

TL 82316 2013-09

Class. No分类号.: 8FI96 分类号.: 8FI96

Descriptors: hose line, tubing, refrigerant, refrigerant oil, R134a, R1234yf, PAG oil

描述: 软管, 管路制冷剂, 冷冻机油, R134a, R1234yf, PAG油

R134a/R1234yf Refrigerant Lines R134a/R1234yf制冷剂管路

Functional Requirements 功能要求

Previous issues 之前的版本: TL 82316: 2000-01

Changes 变化

The following changes have been made to TL 82316: 2000-01 相对TL 82316: 2000-01有如下变化

- Standard completely revised 标准整体修订
- Preface removed 删除序言
- R1234yf refrigerant lines added 加入R1234yf制冷剂管路

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1 Scope 范围

This Technical Supply Specification (TL) defines the quality, strength, and service life for refrigerant lines in motor vehicle air conditioning systems that operate with R134a or R1234yf refrigerant.

该技术标准(TL)定义了使用R134a或R1234yf的汽车空调系统的制冷剂管路的质量、强度和使用寿命

2 Requirements要求

The necessary functional requirements are the minimum requirements for a hose line.

Statistical methods must be applied for documentation purposes. Complete () tests must be marked separately. The department that arranges for the testing defines the data that is required for the testing, such as the sampling, the random sample size, the timing, and frequency of the testing.

该必须的功能要求是软管的最低要求。作为证明目的，必须运用统计方法。完整的100%试验须分别标记。负责安排试验的部门定义试验的必须的数据，如抽样、随机样本量、时间、试验的频次。

2.1 General information 一般信息

The refrigerant lines can consist of both pipes and also a combination of tubes and hoses with ends that are provided with connection fittings. The connection fittings can be crimped onto the hose lines or manufactured in accordance with qualitatively equivalent joining techniques and the connections of the hose lines can be soldered or solder-free.

制冷剂管可以是软管或硬管或者软硬结合、端部由连接附件连接在一起的组合管。连接附件可以夹紧在软管上或按相同质量效果的连接工艺进行制造，硬管的螺纹管接头可以是焊接或不焊

The hoses or hose lines must not have any flaws as per test specification PV 6240 that have more than negligible effects on the use and assembly properties.

软管/管路上不允许出现任何 PV 6240 标准要求的影响装配特性和微小使用效果的缺陷。

The hose lines must be designed so that a positive-locking connection is produced between the fitting and the hose, the inner layer of the hose is not damaged, and the bonding between the individual layers is not destroyed.

管路须设计成在连接件和软管间的适应性的锁紧连接，并且软管的内层既不能损坏，也不能损坏各层之间的连接。

This includes, e.g., surface flaws such as bubbles, sink marks, folds, beads, and inhomogeneity in the individual materials or their bonds, as well as improper construction of the fastening for the connection fittings.

包含诸如表面缺陷，如气泡、缩孔、皱边凸起和在各个材料中的不均匀性或各层材料间连接、固定连接附件的不合适的外型结构方面的缺陷也不允许出现。

The solder connection must be free of fluxing agents and residues. The solder gap surface must be at least 60% free of shrinkage cavities and continuous pores or wormholes (DIN EN ISO 18279) are not permissible.

焊接处无焊剂和残留物，焊缝表面必须至少 60% 无缩孔，其中不允许有连贯的多孔区(DIN EN ISO 18279)。

There must be an area with a length of at least 2,5 mm free from shrinkage cavities and inclusions in each cross section made from a pure AlSi solder material (if other materials are present, the release must be approved by the purchaser). Fluxing agent inclusions must not contact the line cross section or the environment. The solder depth must be at least 5 mm at the connection fittings.

在每个纯 AlSi 焊剂形成的横截面上必须保证在至少 2.5mm 长的范围内无缩孔和夹杂物，焊剂夹杂物不允许与管路横截面及周围接触(如使用其他焊接材料须由买方批准)。在连接附件上，焊接深度至少为 5mm。

2.2 Shelf life 保存期限

The properties required in this functional instruction for refrigerant lines must still be guaranteed up to 24 months after production, under consideration of DIN 7716.

由制冷剂管路的功能结构的特性要求，必须保证生产后24个月可以保证(按DIN7716)

3 As-received condition 收货条件

3.1 Quality requirements 质量要求

The refrigerant lines in their as-received condition must correspond to the drawing and/or or the released first sample. The refrigerant lines must be provided at both ends with dust-proof caps.

These caps must be captively fastened but easily removable. The material used for the caps must not emit any substances that have a negative effect on the O-rings that are used. The preferred material is HDPE. 收货状态下的制冷剂管路必须符合图纸和/或批准的首件样品，必须两端带容易盖上且移除的防尘帽。使用时，帽的材料不允许释放任何物质以致对密封圈产生负面影响。优先选择高密度聚乙烯材料。

The dust caps must not contact the preassembled O-rings and must not damage the lubricant layer.

In the as-received condition, the hose lines must be dry and free of soiling and processing aids, e.g., release agents, on the inner and outer surfaces.

防尘帽不允许接触预先装配的密封圈，损伤其润滑层。收货状态下，管路必须干燥、无污物和加工助剂，例如内外表面的脱模剂。

The interior of steel pipes and fittings must be protected against corrosion by temporary corrosion protection (e.g., refrigerant oil or another suitable medium that has been released by the purchaser). After removing the caps, it must be possible to easily turn and close the union nuts on the fittings, so that the contact surface for the seal is freely visible.

钢管的内部和接头必须做临时的防腐蚀保护措施(制冷油或其他合适的由买方批准的介质)。防尘帽去除后，接头上连接螺母必须很容易扭转和闭合，以使密封接触面自由的装配。

3.2 Part marking 零件标记

The tubes and/or hose lines, including their fittings, are marked as per the drawing.

