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Group standard **TL 52018**

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Descriptors: foam adhesive tape, foam, adhesive tape, double-sided, bonding, plastic, body, adhesive bonding, protective side molding, spoiler

Double-Sided Foam Adhesive Tape

Materials Requirements

5 types: A, B, C, D, and E

Previous issues

TL 52018: 1976-05, 1977-05, 1979-01, 1984-03, 1991-01, 1992-08, 1993-02, 1996-05, 2011-03

Changes

The following changes have been made to TL 52018: 2011-03:

- Section 1 "Scope", Section 3.1 "Basic requirements", and Section 5.2 "Heat and humidity aging" changed
- Temperatures changed for the ball drop test and low-temperature aging
- Technical responsibility updated

1 Scope

Adhesive bonding of add-on parts, e.g., protective side moldings and add-on parts with a two-component or multi-component structure (modular components such as trim components with inserts, multi-shell spoilers, or brackets bonded onto plastic body elements).

This Technical Supply Specification (TL) contains the requirements for adhesive tapes as well as the adhesive bonds established with them. The specified values refer to full-surface bonds between partial areas of the paneling and the body, and do not include bonds on ribbing or honeycomb structures.

The values are minimum requirements for the adhesive tapes and must not be equated with a statement of functional capability.

Technical responsibility			The Standards department	
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2 Designation

Foam adhesive tape as per TL 52018

3 Requirements

3.1 Basic requirements

Approval of first supply and changes as per Volkswagen standard VW 01155.

Avoidance of hazardous substances as per VW 91101.

The required numerical values apply to each individual measurement.

At least 5 m of the tape, or a corresponding number of self-adhesive add-on parts and painted body panel sections, are required for complete testing.

- No customer complaints; max. 1 warranty claim per 1 000 vehicles
- In-line assembly with process reliability and without any additional equipment
  Required time < 10 seconds per component
- Easy removal without special tools in the case of after-sales service.

When producing the specimens, testing must always be carried out on a reconstructed model of the original structure. In the case that the intended adhesive surface is not a painted body panel, the tensile shear specimens must be produced with the original surface or at least the same material type (example: glass plate or plastic plate).

For modular and multi-shell structures (see above), the shear specimens must be produced from the components.

3.2 Delivery form

The adhesive tapes are delivered already bonded to the add-on parts.

3.2.1 After-sales service parts

The side of the adhesive tape to be bonded to the body panel is covered by a protective film (≥ 0.05 mm thick), preferably made of polyethylene (PE).

The add-on parts with a pre-applied adhesive tape are delivered in hermetically sealed bags made of PE film with a thickness ≥ 0.1 mm.

3.2.2 Shelf life

At least 3 years in a standard climate (23 °C/50% relative humidity) as per VW 50554 – 23/50-2 for standard paneling made of materials such as TPV > EPDM+PP < (TPV – thermoplastic vulcanizate; EPDM – ethylene propylene diene rubber; PP – polypropylene). Exposure to direct solar radiation must be avoided. The PE protective film must be easy to remove before installation without leaving any residue. The installation workshop must check the parts before using them to make sure the liners are still attached to the tapes. If the protective film is detached, or if surface damage or traces of soiling are present, the parts must be discarded. Materials containing plasticizers (such as polyvinyl chloride – PVC) are not suitable for storage periods exceeding 1 year.

3.3 Notes on the selection of adhesive tapes

Apart from the characteristics of the bonding system, the properties of an adhesive bond are also determined by the material composition (e.g., plasticizer content), geometry, weight, as well as by the mechanical properties (e.g., elasticity, inherent stiffness, dimensions) of the add-on part. Heavy add-on parts with a high inherent stiffness and without any additional fastening are not suitable for bonding using exclusively pressure-sensitive adhesives (PSAs).

The requirements apply to systems that are not exposed to any dynamic loading. In the case of bonded add-on parts with more stringent mechanical requirements, new values for the adhesive bond must be specified in the drawing.

