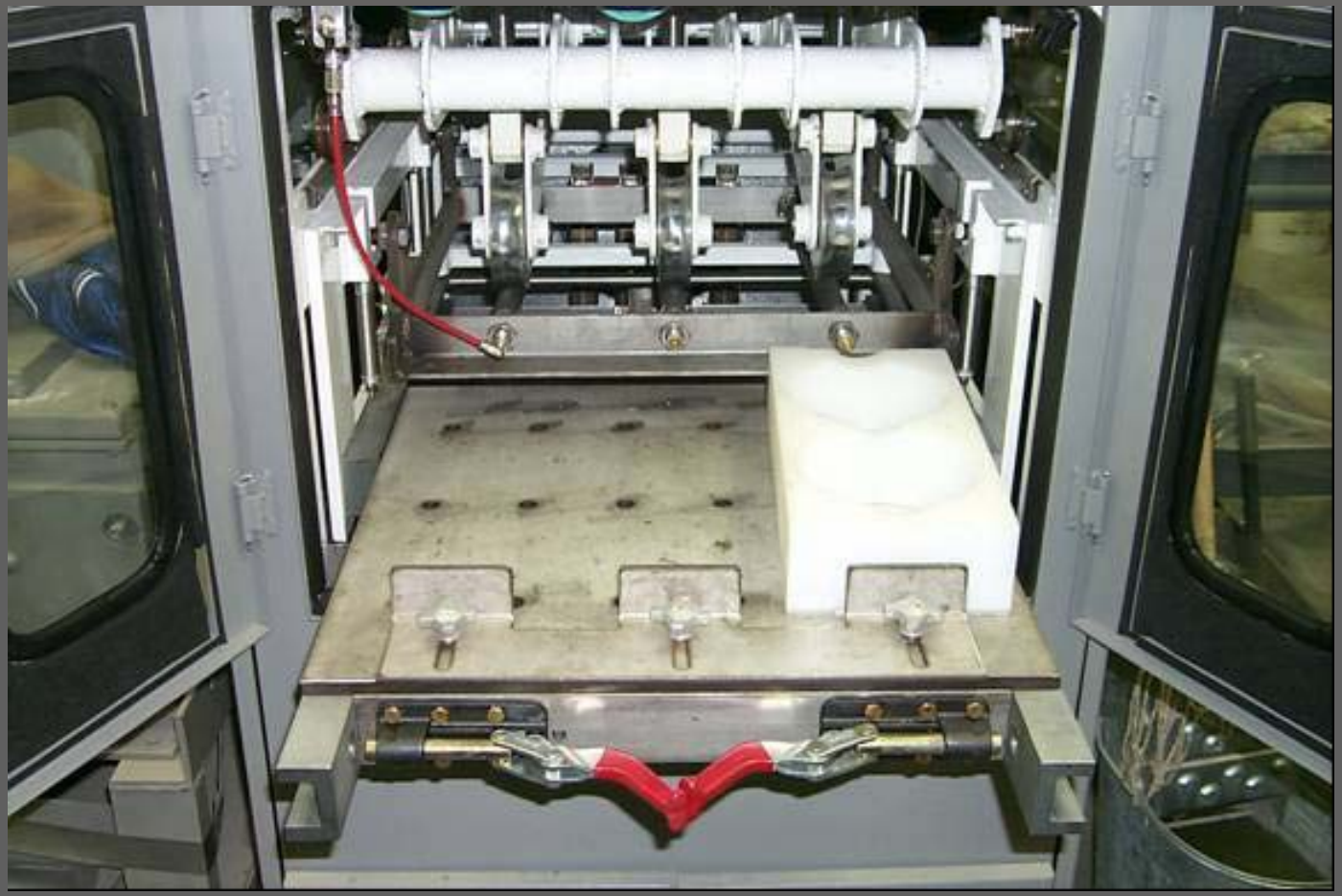
ECS

- Interpreting the Results
  - Modulus Ratio
    - Multiple conditioning cycles
    - Accumulation of moisture damage