软管和/或硬管管路包括接头须按图纸标记

The labeling on the hose must have a maximum spacing of 300 mm:

胶管上的标签须有一个不大于300mm的空间

– Type and material designation 材料类型和牌号

– Hose size 胶管尺寸规格

– Intended use (R134a/R1234yf; polyalkylene glycol (PAG) oil)

预期用途(R134a/R1234yf;聚二醇(PAG) 油)

– Date of manufacture 生产日期

– Manufacturer's identification 生产厂识别号

3.3 Reduced cross section 横截面压缩

The maximum reduction in the tube's cross section due to the outer deformation must be 15% of the original cross section. 由于外部变形而形成的硬管横截面的收缩最大为初始横截面的**15%**。

The maximum permissible values for the narrowing of the diameter at the nipple are defined in table 1. 在(软硬管)接头处直径收缩的最大允许值规定于表 1 中。

Table 1 – Reduced cross section 横截面收缩

Nominal width(mm) 名义直径	Tube dimensions (mm) 硬管尺寸, 按 As per DIN 8905-1	Nominal width d _i at the nipple (mm) 接头处名义内径	
		Rubber hose 橡胶管	Plastic film hose 带胶管塑料层
6,0	8,00 x 1,00 8,50 x 1,25	-	4,5
8,0	10 x 1,00 10 x 1,25	5,3 4,6	4,5
10,0	12 x 1,25	8,0	6,0
13,0	16 x 1,25	10,0	8,6

	16 x 1,50		8,2
16,0	18 x 1,50	11,8	11,8
17,5	18 x 1,50		14,0
19,0	22 x 1,50	14,5	14,5

3.4 Leak tightness test for production monitoring 批量生产的密封性监控

The refrigerant lines must pass tests of 10 seconds at 3 bar and 20 seconds at 35 bar. No leaks must be detected. The supplier must perform this test to 100% satisfaction during the final inspection. Preferably, a helium leak tightness test must be performed for the production end testing. The permissible leakage rate is in accordance with the equivalent of 5 g/a R134a or R1234yf at 35 bar.

制冷剂管必须在3bar、10秒，在35bar、20秒条件下通过测试，无泄漏检出。在供货厂最终检验中进行100%检验。更适宜的是，氦气密封检测须作为标准产品的最终检测。可允许的泄漏符合相当于R134a或R1234yf的泄漏5 g /年/35 bar。充以干燥空气或氮气，在无压力水下管内压力下进行管内压力下进行

3.5 Hose structure 胶管结构

3.5.1 Fabric-reinforced rubber hose, with and without barrier layer 带和不带隔离层的织物增强橡胶管

The hose must be built on a mandrel and constructed with a seamless, refrigerant oil-resistant barrier layer on the inside, so that as little refrigerant as possible penetrates and the system is contaminated as little as possible.

软管内部必须用芯棒制成具有无缝耐制冷剂油阻隔内层的结构，以保证尽可能少的制冷剂渗透，并使系统尽可能少的污染。

For hoses with barrier layers, a mandrel-built, seamless, synthetic rubber inner sheathing that is resistant to refrigerant oil is provided between the core and reinforcement. The reinforcement must consist of one or more yarn layers and must bond rigidly to the insert and sheathing.

带隔离层的胶管，用芯棒制成具有无缝耐制冷剂油阻隔内层的合成橡胶内层防护，在芯子和加强层之间。加强层应由一层或多层纱线层组成并牢固地粘附在衬垫和防护层上。

The outer sheath must be made from a synthetic rubber mixture that is resistant to abrasion, resistant to contact with compressor oil, and resistant to ozone. The sheathing can be needle-punched or perforated.

外层应由耐磨、耐(压缩机)油、耐臭氧的合成橡胶混合物组成。外层可以用针刺孔或成排打孔的结构

3.5.2 Reinforced plastic hose 增强塑料胶管

The thermoplastic hose must have a thermoplastic insert that is designed so that as little refrigerant as possible penetrates, the system is contaminated as little as possible, and it is resistant to refrigerant oils released by the plant.

热塑性软管必须具有一层热塑层结构，以保证制冷剂可能少的渗透，并使系统尽可能少的制冷剂油污染。

The reinforcement must be one or more layers of suitable materials. The outer sheath must be made from a thermoplastic or rubber that is resistant to abrasion, resistant to contact with compressor oil, and resistant to ozone. Perforation is permissible.

加强层是一层或多层合适的材料。外层应由耐磨、耐(压缩机)油、耐臭氧的热塑性塑料或橡胶，允许打孔

3.5.3 Molded hose 成型胶管

Molded hoses are built in accordance with the hose types named above, but a suitable method gives them a defined shape corresponding to the drawing specifications.

成型胶管的生产符合以上定义的胶管类型，但根据图纸要求以合适的方式形成定义好的形状。

Additional tests that result from the requirements on the dimensional stability and also from a modified production process must be taken from the Performance Specification that is valid for the respective project and/or must be agreed upon with the applicable department.

对于尺寸稳定性要求的结果的附加测试和改进的生产过程必须来自功能要求，对各个项目有效，获得适当部门的同意。

3.6 Hose quality 胶管质量

The covers and cores of the hose lines must be free of bubbles, cracks, inclusions, and damage or other surface flaws.

软管的内外表面和芯部不允许有气泡、裂纹、夹杂物、损伤或其它表面缺陷。

The reinforced inserts or supports must be machined to be uniformly tight, have a constant thread angle, and bond rigidly to the hose core and hose cover without breaks or flaws.

加强层或支持物必须均匀致密，具有恒定的交织角，无断开或缺陷，并牢固粘附在管的芯部和表层上。

The type and design of the insert and/or backing must be specified for the sample inspection (e.g., braid angle and type of yarn).

衬层及基底的种类和结构在样品检测时应说明(如纺织角和纱线种类)

3.7 Dimensional requirements for hoses 胶管尺寸要求

Table 2 – Hose dimensions 胶管尺寸

Nominal width(mm) 名义直径	Nominal width (inches) 名义直径	Max. outside diameter d _o (mm) 最大外径		Min. bending radius for 90°arc (mm) 90°弧时的最小弯曲半径	
		Rubber hose 橡胶管	Plastic film hose 带胶管塑料层	Yard goods 通长货品	Molded hose 成型胶管
6,0	-		12,0	35	-
8,0	5/16	19,3	15,0	75	35
10,0	13/32	22,2	18,0	90	45
13,0	1/2	25,9	22,0	100	50
16,0	5/8	28,5	24,5	120	60
17,5		-	25,0	120	70
19,0	3/4	32,5	28,5	160	70

4 Operating conditions 操作条件

4.1 General use criteria 一般使用条件

The specified temperature and pressure ranges correspond to the generally valid operating states of the vehicle and air conditioning system. However, depending on the respective use case, these criteria must be brought into agreement with the specific Component Performance Specification and, if necessary, redefined in consultation with the applicable department.

规定的温度和压力范围符合通常有效的汽车和空调系统操作状态。然而，取决于不同的情况，条件必须对具有特定零件功能要求达成协议。如果必要，经与适当部门磋商，可重新定义。

4.2 Temperature resistance 耐温性

For use in the vehicle, depending on the model series and/or engine type, the temperature-resistance test is divided into two temperature ranges. It must be possible to use the hose lines for continuous operation in these ranges without failure (breaks, leakage, etc.).

Short-term loading is a peak loading (168 x 1 hour), no holding time at the high temperature.

