

# **Evolution of the Direct Tension Tester**

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on Binder Rheology and  
Pavement Performance**

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# *Presentation Overview*

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- ◆ Instron's involvement with asphalt industry
- ◆ Family of asphalt products
- ◆ Direct tension testing evolution
- ◆ Hot issues (calibration, fluid, chillers)
- ◆ AsphaltPro-BBR
- ◆ Questions & Answers



# *Why is the asphalt industry so important?*

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- 95% of all US roads are asphalt-based
- 500 million tons of HMA are placed each year
- \$8 billion of asphalt binder sold per year
- \$60 billion highway budget
- \$20 billion is spent on road maintenance
- Maintenance budget increases 9% each year
- European roads last approx. 15 years longer than US



# *What types of testing does Instron provide?*

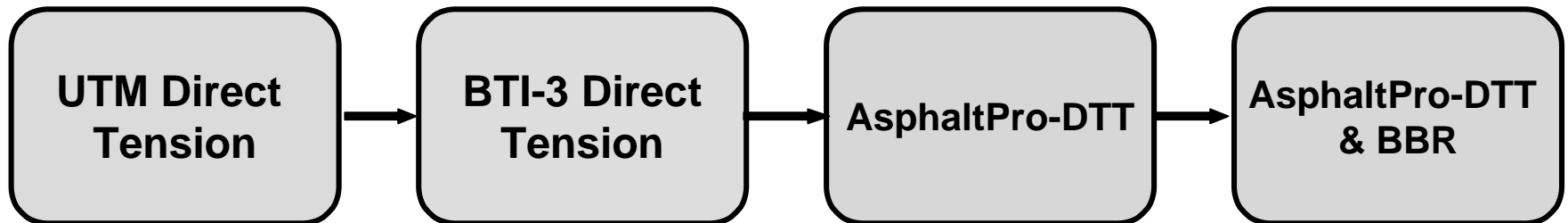
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- Direct Tension Testing
- Indirect Tension Testing
- Soil and Asphalt Resilient Modulus
- Toughness and Tenacity



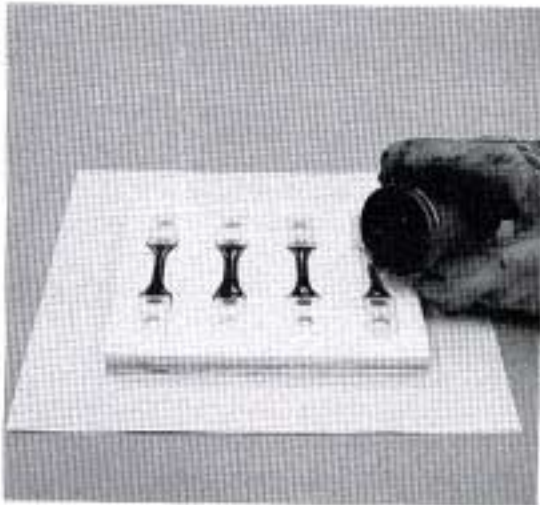
# *Direct Tension Evolution*

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# *Direct Tension Tester (UTM)*

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# *Direct Tension Tester (BTI-3)*

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# *Direct Tension Tester (AsphaltPro)*

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# *TSAR Software*

*(Thermal Stress Analysis Routine)*

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- A tool for classifying the performance grade of asphalt binders
- Calculates the critical temperature corresponding to thermal cracking
- Based on data from the Bending Beam Rheometer (BBR) and Direct Tension Test (DTT)



