VOLKSWAGEN

AKTIENGESELLSCHAFT

Group Standard

TL 52682

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Descriptors: PA66, polyamide 66, glass fiber-reinforced, reservoir, coolant pipe, thermostat housing

PA66, Glass Fiber-Reinforced, for Finished Parts Carrying Coolant

Material Requirements

Previous issues

TL 52682: 2009-08

Changes

The following changes have been made as compared to TL 52682: 2009-08:

– Section 6.11 "Static long-term test" expanded

1 Scope

This Technical Supply Specification (TL) defines the material requirements for glass fiber-reinforced PA66 used in components carrying coolant. TL 52062 applies to components made of PA66-GF30 that do not come in contact with coolant.

2 Description

Description example for a cooling water pipe made of PA66-GF30:

PA66-GF30 acc. to TL 52682, black

3 Requirements

3.1 General requirements

Approval of first supply and changes acc. to Volkswagen standard VW 01155.

Emission behavior according to VW 50180.

Avoidance of hazardous substances according to VW 91101.

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The tests must be carried out on finished part specimens.

Approx. 24 parts are required for complete testing.

3.2 Appearance

The surface and inside of the finished parts must be free of flaws and processing defects (voids, cracks, joining seams, etc.) that have a negative effect on strength, service life, and required appearance.

Sink marks at the base of ribs, reinforcements, and pipe unions are only permissible if they do not adversely affect the assembly and function of the parts. The parts must permit proper assembly.

The distribution of the glass fibers throughout the material must be sufficiently uniform so that three specimens taken from different points on a finished part do not differ in glass fiber content by more than 1,0%.

3.3 Manufacture

Injection molding or related process (water injection technology)

3.4 Conditioning

Prior to testing, the specimens must be conditioned in the ISO 554-23/50 standard climate for at least 48 h.

3.5 Evaluation of measurement results

The required numerical values apply to each individual measurement.

3.6 Marking according to VDA 260

> PA66-GF30 <

4 Material requirements

4.1 Material

See Section 6.1.

Polyamide 66, glass fiber-reinforced, heat-stabilized, hydrolysis-resistant

4.2 Glass fiber content acc. to DIN EN ISO 1172

The glass fiber content is determined gravimetrically and must be (30 ± 2) weight percent.

4.3 Moisture content in as-received condition (drying until constant weight is reached at 100 °C)

The moisture content in the as-received condition at the installation location must be (1,0 to 3,0) weight percent.

The moisture content is determined by means of weighing before and after drying. Constant weight is reached once the weight of the specimen deviates less than 0,2% from the previous weight after a drying cycle.

5 Required properties

See Table 1.

Table 1

No.	Property	Unit	Requirement
1	Density acc. to DIN EN ISO 1183-1, method A	g/cm³	1,36 ± 0,02
2	Melting temperature acc. to ISO 11357-3	°C	≥ 255
3	Ball indentation hardness acc. to DIN EN ISO 2039-1 and Section 6.2	N/mm²	≥ 195
4	Flexural strength acc. to DIN EN ISO 178 and Section 6.3	N/mm²	≥ 160
5	Impact strength acc. to DIN EN ISO 179-1 and Section 6.4	kJ/m²	≥ 35
6	Notched impact strength acc. to DIN EN ISO 179-1 and Section 6.5	kJ/m²	≥ 6
7	Elevated-temperature behavior Aging-at-elevated-temperature test acc. to DIN 53497, method B, 24 h at (135 ± 1) °C		Changes in shape or surface texture must not occur.
7.1	Dimensional change Length and width	%	≤ 0,5
8	Low-temperature behavior See Section 6.6		The finished parts must remain fully functional at low temperatures and remain free of any damage. They must not exhibit any cracks or other damage, even after subsequent heating to (23 ± 2) °C.
9	Processing quality See Section 6.7		No cracks are permissible on mating surfaces. Cracks are only permissible in other areas if they do not have an adverse effect on function.
10	Lightfastness acc. to Test Specification PV 1303 and Section 6.8 (requirement applies only to visible parts in the vehicle interior or if specified in the drawing). Number of light exposure periods according to drawing.		The exposed surface must not exhibit any changes compared to its as-received condition, e.g., color change, chalking, and/or cracking; gray-scale level 5 acc. to DIN EN 20105-A02.