在实车上，取决于模块系列和发动机类型，耐温性试验分2个温度范围。在这个范围内用管路连续运行必须是可能的，不发生失效(破裂、泄漏等等)

Table 3 – Temperatures 温度

	Normal temperature (°C) 常温	High temperature (°C) 高温
Refrigerant temperature during continuous operation 连续工作的制冷剂温度	-12 to +60	-12 to +140
Short-term refrigerant temperature 短期工作的制冷剂温度	≤+80	≤+150
Ambient temperature during continuous operation 连续工作的环境温度	-40 to +120	-40 to +120

Short-term ambient temperature 短期工作的环境温度	+150	+150
In special cases (project-dependent) 特殊情况(取决于项目)	+180	+180

4.3 耐压 Pressure resistance

The hose lines must withstand the maximum pressures that occur in the refrigeration cycle:

胶管管路必须承受发生在制冷循环中发生的最大压力

Table 4 – Pressures 压力

	High-pressure side 高压侧	Suction side 吸入侧
Max. Blow-off pressure (bar) 最大流通压力	41,4	-
Max. Operating pressure (bar) 最大工作压力	35,0	15,0
Max. Standing pressure (bar) 最大标准压力	15,0	15,0

4.4 Resistance to agents 耐介质性

All lines must be resistant at the inner layer against the refrigerants used in vehicle air conditioning systems (as per DIN 8960, SAE J639, SAE J2099 "Standard of Purity for Recycled R-134a (HFC-134a) and R-1234yf (HFO-1234yf) for Use in Mobile Air-Conditioning Systems", and against the oils that are compatible as per the compressor manufacturers (for a list, see Volkswagen standard VW 50170) (e.g., PAG oil as per TL 52535) (in all functional tests, the temperature ranges specified by the manufacturer must be observed).

The outer layer must withstand all climatic influences and influences of the engine compartment during driving operation.

所有管路内层必须耐汽车空调系统使用的制冷剂(按DIN 8960, SAE J639, SAE J2099 “车用空调系统 R-134a (HFC-134a) 和R-1234yf (HFO-1234yf)的纯度标准”，)防止不同压缩机制造厂的油混合(见大众标准VW50170清单)(如PAG油符合TL52535)(功能试验中温度范围由制造厂规定的需要观察)。所有外层必须满足气候的影响以及发动机舱在运行驱动操作下的运行。

5 Requirements for the hose line 管路的要求

5.1 Flexural strength 抗弯强度

The test lines (see table 9, DUT type b) must be clamped vertically in a suitable test stand. Each line must be bent from the vertical position into the horizontal position in all four directions (in the direction and against the direction of the natural curvature of the hose and to the left/right).

After a holding period of 3 seconds in each case, the required tensile force must be read from a suitable spring scale (the holding force must be exerted perpendicular to the hose axis at the point of attachment). Two lines for each nominal width must be tested in each case. The measured values must not exceed or fall below the values from table 5. The average must be computed.

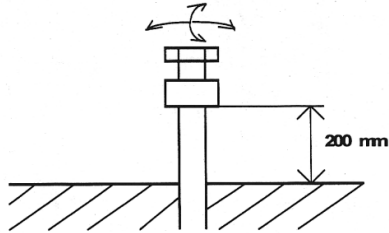
试验管(见表 9.b 型)必须垂直夹紧在合适的试验设备上,每根管均须由垂直位置弯成水平位置的 4 个方向(软管的自然曲率方向相反于自然曲率的方向和左/右方向)持续 3s 后, 读出在相应弹簧秤上所需的拉力读数(在连接点, 保持的拉力须明显垂直于软管轴向)。每次对每个公称尺寸的管用 2 根作试验, 测量值不许低于或高出下列表 5 的值, 用平均值进行评定。

Table 5 – Flexural strength 抗弯强度

Nominal width(mm) 名义直径	Min. holding force(N) 最小夹持力	Max. holding force (N) 最大夹持力
8,0	1,5	6,5
10,0	5,0	8,5
13,0	6,0	11,0
16,0	8,0	15,0
17,5	9,0	18,0

19,0	10,0	20,0
------	------	------

Figure 1 图1 – Flexural strength 抗弯强度



5.2 Kink resistance 抗扭曲

The test lines, see table 9, DUT type b, must bend in the shape of a ring until the fittings overlap.

After a holding time of 10 min in this state, the hose's smallest outside diameter (d_k) and greatest outside diameter (d_g) must be determined; see figure 2.

The deviations from table 6 must not be exceeded with respect to the actual diameter.

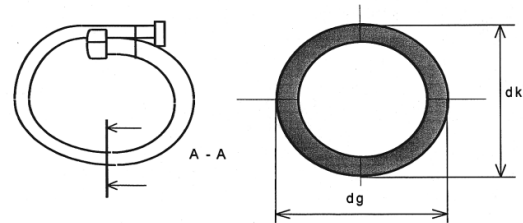
These values must be determined and documented for each nominal width for two DUTs in each case.

试验管理, 见表9, DUT型号B, 在一个环形进行弯曲直到接头部分重叠。保持10分钟这种状态, 软管的最小外径(D_k)和最大外径(d_g)必须被确定, 见图2。

Table 6 – Deviation 偏差

Nominal width (mm) 名义直径	Permissible deviation (mm) 容许偏差
8,0	$\pm 0,6$
10,0	$\pm 0,8$
13,0	$\pm 0,9$
16,0	$\pm 1,5$
17,5	$\pm 1,8$
19,0	$\pm 2,0$

Figure 2 – Kink resistance 抗扭曲



5.3 Shape resistance when a vacuum is applied 抽真空时的形状稳定性

The refrigerant hose lines (see table 9, DUTs type b) are bent about a mandrel as per figure 3 to form a U-shape according to the natural curvature of the hose, as per table 7. Then the hose lines are evacuated to an absolute pressure of 0,02 bar. After a period of 5 minutes, the reduction of the hose line's outside diameter must be no more than 5% of the original outside diameter in the unbent and vacuum-free state.

A maximum pressure increase of 1 mbar/min is permissible.

将制冷剂管(见表 9, B 型)按自然曲率的方向在一芯棒上按图 3 弯成 U 型(按表 7)。之后将其在 0.02bar 的绝对压力下抽真空持续 5min 后, 软管直径的缩小量不能大于在未弯曲和未抽真空状态下原始外径的 5%, 允许的最大压力上升为 1 mbar/min。

Figure 3 – Vacuum resistance 耐真空

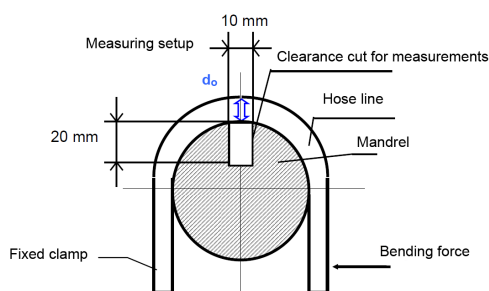


Table 7 – Mandrel diameter 芯轴直径

Nominal width (mm)	Mandrel diameter $d_{mandrel} \sim 8 * d_o \max$	
	Rubber (mm)	Film (mm)
8,0	150	120
10,0	180	150
13,0	200	170
16,0	230	200
17,5	-	210
19,0	260	230

5.4 Change in length and angle 长度和角度改变

For the hose line as per table 9, DUT type b, the changes in length and angle deviations specified in table 8 must not be exceeded after the effect of the specified pressure (loading for at least 1 min).

