VOLKSWAGEN
AKTIENGESELLSCHAFT

Group Standard

VW 60562

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Descriptors: fittings, hose, clamp, hose connection, charge air, screw clamp, worm gear, spring washer, pressure ring, charge air system

Charge Air System

Hoses and Fittings for Hose Clamps and Pressure Rings

Previous issues

VW 60562: 2007-04, 2010-05

Changes

The following changes have been made as compared to VW 60562: 2010-05:

- Table 2 and Table 3 changed
- Section 4.2.2 expanded

1 Scope

This standard applies to hose connections in the charge air system using hose clamps according to Volkswagen standard VW 60510, strip width 12 mm. It specifies the dimensions, requirements, and types of hoses and fittings.

2 Definitions

Hose and pipe are differentiated as follows:

- A hose is defined by inside diameter × wall thickness.
- A pipe is defined by outer diameter × wall thickness.

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3 Requirements

3.1 General requirements

In order to ensure leak tightness of the system, minimum requirements are specified for hose and fitting geometry. To achieve these minimum requirements, dimensions, tolerances, mold misalignment and degree of mold separation of fitting and hose must be matched to each other. The secure fit must be checked in accordance with the application and/or installation location (see Section 4.2). The installation markings for hose and fitting must be made according to the series production drawing.

3.2 Connection concepts

3.2.1 Injection-molded tabs on the hose end

Injection-molded tabs on the hose end with splint fixing on the hose clamp (see Figure 1).

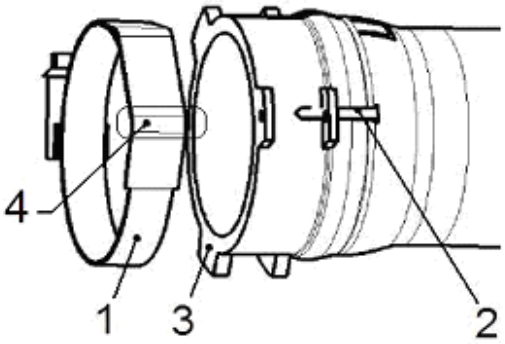

Figure 1 – Splint fixing

Legend

1	Hose clamp
2	Pin made of plastic, fracture-resistant and captive, inserted through hose clamp spring (observe insertion direction)
3	Injection-molded tabs
4	Splint inserted into this part of spring washer

3.2.2 Metal cage clamped to hose (observe patent rights)

For an example, see Figure 2; for supplier-specific and released types, see Figure 3.

For clamp fastening requirements, see Section 3.6.

If new fastenings systems are used, joint testing and release by Design Engineering and Quality Assurance is absolutely required!

