

Asphalt Binder Cracking Device (ABCD)

Highways for LIFE Technology Partnerships 2008 Award \$225,061



U.S. Department of Transportation
Federal Highway Administration
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Correlation with Field Test Roads

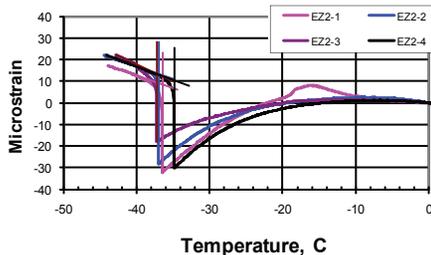
AASHTO M320 results show an increase in cracking temperature as SBS concentration increases. The ABCD test shows the expected decrease in cracking temperature and increased strength (strain jump).

Test Roads	Coefficient of Determination (R ²) 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.

	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
Strain Jump (µε)	40.5	41.8	31.2	40.5	38.5	4.91
Cooling Rate (C/hr)	-22.7	-22.7	-22.7	-23.0	-22.8	0.1



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.

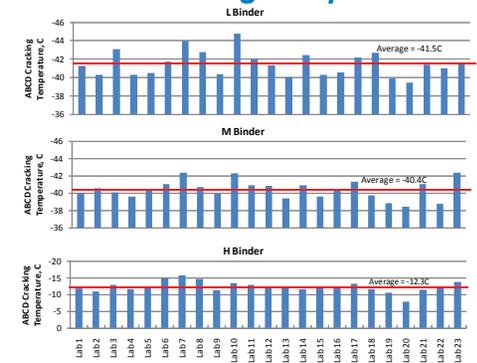


The ABCD system includes a computer to collect data and control the environmental chamber, which cools the asphalt binder samples at a controlled rate.



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.

ABCD Cracking Temperature



BBR Critical Temperature

EXTRAPOLATED	L Binder (PG 70-22 SBS)	M Binder (PG 76-22 SBS)	H Binder (PG xx-0)
Average	-25.0°C	-24.0°C	-2.1°C
min	-26.3°C	-27.0°C	-4.6°C
max	-23.2°C	-21.8°C	-0.6°C
Within Lab Var	0.30	0.96	0.21
Between Lab Var	0.62	1.78	2.29

INTERPOLATED	L Binder (PG 70-22 SBS)	M Binder (PG 76-22 SBS)	H Binder (PG xx-0)
Average	-16.8°C	-15.1°C	1.7°C
min	-17.8°C	-15.8°C	-0.4°C
max	-16.1°C	-14.7	2.9°C
Within Lab Var	0.06	0.06	0.45
Between Lab Var	0.23	0.09	1.38

Precision: Inter-Laboratory Study Results

	BBR, T _{cr} (Extrapolation)	BBR, T _{cr} (Interpolation)	ABCD Cracking Temp	ABCD Strain Jump
Single-Operator Precision				
Acceptable Range of Two Tests	1.9°C	1.2°C	2.7°C	15.5 µε
Multilaboratory Precision				
Acceptable Range of Two Tests	3.5°C	2.1°C	3.9°C	20.4 µε

Note: T_{cr} by BBR is based on an assumption that the fracture strength of asphalt binders is a constant.

Project Team

EZ Asphalt Technology, LLC
28 laboratories and 11 BBR laboratories

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Conclusion

Precision of ABCD test is comparable to that of BBR test when it is considered that the variability of fracture strength of asphalt binders is included in ABCD test. An AASHTO provisional specification has been adopted as a result of this work: TP92-Determining the Cracking Temperatures of Asphalt Binder Using the Asphalt Binder Cracking Device. The final report and a video is available at <http://www.fhwa.dot.gov/>