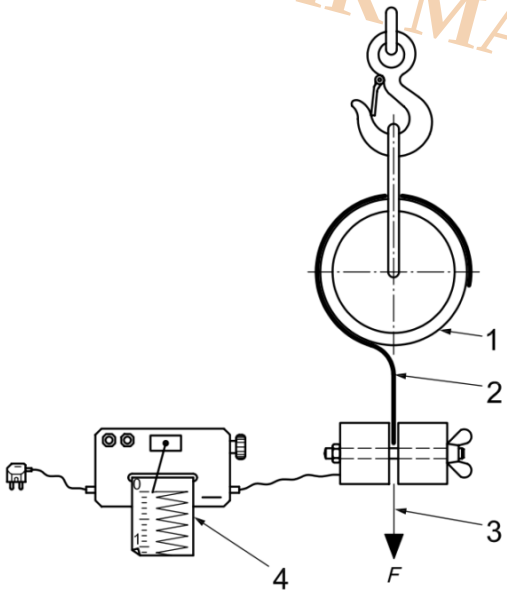
# DIN EN ISO 21809-1 External Coatings for Buried or Submerged Pipelines/ Polyolefin coatings (3-layer PE and 3-layer PP) / Annex C Peel Strength Test / Testing Equipment

## Description

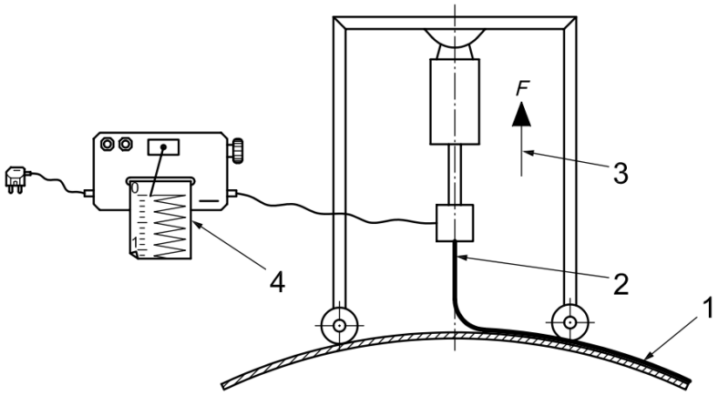
C.1 General
The test shall consist of measuring the force required for peeling the coating from the metal substrate of the pipe at a constant rate of pull.
C.2 Equipment
C.2.1 Tensile testing machine, capable of recording the peel force with a 5 % reading accuracy, that operates at a rate of pull of 10 mm/min, as shown in Figure C.1 for small diameters or in Figure C.2 for large diameters.
C.2.2 Cutting tool (e.g. knife).






**Key**
1 pipe ring
2 coating strip
3 peel force, $F$
4 registration unit

**Figure C.1 — Peel strength test equipment for a small-diameter joint**




**Key**

1 coated pipe surface
2 coating strip
3 peel force, $F$
4 registration unit

**Figure C.2 — Peel strength test equipment for a large-diameter joint**



C.3 Procedure

C.3.1 General

C.3.1.1 The coating thickness may be reduced to the minimum thickness of the coating class to facilitate
peel testing.

C.3.1.2 The peel test shall be performed at the temperatures specified in Table 7.

C.3.1.3 The temperature shall be measured by means of an adapted probe on the external surface of the
pipe at the root of the peeled strip.

C.3.1.4 The peel force shall be graphically recorded over 140 mm using a constant peeling speed of 10 mm/min.

C.3.2 Small-diameter pipes

C.3.2.1 A pipe ring of 200 mm in length shall be cut from the pipe.

C.3.2.2 A sample coating strip shall be cut in the circumferential direction of the pipe ring, measuring a minimum of 160 mm long and 20 mm to 50 mm wide.

C.3.2.3 The pipe ring shall be free to rotate about its axis as shown in Figure C.1.

C.3.2.4 The cut end of the coating strip shall be secured to one of the gripping jaws of the testing machine and peeled perpendicular to the pipe axis.

C.3.3 Large-diameter pipes

C.3.3.1 The pipe shall be supported during the test to prevent movement.

C.3.3.2 A sample coating strip shall be cut in the circumferential direction of the pipe, measuring a minimum of 160 mm long and 20 mm to 50 mm wide.

C.3.3.3 The cut end of the coating strip shall be secured to one of the gripping jaws of the testing machine and peeled perpendicular to the pipe axis.

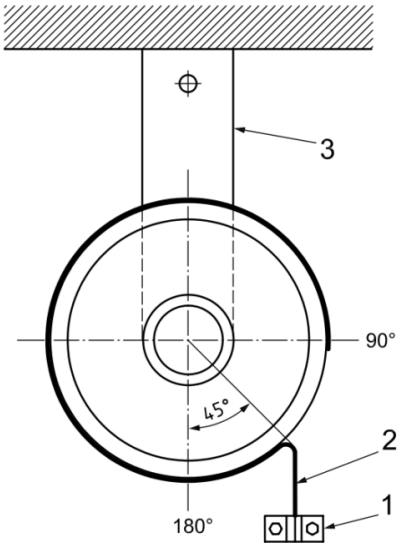
C3.3.4 Ring pipe or a cut sample can be used for measurement at high temperature instead of the pipe.