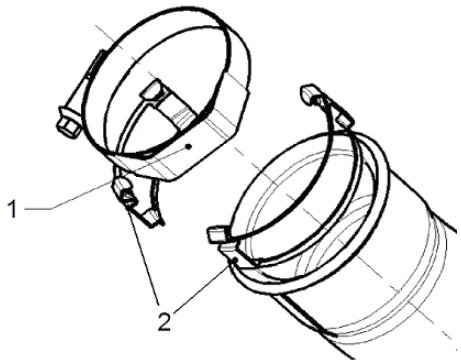

Figure 2 – Metal cage

Legend

1	Hose clamp
2	Clamp fixing using a metal cage

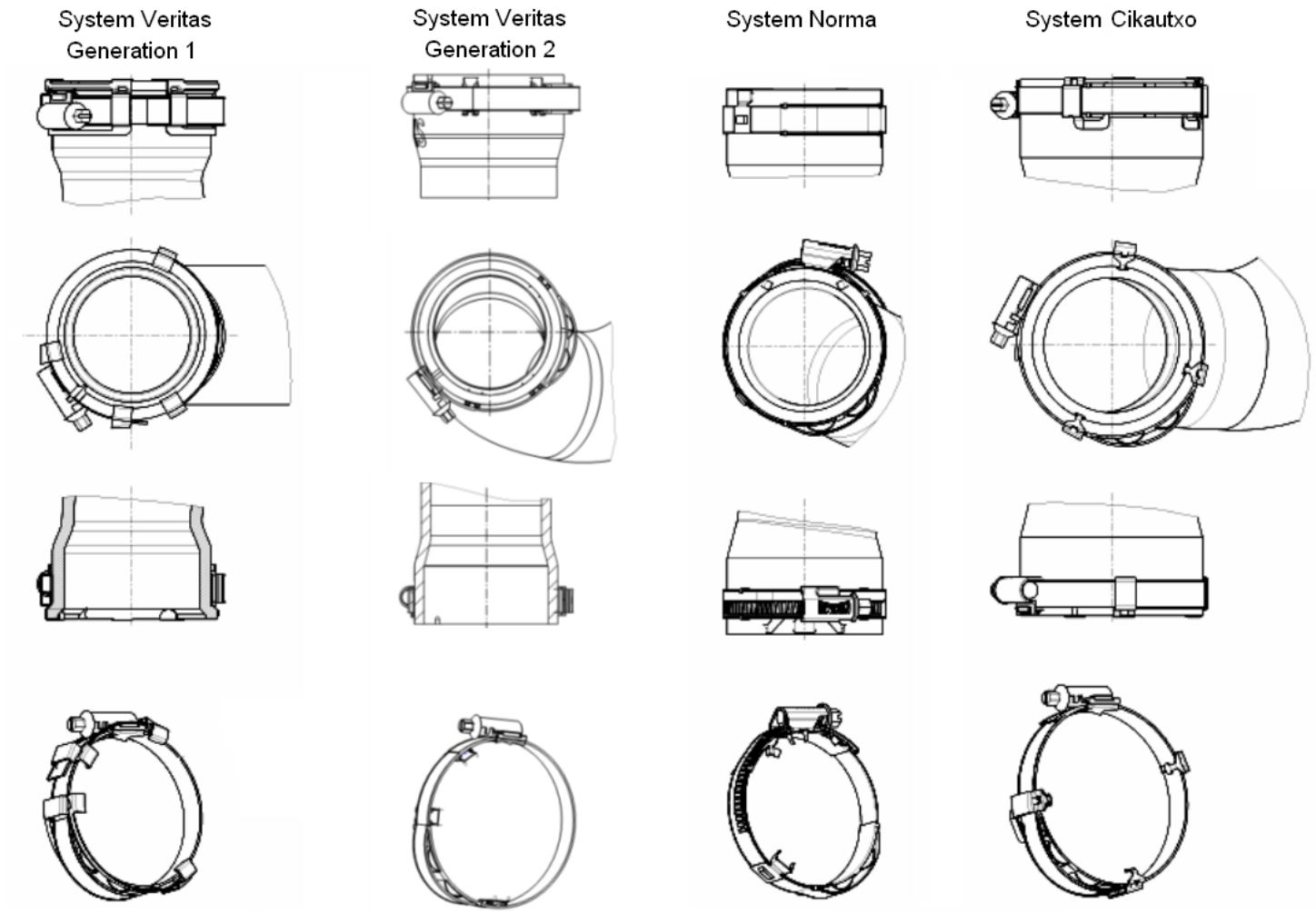

Figure 3 – Supplier-specific and released types from TAB 027 220

3.3 Clamp

Hose clamp according to VW 60510, strip width 12 mm (see Figure 4).

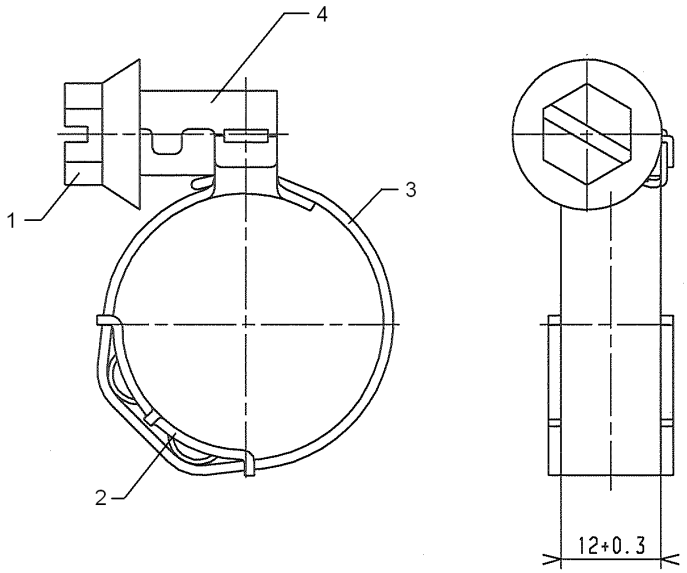

**Figure 4 – Hose clamp with spring washer
(for missing dimensions and specifications, see drawing)**

Legend

1	Worm
2	Spring washer
3	Strip
4	Housing

For released hose clamps, see the standard parts management system (NVS).

