Shear Testing Machines
Series STM

According to European Standard EN 15340

Determination of Shear Load Resistance of Thermally Sprayed Coatings

Standard was developed within a European Joint Research Project together with:

- **EMPA - Materials Science & Technology**
- **walter+bai ag Testing Machines**

EMPA Materials Science & Technology

The STM is used for the characterizing of the adhesion and cohesion of thermally sprayed coatings in accordance with EN 15340.

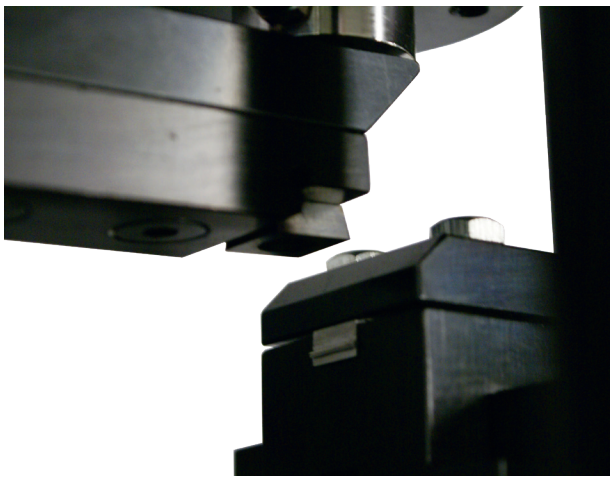
The shear loading method according to EN 15340 describe a simple and fast shear test that does not require the use of an adhesive agent or curing at temperature and represents most of the generally occurring failures in manufactured, coated parts.

The test is conducted to determine the strength of the bond between the spray deposit and the parent material (adhesive strength) and/or the strength of the coating (cohesive strength).

If adhesive strength to the base material supersedes cohesive strength of the sprayed coating primarily the cohesive strength of the deposit is determined.

The specimen / coating is loaded parallel to the interface coating / substrate. The test is used to evaluate the effects of parent material and spray material, surface preparation of the work piece before spraying, and the spraying conditions on the adhesive strength of thermally sprayed coatings, or for quality control and routine supervision of the spray works.

walter+bai ag · Industriestrasse 4 · 8224 Löhningen · Switzerland
Tel. +41 (0)52 687 25 25 · Fax +41 (0)52 687 25 20 · info@walterbai.com · www.walterbai.com

