

# Asphalt Binder Cracking Device (ABCD)

Highways for LIFE Partnerships 2008 Award \$225,061

# HIGHWAYS FOR LIFE

Accelerating Innovation for the American Driving Experience.

## Correlation with Field Test Roads

AASHTO M320 results show an increase in cracking temperature as SBS concentration increases. The ABCD test shows the expected decrease in cracking temperature and increased strength (strain jump).

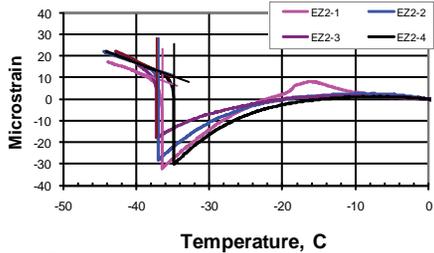
Test Roads	Coefficient of Determination (R <sup>2</sup> ) Critical Temp vs. Cracking Index of Test Roads		
	ABCD	M320 Table 1	M320 Table 2
Elk Co, PA	0.94	0.21	0.95
Lamont	0.92	0.79	0.76
Highway 17	0.80	0.92	0.56

## Data Analysis

After the test, the data are analyzed and presented as a graph of strain vs. temperature (each data point recorded at the same time) and a summary table in Excel. The summary table shows cracking temperatures, strain jumps, averages, and standard deviations.

Operator:	Enn-Young	EZ2-1	EZ2-2	EZ2-3	EZ2-4	Avg	Std Dev
Crack Temperature (C)	-36.4	-37.0	-37.2	-34.8	-36.4	1.07	
ABCD Strain Jump (µε)	40.5	41.8	31.2	40.5	38.5	4.91	
Test Results Cooling Rate (C/hr)	-22.7	-22.7	-22.7	-23.0	-22.8	0.1	

Cooling rate is the slope of 10 consecutive time-sample temperature data when cracked



## Need for Innovation

The way asphalt responds to low temperatures is critical to its performance. Low temperature thermal cracking (contraction of the pavement) is a major type of asphalt pavement failure. Millions of dollars is spent annually for pavement repair. To minimize premature failure due to thermal cracking, it is essential to properly grade asphalt binders for the expected climatic environment.

## Project Overview

EZ Asphalt Technology conducted a field validation of the Asphalt Binder Cracking Device (ABCD), refined the equipment and analysis software, and conducted a ruggedness test and interlaboratory study with 28 labs. The interlaboratory study evaluated the binder cracking temperature and strength, ease of sample preparation and test procedures, and repeatability at other laboratories.



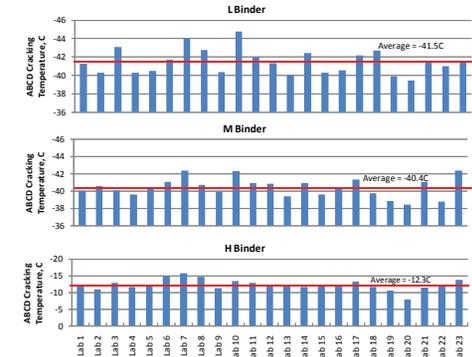
The ABCD system includes a computer to collect data and control the environmental chamber, which cools the asphalt binder samples at a controlled rate.



In the ABCD test, the binder sample is placed outside of a 2-inch diameter ABCD ring which has near-zero thermal contraction. The test specimen is placed in a cooling chamber where the temperature is steadily reduced. As the temperature is lowered, the binder specimen contracts and compresses the ABCD ring. The sensors installed inside the ABCD ring measure and record temperatures and strains. When the binder specimen cracks, the strain is relieved abruptly and the temperature at that moment is the ABCD cracking temperature.

## Results

### ABCD Cracking Temperature



The results of ABCD interlaboratory study; ABCD cracking temperature

### BBR Critical Temperature

	L Binder (PG 70-22 SBS)	M Binder (PG 76-22 SBS)	H Binder (PG xx-0)
<b>EXTRAPOLATED</b>			
Average	-24.9	-24.0	-2.1
min	-26.3	-27.0	-4.6
max	-23.2	-21.8	-0.6
Within Lab Var	0.32	0.96	0.21
Betwn Lab Var	0.77	2.30	2.36

	L Binder (PG 70-22 SBS)	M Binder (PG 76-22 SBS)	H Binder (PG xx-0)
<b>INTERPOLATED</b>			
Average	-16.9	-15.1	1.7
min	-17.8	-15.8	-0.4
max	-16.4	-14.7	2.9
Within Lab Var	0.06	0.07	0.45
Betwn Lab Var	0.21	0.11	1.53

### Precision: Interlaboratory Study Results

	BBR, T <sub>cr</sub> (Extrapolation)	BBR, T <sub>cr</sub> (Interpolation)	ABCD Cracking Temp	ABCD Strain Jump
Single-Operator Precision				
2 Tests	2.0°C	1.2°C	1.9°C	14.3 µε
3 Tests	2.3°C	1.5°C	2.2°C	16.6 µε
Multilaboratory Precision				
2 Labs	3.8°C	2.2°C	3.3°C	14.3 µε

## Project Team

EZ Asphalt Technology, LLC  
28 laboratories and 11 BBR laboratories

## Contact Information

Highways for Life Technology  
Partnerships Program  
Julie Zirlin, 202-366-9105  
www.fhwa.dot.gov/hfl

EZ Asphalt Technology  
Sangsoo Kim, 740-593-1463  
www.ezasphalttechnology.com/