In the as-received condition, the mounting opening dimension of the clamp must be preopened so that: as-received diameter < injection-molded tab on hose.

Dimensional increments due to standard sizes or, where appropriate, preset intermediate sizes. The band protrusion must be kept as small as possible to prevent injury or damage.

Each clamp can bridge a tensioning range of 20 mm on the mounting diameter.

For prefixed clamps, the as-received diameter of the clamp must be set between 5 and 7 mm larger than the hose outer diameter in order to reduce assembly costs.

The distance from the hose end to the clamp strip must be 5 mm; deviations are possible in individual cases but must be verified by assembly tests and testing according to Section 4.2.

For clamps which are individual parts, the as-received diameter must be according to the drawing and VW 60510.

A pressure ring connection (see Figure 5) may also be used for non-removable connections.

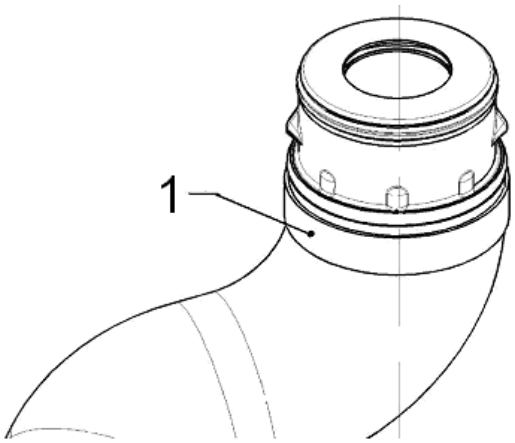

Figure 5 – Example of a pressure ring (1) on the muffler

3.4 Hose

3.4.1 General requirements

Free of manufacturing residues, lubricants and parting agents.

Snap beads are impermissible.

Roundness: straight hose ends (at least 30 mm) and uniform wall thicknesses must be ensured by means of end caps without length limitation.

Ground grooves are impermissible.

3.4.2 Type, prefixing and dimensions

Examples in TAB 027 052.

3.4.3 Materials

AEM according to Technical Supply Specification TL 52486, alternatively ACM according to TL 52494, FPM/silicone according to TL 52600, ACM (high temperature) according to TL 52634, or CM according to TL 52648, materials according to TL 52672, Type A, or according to TL 52672, Type B. Other similar materials and hose structures as agreed upon.

3.5 Fitting

3.5.1 General requirements

- Free of manufacturing residues and lubricants (e.g., oil, grease, soap).
- Snap bead ("bead, thickening, barb") all around on the fitting.
- 3 hose stops distributed regularly on the circumference or stop along the whole circumference.
- As a general rule, the fittings must be designed with the following roughness specifications:
  $R_{max.}$ ≤ 50 µm according to VW 13705,
  W (waviness) + $R_{max.}$ ≤ 100 µm,
  Wavelength at least 5 mm,
  Burrs with R < 1 mm are impermissible,

Depressions/score marks in the longitudinal direction are impermissible,

Maximum burr and mold misalignment 0,1 mm,

Rz 10 to 40 µm according to VW 13705.

NOTE 1 A thermally stable paint must be used for painted pipes to ensure transference of the temperatures and tensile forces present at the connecting point over the service life. Avoid cathodic electrocoating with prior zinc coating/phosphating. The slip-on area must be free of paint.

NOTE 2 If the fitting is made of plastic and deforms under load, type C can be stiffened with an additionally pressed-in inside sleeve made of metal.

3.5.2 Types and dimensions

(Types A and C must be preferably used.)

See Table 1, Figure 6, Figure 7, and Figure 8.

Table 1 – Dimensions (in mm) for types A, B, and C

Tensioning range clamp d	Fitting dimension d_s	Tol.
35 to 55	40	± 0,3
40 to 60	45	± 0,3
45 to 65	50	± 0,3
50 to 70	55	± 0,3
55 to 75	60	± 0,3
60 to 80	65	± 0,3
65 to 85	70	± 0,3
70 to 90	75	± 0,5
74 to 94	80	± 0,5