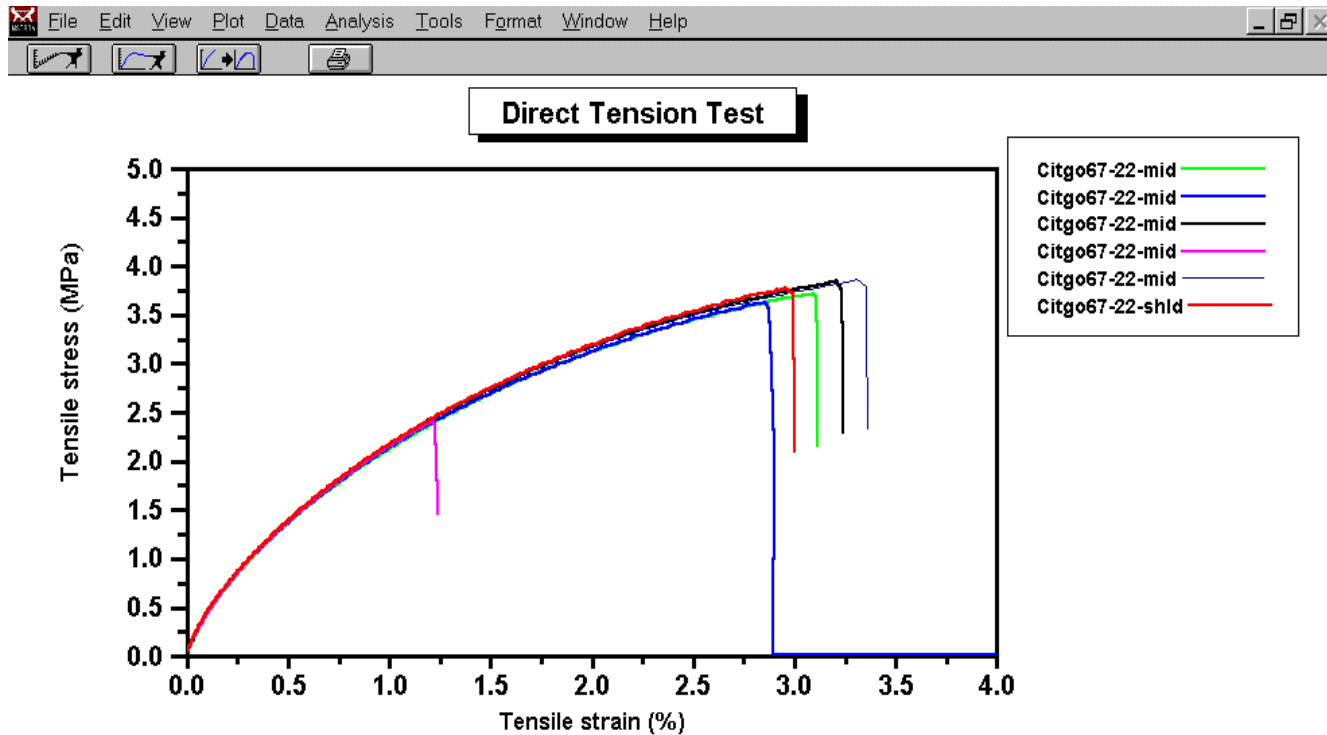
# *Key Features of DTT*

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- ✓ Load frame is mounted diagonally - provides easy access and serviceability
- ✓ Modularized frame design means load cell and LVDT can be calibrated separately
- ✓ Verification specimen to qualify the system's accuracy and performance
- ✓ Software includes Test Director, which guides the operator through the test