The physical/chemical surface condition of the various coating systems is an additional influencing factor of vital importance. A minimum surface energy of 36 mN/m to 40 mN/m with a minimum polar component of 3.6 mN/m to 4 mN/m has been determined empirically for the surface to be bonded. Low-energy surfaces such as those of PP and TPV > EPDM+PP < are not suitable for adhesive bonds with standard acrylate adhesives. In this case, either special, modified adhesives must be used or the surfaces must undergo pre-treatment. In some cases, if tolerances need to be compensated, it may be necessary to use a softer adhesive tape. Although this will result in lower strength values obtained in the tensile shear test, it will, at the same time, yield a larger joining surface that can be realized with a high degree of process reliability. Softer foam cores/systems may be used in this case. The lower tensile shear strength as per table 2 required in this case must be specified in the drawing.

These parameters must be taken into account when selecting an adhesive tape design. Examinations for validating the parameters are mandatory.

3.4 Dimensions of the adhesive tape

Width and thickness: as per drawing.

3.5 Design requirements for reliable processing with adhesive tapes

The contours of the bonding surfaces must only have a slight change in the curvature radius, and the parts to be joined must be designed to have plane contact surfaces corresponding to the mating body surfaces. Edges and tight radii must be avoided in order to prevent peak stresses in the bonds between the paneling and the body.

Joints and bonding gaps must be designed to allow the adhesive tape to be compressed to a specific thickness when applying the defined contact pressure; for example, it must be possible to compress an adhesive tape with a thickness of 0.8 mm to at least 50% of its thickness. Specifications concerning the contact pressure of the adhesive tape (in N/cm^2) and the holding time (in seconds) must be taken from the data sheets and verified on the component using suitable measuring technology (TekScan). The goal is a full-surface adhesive bond. Bonding on ribs leads to a decrease in bond strength compared to a full-surface adhesive bond. Embossed areas and swages often have higher tolerances than other contact surfaces, which must be taken into account in the design.

To ensure reliable installation, positioning aids must be planned for in the paneling packages.

When designing components, it must be ensured that installation does not result in any plastic deformation of the paneling or to body packages.

Selection of the adhesive tape is considered an inherent part of component design engineering.

The different properties of the adhesive tape dependent on the coatings used must be taken into account, such as different hardness values (paints, base coats) or surface geometries

(microgeometry). Thin adhesive tapes applied to uneven surfaces will result in insufficient contact. Thick, softer adhesive tapes provide better contact on uneven surfaces. For critical paints, it may be necessary in some cases to support the adhesive bond (adhesion) with primers or suitable pre-treatment methods.

Joining surfaces must be designed in such a way that the entire theoretical bonding surface is utilized. Ribs and honeycomb structures minimize the effective bonding surface, and air inclusions will result in additional stress when the air expands. In some cases, adhesive bonds on ribs might allow the ingress of moisture. Geometrical deviations of the parts to be joined, especially at the ends, lead to permanent stresses resulting in detachments. Adhesive bonds in embossed areas and panel swages are critical in terms of the resulting potential tolerances (see above).

Type approval markings must not be undersized (< 0.25 cm^2), or else the adhesive bond will not provide sufficient shear resistance which would prevent shifting/sliding. The length-to-width ratio must not exceed 2:1 for purely uniaxial geometries.

3.6 Types

- TL 52018-A Adhesive tape with post-consumer resin (PCR) foam as the substrate
- TL 52018-B Adhesive tape with polyurethane (PUR) foam as the substrate
- TL 52018-C Adhesive tape with ethylene-vinyl acetate copolymer (EVA) foam as the substrate
- TL 52018-D Adhesive tape with PE foam as the substrate
- TL 52018-E Adhesive tape with a closed-cell polyacrylate foam core

3.7 Structure and composition

- TL 52018-A PCR foam, double-sided with acrylic-ester-based adhesive compound, covered with a protective film on one side.
- TL 52018-B PUR foam, double-sided with acrylic-ester-based adhesive compound, covered with a protective film on one side.
- TL 52018-C EVA foam, double-sided with acrylic-ester-based adhesive compound, covered with a protective film on one side.
- TL 52018-D PE foam, double-sided with acrylic-ester-based adhesive compound, covered with a protective film on one side.
- TL 52018-E Polyacrylate foam core, joined into a unit having interlaminate strength by means of acrylic-ester-based adhesive on both sides, covered with a protective film on one side.