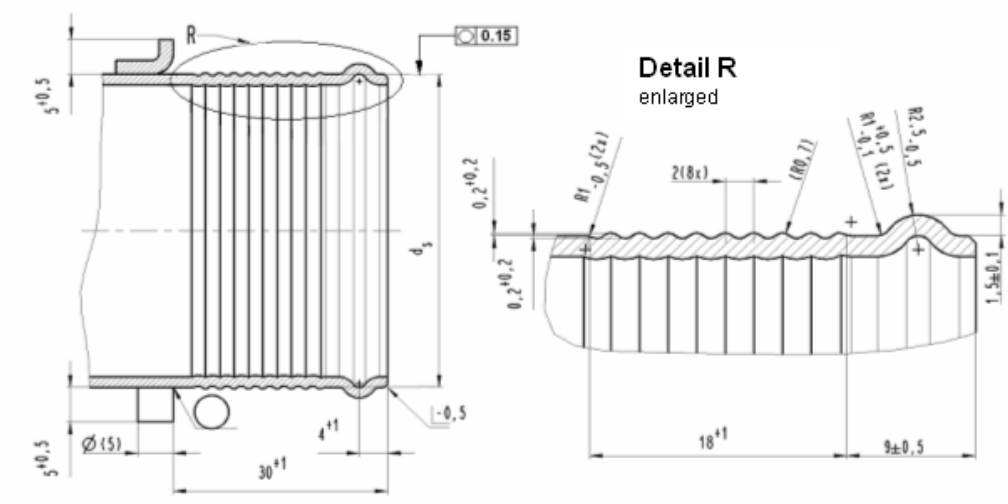

Figure 6 – Type A (formed)

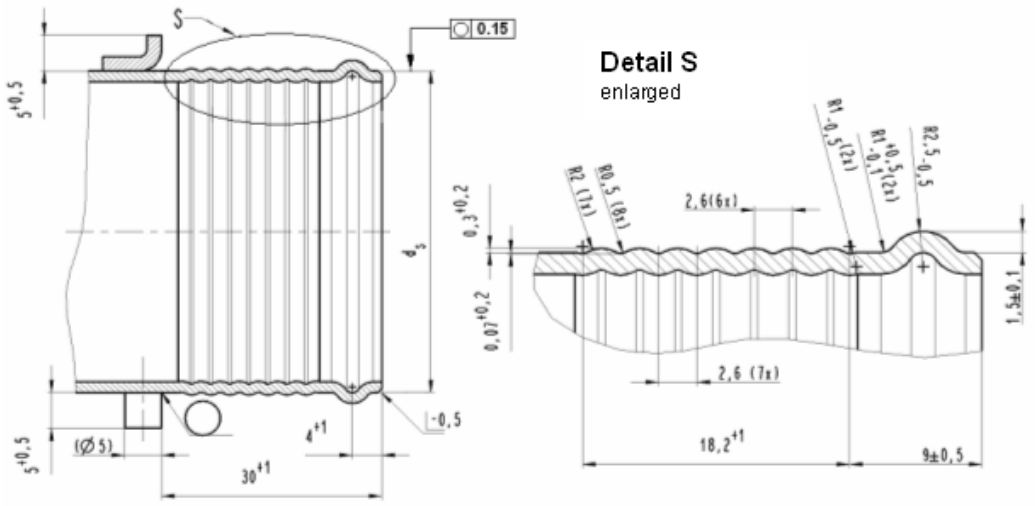

Figure 7 – Type B (formed, resulting from manufacturing in the case of stainless steel)

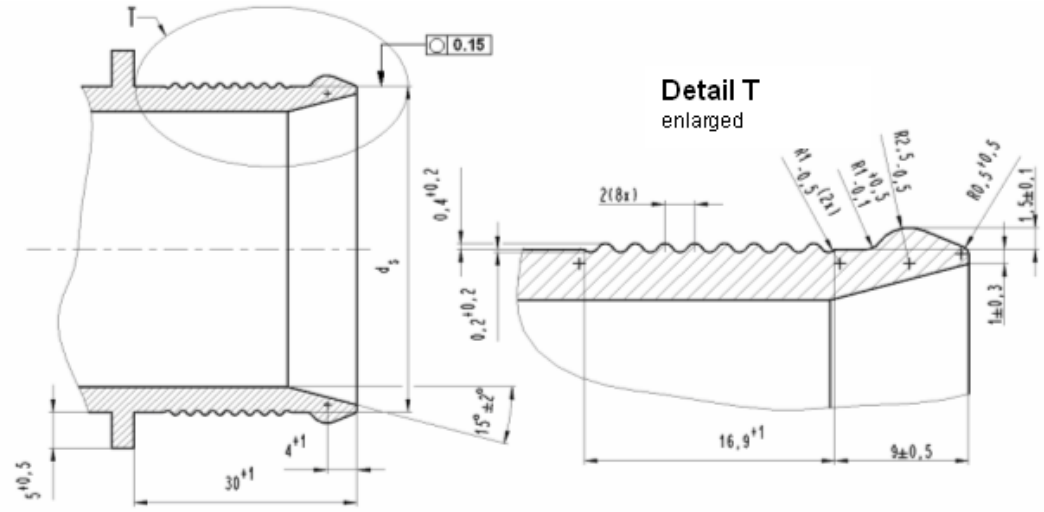

Figure 8 – Type C (processed/cast)