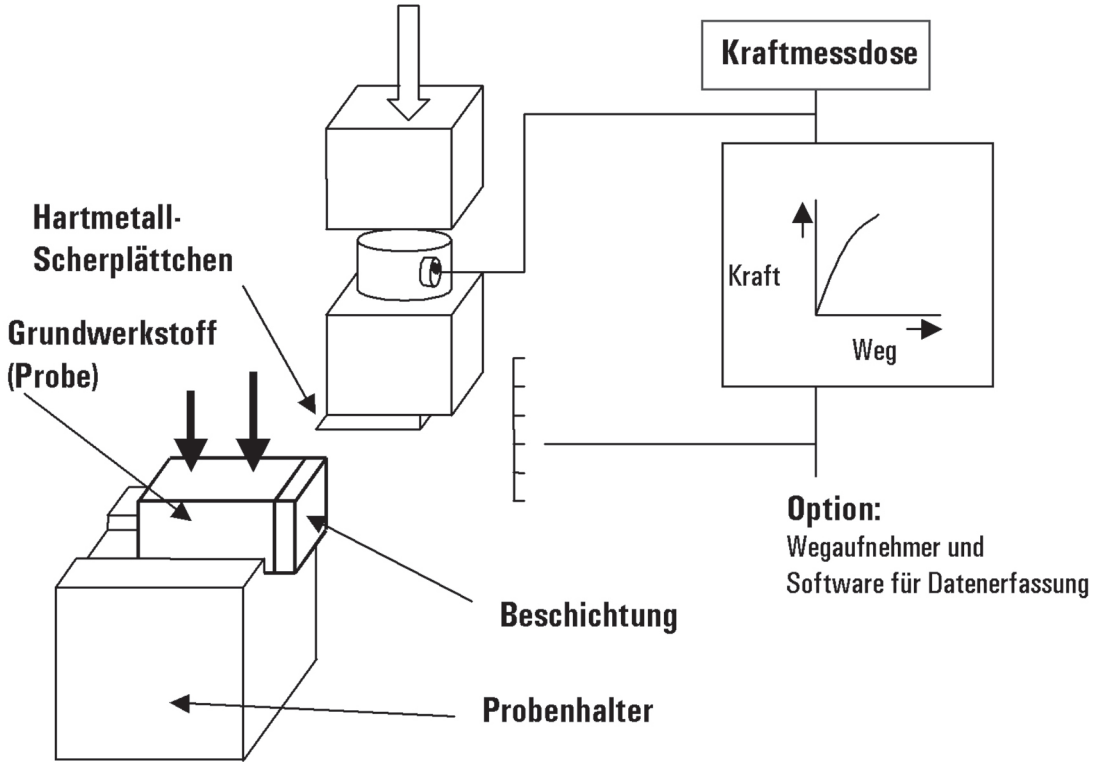


The principle of the testing set up is demonstrated in figure 1.

An exact fixation and alignment of the specimen in the sample holder is necessary and shall avoid any movement of the sample during the shear test.

The shear plate is made of hard metal. A suitable cutting plate stands the test. The shear plate is fixed in a suitable manner to a cantilever that allows a movement during loading without deviations in the guideways. The edge of the shear plate shall be parallel to the interface coating/substrate and parallel to the upper face of the sample. Thus a uniform loading of the coating is ensured.

Test Set up Principle Figure 1



Technical Data:		Series STM	
Electromechanical loading system with central screw with speed reduction gear and speed-controlled DC-Motor an precision load cell.			
Force Capacity:	kN	10	20
Digital force read out ranges with peak store:	kN	2 to 10	4 to 20
Force Measuring Accuracy according to	ISO 7500-1	Class 1	
Displacement Transducer:	mm	5	
Precision according to	ISO 9513	Class 0.5	
Loading Speed Range:	mm/sec.	0.01 to 0.5	
Fixture for Sample Size:	mm	30 x 10 x 5	
Power Supply:		230 V / 50 Hz (60 Hz available) 6 A	
Dimensions Machine W x D x H:	mm	600 x 450 x 210	
Dimensions Digital Read Out W x D x H:	mm	350 x 300 x 150	
Net Weight with Display:	kg	52	

Terms and Definitions

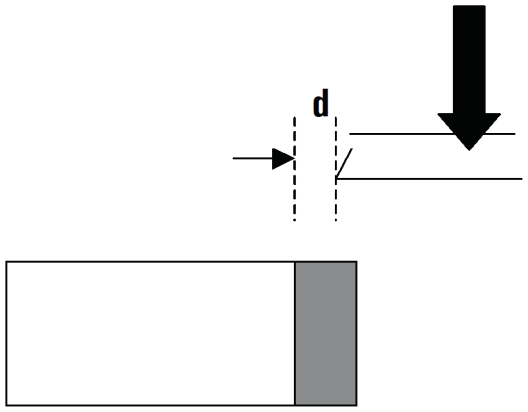
For the purposes of this European Standard the following definitions apply:

Shear Strength Fs

Maximum force that causes fracture of the specimen in the interface coating/substrate (FSa=adhesive) or within the coating (FSc=cohesive) or mixed (FSa/c).

Shear Distance d

Length from the interface between coating and substrate to the edge of the shear plate. See figure.
The shear distance shall be 50 µm ±20 µm.