The changes must be measured while the pressure is being applied.

软管按照表9, b型管, 在规定的压力下(加载至少1min)表8规定的角度长度偏差的变化不允许超出。该变化必须在加压力负载下进行测量。

Table 8 – Change in length, angle deviation 长度角度改变

Pressure 压力	Max. Change in length 最大长度变化	Max. Angle deviation 最大角度偏差
(35 ± 2) bar	-4% / +2%	5°

5.5 Expansion of hose volume 软管体积膨胀

This test is used to inspect the strength of the fabric layer. The computation of the inner volume of the refrigerant lines as per table 9: DUTs, type b, is performed in the area of the free hose length.

Then the DUT is mounted vertically in a safety container, connected to a hydraulic pump, and air is evacuated until the PAG oil or suitable medium is discharged from the top without bubbles. Then the upper stop valve is closed and the DUT is loaded with 50 bar for 1 min.

After 1 min, the lower stop valve between the pump and hose is closed. The over-pressure in the hose is let off at the upper hose valve and the test fluid discharged there is collected in a graduated cylinder (expansion volume V_d).

The volume expansion is now calculated in percent and documented in the test report using formula 1 below.

本试验用于检验纺织层强度, 制冷剂管的内部体积的计算(按表 9, b 型管)在软管的自由长度内进行。接着将试样垂直拧紧到一安全容器上, 并接到一液压泵上排空空气, 直至将 PAG 油或相应的介质从上端排出为止(无气泡)。之后关闭上面的止回阀, 并在 50bar 压力下对试样加载 1min。

1min后将泵与管之间的下止回阀关闭, 在管中超过的压力在软管上面的阀得以排出, 由此而出来的试验液体被收集在量筒中(膨胀体积 v_d)。膨胀体积计算用下列公式, 百分比表示, 记录在试验报告。

Calculating the volume expansion 膨胀率计算

Legend 说明

V_d Expansion volume 膨胀体积

V_i Inner volume 内容积

d Inner diameter of hose 胶管内径

L Free hose length 自由胶管长度

$$\Delta V = \frac{V_d}{V_i} * 100\%$$

$$V_i = \frac{d_i^2}{4} * \pi * L$$

6 Test procedure 试验流程

6.1 Test chamber temperature and aging 温度及老化试验箱

If not specified otherwise, the tests are performed at room temperature, 18 °C to 28 °C, as per ISO 554. The minimum prior aging time must be at least 24 hours from the date of manufacture.

In-between the individual tests, the lines must each be aged in a sealed and unfilled state for at least 24 hours at room temperature. This does not apply to section 3.7 and section 9.7 as an intermediate test. It is permissible to shorten the intermediate aging time, but this must be done at the responsibility of the supplier.

如果没有特殊规定, 试验是在室温18 °C到 28 °C之间进行, 按ISO 554。最少前期老化时间至少在制造日期的24小时后。中间单独试验, 管路必须在一个密封、未填充状态下室温放置24小时后进行老化。此要求不适用于3.7和9.7章节作为中间的试验。减短中间老化时间是允许的, 但这是供应商的责任所在。

DUTs

Depending on the type of release, test samples with hoses or fittings from production and/or from a run-at-rate, first sample, and production parts must be differentiated. More precise details on definitions, procedures, test plans (see table 19), and test reports are specified below.

Microsections of reinforcement parts and tolerance considerations must be submitted.

For the basic release, dimension tables of the compression ratios must be submitted to the test institute.

The total number of delivered DUTs must be divided into thirds of maximum, minimum, and nominal compression each.

根据批准的类型，来自生产和/或者run-at-rate带胶管和接头的试验样件，首次样件和(批量)生产零件必须是可区分的。定义更精确详细的细节、流程、试验计划(见表19)和试验报告按如下规定。

加固件的切片和公差考量须被提交。对于基础认可，扣压压缩比的尺寸表须提交给试验机构。总的DUTs的提交数量，被分成最大、最小、名义扣压各1/3。

6.2.1 Test samples for basic release 基础认可的试验样件

Figure 4 – Schematic diagram – DUT示意图

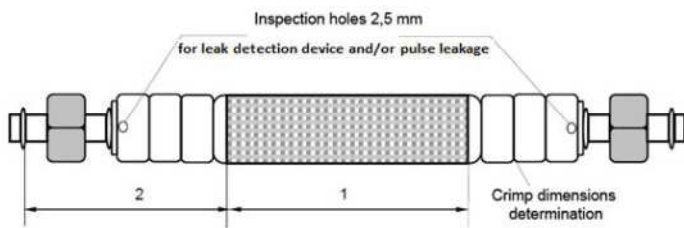


Table 9 – DUTs

Nominal width (mm) 名义直径	Dimension 1: free hose length (mm) 尺寸1: 自由胶管长度				Dimension 2: fitting length Lmax (mm) 尺寸2: 接头最大长度
	Type a	Type b	Type c	Type d	All
6,0	200 ± 5	500 ± 5	680 ± 5	76 ± 5	65 ± 5
8,0	200 ± 5	500 ± 5	680 ± 5	76 ± 5	65 ± 5
10,0	200 ± 5	500 ± 5	680 ± 5	76 ± 5	65 ± 5
13,0	200 ± 5	500 ± 5	680 ± 5	76 ± 5	65 ± 5
16,0	200 ± 5	500 ± 5	680 ± 5	76 ± 5	90 ± 5
17,5	200 ± 5	500 ± 5	680 ± 5	76 ± 5	90 ± 5
19,0	200 ± 5	600 ± 5	680 ± 5	76 ± 5	90 ± 5

Table 10 – Closing pieces, tightening torques 锁紧件，锁紧扭矩

Nominal width (mm) 名义直径	V inner of the closing pieces (cm ³) 锁紧件内部体积	Ma of the union nut 锁紧螺母的扭矩
8,0	1,0 ± 0,1	16,5 ± 1,65
10,0	2,0 ± 0,2	16,5 ± 1,65
13,0	4,0 ± 0,4	30,0 ± 3,0
16,0	7,0 ± 0,7	42,0 ± 4,2
19,0	10,0 ± 1,0	50,0 ± 5,0

6.2.2 Possible tolerances 可能产生的公差

The drawing tolerances and/or the individual control limits for the respective production process, corresponding to the in-house Cpk factor (process capability (corrected)), are the decisive factors for the tolerance zone positions to be tested. Accordingly, the refrigerant lines must be tested with minimum and maximum crimp ratios (see table 11). The required tolerance zone positions can be modeled by varying

the crimp dimensions and the nipple diameters.