3.6 Screw clamp fixing for charge air hoses

3.6.1 Functional requirements

The system must not negatively affect the secure fit test according to Section 4.2.

The clamp must be fixed as follows:

- Axially (position between the fitting bead and the hose end/fitting stop, radially matching the fitting dimensions)
- Against tilting (angled assembly, secure support of the tightening torque)
- Against twisting in the circumferential direction ("one-hand installation")
- In the as-received condition (captive, the hoses must not get caught on each other)

It must be ensured that the clamp lock can freely move in the circumferential direction during assembly ("lock movement"). The fixing must not distort the tightening torque of the clamp and thus the tensile forces (preferred fixing against twisting is therefore on the side opposite the clamp lock).

The free clamp end ("clamp tab") must not distort the tightening torque of the clamp and thus the tensile forces. The free clamp end must not stick out. The clamp tab must not additionally expand away from the circumference or get caught on the fixing.

It must be possible to use the fixing on all hose materials.

The clamp fixing must not damage the fitting or the hose over the service life.

The clamp fixing must not reach under the hose (clamp seat area). The hose retention forces must not be impaired by the fitting/hose connection.

It must be possible to change the position of the clamp on the hose without effort (adjustment of the position based on development progress and installation test).

Variants for right/left installation must be provided.

Screw clamps with a spring washer insert, 12 mm wide, according to VW 60510 must be used.

The system must fit for all diameters or continuous dimensional increments.

The radial and axial structure must be small.

The axial protrusion of the fixing at the hose ends must be a maximum of 0,3 mm. The fixing must not interfere with sliding on the hose up to the stop, even with soft, easily deformable hose materials.

The following requirements must also be fulfilled:

– The possibility of equipping prototype hoses with a fixing early on.
– Low individual part costs and tool costs.
– It must be possible to replace the clamp in after-sales service.
– The system must fulfill the same corrosion protection requirements as the clamps.

3.6.2 Installation requirements

– Sufficient position retention forces in the axial direction (pulling-off, tilting, etc.) during installation.
– Sufficient position retention forces in the circumferential direction ("one-hand installation")
– No effect on clamp clamping forces or clamping force distribution.
– No effect on hose strength.
– The clamp must not get caught on the fixing, even in the worst case scenario.
– The clamp fixing must not damage the fitting or hose during installation.
– No risk of injury when handling the hose or during assembly. Sharp and pointed edges are impermissible.
– The as-received condition must enable trouble-free installation of the hose on the fitting bead (diameter, roundness, retention forces of the fixing).
– No deformation of the hose diameter in the as-received condition (round cross-section, not deformed).
– No increase in the hose installation forces.
– It must be possible to install and remove the clamp multiple times.

3.6.3 Release criteria for a new fixing that is not yet in use

1. Tests according to Section 4 with various fitting materials and diameters (small, medium, large).
2. Test of function in a pilot project with reasonable loading (temperature and boost pressure).
3. Test of the radial tensile forces (uniformity) over the applied torque. No distortion due to the fixing compared to the same clamp without fixing (diameter: small, medium, large).

4 Test

4.1 Function test

See Table 2.

Table 2

Requirement	CM according to TL 52648 or materials according to TL 52672, Type A	Mixed structure with AEM inside layer according to TL 52672, Type B	AEM according to TL 52486	ACM according to TL 52494	ACM according to TL 52634	FPM/silicone according to TL 52600
Pressure pulse range	Maximum engine boost pressure (+ 100 kPa over-pressure)					
Test medium	Air					
Operating temperature	(125 ± 5) °C	(155 ± 5) °C	(155 ± 5) °C	(150 ± 5) °C	(185 ± 5) °C	(210 ± 5) °C
Test temperature (inside)	(125 ± 5) °C	(155 ± 5) °C	(155 ± 5) °C	(150 ± 5) °C	(185 ± 5) °C	(210 ± 5) °C
Cabinet temperature (outside)	(120 ± 5) °C	(135 ± 5) °C	(135 ± 5) °C	(130 ± 5) °C	(165 ± 5) °C	(180 ± 5) °C
Recirculated air temperature	See drawing					
Test frequency	≤ 0,5 Hz (depending on the system)					
Number of load cycles (LC) (without damage or leakage)	For series production monitoring (without failure): N ≥ 100 000 LC Final number of load cycles: N ≥ 250 000 LC For technical engineering release (without failure): N ≥ 150 000 LC Criterion for process reliability: N_{transv} - 2 s ≥ 100 000 LC, see (1) Number of test parts: n = 8					