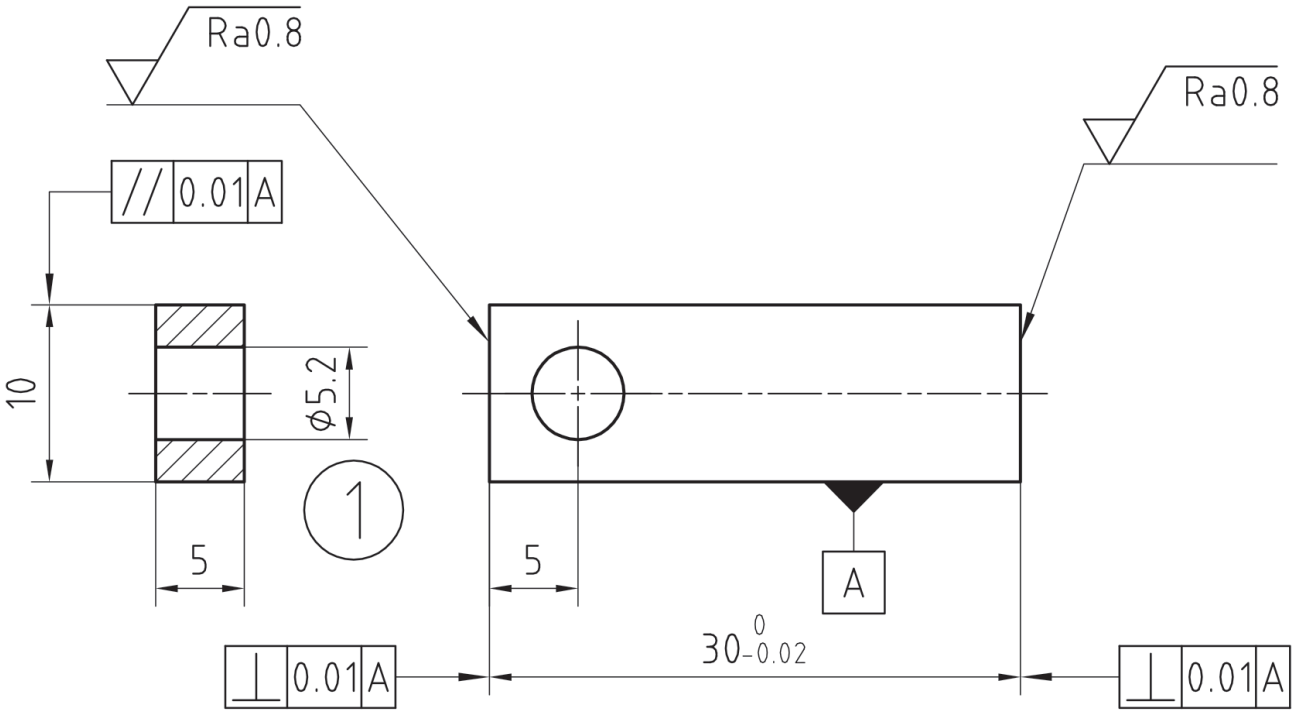


Specimen

Dimensions:

Length:	30 mm	+0 /-0.02 mm
Width:	10 mm	+0 /-0.11 mm
Depth:	5 mm	+0 /-0.075 mm

Note: For the determination of the shear load resistance is not recommended for sprayed coatings thinner than approx. 150 µm because the adjustment of shear distance becomes critical.



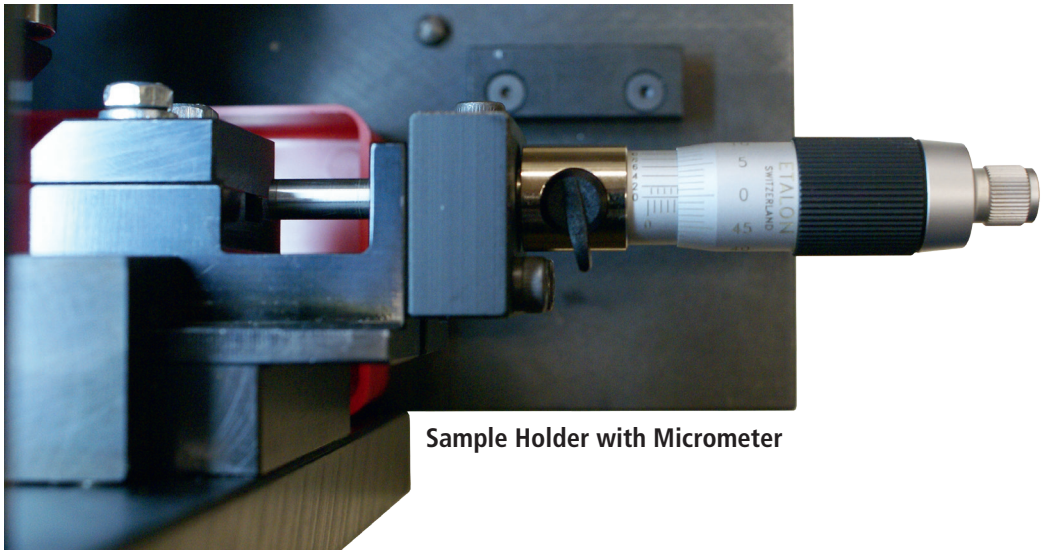
Preparation:

The specimen is made of the specified material and shall be pre-treated in the same way as the work piece in practice. The coating is applied to the face 5 x 10 mm. No spray material shall deposit on the other sides. Unavoidable overspray on the sides must be removed by abrasive paper. Spray conditions shall be equal to those of practical work. Coating thickness shall be constant. Care shall be taken to ensure the perpendicularity of specimen faces after cleaning. Other post treatment should be done only if it belongs to the treatment of the work piece in practice. Before the test coating thickness is measured non-destructively or by metallographic examination of an accompanying specimen. Care shall be taken that measurement by slide gauge often yields values that are too high.

Number of Specimen to be tested:

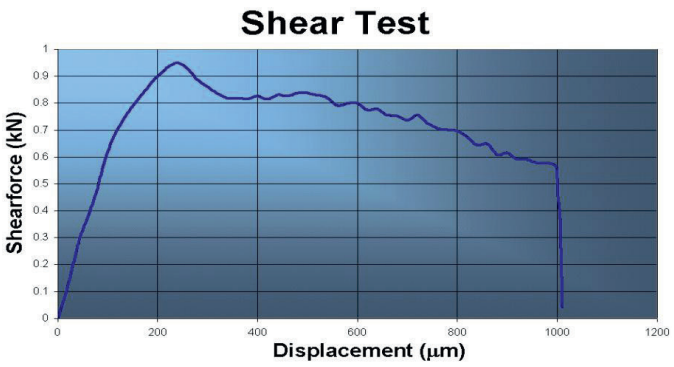
At least five specimens, spray deposited in one cycle, shall be tested.

Test Procedure:
The specimen is inserted into the sample holder of the test device and securely clamped. Any movement of the specimen during loading, lateral, back, or tilting must be excluded. Shear distance is adjusted to 50 µm. The coating is loaded on the small side (thickness) by thrust of the shear plate at a constant rate and without jerks until fracture occurs and the recorded load decreases. A suitable thrust of the shear plate is about 20 µm per second.
Testing is to be performed at ambient temperature. For a series of tests, equal test conditions shall be maintained.

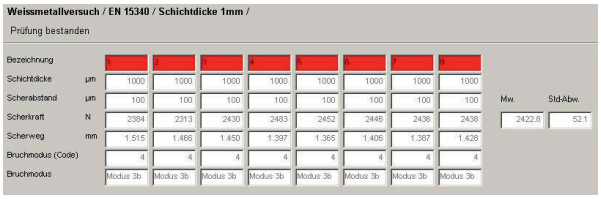


Sample Holder with Micrometer

Evaluation:



The shear load resistance is taken from the first maximum of the force displacement curve. To clearly distinguish between cohesive and adhesive fracture of the coating it is advisable to evaluate the fracture interface by means of a stereo microscopy. The statistical mean value for the shear force is shall be calculated.



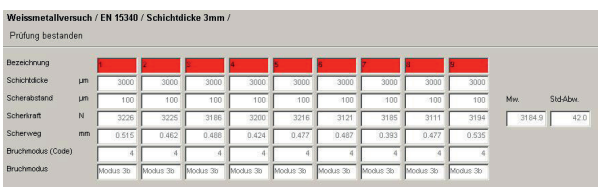
Test Reports:

The test reports shall contain the following information about factors for every specimen tested in accordance with this standard:

a) inspection body, inspector, date
b) coating thickness
c) shear distance
d) thrust velocity
e) type of fracture (interface between coating and substrate, in the spray deposit, mixed fracture, portion of the coating spalled off)
f) particularities

Possible faults in the preparation of specimen and in testing:

a) Surfaces of the specimen are not cleaned exactly from overspray
b) Angular and positional displacement of specimen in the sample holder
c) Movement of the specimen during loading
d) Shear distance is low; shear plate scrapes the substrate material
e) Shear distance is too large, only the coating surface is scraped



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