For all of the tests with hose lines, two different batches must be used. The hose material must be taken in intervals of 10 meters for each case.

对于测试的偏差区域,起决定性的因素是图纸的公差和/或针对分别的过程的单独的厂内生产 CPK 控制限(这算的过程能力).因此制冷剂管必须是在最大和最小扣压比率下测试(表 11)。必要的公差通过扣压和插入端尺寸的变化量体现。

Table 11 – Tolerances公差

Compression ratio 压缩比	Crimp diameter (mm) 扣压直径	Nipple outside diameter (mm) 插入端外径
Max. 最大	Minimum dimension 最小尺寸	Maximum dimension 最大尺寸
Min. 最小	Maximum dimension 最大尺寸	Minimum dimension 最小尺寸

6.2.3 Reference sample参考样件

In all tests that determine weight losses, reference DUTs (without filling) with the same geometry as the tested DUT must also be tested to determine the hose weight losses.

确定重量损失的所有试验中, 参考的具有相同几何形状未冲注的DUTs, 作为试验的DUTs必须被测试以确定重量损失。

7 Release types 认可类型

7.1 Basic release 基础认可

The test sequences required for a basic release are listed in table 9. Deviations specific to the project or product must be agreed upon with the appropriate department before the beginning of the test. Any measures resulting from this agreement are not transferrable directly to other projects.

基础认可要求的试验次序按表9所列, 项目、产品的偏差规定由适当的部门在试验开始前同意。协议中的任何测量结果将不会转移给其他项目。

These release tests of the hose or the fitting must use test samples corresponding to section 6.2,DUTs with straight connections, and the respectively defined hose length.

这些软管或接头认可试验, 必须用符合6.2章节规定的试验样件完成, 直的DUTs, 分别定义的胶管长度。

Molded hoses must be tested without loading, and also with straight fittings, as in the as-installed position. Each nominal width must be individually tested and released. If a test value is outside the required limit, this test must be repeated with twice the number of DUTs.

Tested lines as per sections section 5, section 8, and section 9 must no longer be used as production parts.

成型软管必须带直的接头供货,并且如同在汽车上的安装位置一样在无应力的情况下进行试验。

每个公称尺寸必须进行单独的试验和认可,如果在某个试验中试验值超出了所要求的极限值,那么要用双倍的试样件数重复进行试验.按章节 5 至章节 8、章节 9 进行过试验的管路不允许再作为批量生产件使用。

7.2 Vehicle release 整车车型认可

The prerequisite for the beginning of vehicle testing is the fulfillment of the tests in table 19. A complete functional production release for a refrigerant line is possible only after the completion of corresponding reliability testing in the vehicle. The extent and duration of testing are dependent on the scope of changes to the refrigerant line with respect to a corresponding release version and also on the individual Component Performance Specification for the actual use case.

开始做整车试验的前提是满足表 19 中的试验要求。对于制冷剂管, 一个完整的功能性生产认可是可能的, 仅在相应的车辆上的稳定性测试后。其范围和试验的时间取决于相应认可版本的制冷剂管路的变化范围和实际使用情况下的各单独的零件性能要求。

The appropriate department of Design Engineering defines the exact number of DUTs and the scope of testing.工程设计适当的部门定义精确的DUTs和试验范围的数量

The DUTs from completed vehicle and service life testing must be analyzed by the contractor (the supplier that combines the hose and pipe in the ASSY) in accordance with the test plan and in agreement with the purchaser.

完整的整车和生命周期测试的DUTs须由分供方分析(总成中的硬管和软管供应商组成), 与试验计划和采购方协议一致。

8 Hose requirements 胶管要求

8.1 Water content 含水量

This test is performed in the as-received condition. 该试验是收货的条件。

The water content in the refrigerant lines must not exceed 1,0 mg/dm² of the inner surface in the as-received condition. 制冷剂管路的内表面含水量不能超出1,0 mg/dm²。

The test is performed as per the method A2 (section 5.3) described in DIN 8964-1 or as per another method agreed upon between the hose manufacturer and the appropriate test department.

该试验按DIN8964-1介绍的A2(5.3章节)或另外一种在胶管生产商和适当的(VW)试验部门同意的方式进行。

8.2 Inner surface purity 内表面洁净度

This test is performed in the as-received condition. 该试验是收货的条件。

There must be no residues, deposits, cuttings, greases, or oils, except for the compressor lubricant, in the refrigerant lines. 管内必须无残渣、沉积物、碎屑、油脂、油, 除了压缩机润滑剂。

The determination of: 测定

– soluble contaminating particles is performed as per DIN 8964-1, section 7, method C2

可溶杂质颗粒按DIN8964-1第7章节C2方式执行

– insoluble contaminating particles is performed as per DIN 8964-1, section 7, method C1

不可溶杂质颗粒按DIN8964-1第7章节C1方式执行

or as per another method agreed upon between the hose manufacturer and the appropriate test department. 或者按另一种在胶管生产商和适当的(VW)试验部门同意的方式进行。

The weight of insoluble contaminating particles that can be flushed away must not exceed a maximum weight of 2,7 mg/dm². The hardness must be <400 HV and the size of the particles must be <500 µm.

Dust and textile lint up to a maximum size of 1 mm are permissible.

能冲洗出的不可溶杂质颗粒重量不能超过2,7 mg/dm²。硬度<400 HV。颗粒尺寸<500 µm。灰尘和织物线头最大尺寸1mm是允许的。

8.3 Water permeability 透水性

Before the beginning of the test, the water content of the test fluid (PAG oil) must be determined as per DIN 51777-1 and DIN 51777-2 (Karl Fischer method).

试验开始前, 试验流体(PAG油)的含水量必须按DIN 51777-1和DIN 51777-2 (Karl Fischer 法)确定 PAG oil (type in agreement with the appropriate department) with a water content <500 ppm as per manufacturer specifications must be used as the test fluid.

按制造厂规定作为试验流体的PAG油(型号根据适当部门同意的)含水量<500 ppm。

Immediately before filling, the 6 refrigerant lines as per table 9, DUTs type b, must be flushed with an unsaturated test fluid. 加注前6个制冷剂管路按表9的DUTs的b型立即以不饱和试验流体冲洗。

The DUTs are filled with the test fluid up to 5 mm below the ends of the hoses and sealed in a gastight manner with O-rings that are typically used in refrigerant circuits.