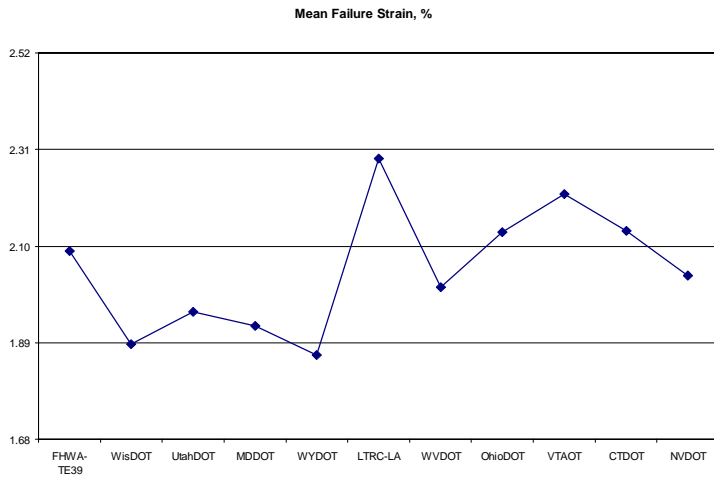


# Graphical results from AsphaltPro's Merlin Software

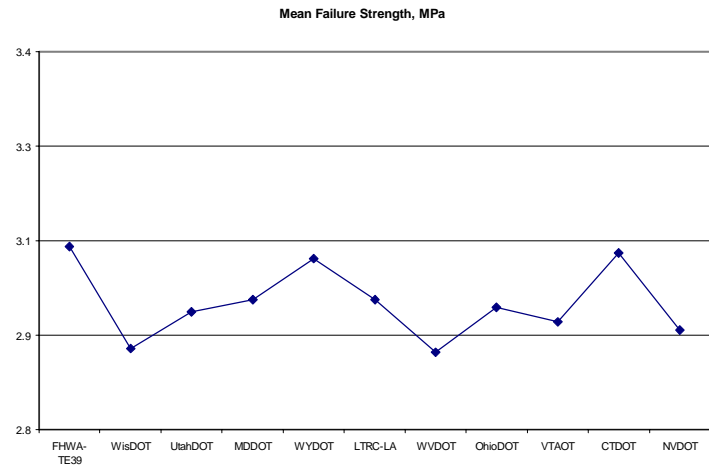


# Training Course Results

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**Failure Strain, %**



**Failure Stress, MPa**



# *DTT Critical Issues*

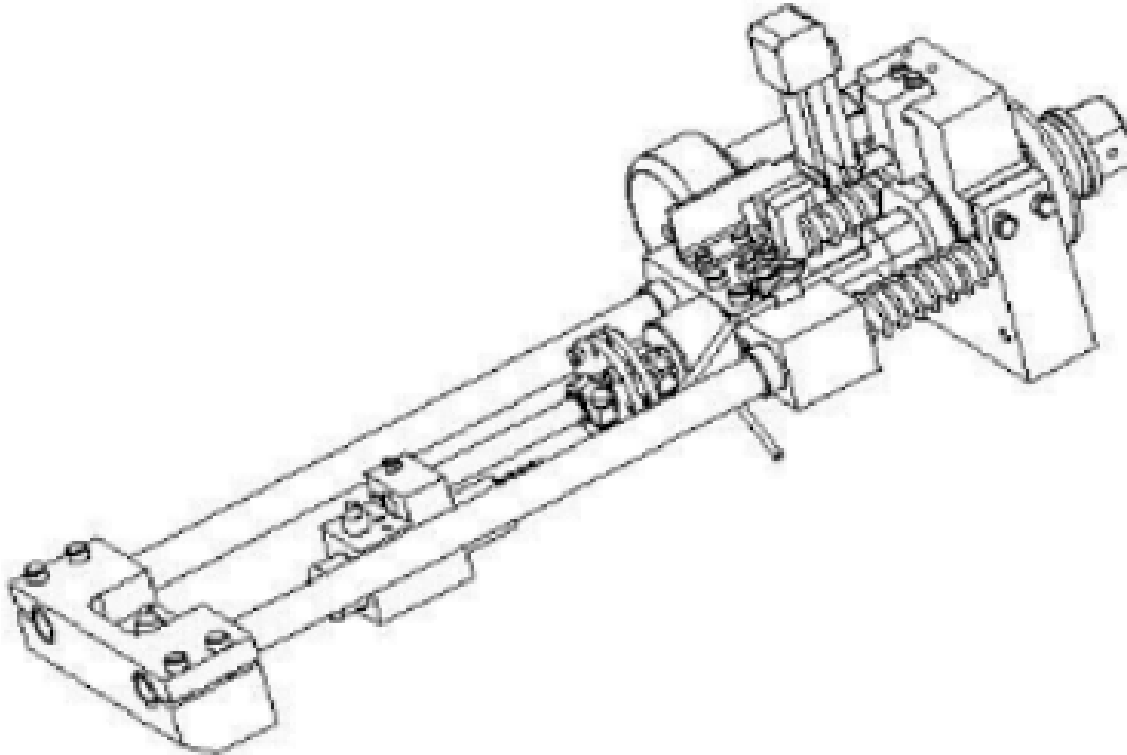
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- Specimen preparation
- Calibration & verification
- Bath fluid
- Chillers
- Education & Training



