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Draft Afera Test Method “Dynamic shear” (version 5)

Dynamic Shear Strength of Double-Sided Pressure Sensitive Adhesive (PSA) Tapes

Introduction

The method complements the well-established static shear test methods for PSA tapes and as such enables additional insights into the nature of joints bonded with PSA tapes. The term “dynamic” emphasizes the fact that the mechanical load is constantly increasing over the time of measurement, in contrast to the static methods with constant mechanical load. The method addresses the need to provide data for double-sided tapes that are widely in use for mounting applications, in particular bonding of rigid substrates. The method takes the specific characteristics of PSA tapes into account, e. g. their viscoelasticity, their thickness, which are not in the focus of methods for determination of lap shear strength of structural adhesives.

The method is not considered to replace the internal methods of Afera member companies. It offers a standard reference and can be a starting point for more specialized methods for certain products or applications. Where appropriate, the rationale for the selected standard parameter is given to make adaptations easier. It is understood, however, that values obtained from measurements with different parameters are not comparable.

The method does not address all possible health and safety concerns associated with its use. The user is responsible for implementing appropriate health and safety measures prior to use as well as to comply with regulatory standards for the materials employed.

1. Scope

This standard specifies a method for determination of the shear strength of single-lap-joints at a constant speed of separation, bonded with double-sided or transfer PSA tapes.

2. Reference Documents

ASTM D1002

DIN EN 1465 (?)

DIN EN 14869-2

Afera 5012

ISO 29863

ISO 10365

…. to be completed later..

3. Terms and Definitions

3.1

3.2

4. Summary of Test Method

The test method describes the determination of the shear strength of single-lap-joints bonded with PSA tapes at a constant speed of separation (+ other specified conditions). The shear strength of the single-lap-joint is determined by subjecting the joint of a rigid-to-rigid substrate combination to a shear force that acts in parallel to the plane of the bond and in parallel to the main axis of the test specimen and that increases as a constant speed of separation is applied until failure of the bond. The result is determined as the maximum force and/or the maximum shear stress recorded, as well as the failure mode.

5. Significance and Use

This test method is predominantly for comparative purposes. Regarding the limitations to use the results as design-allowable stress values, the same considerations as in ASTM D1002-10 (Clause 4) apply.

Perhaps reference to DVS3320; for application related purposes time scale of measurement to be adapted to time scale of application? To be decided later.

6. Apparatus

6.1 A constant rate of extension (CRE) tension testing machine shall be used. The device shall have two self-aligning clamps with centres in the same plane, parallel with the direction of the motion on the stressing clamp, a means of moving the stressing clamp at a uniform rate of 12.7 mm/min and a device for recording load. The testing machine shall be calibrated in accordance with the requirements of DIN EN ISO 7500-1, class 1 (corresponding to an accuracy of 1 %), or better. The response time of the machine shall be sufficiently short so that the accuracy of the measurement at the moment of failure is not affected.

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Kommentiert [KS1]: ! Class 1 may be different from the requirement “accuracy 0.5 %”. Input on 7500-1 comes from Zwick/Roell

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6.2 Device to connect the test specimen to the clamps/crossheads. In order to minimize forces on the tape that are acting other than in shear, care must be taken that the tape is without restraint. Therefore, the centre lines of the clamps must be as parallel as possible. As double-sided PSA tapes often have a relatively high thickness, this may be very laborious and challenging to accomplish by direct placement of the test specimen in the clamps (Figure 1). Therefore, two alternatives are described as methods for connection of the test specimen to the clamps/crossheads.

6.2.1 Connection via steel hooks and ancillary steel plates as shown in Figure 2. The test specimen shall be placed in the angular points of the hooks before the measurement starts.

For the selection of hooks and plates, care must be taken that their deformation is negligible compared to the deformation of the tape, especially when strain values are of interest in addition to the force/stress values. Pretests should be performed to ensure that this precondition is fulfilled within the force range of the test.

6.2.2 Connection via splints as shown in Figure 3 (similarly depicted in DIN EN 14869-2, Fig.2). The test specimen is connected to the clamps via splints that are driven through the holes of the test plates. The splints are mounted to a special holder that replaces the

standard clamps or is added to it. The diameter of the splints should be close to the diameter of the holes in the specimen.

For the mechanical stability of splints and holder the same considerations as for hook/plate systems apply. ~~(Muss man an dieser Stelle noch etwas zur Beachtung erwähnen, z. B. Ausrichtung auf dem Splint? Oder in 10. integrieren)~~

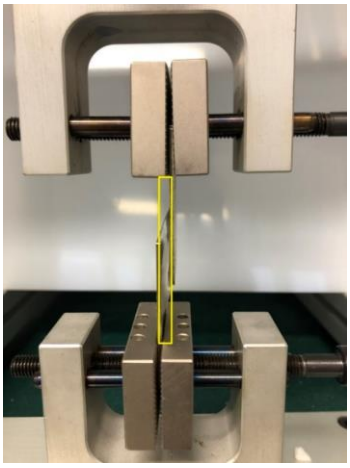

Figure 1

Figure 2

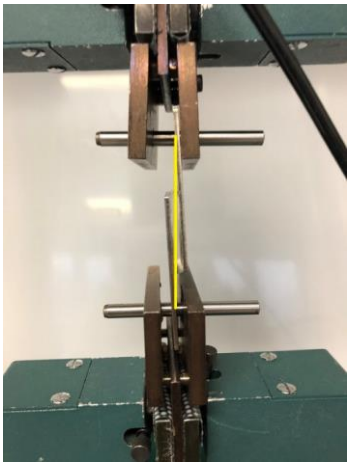

Figure 3

6.3 Materials for preparation of test specimens, described in clauses 9. and 10.

6.4 Means for Climatisation, see clause 8.

7. Sampling

Sampling shall be in accordance with ASTM Practice D3715/D3715M or other formal sampling procedure agreed to by both parties in case of arbitration procedures. (Braucht es diesen Abschnitt wirklich?)