DUTs以试验流体加注至胶管和密封圈密封处下5mm, 作为制冷剂回路。

The filled DUTs are bent into a U-shape and stored in a water bath (40 ±2) °C up to half of the crimp sleeve. The aging time is 500 hours (make sure that the water level does not fall more than 10mm below the crimp sleeve during the aging).

加注的DUTs弯曲成U形, 在(40 ±2) °C水浴中放置至半个套筒(露出)。老化时间500小时(老化期间确保水平面比套筒不低于10mm)

After removing the DUTs, swing them 10 times to ensure thorough mixing of the test fluid. Immediately afterwards the water content must be determined as per the Karl Fischer method.

The water content after 500 hours of aging must not exceed 1,5%.

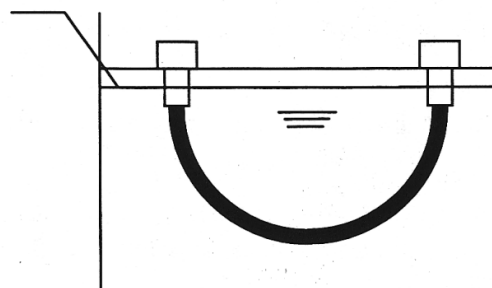
移走DUTs后。摆动10次保证彻底混合试验流体。然后立即用Karl Fischer法测定含水量。500小时老化后的含水量不能超过1.5%。

1 Water level

Legend说明

Figure 5 – Schematic diagram - Water permeability

示意图-透水率



8.4 Corrosion test 腐蚀试验

8.4.1 Prerequisite 前提

New proof of the corrosion resistance of the refrigerant lines must be demonstrated for each new aluminum alloy or each new production process. To be able to grant a release, at least 5 lines with production fittings (hose length type a, see table 9: DUTs) and mating connections (e.g., air conditioning condenser connection) must pass the following tests:

制冷剂管路耐腐蚀的必须对每种铝合金制品或新生产过程进行新试验。为能得到认可，至少5个带生产接头(软管长度按表9的DTUs的a型)和对配的连接件(如空调冷凝器接头)的管子，通过如下试验：

Environmental corrosion cycle test as per PV 1209 环境腐蚀按PV1209

The DUTs must correspond to the as-received condition in section 3 and be tested in terms of leak tightness as per section 3.4. DUTs须符合收货条件按第3章节，测试密封性按3.4章节。

The test is performed with 5 DUTs for each nominal width as per PV 1209.

按PV1209测试5个DUTs(名义直径的)。

The test consists of 4 phases, with phases 1 through 3 being repeated over a time period of 5 days and phase 4 running over 2 days as a "weekend aging" test. Consequently, one cycle takes one week to complete. 试验分4个阶段，阶段1至3，重复超过5天的周期，阶段4运行超过2天，作为“周末老化”测试。一个循环为完整的一周。

The total runtime of the test is 试验总运行时间：

for lines exposed to spray/rain water 24 weeks 管路在喷淋、雨水中暴露24周

for lines not exposed to spray/rain water 12 weeks 管路不在喷淋、雨水中暴露12周

The test devices and conditions must also be taken from PV 1209. 试验设备和条件必须按PV 1209

After completion of the testing, the DUTs must fulfill the criteria specified in section 8.4.4.

完整的试验后，DUTs须符合8.4.4章节的要求。

Sea water acetic acid corrosion test (SWAAT) test as per PV 1208. 海水醋酸腐蚀试验按PV 1208

The runtime of the test is 试验运行时间：

for hoses exposed to spray/rain water 40 days 管路在喷淋、雨水中暴露40天

for hoses not exposed to spray/rain water 20 days 管路不在喷淋、雨水中暴露20天

The corrosion resistance of the refrigerant lines is evaluated using 5 DUTs in an accelerated method as per section 4 of PV 1208. The leak tightness is checked as per section 9.7 after every 20th day.

The DUTs must fulfill the criteria specified in section 8.4.4.

制冷剂管路的耐腐蚀试验用5个DUTs评价，按PV 1208第4章节加速方式。每20天后，密封性检查按9.7章节检查。DUTs须符合8.4.4章节的标准要求。

8.4.4 Acceptance of the test 验收试验

There must be no detectable corrosion that might negatively affect the function on the entire refrigerant line after the test. 试验后，在整个管路上，须没有可探测到的有消极功能影响的腐蚀

The parts must pass the subsequent tests specified in the test plan. 零件须通过试验计划中之后的试验
Uniform surface erosion and recess corrosion with a depth of up to 30% of the examined wall thicknesses is permissible in aluminum parts. 一致的表面侵蚀和深度不超过壁厚30%的凹坑腐蚀对铝件是允许的。
Pitting and other types of corrosion, e.g., intercrystalline corrosion, are not permissible.

点状腐蚀和其他类型腐蚀如晶间腐蚀不允许。

9 Basic release 基本认可

9.1 Ability to rotate 旋转能力

The fittings must be designed structurally so that they cannot rotate relative to the refrigerant hose (hose relative to fitting/holder).

接头必须结构化设计以使其制冷剂软管不能转动(软管涉及的接头和支架)

The torsional torque (hose relative to fitting/holder) must be at least 3,5 Nm after all tests. The demonstration of higher torsional torque is not necessary.

扭矩(软管涉及的接头和支架)在所有试验后至少3.5Nm。不必要更高的扭矩的证明。

The values achieved must be documented for room temperature as per ISO 554-23/50 and 90 °C.

室温下，达到的值必须按ISO 554-23/50和90°C条件加以记录

9.2 Artificial aging 人工老化

This test is a pretreatment for the individual functional tests (see table 19 as per DIN 53508).

The DUTs required in the respective functional tests must be provided with closing pieces as in table 10: Closing pieces, tightening torques. They must be stored in the climatic cabinet in a condition offset corresponding to the natural curvature of the hose and evacuated to 0,02 bar over 72 hours at (110 ±2) °C for the normal temperature hose, at (125 ±2) °C for the high-temperature hose.

这个试验是功能试验单独的预处理试验(参照表 19 按 DIN53508).各功能试验要求的 DUTs 按表 10 提供闭合的样件：闭合样件、拧紧力矩。样件在补偿条件下放置在气候试验箱，与胶管自然弯方向一致，抽真空至 0.02bar 状态下对于常温管在 110°C ±2°C 下，对于高温管在 125°C ±2°C 下存放 72h 以上。

9.3 Crack test 裂纹试验

The hose lines, including the fitting area, must be cut in the longitudinal direction and be examined for cracking. They must not have any cracks or fracture points or any other damage.

将制冷剂管包括接头部位必须沿轴向切割开，检查裂纹的形成，不允许出现裂纹、断裂点或其它损伤。

9.4 Tensile strength 抗拉强度

9.4.1 Tensile test as release test 作为认可试验的拉力试验

The hose lines with fittings must withstand at least the tensile forces specified in table 12 without failure.