3.8 Designation as per German Association of the Automotive Industry (VDA) standard VDA 260

- TL 52018-A > PCR,Acrylic <
- TL 52018-B > PUR,Acrylic <
- TL 52018-C > EVA,Acrylic <
- TL 52018-D > PE,Acrylic <
- TL 52018-E > Acrylic <

3.9 Determination of measured values

Unless otherwise specified, measurements are taken after 24 h of acclimatization in a standard climate as per VW 50554 – 23/50-2.

4 Requirements for properties

4.1 Adhesive tape

See section 3.

4.2 Bond between adhesive tape/add-on part

See table 1.

Table 1

No.	Property	Unit	Requirements	
1	Floating roller peel test, all types; see section 5.4			
1.1	As-received condition	N/cm	Peel resistance (P_S) ≥ 14	or material fracture in the foam substrate
1.2	After heat aging for 240 h at 90 °C; see section 5.1		P_S ≥ 14	
1.3	After heat and humidity aging for 240 h at 70 °C; see section 5.2		P_S ≥ 12	
1.4	After low-temperature aging for 48 h at -40 °C; see section 5.3		P_S ≥ 12	

4.3 Bond between painted panel/add-on part

See section 5.5 and table 2.

Table 2

No.	Property	Unit	Requirements		
			TL 52018-A to TL 52018-F	TL 52018-D	TL 52018-E
1	Tensile shear strength; see section 5.6				
1.1	As-received condition	N/cm²	≥ 50	≥ 40	≥ 60
1.2	After heat aging for 240 h at 90 °C; see section 5.1	N/cm²	≥ 50	≥ 40	≥ 60
1.3	After heat and humidity aging for 240 h at 40 °C; see section 5.2	N/cm²	≥ 40	≥ 30	≥ 60

No.	Property	Unit	Requirements		
			TL 52018-A to TL 52018-F	TL 52018-D	TL 52018-E
1.4	After low-temperature aging for 48 h at -40 °C; see section 5.3	N/cm²	≥ 40	≥ 30	≥ 50
1.5	After aging in glass cleaner test solution for 1 h ;see section 5.9	N/cm²	≥ 40	≥ 30	≥ 50
1.6	After aging in transit coating remover test solution for 5 min; see section 5.9	N/cm²	≥ 40	≥ 30	≥ 50
1.7	After aging in test fuel for 5 min; see section 5.10	N/cm²	≥ 40	≥ 30	≥ 50
2	Long-term tensile shear strength, all types; see section 5.7				
2.1	At room temperature	N/cm²	≥ 6		
2.2	At elevated temperature of +70 °C	N/cm²	≥ 2		
3	Low-temperature behavior, all types; see section 5.8				
3.1	Ball drop test at -40 °C	N/cm²	No destruction or damage to the bond between painted panel/add-on part		

5 Notes on testing

5.1 Heat aging

Aging for 240 h at 90 °C.

The measurement is taken after at least 24 h of acclimatization in a standard climate as per VW 50554 – 23/50-2.

5.2 Heat and humidity aging

– Aging for 240 h at +40 °C and 100% relative humidity.

  Once aging is complete, a drying phase ensues with recirculated air at 70 °C using a fresh air feed, for a duration of 8 h.

  The measurement is taken after at least 24 h of acclimatization in a standard climate as per VW 50554 – 23/50-2.

– Aging for 240 h at 70 °C and 100^{+0}_{-5}% relative humidity.

  Once aging is complete, the measurement is taken after at least 24 h of acclimatization in a standard climate as per VW 50554 – 23/50-2.

5.3 Low-temperature aging

Aging for 48 h at -40 °C.

The measurement is taken after 2 h of acclimatization in a standard climate as per VW 50554 – 23/50-2.

5.4 Determination of relative peel resistance

The specimens must be prepared as follows:

- Remove any plastic material hindering the peel process beforehand.
- Remove the protective film and replace it with a reinforcing aluminum strip. Peel off the adhesive tape together with the aluminum strip.