$$N_{quer} = 10^{\frac{1}{n}\sum_{i=1}^{N}\log_{10} N_i} \quad (1)$$

4.2 Testing secure fit of hoses

4.2.1 Audi scope

Hoses must undergo the following test mounted on series-production fittings:

1. Hose installation on fittings at room temperature.
2. Let the connection settle for 24 hours.
3. Increase of internal/external temperature to 155 °C.
4. Apply air at 200 kPa (2 bar) for 10 s.
5. Apply air at 200 kPa (2 bar) for 5 minutes.
6. Apply air at 400 kPa (4 bar) for 5 minutes.
7. Apply air for 1 000 LC at (150 ± 150) kPa.

4.2.2 Volkswagen scope

4.2.2.1 Pressure pulse test, components clamped in the test bed

During the pressure pulse test (see Table 3), the test parts are mounted stress-free on the pipe holders or hose ends provided for this purpose according to their installation position and dimensions in the vehicle. Optionally, a test with at least one free end is permissible.

Table 3 – Pressure pulse test

Property	Requirement
Test temperatures (inside, outside)	See Table 2
Lift stress	Resulting from the aggregate movements according to size and direction, see drawing.
Test sequence	Up to N = 90 000 LC initially at 90% value (endurance loading), then up to N = 100 000 LC at 10% value (peak loading), etc.
Test medium	Air
Test pressure	See component drawing
Test frequency (lift)	f_{lift} not equal to $f_{pressure}$, Δf = 0,05 to 0,2 Hz
Nominal load cycle time (lift and pressure)	N_{transv} ≥ 150 000 LC, see (1)
Standard deviation	s_{log} ≤ 0,15, see (2)

$$S_{log} = \sqrt{\sum_{i=1}^{n} (\log_{10} N_i - \log_{10} N_{quer})^2 \frac{1}{n-1}} \quad (2)$$

4.2.2.2 Motion test

If engine/body relative motions are absorbed by the components during driving operation, an additional motion test must be superimposed on the pressure pulse test. The lift amplitude of the powertrain motions relevant to the particular component or group of components must be determined from the envelopes available in the engine designs regarding magnitude and direction and must be specified in the component drawing. The test is limited to the dominant loading direction in each case. A two-dimensional motion is combined into one resultant motion. If the motions are divided into endurance loading (90%) and individual peak loading (10%), first the 90% value is set until N = 90 000 LC, then the 10% value is set over 10 000 LC, and afterwards the cycle is repeated.

5 Mounting instructions

The hose must be pushed on fully up to the stop.

The hose must be aligned with (rotated to) the mounting mark.

The clamp must be tightened with auto-shut off torque screwdrivers at a speed of up to 100 min^{-1}. The use of two-stage screwdrivers attached to the line is prescribed.

The desired tightening torque is (5,5 ± 0,5) Nm.

The hose is mounted with the following lubricant:

– GS 52, material no. 294 425 or isopropanol (use only at Audi)
– MPG, material no. 294 440 or PEG 294 435 (use within the Volkswagen Group, but not at Audi)

Only the aforesaid lubricants are permissible. New lubricants can be released only after positive results in laboratory tests.

6 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.

TL 52486	AEM for Charge Air Hoses; Material Requirements
TL 52494	ACM for Charge Air Hoses; Material Requirements
TL 52600	Charge Air Hoses for High-Performance TDI Engines; Material Requirements
TL 52634	Charge Air Hoses Made of High-Temperature ACM Elastomer; Material Requirements
TL 52648	Charge Air Hose Made of CM Elastomer; Material Requirements
TL 52672	Ladeluftschläuche mit gemischtem Aufbau; Werkstoffanforderungen
VW 13705	Specification of Surface Texture; Geometrical Product Specifications; Engineering Drawings
VW 60510	Hose Clips; Hose Clamp with Worm Drive; Special Shape: with Spring Washer