带接头的管路必须符合表12 固定的最低拉力值而无失效。

Table 12 – Tensile strength 抗拉强度

Nominal width (mm) 名义直径	Tensile force (N) 拉力值
6,0	1 500
8,0	1 500
10,0	1 500
13,0	2 500
16,0	2 500
17,5	2 500
19,0	2 500

In the tensile test, a hose as per table 9, DUTs type a, (for production monitoring measures with larger hose lengths, the hose can be shortened to a free hose length of 200 mm) is subjected to an increasing tensile load in a suitable test machine until either the hose separates from the fitting or it tears. The hose mounted in the test machine is loaded in tension at a rate of 25 mm/min. The tensile force must be applied until failure.

在拉力试验中，对按表 9，DUTs 型号 a 型的软管，在一合适的试验机上施加一增加的压力负荷，(在用较长的软管进行批量监测时，可以将软管长度缩短至自由长度为 200mm)，直至软管从附件中脱开或撕裂。夹紧在试验机上的软管以 25mm/min 的速度施加拉力负荷。拉力加至失效为止。

The course of the tensile force must be documented in a load-displacement curve (N/mm). The location and type of destruction must be documented in the test report.

拉力过程表示在力-位移的负载曲线图表(N/mm)中。被破坏的位置和形式须记录在试验报告中。

9.4.2 Tensile test after functional test 功能试验后的拉力测试

Perform the test as described in section 9.4.1. 80% of the values required as per table 12 must be reached. 须达到按9.4.1章节描述的试验表12的值的80%。

9.5 Compressive strength 抗压缩强度

9.5.1 Preparation 准备

PAG oil or an equivalent medium must be used in all compression tests. In this process, make sure to remove all air from the entire system. The final pressure must be reached within a period of 20 seconds in each case.

PAG油或相当的介质须用于所有压缩试验。该过程中，确保从整个系统中除去空气。最后的压力在每种情况都达到20秒的一个周期。

9.5.2 Burst pressure test 爆破压力试验

The hose lines as per table 9, DUTs type b, must withstand the following pressures at room temperature over 1 min without hydraulic leaks.

按表9的DUTs的b类型的管路，在室温下须符合下列压力无液体泄漏超过1分钟。

High pressure lines pH Burst ≥ 137 bar 高压管爆破压力PH ≥ 137 bar

Suction lines pS Burst ≥ 120 bar 吸气管爆破压力PS ≥ 120 bar

Then the pressure is increased at the same rate until the hose or the hose line bursts.

The burst pressure, location, and type of destruction must be documented in the test report.

压力以匀速上升直至软管或管路爆裂。破裂的位置、压力和形式须记录在试验报告中。

9.5.3 Compressive test at elevated temperature 提升温度情况下的压缩试验

The hose lines as per table 9, DUTs type b, must withstand, at (125 ± 2) °C over 5 min, a pressure of (55 ± 1) bar (for normal temperature hose) and, at (150 ± 2) °C, a pressure of (65 ± 1) bar (for high temperature hose) without hydraulic leaks.

按表9的DUTs的b类型的管路，须符合 (125 ± 2) °C，5分钟以上 (55 ± 1) bar的压力(对于常温管)；对于高温管，须符合 (150 ± 2) °C， (65 ± 1) bar压力，而无液体泄漏。

In this way, The temperatures of the DUT and the medium are equal; the DUT must be aged for 1 hour at the test temperature. 在这种方法中，DUT的温度和介质是一致的。DUT必须在试验温度下老化1小时。

9.5.4 Compressive test after functional test 功能试验后的压缩试验

The lines must withstand the following pressure loads over 5 min 2 times in each case after all functional tests corresponding to table 19: 管路功能试验后按表19，须符合每种情况下，下列压力负载超过5分钟2次

High pressure lines pH Test = 100 bar 高压管爆破试验pH = 100 bar

Suction lines pS Test = 84 bar 吸气管爆破试验pS = 84 bar

9.6 Pulse test 脉冲试验

9.6.1 Release test 认可试验

The hose lines with fittings as per table 9, DUTs type c, are mounted, bent into a U-shape, in a corresponding test stand with both ends fixed, and connected to a hydraulic pump; see figure 6.

The center distance is 350 mm; see figure 6.

将按表 9，C 型的 DUTs 弯成 U 型。两端牢固夹紧(见图 6)连接在一液压泵上，中心距离 350mm。

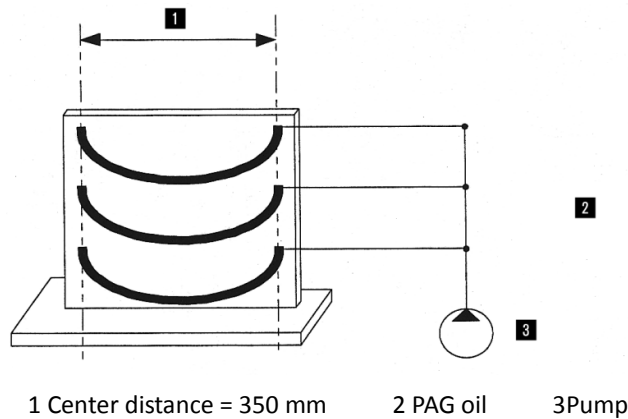


Figure 6 – Schematic diagram - Compressive pulse test 压缩脉冲试验示意图

PAG oil must be used as the test medium. 试验介质应为PAG油。

In this way, the oils released by the compressor manufacturers must be used with a maximum water content ≤ 500 ppm. The required number of pulses is 250 000 at an ambient temperature and test medium temperature corresponding to table 13.

在该方法中，按压缩机制造厂商认可的PAG油的最大含水量 ≤ 500 ppm。要求按表13的环境温度和试验介质进行脉冲次数为250 000。

The line is loaded with pressure pulses of (1 to 35) bar for a trapezoidal pressure profile; see figure 7, and a frequency of $(15 \pm 1,5)$ 1/min.

管路负载脉冲压力(1 到35) bar以梯形压力分布，见图7，频率为 $(15 \pm 1,5)$ 1/分钟。

Pulse pressure maximum 脉冲最大应力: (35 ± 1) bar

Pulse pressure minimum 脉冲最小压力: $(1 + 4)$ bar

Pressure rise time 压力上升时间: $(0,2 \pm 0,05)$ seconds

Pressure fall time 压力下降时间: $(0,2 \pm 0,05)$ seconds

Pressure hold time 保压时间(35 bar): $(1,8 \pm 0,1)$ seconds

Pressure hold time 保压时间(1 bar): $(1,8 \pm 0,1)$ seconds

Table 13 – Parameters for the pulse test 脉冲试验参数

		Suction line 吸气管	Fluid line 流体管	Hot-gas line 热-气管
Test pressure 试验温度	(bar)	1 to 25	1 to 35	1 to 35
Ambient temperature 环境温度	(± 2) °C	0 to 120	0 to 120	0 to 140
Temperature of medium 介质温度	$(+5/-2)$ °C	0 to 120	0 to 120	0 to 140

Figure 8, Ambient temperature plot, shows the temperature curve. The pressure curve must be documented with at least 5 successive cycles in a plot (see Figure 7, Pressure curve, compressive pulse test) with units of measurement for 0 °C and for 100 °C or 140 °C in each case.