No.	Property	Unit	Requirement
11	Resistance to open-air weathering according to VW 50185 (if required in the drawing).		No complaints
12	Leak tightness test, see Section 6.9		No complaints
13[a)]	Resistance to coolant See Section 6.10	N/mm^2	≥ 80
14[a)]	Dynamic strength See Section 6.11		N_{transv} ≥ 180 000 load cycles, Standard deviation S_{lg} ≤ 0,15
15[a)]	Static strength See Section 6.12		N_{transv} – 2 × S ≥ 30 000 load cycles

a) The requirements apply to new-sample and first-sample deliveries (basic material suitability test). The purchaser reserves the right to use these for the evaluation of series production deliveries as well.

6 Notes on testing

6.1 Material

The identity test can be performed by infrared spectroscopy.

6.2 Ball indentation hardness

Measurements must be performed on at least three (20 × 20) mm specimens (2 measurements per specimen). On specimens that have been taken from molded parts with one-sided graining or paint finish, the grain or paint must be removed using a surface grinding machine. The flat surface created this way serves as the resting surface. The measurements are taken on the untreated back of the specimen.

6.3 Flexural strength

Determination of flexural stress at maximum load according to DIN EN ISO 178; except that the specimen deviates as follows: length: (50 ± 1) mm; width: (6 ± 0,2) mm; thickness according to product thickness (up to a maximum of 4 mm); support separation: 40 mm; test rate: 14 mm/min.

Specimens taken from molded parts with one-sided graining or paint must be placed on the test machine support in such a way that the grained or painted side faces the pressure fin.

6.4 Impact strength

Impact strength testing according to DIN EN ISO 179-1; except that the specimen deviates as follows: length: (50 ± 1) mm; width: (6 ± 0,2) mm; thickness according to product thickness (up to max. 4 mm); support separation (support width): 40 mm; test equipment: 4 J pendulum impact tester.

Specimens taken from molded parts with one-sided graining or paint must be placed on the supports of the pendulum impact tester in such a way that the grained or painted side faces the direction of impact.

6.5 Notched impact strength

Notched impact strength test (broadside impact) according to DIN EN ISO 179-1; except that the specimen deviates as follows: length: (50 ± 1) mm; width: (6 ± 0,2) mm; thickness according to product thickness (up to max. 4 mm); support separation (support width): 40 mm; test equipment: 4 J pendulum impact tester.

A 0,8 mm-wide U-shaped notch is made on the broad side of the specimens. The notch depth is 1/3 of the specimen thickness. The edges outlining the notch root must have a curvature radius of < 0,1 mm.

Specimens taken from molded parts with one-sided graining or paint are notched on the grained or painted side.

6.6 Low-temperature behavior

A minimum of 2 finished parts are aged at (-40 ± 1) °C; aging period: (22 ± 2) h.

6.7 Workmanship

A minimum of 3 whole finished parts are aged in coolant according to TL 774 without adding water. The type currently used for the factory filling must be used. Aging is performed for 48 h at an aging temperature of: (135 ± 1) °C.

Aging must be performed in a covered container filled with the test medium and equipped with temperature control (e.g., Lauda Ultra thermostat, U12 model, manufactured by Messgerätewerk, Dr. Wobser KG). The DUTs must be heated to 135 °C together with the test fluid. After coolant aging, the DUTs must be rinsed with tap water and then dried for 3 h at 70 °C. They are then evaluated.

6.8 Lightfastness

Testing according to PV 1303. If the number of exposure periods is not defined in the drawing, the following rule applies:

3 periods of exposure for components in areas with indirect sun radiation.

5 periods of exposure for components in areas with direct sun radiation (e.g., door waist rail).

10 periods of exposure for components in areas subject to maximum sun radiation (e.g., rear shelf).

6.9 Leak tightness test

Component leakage is not permissible.

The following procedures may be used for the leak tightness test:

6.9.1 Vacuum

The following parameters apply to the vacuum test:

Test medium:	Air
Test temperature:	(23 ± 5) °C
Test pressure:	0,03 bar absolute
Hold time after reaching the test pressure:	5 s
Criterion for leak tightness:	0,001 bar maximum pressure rise within the hold time

6.9.2 Overpressure

The following parameters apply to the overpressure test:

Test medium:	Air
Test temperature:	(23 ± 5) °C
Test pressure:	2,5 bar overpressure, unless otherwise specified in the drawing
Hold time after reaching the test pressure:	5 s
Criterion for leak tightness:	No air bubbles rising to the surface when the pressurized component is submerged in water for at least 5 s.