8. Conditioning

Tape samples and test plates shall be conditioned at (23 ± 1) °C, (50 ± 5) % r.h. for 24 h prior to bonding. Preparation of the test specimens, i. e. bonding, shall take place at the same conditions. Bonded test specimens shall be stored at the same conditions for 48 h prior to measurement. Measurement shall take place at the same conditions.

Note: The storage time of 48 h for the bonded specimens is selected to provide sufficient time for full dwelling of the PSAs. Other dwell times maybe chosen for special purposes but have to be noted in the final report.

9. Test Specimens

9.1 Standard Substrates shall be stainless steel shear test plates. Dimensions: 50 mm x 25 mm x 2 mm. The plates shall have a drill hole of 6 mm diameter at their upper end (Figure 4). Material shall be in accordance with description in ISO 29863: stainless steel type 1.4301, 2R quality defined in EN 10088-2, bright annealed finish, surface roughness Ra = 50 nm +/- 25 nm. The surface shall be free of macroscopic visible dents or irregularities. In order to avoid any deformations of the plates that could lead to deviations from planarity, gate shears shall not be used in the production process of the plates.

~~Note: Test plates according to this description may be purchased from several suppliers, e. g. Rocholl GmbH, Germany.~~

Note: Other substrate materials; need to mention that materials should be strong enough to avoid elongation/bending during measurement. Material quality, dimensions and any pretreatment measures have to be noted in the ~~final r~~report.

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Figure 4

9.2 Cleaning and surface preparation of the steel plates shall be in accordance with the materials and procedures described in Afera 5012 or ISO 29863.

Note: any deviation from the surface pretreatment described here must be reported in the test report.

9.3 Bonding area: 25 mm x 25 mm

Note: For very thick tape samples an overlap of more than 25 mm in the lengthwise direction may be appropriate to ensure that the substrate plates are not sheared to zero overlap during measurement. Any deviation from the bonding area as given in 8.3 must be noted in the test report.

Note: Results from tests with different bonding areas cannot be compared directly.

10. Procedure

10.1 Preparation of test specimen

10.1.1 Clean the steel test plates prior to use according to Afera 5012, subclause 10.2.1 or ISO 29863, subclause 5.5.2.

10.1.2 Cut a 25 mm wide strip of tape from a roll or a sheet sample with a specimen cutter as described in Afera 5012, subclause 5.1 (25 mm width)

10.1.3 Apply the tape to the first steel plate, flush with the edges of the plate, apply light pressure, e. g. by using a light roller. Avoid inclusion of air bubbles. Don't use finger pressure to avoid dents in the tape. Cut off the excess end(s) carefully, flush with the edge(s) of the steel plate. Remove the liner.

Note: make sure not to confuse the lengthwise direction of the test specimen and the lengthwise direction of the tape sample.

10.1.4 Bond the second steel plate to the closed side (= liner side) of the tape, flush with the edge of the first plate. Avoid inclusion of air bubbles. Apply pressure of 10 N/cm² for 1 min on the bond area by placing a weight of 6.25 kg on the test specimen or using equivalent hydraulic pressure. Avoid tilting of the test plates.

Note: For full analysis of the failure mode after the test, note the position of open and closed side.

Note: Experience has shown that a bonding pressure of 10 N/cm² is sufficient for most PSAs However, there may be PSAs with a viscoelastic profile that requires a higher bonding pressure to obtain optimum results.

10.2 Measurement

10.2.1 Fix the test specimen to one of the clamp assemblies described in section 5.2. Set the force reading to zero and start the measurement.

10.2.2 Crosshead speed: 12.7 mm/min

Note: As the duration of the measurement varies significantly with the thickness of the tape and the viscoelasticity of the PSAs, different speeds may be appropriate for very thick or very thin tape samples and/or special PSA types. Results obtained from measurements with different speeds cannot be compared.

10.3. The measurement is ended when the force reading has dropped to 50% of the maximum value.

10.4 The number of test specimens to produce one result is min 5. Higher numbers of specimen may be chosen when higher accuracy is needed.

11. Calculation, Results

11.1 Lap shear strength

Divide the force reading at maximum in N (Newton) by the bond area (Standard: 625 mm²) to obtain the lap shear strength of the test specimen. The lap shear strength can be expressed in N/cm², N/mm² = MPa or KPa.

The result is the mean value and the standard deviation of the tested items.

11.2 Failure mode

Note the failure mode of each tested specimen, including a quantified estimation of the respective failure mode (e. g. 80% cohesive, 20% adhesive). For full analysis, the result includes the side of the tape where the failure occurred. The description of the failure modes shall be in accordance with ISO 10365.

Note: As the measurement does not only produce force/stress values but delivers elongation/strain values at the same time, further results may be obtained from the test.

12. Report

To be filled in later.