VOLKSWAGEN

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Group standard

TL 52361

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Descriptors: coolant hose, hose, aramid, elastomer, elastomer compound, hose for coolant, coolant, coolant system, coolant circuit

Coolant Hoses with Aramid Reinforcement

Material and Functional Requirements

Previous issues

TL 52361: 1990-09, 1994-04, 1995-09, 1998-02, 1999-10, 2002-03, 2003-03, 2005-10, 2005-11, 2011-02

Changes

The following changes have been made to TL 52361: 2011-02:

– Technical responsibility and applicable documents updated
– Table 1, consec. no. 6.3: Typing error corrected (60 °C changed to 160 °C)
– Table 1, consec. no. 12: Coolant specification updated
– Section 6.1.1 "Pressure pulsation test", Section 6.1.2 "Static long-term test", Section 7.3 "Coolant aging", and Section 7.4 "Aging in diesel fuel" revised

1 Scope

This Technical Supply Specification (TL) defines requirements for elastomer compounds used for hoses in the coolant circuit. The hoses are suitable for the temperatures occurring in the coolant system (-40 °C to 150 °C; up to 160 °C for brief periods). In addition, the hoses are available with an inner layer stabilized against electrochemical corrosion.

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2 Designation

Designation example for a coolant hose with aramid reinforcement:

Coolant hose as per TL 52361

Designation example for a coolant hose with an inner layer additionally stabilized against electrochemical corrosion (German: **el**ektrochemische **Ko**rrosion):

Coolant hose as per TL 52361-elko

3 Requirements

3.1 Basic requirements

Approval of first supply and changes as per VW 01155

Avoidance of hazardous substances as per VW 91101.

10 finished parts (larger type) and 20 finished parts (smaller type) are required for complete testing.

3.2 Quality

The inner surface of the hose must be free of defects and must not show any unevenness. Defects in the overall structure, such as blisters and inclusions in the rubber, and flaws in the fabric are not permissible. The hoses must be free from stains, bleached areas, crystalline deposits, and gray cast. The individual layers must be properly bonded, even after contact with media. The hoses must be free from release agents and impurities, e.g., rubber particles and fabric fibers.

3.3 Design

As per drawing; deviating requirements in drawings take precedence over this TL.

3.4 Operating pressure range

0 bar to 2.4 bar overpressure, as per drawing

3.5 Color

Black

3.6 Material

3.6.1 Structure

- Inner layer: The layer thickness must be 60% to 70% of the overall wall thickness.
- Reinforcement
- Outer layer

3.6.2 Materials

- Inner layer: > EPDM <, optionally > EPM < (peroxide crosslinked)
- Reinforcement: Aramid (knitted fabric)
- Outer layer: > EPDM <, optionally > EPM < (peroxide crosslinked)

4 Material properties

See table 1; for specimen preparation, see section 7.1.

Table 1

No.	Property	Unit	Requirement	
			Inner layer	Outer layer
1	Thermogravimetry as per Test Specification PV 3927		As per sample	
2	Density as per DIN EN ISO 1183-1 and VW 2.8.1		As per sample	
3	Pyrolysis GC (gas chromatography)/MS (mass spectrometry) as per PV 3935		As per sample	
4	Zinc content Determination as per disintegration method (sulfuric/nitric acid); the Zn concentration is measured using atomic absorption spectroscopy (AAS) or inductively coupled plasma (ICP) analysis	%	< 0.02	
5	Hardness as per DIN ISO 7619-1			
5.1	As-received condition	Shore A	65 ±5	
5.2	After heat aging 96 h at 160 °C, see section 7.2	Shore A	–	0 to 6 as compared to as-received condition
5.3	After aging in coolant 96 h at 160 °C, see section 7.3	Shore A	-5 to 2 as compared to as-received condition	–
5.4	After aging in diesel fuel 46 h at (23 ±2) °C, see section 7.4	Shore A	–	0 to -25 as compared to as-received condition
6	Tensile strength as per DIN 53504			
6.1	As-received condition	N/mm^2	≥ 10.0	
6.2	After heat aging 96 h at 160 °C, see section 7.2	N/mm^2	–	≥ 8.0