Loaded Wheel Tests

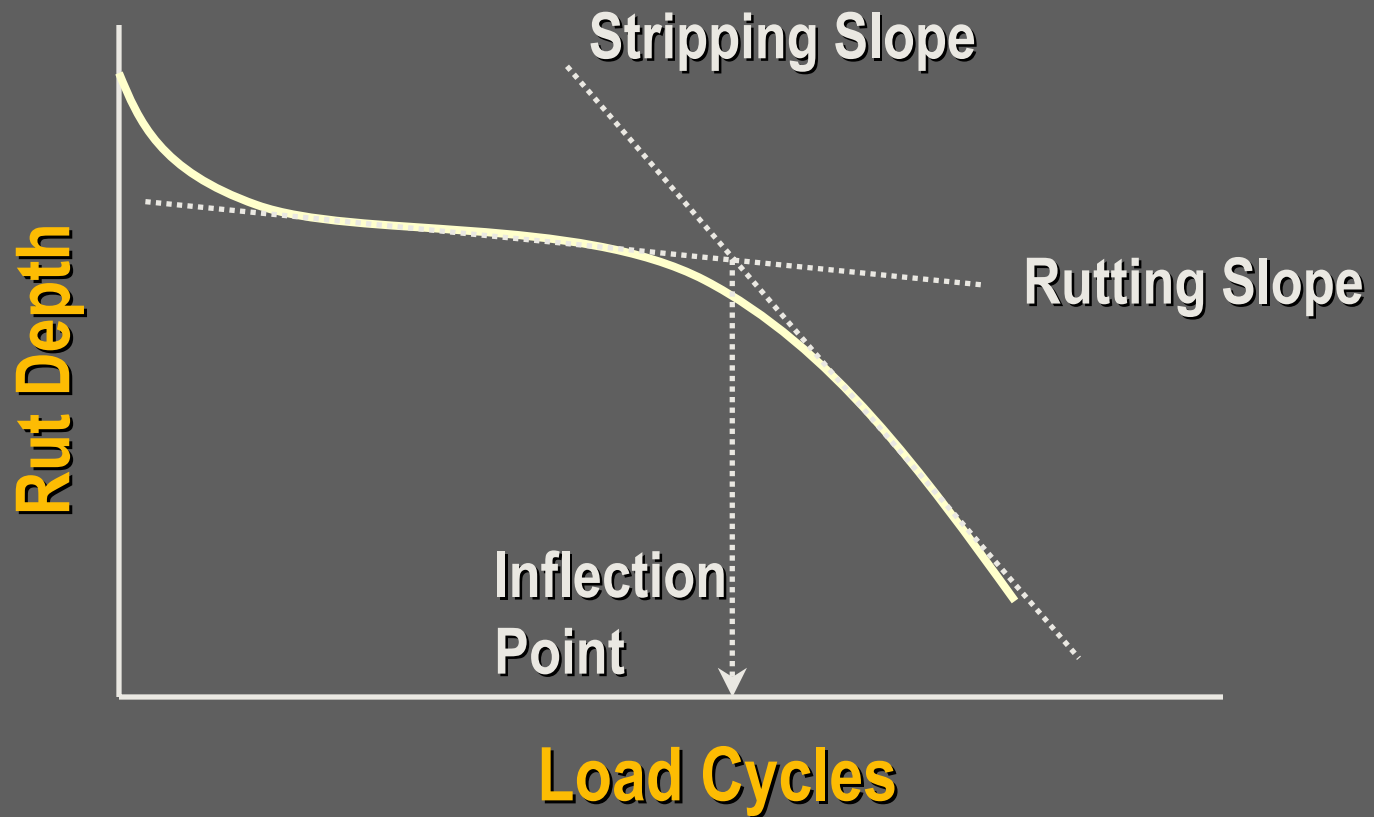
- Test Temperature
  - High Temperatures (40-60C)
  - Conducted under water
- Loading
  - Repeated Wheel Passes
    - Pressurized rubber hose w/ wheel
    - Steel wheel
    - Pneumatic wheel