C.4 Results and test reports

The results shall be calculated by dividing the peel force data for 140 mm of peeling into seven intervals of 20 mm, discarding the first and last intervals. The peel strength shall be calculated from the

remaining data.
The average peel strength shall be the arithmetic mean over the 100 mm length. If this value is not automatically determined, the arithmetic mean may be estimated from the 20 mm bands across the 100 mm length.
The average peel strength shall meet the requirements of Table 7 and no single recorded peeling value shall be 30 % below the specified value.
The test reports shall include at least the following:
âŽ¯ identification of test specimens;
âŽ¯ procedure used;
âŽ¯ instruments used;
âŽ¯ reference to this part of ISO 21809;
âŽ¯ temperature of test;
âŽ¯ date of test;
âŽ¯ test results.

C.5 Measurement of the peel strength with a hanging mass
C.5.1 General
The method shall consist of measuring the rate at which the coating is peeled from the metal substrate of the pipe at constant load (see Figure C.3).
C.5.2 Equipment
C.5.2.1 Mass, of 25 kg (for system A), 38 kg (for system B) or 63 kg (for system C) for 23 Â°C Â± 3 Â°C.
C.5.2.2 Mass, of 5 kg (for system A), 7,5 kg (for system B) or 10 kg (for system C) for high temperature conditions.
C.5.2.3 Cutting tool (e.g. knife).
C.5.2.4 Timing device.
C.5.2.5 Attaching device.




Key
1 mass
2 peel strip
3 attaching device



**Figure C.3 — Peel strength test equipment with a hanging mass**

C.5.3 Test specimens

Each test specimen shall consist of a complete pipe or test ring cut from a pipe. The test ring shall be approximately 150 mm long.

C.5.4 Procedure

C.5.4.1 The test shall be performed at temperatures in accordance with Table 7.

C.5.4.2 The peel strip shall be 25 mm Â± 1 mm wide.

C.5.4.3 The peel orientation shall be circumferential.

C.5.4.4 If a test ring is used, it shall be conditioned at the test temperature for at least 1 h before starting the test.

C.5.4.5 Two cuts shall be made 25 mm Â± 1 mm apart through the coating to the steel substrate with the cutting tool, from the 90Â° position to the 180Â° position. The coating shall be cut at a right angle at the 90Â° position and it shall be peeled off down to the 135Â° position, as shown in Figure C.3.

C.5.4.6 The temperature shall be measured by means of an adapted probe on the external surface of the pipe at the root of the peeled strip.

C.5.4.7 Attach the appropriate mass to the free end of the strip, as shown in Figure C.3.

C.5.4.8 Peeling time shall be measured in minutes from the 135Â° position to the 180Â° position. Alternatively, terminate peeling when the test time, t, expressed in minutes, calculated in accordance with Equation (C.1), has been exceeded:

t = (0,125 Ã— 3,14 Ã— D)/10 (C.1)

where D is the specified outside diameter, expressed in millimeters.

C.5.4.9 The distance peeled shall be measured in millimeters from the time the test is initiated until it is

terminated.
C.5.4.10 The peeling speed, vp, expressed in millimetres per minute, shall be calculated as given by Equation (C.2):
vp = l/t (C.2)
where
l is the distance peeled, expressed in millimetres;
t is the peeling time, expressed in minutes.
If the peeling speed exceeds 10 mm/min, the test shall be considered to have failed.

C.5.5 Report and test report
If a report is required, the following information shall be reported:
âŽ¯ date of test;
âŽ¯ identification of test specimen;
âŽ¯ specified pipe outside diameter;
âŽ¯ mass, expressed in kilograms;
âŽ¯ distance peeled, expressed in millimeters;
âŽ¯ peeling time, expressed in minutes;
âŽ¯ peeling speed, expressed in millimeters per minute;
âŽ¯ temperature of test.

**Peel Tester According to ISO 21809-1 Annex C / ISO 21809-3 Annex D**

- Servo controlled
- Fixture for peel testing according to above standards
- Long travel extensometer (is as option in case of customer request)
- Ball screw
- Double column
- USB port for  computer connection
- Windows based software is included
- Computer will be quoted separately as per customer request
- Load resolution 1/10000
- Speed as per customer request
- Grips as per customer request for different products
- Easy operation and clear visualization (test curves, calculations)
- Easy to change the grips via male-female connection
- Accuracy Â±0.5% of full scale
- Precise self-cleaning ball-screw
- Brush-less servo motor quarantine maintenance-free operation
- Easy calibration of load-cell
- Training video



YOUTUBE VIDEO

**Category**

1. Equipment for Standards
2. Standards