No.	Property	Unit	Requirement	
			Inner layer	Outer layer
6.3	After aging in coolant 96 h at 160 °C, see section 7.3	N/mm²	≥ 9.0	–
6.4	After aging in diesel fuel 46 h at (23 ±2) °C, see section 7.4	N/mm²	–	≥ 5
7	Elongation at tear as per DIN 53504			
7.1	As-received condition	%	300 to 550	
7.2	After heat aging 96 h at 160 °C, see section 7.2	%	–	≥ 250
7.3	After aging in coolant 96 h at 160 °C, see section 7.3	%	≥ 250	–
7.4	After aging in diesel fuel 46 h at (23 ±2) °C, see section 7.4	%	–	≥ 100
8	Stress value as per DIN 53504 at 100% elongation in as-received condition	N/mm²	≥ 3.0	
9	Change in weight			
9.1	After aging in coolant 96 h at 160 °C, see section 7.3	%	±4.0	–
9.2	After aging in diesel fuel 46 h at (23 ±2) °C, see section 7.4		–	≤ 125
10	Determination of residues as per PV 3339 after aging in coolant 96 h at 160 °C, see section 7.3	%	≤ 0.04	–
11	Tear propagation resistance based on DIN ISO 34-1, method A and section 7.5			

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Property</th><th rowspan="2">Unit</th><th colspan="2">Requirement</th></tr>
<tr><th>Inner layer</th><th>Outer layer</th></tr>
<tr><td>11.1</td><td>As-received condition</td><td>N/mm</td><td colspan="2" rowspan="3">≥ 4</td></tr>
<tr><td>11.2</td><td>After heat aging
96 h at 160 °C,
see section 7.2</td><td>N/mm</td></tr>
<tr><td>11.3</td><td>After aging in coolant
96 h at 160 °C,
see section 7.3</td><td>N/mm</td></tr>
<tr><td>12</td><td>Electrochemical resistance of the inner layer (only for TL 52361-elko), testing with the DSM test at 50% elongation, coolant of the current type/water: (50 : 50), voltage: 10 V, time: 10 days, temperature: 100 °C</td><td></td><td>No cracking, and 90% of the initial elongation at tear as per DIN 53504</td><td>–</td></tr>
</table>

5 Finished-part properties

See table 2.

Table 2

No.	Property	Unit	Requirement
1	Odor		No objectionable intrinsic odor
2	Ozone resistance as per VW 2.8.1 and section 7.6		No cracks
3	Behavior in cold air Bend test as per PV 3304 22 h at -40 °C		Elastic, no cracks, no fractures
4	Plastic deformation as per PV 3307 and section 7.7		During aging, the specimen must not tear in the area around the edge of the ram.
	After heat aging 22 h at 160 °C	%	≤ 75
5	Delamination resistance as per DIN 53530, per mm of specimen width, see section 7.8		The lowest peak force shown in the diagram must meet this requirement.
5.1	As-received condition	N	≥ 2.5
5.2	After aging in coolant 96 h at 160 °C, see section 7.3	N	≥ 2.0
5.3	After aging in diesel fuel 46 h at (23 ±2) °C, see section 7.4	N	≥ 0.5

6 Functional requirements

6.1 Pressure pulse resistance

6.1.1 Pressure pulsation test

Number of pulse cycles in destructive testing (build sample approval and initial-sample release):	N_{trans} > 180 000 load cycles (LC) $s_{log} \leq 0.15$
Termination of the test:	N ≥ 250 000 LC
For testing during production:	N_{trans} > 150 000 LC without failure
Number of specimens:	8 each
Pressurizing medium:	100% coolant additive as per TL 774 The coolant additive to be used is the factory-fill coolant additive and must be requested from the appropriate materials engineering department (GQL-B/5) if necessary.
Test pressure:	ρ = (1.25 ±1.15) bar overpressure
Temperature of the medium:	$T_M = 135\,^{+0}_{-5}$ °C
Test chamber temperature:	$T_C = 85\,^{+5}_{-0}$ °C
Pressure pulse frequency:	f = (1.0 ±0.5) Hz

6.1.2 Static long-term test

For hoses with PP or PA components.

Fill the components (number of specimens: 4) with test medium and deaerate them. Hermetically seal the fittings with plugs and series-production clamps. Flow through the specimens is permissible if this is necessary to ensure a constant temperature. The maximum flow rate per specimen must be agreed upon with the appropriate department before starting the test and must be documented using examples.

Erosion within the specimen caused by flow is not permissible.

Test medium: mixture of coolant additive as per TL 774 and water at a ratio of 60 : 40. The coolant additive to be used is the factory-fill coolant additive and must be requested from the appropriate materials engineering department (Volkswagen Laboratory for Fuels, Coolants, Fluids, and Lubricants) if necessary.

Test chamber temperature: $135\,^{+0}_{-5}$ °C

Interior test pressure: 2 bar overpressure (controlled over the entire test duration)

Test sequence:

Heating cycle:

1. Heat the pressurized components to 135 °C
2. 170 h at 135 °C, then cool down to room temperature
3. Store for 1 h at room temperature and replace existing test medium with new test medium
4. Heat to 135 °C
5. Check the leak tightness at 135 °C

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

Afterwards, determine the residual loading capacity as per the pressure pulsation test in section 6.1.1, but with the following deviating specifications:

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

Requirement: $N_{trans} - 2 \times s \geq 30\,000$ LC

7 Notes on testing

7.1 Specimen preparation

For specimen preparation, separate the outer and inner layers of the coolant hose using a band-knife splitting machine.