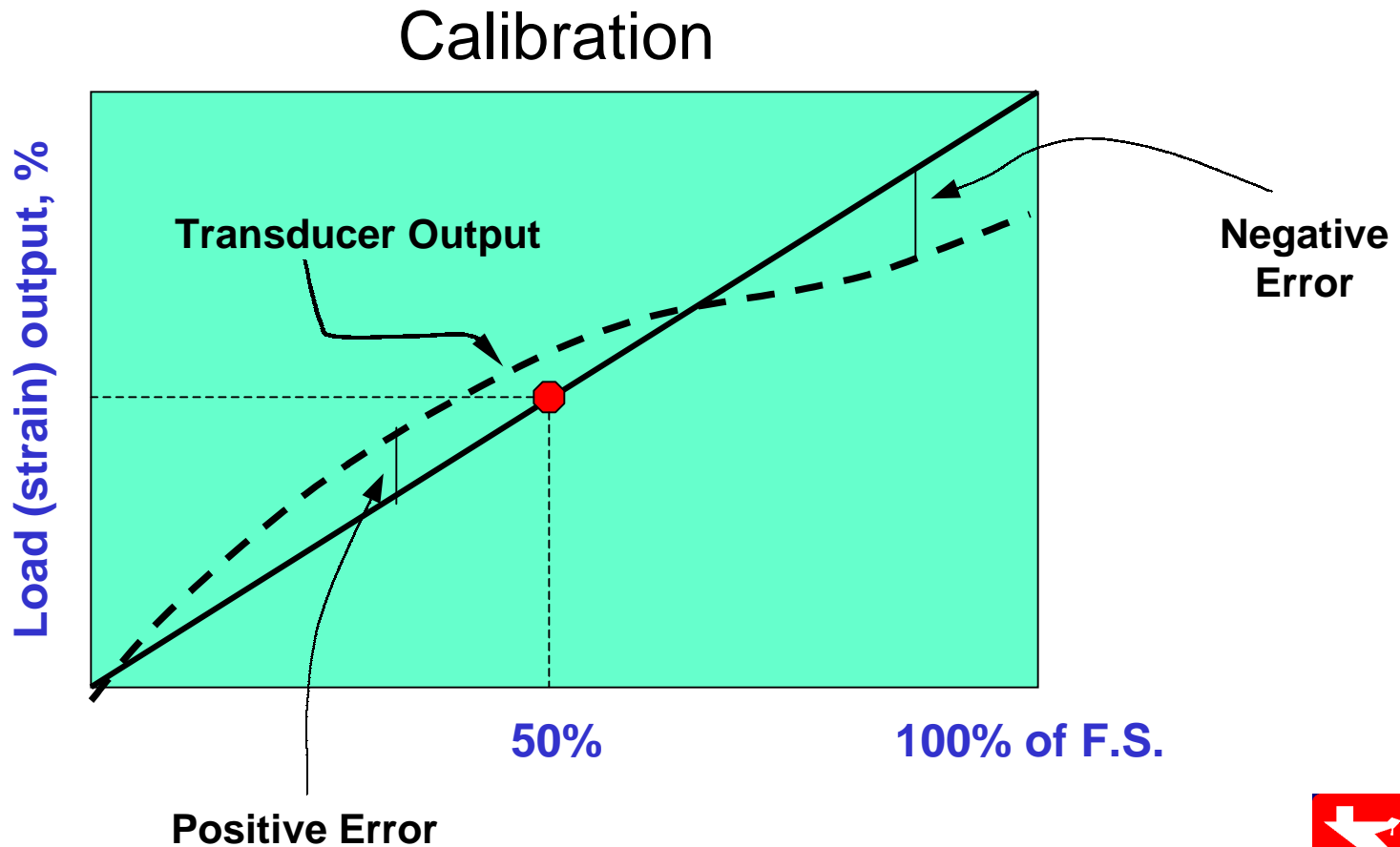
# *Strain Verification*

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# Calibration Principle

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# *Chiller Fluid*

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- CF7 de-icing fluid
- Potassium Acetate solution
- 42% aqueous solution by weight
- Specific gravity = 1.24 +/- 0.005
- Supplier is Cryotech Deicing Technology



# *Chiller Selection Criteria*

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- Effective circulation of potassium acetate solution
- Ability to cool large fluid volume (4-5 liters)
- Control temperature to +/- 0.1 °C
- Chiller needs large circulating pump, internal heat exchanger, and sealed reservoir for improved fluid flow
- Instron's choice: FTS Systems



# *Steps taken by Instron to improve the FTS chiller performance*

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- Replace the internal fuse with an external circuit breaker
- Replace the bottom tray with stainless steel for corrosion resistance
- Instron to offer a Repair & Exchange Program following the warranty period
- Educate customers on proper chiller operation



Education, Education, Education!



