

## Quality Control Tests for Asphalt Cement

The following table shows the main testing methods of asphalt cement with their engineering significance and the required properties of the penetration grade bitumen 40-50 which is locally used in Iraq.

No.	Testing Methods	Engineering Significance	Requirements for (40-50)Pen
1	Penetration test for bituminous materials, <b>ASTM D5</b> <a href="https://www.youtube.com/watch?v=x0MERLScCNc">https://www.youtube.com/watch?v=x0MERLScCNc</a>	To examine the <b>consistency</b> of a sample of bitumen (relative hardness).	40-50 as the distance in tenths of a millimeter (0.1mm), decimillimetre (dmm)
2	Method for determination of softening value of bitumen, <b>ASTM D36</b> <a href="https://www.youtube.com/watch?v=wshdQfiBLHk">https://www.youtube.com/watch?v=wshdQfiBLHk</a>	-To examine the <b>tendency</b> of bitumen <b>to flow</b> at <b>elevated temperatures</b> encountered in service ( <b>Higher softening point</b> ensures that bitumen <b>will not flow during service</b> ). - To know the <b>temperature</b> up to which a bituminous binder should be <b>heated</b> for various road use applications.	<b>(50–58)°C for (35-50)Pen*</b> <b>(48–56)°C for (40-60)Pen*</b> <b>(46–54)°C for (50-70)Pen*</b>  <b>*Shell Bitumen Handbook (6th Edition), 2015</b>
3	Determination of ductility value of bitumen <b>ASTM D113</b> <a href="https://www.youtube.com/watch?v=SxU00_wlzA4&amp;t=26s">https://www.youtube.com/watch?v=SxU00_wlzA4&amp;t=26s</a>	To examine <b>tensile properties</b> and <b>adhesiveness</b> of bitumen.	≥ 100cm
4	Method for finding out flash and fire point of bitumen <b>ASTM D92</b> <a href="https://www.youtube.com/watch?v=PR7q4-ilENA">https://www.youtube.com/watch?v=PR7q4-ilENA</a>	To know the <b>safe</b> mixing and heating temperature values of a particular bitumen grade.	≥ 232°C

No.	Testing Methods	Engineering Significance	Requirements for (40-50)Pen
5.	Effects of heat and air on asphalt materials (Thin-Film Oven Test) <b>ASTM D 1754</b> <a href="https://www.youtube.com/watch?v=DubJZ55F5xY">https://www.youtube.com/watch?v=DubJZ55F5xY</a>	<ul style="list-style-type: none"> <li>To simulate the <b>short-term aging</b> of bitumen by heating a film of asphalt binder in an oven for 5 hours at 163°C.</li> <li>To examine the <b>effects of heat and air</b> on the hardening and tensile properties of bitumen.</li> </ul>	<b>Residue from thin-film oven test should have</b> <ul style="list-style-type: none"> <li>Penetration value &gt; 55% of the original penetration value.</li> <li>Ductility value &gt; 25 cm</li> </ul>
6.	Kinematic viscosity at 135°C, <b>ASTM D2170</b>	To characterize the <b>flow behavior of bitumen</b> (resistance to flow at elevated temperature under gravity).	$\geq 370$ cSt for (35-50)Pen* $\geq 325$ cSt for (40-60)Pen* $\geq 295$ cSt for (50-70)Pen* *Shell Bitumen Handbook (6th Edition), 2015.
7.	Dynamic viscosity at 60°C, <b>ASTM D2171</b>	To examine the <b>consistency</b> of a sample of bitumen (relative hardness).	$\geq 225$ Pa . s for (35-50)Pen* $\geq 175$ Pa . s for (40-60)Pen* $\geq 145$ Pa . s for (50-70)Pen* *Shell Bitumen Handbook (6th Edition), 2015.
8.	Solubility in trichloroethylene <b>ASTM D2042</b>	To determine <b>bitumen content or homogeneity</b> (to check the purity of asphalt).	> 99%
9.	Specific gravity <b>ASTM D70</b> <a href="https://www.youtube.com/watch?v=Mf4ds_7SETw">https://www.youtube.com/watch?v=Mf4ds_7SETw</a>	It is used for <b>mixture calculations</b> .	1.02 - 1.05
10.	Fraass breaking point test <b>EN 12593</b> Watch the following from 0:20 up to the minute 4:10 <a href="https://www.youtube.com/watch?v=hdIuF2pciDc&amp;t=11s">https://www.youtube.com/watch?v=hdIuF2pciDc&amp;t=11s</a>	<ul style="list-style-type: none"> <li>To describe the <b>behavior</b> of bitumens at very low temperatures (as low as -30°C).</li> <li>To determines the <b>temperature</b> at which bitumen reaches a critical stiffness, and cracks (breaking point).</li> </ul>	<b>Max -5 for (35-50)Pen*</b> <b>Max -7 for (40-60)Pen*</b> <b>Max -8 for (50-70)Pen*</b> *Shell Bitumen Handbook (6th Edition), 2015.