7.2 Heat aging

Age S 3A dumb-bell specimens as per DIN 53504, which have been taken from the outer layer of the coolant hose, in a forced-air oven as per DIN 53508.

Perform the measurements 30 min after removal.

7.3 Coolant aging

Age S 3A dumb-bell specimens as per DIN 53504, which have been taken from the inner layer of the coolant hose, in an autoclave at 160 °C in test fluid which consists of 50 volume percent deionized water and 50 volume percent coolant additive as per TL 774. The coolant additive to be used is the factory-fill coolant additive and must be requested from the appropriate materials engineering department (GQL-B/5) if necessary. The fluid volume must be 150 times to 180 times the specimen volume.

Cool the samples down to room temperature (23 ±2) °C in the test medium and then measure them.

7.4 Aging in diesel fuel

Age the specimens in standard diesel fuel for 46 h at (23 ±2) °C.

The following test mixture must be used for the aging:

80 volume percent standard diesel Liquid F as per DIN ISO 1817; 20 volume percent fatty acid methyl ester (FAME) as per DIN EN 14214. Soy methyl ester must be used as the fatty acid methyl ester component.

In justified cases, the use of the following test mixture is also permissible for aging in diesel fuel:

95 volume percent standard diesel Liquid F as per DIN ISO 1817; 5 volume percent fatty acid methyl ester as per DIN EN 14214 with rapeseed methyl ester as the fatty acid methyl ester component.

The liquid volume must be (80 ±5) times the specimen volume. Test containers and specimen holders as per PV 3323 must be used.

After the aging period is completed, remove the specimens and immediately wipe off any fluid using filter paper. Measure the weight change of the specimens after 1 min, followed by the tensile strength, elongation at tear, and hardness.

7.5 Tear propagation resistance

The test is performed in deviation from DIN ISO 34-1, method A concerning the following aspects:

Specimen thickness: ≥ 1 mm

For aging in coolant, proceed as per section 7.3. The volumetric ratio of fluid to specimen can be ignored.

7.6 Ozone resistance

Compress hose sections (as hose ring) of 20 mm width with a screw pinch cock until the inner surfaces touch. Then age them in this condition. Place the specimens in the ozone climate chamber 15 min after clamping in the screw pinch cock.

7.7 Plastic deformation

Prepare the specimens from the finished part ends using a hardened hollow drill as per DIN ISO 4649, going from the inner hose layer to the outer hose layer. The outer hose layer must face downwards in the test frame.

Grind flat any uneven patches in the outer hose layer in the area to be measured.

7.8 Delamination resistance

The test is performed in deviation from DIN 53530 concerning the following aspects:

Specimen width:	20 mm
Sampling:	In longitudinal direction of the hose
Evaluation:	State x_{min}, x_{max}, arithmetic mean, standard deviation

Clamp the hose section into the specimen holder with the outer layer facing downwards.

For aging in coolant, proceed as per section 7.3. The volumetric ratio of fluid to specimen can be ignored.

8 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 3304	Fuel Hoses; Testing of Low Temperature Resistance and Diffusion Strength
PV 3307	Elastomer Components; Plastic and Elastic Deformability
PV 3323	Test Vessels and Specimen Holders for Aging Standard Specimens
PV 3339	Kühlmittelschläuche; Bestimmung der Ablagerung
PV 3927	Thermogravimetric Analysis for Plastics and Elastomers; Determination: Plasticizers, Carbon Black

PV 3935	Plastics and Elastomers; Pyrolytic Gas Chromatography/Mass Spectrometry
TL 774	Ethylene-Glycol-Based Coolant Additive; Materials Requirements
VW 01155	Vehicle Parts; Approval of First Supply and Changes
VW 2.8.1	Elastomers; Materials Requirements and Testing
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
DIN 53504	Testing of rubber - determination of tensile strength at break, tensile stress at yield, elongation at break and stress values in a tensile test
DIN 53508	Testing of rubber - Accelerated ageing
DIN 53530	Testing of organic materials; Separation test on fabric plies bonded together
DIN EN 14214	Liquid petroleum products - Fatty acid methyl esters (FAME) for use in diesel engines and heating applications - Requirements and test 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 ISO 1817	Rubber, vulcanized or thermoplastic - Determination of the effect of liquids
DIN ISO 34-1	Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 1: Trouser, angle and crescent test pieces
DIN ISO 4649	Rubber, vulcanized or thermoplastic - Determination of abrasion resistance using a rotating cylindrical drum device
DIN ISO 7619-1	Rubber, vulcanized or thermoplastic - Determination of indentation hardness - Part 1: Durometer method (Shore hardness)