  (Company: Lawrence & Frederick, Inc. / 501 E. Lake Street / Streamwood, IL 60103; Fax: +1 (630) 289-9617, Phone: +1 (630) 289-8300

  Material designation: 0.127 mm thick anodized aluminum foil, 1145-0-SB undyed/unsealed – roll length 750 linear feet, 16 mm width; wound flat anodized side in. Rolls packaged individually to protect from moisture.)

  Then move a 5-kg roller over the specimen once in each direction at a speed of 300 mm/min, and condition the specimen for 24 h.

P_S in a floating roller peel test fixture as per DIN EN 1464.

The following deviation applies: Traverse speed 50 mm/min.

Testing is performed using a tensile test device conforming at least to the requirements of class 1 as per DIN EN ISO 7500-1.

The following must be determined from the peel diagram:

Relative peel resistance (equivalent to the average resistance during a continuous peeling-off action).

An area of the peel test diagram from 30% to 90% of the diagram length must be used for the evaluation.

Number of specimens: 5

5.5 Producing tensile shear specimens

Sections of add-on parts with a length of 70 mm are bonded to painted test sheets (measuring 70 mm × 30 mm).

Remove any plastic material hindering the test process beforehand.

The painted test sheets must only be used once.

All coating systems (e.g., non-metallic paint, 1-component metallic clear coat, 2-component PUR clear coat) must be incorporated in the examinations as needed.

The bonding surface area in the overlap area between painted panel/add-on part must be as close to 3 cm^2 as possible.

Characteristic data of the bonding process:

– Joining of the parts to be bonded with a contact pressure according to the Product Description Manual (PDM) or Design Engineering department.
– Conditioning of the specimen in a standard climate as per VW 50554 – 23/50-2 for at least 24 h.

The specimen is ready for testing after an acclimatization period of 1 h at room temperature.

5.6 Determination of tensile shear values

The tensile shear strength is determined as per DIN EN 1465 at a traverse speed of 50 mm/min.

Testing is performed using a tensile test device conforming at least to the requirements of class 1 as per DIN EN ISO 7500-1.

The specimen is kept upright in the clamping fixtures of the tensile test device using suitable mounts.

Number of specimens: 5

5.7 Determination of long-term tensile shear values

Determination of long-term tensile shear strength as per DIN EN 15336 for a test duration ≥ 30 min.

Before testing at an elevated temperature of 70 °, the specimens are conditioned for 30 min.

Number of specimens: 5

5.8 Low-temperature behavior

Testing of low-temperature as per Test Specification PV 3905; ball drop height: 23 cm (not against glass).

Production of specimens as per section 5.5 with the following deviation: Flush bonding between the painted panel/add-on part sections, each with a length of 70 mm.

Before the test, the specimens are conditioned for 24 h at -40 °C before the test.

5.9 Aging in glass cleaner test solution

Testing as per PV 2037 (only if contact is theoretically possible) with the following deviation: aging period 1 h or 5 min

5.10 Aging in test fuel

Aging in FAM test fluid as per DIN 51604-1 at (23 ±2) °C (only if contact is theoretically possible); duration 5 min.

The test is carried out 30 min after the specimen is removed from the medium.

6 Applicable documents

The following documents cited in this standard are necessary to its application.

Some of the cited documents are translations from the German original. The translations of German terms in such documents may differ from those used in this standard, resulting in terminological inconsistency.

Standards whose titles are given in German may be available only in German. Editions in other languages may be available from the institution issuing the standard.

PV 2037	Kunststoffteile, Verklebungen: Metall/Nichtmetall; Konservierungs- und Reinigungsmittel-Beständigkeit
PV 3905	Organic Materials; Ball Drop Test
VW 01155	Vehicle Parts; Approval of First Supply and Changes
VW 50554	Standard Atmospheres and Room Temperatures; Requirements on Standard Atmospheres
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
DIN 51604-1	FAM testing fluid for polymer materials; Composition and requirements
DIN EN 1464	Adhesives - Determination of peel resistance of adhesive bonds - Floating roller method
DIN EN 1465	Adhesives - Determination of tensile lap-shear strength of bonded assemblies
DIN EN 15336	Adhesives - Determination of the time to rupture of bonded joints under static load
DIN EN ISO 7500-1	Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Verification and calibration of the force-measuring system
VDA 260	Components of motor vehicles - Marking of material