Asphalt Pavement Analyzer



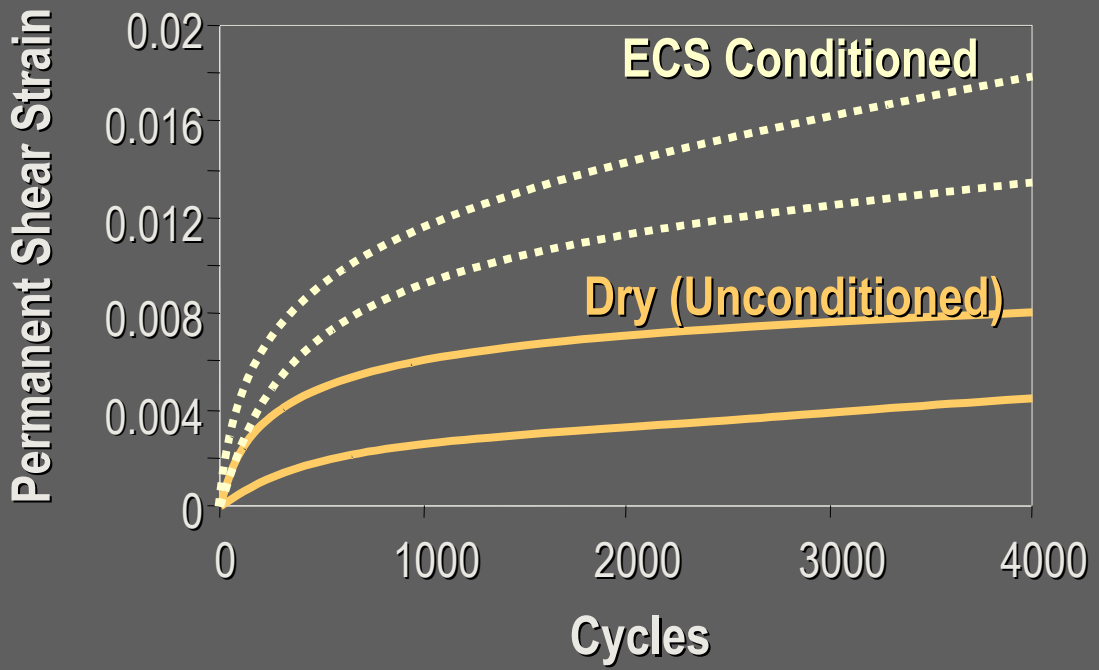
Hamburg Wheel Tracker

Hamburg Wheel Tracking Test



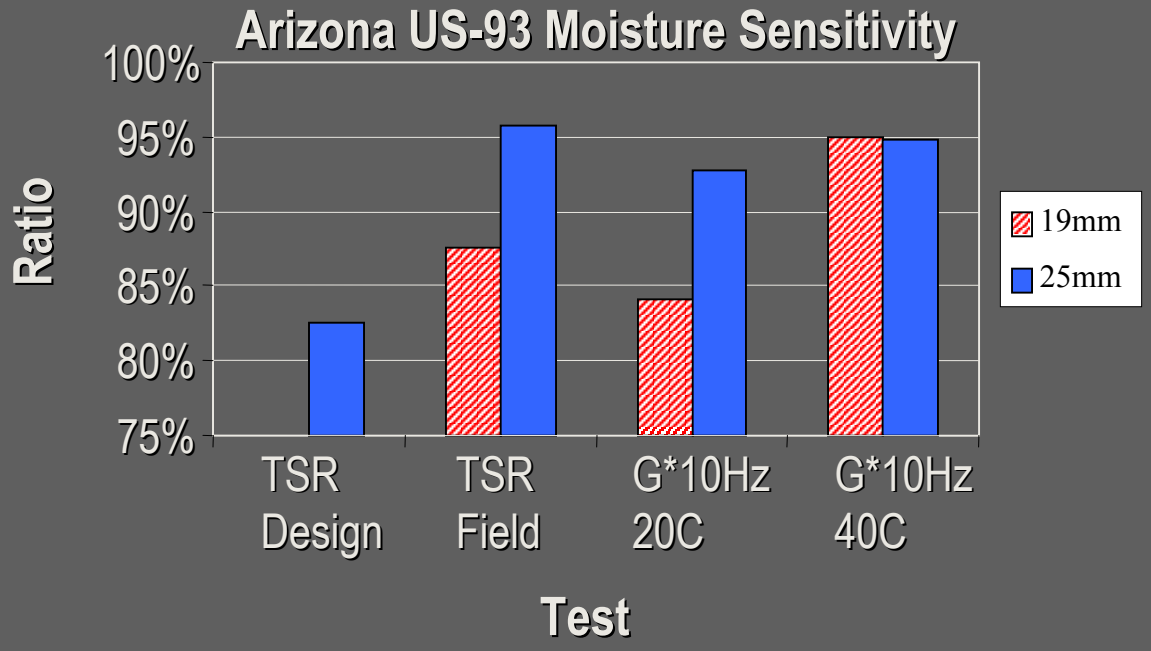
Other Tests

- ECS Conditioning w/ Mechanical Property Test



Other Tests

- Partial Vacuum Saturation w/ Mechanical Property Tests



Thanks !