BENDING BEAM RHEOMETER (BBR) *FLEXURAL CREEP STIFFNESS S AND m-VALUE*

EN 14771: Bitumen and bituminous binders – Determination of the flexural creep stiffness – Bending Beam Rheometer (BBR)

Overview

The test is used to determine the flexural creep stiffness of bitumen and bituminous binders at different test temperatures.

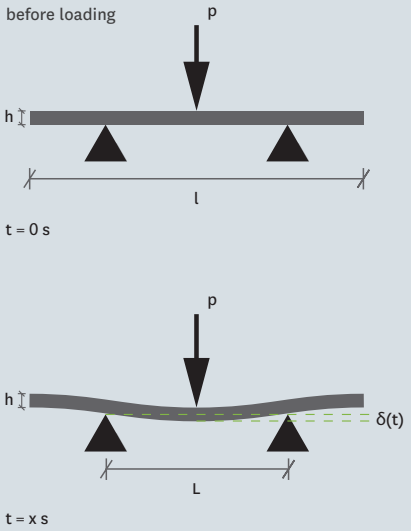
A beam-shaped test specimen in a three-point bending test is loaded with a constant point load and the deflection is measured as a function of time.

The flexural creep stiffness serves to address the behaviour of bitumen and bituminous binders at low service temperatures. The flexural creep stiffness at a given temperature, or the temperature, where the flexural creep stiffness equals a given value, and the respective m-values are the most common parameters determined.

If a single result for the flexural creep stiffness and for the m-value are requested, the values at the load duration of 60 seconds are used.
Creep stiffness is determined using the equation below.

$$S_m(t) = \frac{P\,L^3}{4\,b\,h^3\,\delta(t)}$$

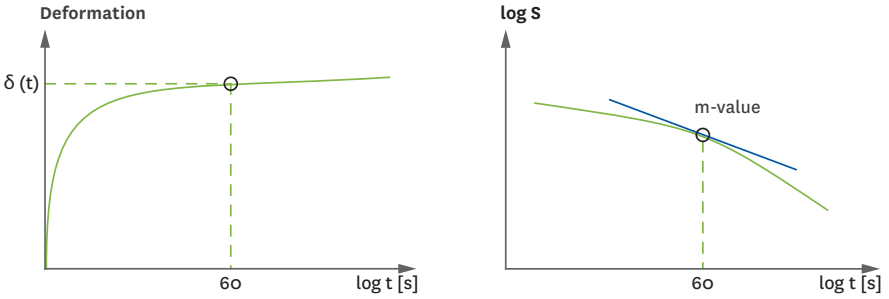
P = test load (N)
L = distance between supports (mm)
b = width of specimen (mm)
h = thickness of specimen (mm)
δ (t) = deflection at time t (mm)



Definition and Terminology

Flexural creep stiffness S(t): Quotient of bending stress and bending strain under constant load.

m-value: Absolute value of the slope of the curve of the logarithm of stiffness versus the logarithm of time.

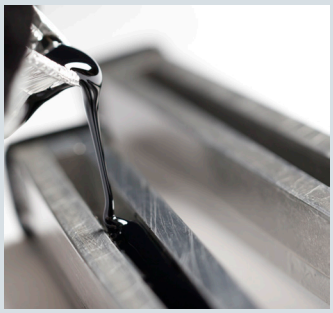


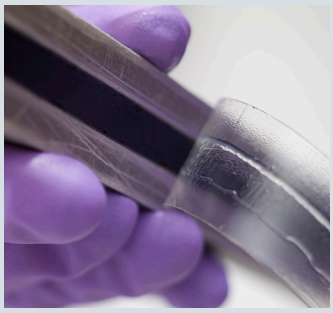
2nd edition ISBN: 978-2-39068028-4 D/2024/7512/159
At the time of publication of this document, EN 14771:2023 `Bitumen and bituminous binders - Determination of the flexural creep stiffness - Bending Beam Rheometer (BBR)` was the reference for testing. This document does not overrule the test standard EN 14771, but is intended to help users of the standard to be aware of important factors. However, the reference for testing remains EN 14771. Temperatures, times, and dimensions and their tolerances must be strictly observed, that is checked for accuracy and for maintaining the tolerance during application. From experience, rheological tests should preferably be carried out by laboratory technicians trained in the individual procedures to be applied.

Practical Information:

The test specimen must be precise in its dimensions and without any defects.

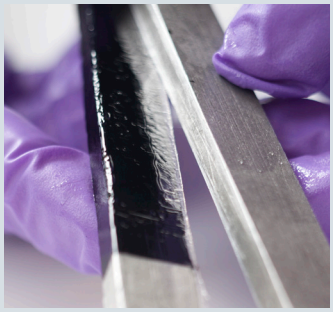
- Mould preparation is given in section 6.2 of EN 14771.
- Cover the inner faces of the metal mould, including ends, completely with a thin film of suitable release agent, or grease.
- Place the plastic (or silicone paper) strips onto the greased base and side surfaces, and remove any air bubbles.
- The strips and the base and side parts must have matching dimensions to the mould, see section 5.3 of EN 14771.
- Test specimens can be stored in their moulds for a maximum of 3 days at room temperature.
- Before demoulding, any excess binder must be trimmed to be level with the surface of the mould using a hot knife or spatula.
- When demoulding the test beam, take care not to damage or deform it.
- Experience shows that demoulding can be made easier by cooling the test specimen in its mould in a liquid bath or cooling chamber for 5 minutes.





The test beam dimensions must be checked carefully.

- Experience shows that direct measurement of the specimen can lead to damage, therefore it is recommended to use the internal dimensions of the mould.
- The thickness of the test beam has a significant influence on the calculated stiffness.



The test must be carried out at suitable test temperatures.

- The chosen test temperature should ensure a mid-point deflection of the specimen between 0,08 mm and 4,0 mm.
- The temperature measuring device of the liquid bath must be calibrated and regularly checked.
- The bath liquid used shall not affect the properties of the examined bitumen. (95% ethanol has proven to be a suitable bath liquid.)

Other parameters are calculated from test data.

- Usually, testing is carried out at several test temperatures to allow calculation of the flexural creep stiffness or m-value. Calculation is done by interpolation.
- For flexural creep stiffness, logarithmic interpolation should be carried out, while for m-value, linear interpolation is recommended (see Annex A of EN 14771).
- Other parameters can be calculated from data obtained using the BBR, including ΔT_C, the difference between the temperatures where S = 300 MPa and where m = 0,3. It can also be useful to report the m-value at the temperature where S = 300 MPa.