6.10 Resistance to coolant

In order to determine hydrolysis stability, injection-molded test specimens (1A, DIN EN ISO 527-2) are aged for 500 h and 1 000 h at (135 ± 2) °C in a coolant (in acc. with TL 774)/water mixture (coolant/water - 50:50) inside a suitable autoclave.

Following the aging processes, flexural strength is determined, according to DIN EN ISO 178, at room temperature with the undried specimens after 1 hour.

The flexural strength acc. to DIN EN ISO 178 remaining after aging for 1 000 h at 135 °C must be ≥ 80 N/mm^2.

6.11 Pressure pulse test

The components (number of test parts = 8) are integrated into a test bed pressure circuit and sealed with series production quick connectors.

Test conditions:

Test medium: 100% of current coolant additive acc. to TL 774

Test medium temperature: (135 - 5) °C (component incident flow temperature)

Test chamber temperature: (85 + 5) °C

Pressure pulse frequency: (1,0 ± 0,5) Hz

Pressure pulse range: 0,1 bar overpressure to 2,4 bar overpressure, (1,25 ± 1,15) bar overpressure

Test duration: Stop after 250 000 load cycles or if there are any leaks/through-cracks

Mean value formula:

$$N_{transv} = 10^{\frac{1}{n} * \sum_{i=1}^{n} (\lg Ni)} \quad (1)$$

Standard deviation formula:

$$S_{\lg} = \sqrt{\sum_{i=1}^{n} (\lg Ni - \lg Ntransv)^2 \frac{1}{(n-1)}} \quad (2)$$

Requirement: see Table 1, consec. no. 14.

6.12 Static long-term test

The components (number of test parts = 4) must be filled with test medium and must be deaerated. The fittings must be hermetically sealed with plugs and series production clips. The DUTs may be subjected to flow if this is necessary to ensure a constant temperature. The maximum flow rate per DUT must be agreed with the responsible department prior to starting the test and must be documented using examples.

An erosion within the DUT caused by flow is "not permitted".

Test medium: Current coolant additive acc. to TL 774: water = 60:40

Test chamber temperature: (135 - 5) °C

Internal test pressure: 2 bar overpressure

Sequence:

Heating cycle: Heat the pressurized components to 135 °C, cool them down to room temperature for 170 h, then age them for 1 h at room temperature and replace the used test medium by new one, heat the components to 135 °C, check leak tightness.

Repeat heating cycle until the component has been loaded for a total of 1 500 h.

Afterwards, determine residual loading capacity acc. to the pressure pulse test in Section 6.11, but with the following deviating specifications:

Test duration: Stop after 60 000 load cycles or if there are any leaks/through-cracks

Requirement: see Table 1, consec. no. 15.

7 Referenced documents

The following documents cited in this standard are necessary for application.

In this Section terminological inconsistencies may occur as the original titles are used.

Standards with the titles given in German are either only available in German or may be procured in other languages from the institution issuing the standard.

PV 1303	Non-Metallic Materials; Exposure Test of Passenger Compartment Components
TL 52062	PA66, Glass Fiber Reinforced, for Finished Parts; Material Requirements
TL 774	Ethylene Glycol-Based Coolant Additive; Material Requirements
VW 01155	Vehicle Supply Parts; Approval of First Supply and Changes
VW 50180	Components in Passenger Compartment; Emission Behavior
VW 50185	Vehicle Parts; Resistance to Open-Air Weathering
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
DIN 53497	Testing of Plastics; Hot Storage Test on Mouldings Made of Thermoplastic Moulding Materials without External Mechanical Stressing
DIN EN 20105-A02	Textiles - Tests for colour fastness - Part A02: Grey scale for assessing change in colour

DIN EN ISO 1172	Textile-glass-reinforced plastics - Prepregs, moulding compounds and laminates - Determination of the textile-glass and mineral-filler content; calcination methods
DIN EN ISO 1183-1	Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pyknometer method and titration method
DIN EN ISO 178	Plastics - Determination of flexural properties
DIN EN ISO 179-1	Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test
DIN EN ISO 2039-1	Plastics - Determination of hardness - Part 1: Ball indentation method
DIN EN ISO 527-2	Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics
ISO 11357-3	Plastics - Differential scanning calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization
ISO 554	Standard atmospheres for conditioning and/or testing; Specifications
VDA 260	Components of motor vehicles; marking of material