The following table presents the requirements for penetration graded asphalt cement locally used in roads construction according to the standard specifications for roads and bridges of the Iraqi state corporation for roads and bridges (SCRB, R9).

**TABLE R9/2B**  
**REQUIREMENTS FOR PENETRATION-GRADED ASPHALT CEMENT.**

Property	Penetration Grade of Asphalt		
	40/50	50/60	60/70
1. Penetration at 25° C, 100gm, 5sec (1/10mm)	40-50	50-60	60-70
2. Ductility at 25°C, 5cm/min, (cm)	>100	>100	>100
3. Flash point, °C	>232	>232	>232
4. Solubility in trichloroethylene, %	>99	>99	>99
5. Residue from thin-film oven test			
- Retained penetration, % of original	>55	>53	>52
- Ductility at 25°C, 5 cm/min (cm)	>25	>40	>50

**Table 5.1** Specifications for paving grade bitumens with penetrations from 20 × 0.1 mm to 220 × 0.1 mm: Tables 1A and 1B of EN 12591 combined, including examples of specific regional requirements (BSI, 2009a)

Property	Test method	Unit	20/30	30/45	35/50	40/60	50/70	70/100	100/150	160/220
Penetration at 25°C	EN 1426	0.1 mm	20–30	30–45	35–50	40–60	50–70	70–100	100–150	160–220
Softening point	EN 1427	°C	55–63	52–60	50–58	48–56	46–54	43–51	39–47	35–43
Resistance to hardening at 163°C	EN 12607-1									
Retained penetration		%	≥55	≥53	≥53	≥50	≥50	≥46	≥43	≥37
Change of mass (absolute value)		%	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.8	≤0.8	≤1.0
Increase in softening point – severity 1		°C	≤8	≤8	≤8	≤9	≤9	≤9	≤10	≤11
or			or	or	or	or	or	or	or	or
Increase in softening point – severity 2 a		°C	≤10	≤11	≤11	≤11	≤11	≤11	≤12	≤12
Flash point	EN ISO 2592	°C	≥240	≥240	≥240	≥230	≥230	≥230	≥230	≥220
Solubility	EN 12592	%	≥99.0	≥99.0	≥99.0	≥99.0	≥99.0	≥99.0	≥99.0	≥99.0
Penetration index	Annex A b	–	← –1.5 to +0.7 →							
Dynamic viscosity at 60°C	EN 12596	Pa·s	≥440	≥260	≥225	≥175	≥145	≥90	≥55	≥30
Breaking point (Fraass)	EN 12593			≤–5	≤–5	≤–7	≤–8	≤–10	≤–12	≤–15
Kinematic viscosity at 135°C	EN 12595	mm <sup>2</sup> /s	≥530	≥400	≥370	≥325	≥295	≥230	≥175	≥135
	France		x		x		x	x		x
	Belgium		x		x		x	x		x
	The Netherlands		x			x		x	x	x
	Germany		x	x			x	x		x
	UK		x	x	x	x	x	x	x	x
	Switzerland				x		x	x	x	x
	Czech Republic		x	x	x		x	x	x	x
	Poland		x		x		x	x		x