# *AsphaltPro Bending Beam Rheometer*

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# *BBR - Key Features*

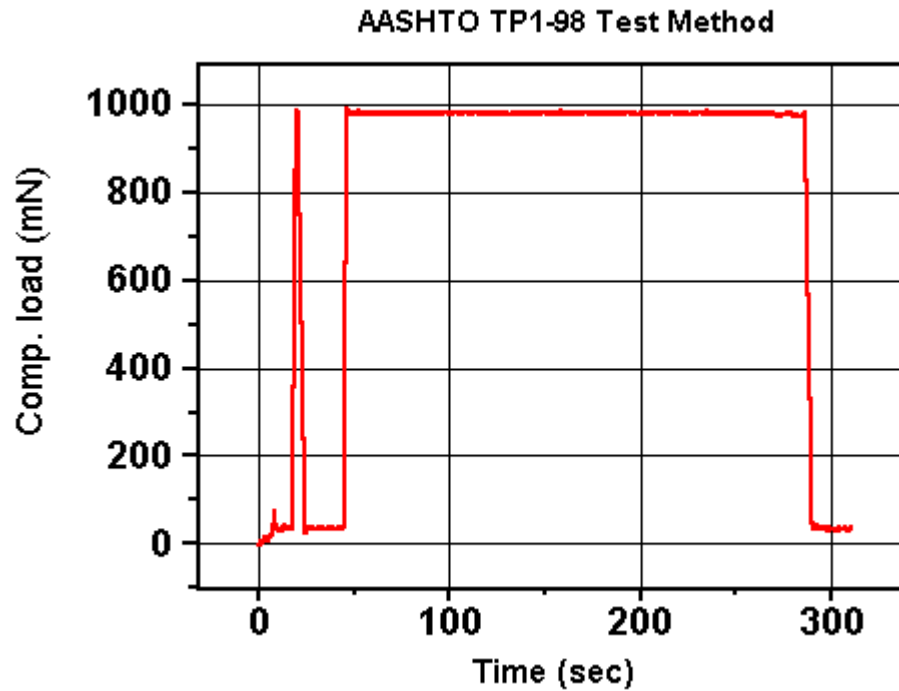
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- ✓ Utilizes Instron's DTT system
- ✓ Modular load frame design for improved serviceability
- ✓ Closed-loop control of load/strain
- ✓ Merlin software performs AASHTO Test Method TP1
- ✓ Simple to setup and operate



# Merlin Plot of BBR Test

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# BBR Test Results

<b>Binder Type: PG 64-22 (AMRL Specimen)</b>						
<b>Test Temp: -12 degrees C</b>						
	<b>Deflection, mm</b>		<b>Stiffness, MPa</b>		<b>m-value</b>	
<b>Time, sec</b>	<b>Mass-DOT</b>	<b>Instron</b>	<b>Mass-DOT</b>	<b>Instron</b>	<b>Mass-DOT</b>	<b>Instron</b>
0.0	0.0001	0.000				
0.5	0.1150	0.041				
8.0	0.2439	0.251	329.7623	319.71	0.29100	0.26307
15.0	0.2951	0.300	272.8454	267.95	0.31247	0.28977
30.0	0.3703	0.370	217.5912	216.97	0.33615	0.31921
60.0	0.4701	0.465	171.2627	172.24	0.35982	0.34865
120.0	0.6071	0.596	132.3571	134.54	0.38349	0.37809
240.0	0.7976	0.782	100.5421	101.59	0.40717	0.40754



# *BBR Configurations*

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- BBR standalone frame (using Instron's existing DTT)
- BBR frame + test bath + chiller (using Instron's existing DTT)
- BBR frame + BTI-3 retrofit package
- BBR frame + AsphaltPro-DTT system
- BBR frame + test bath + chiller + AsphaltPro-DTT system



*Thank you  
very much!*