图 8，环境温度安排，图解说明温度曲线。压力过程必须由至少 5 个彼此相连的负载循环的图表来表示。(见图 7，压力曲线，压缩脉冲试验)，其中每种情况的测量温度为 0 °C 和 +100 °C 及 +140 °C。

Figure 7 – Pressure curve - Compressive pulse test 压力曲线，压缩脉冲试验

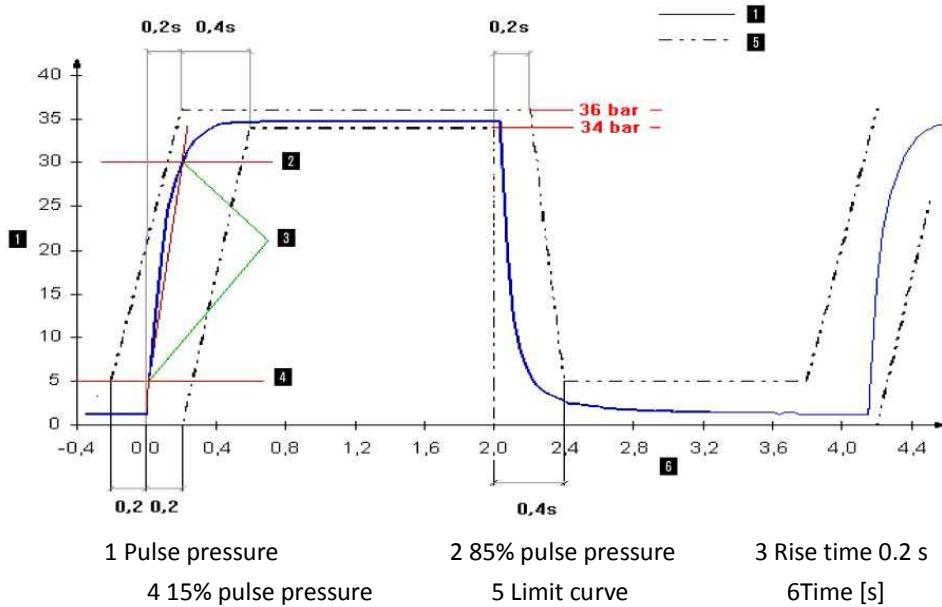
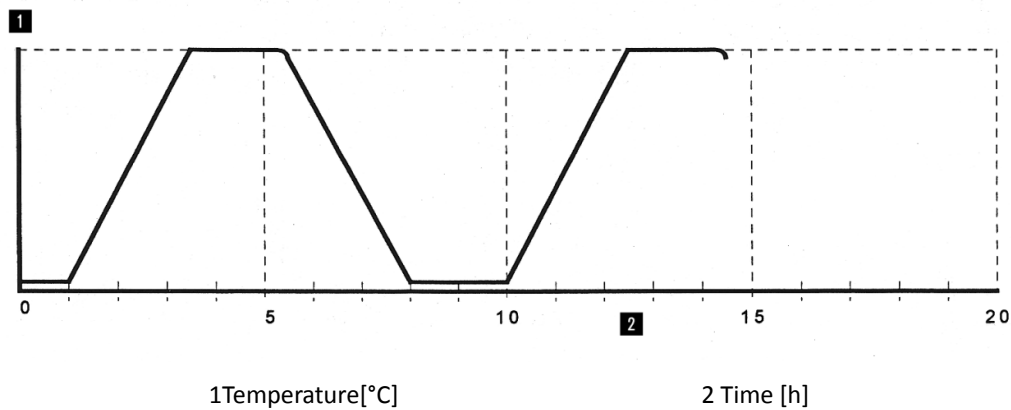


Figure 8 – Ambient temperature curve 环境温度曲线



The temperature is changed in the following way: 按下列方式改变温度

Holding time at T_{min} and T_{max} (保持时间)

2 hours each (for medium and ambient) 每次2小时(介质和环境温度)

9.6.2 Extended pulse test 延伸的脉冲试验

For two lines for each nominal width, the pulse test as per section 9.6.1 is performed until failure, but at a maximum up to 500 000 cycles.

对于名义直径的2个管路，脉冲试验按9.6.1章节执行直至失效，最大至50万次。

The number of cycles, location, and type of destruction must be documented in the test report.

破坏的循环次数、位置、形式须记录在试验报告中。

9.6.3 Pulse test after functional test 功能试验后的脉冲试验

The test is performed as in section 9.6.1, but with 150 000 load cycles. 按9.6.1章节执行，但负载15万次。

9.7 Leak tightness 密封性

The leak tightness test allows the failure of the lines to be detected in good time. The hose lines must be evacuated and filled with refrigerant.

密封性试验允许在正常时间内探测出管路失效，管路须排空后加注制冷剂

Fill quantity: 填充数量 R134a 0,6 g/cm³ R1234yf 0,7 g/cm³

The test pressure is 20 and 30 bar. It must be applied by means of nitrogen, helium, or compressed air. After 5 min, the lines must be examined intensely with a leak indicator (sensitivity = 5 g/year).

There must be no indication of leaks.

As an alternative, the leak tightness test may also be conducted with helium and the pressures specified above.

The leakage rate must not exceed 2,7 e-5 mbar*l/second.

测试压力 20 和 30 bar，可采用氮气、氦气或压缩空气。5 分钟后，管路用泄漏探测仪积极地检测(灵敏性= 5 g/year)，须没有探测到泄漏。作为备选，密封性测试也可以采用规定压力以上氦检。泄漏率不超过 2,7 e-5 mbar*l/秒。

9.8 Gas leak tightness 气密性

9.8.1 Preparation 准备

The DUTs are closed on both sides with closing pieces and the corresponding tightening torque, see table 10. One of the closing pieces must be equipped with a filling valve. The hose lines are filled with refrigerant. DUTs 锁紧在锁紧接头上，扭矩符合要求，见表10。锁紧端之一装有冲注阀。管内充制冷剂。

Fill quantity 冲注量: R134a 0,6 g/cm³; R1234yf 0,7 g/cm³

The reference DUT to be tested at the same time for determining the weight loss of the hose material is closed, but not filled with refrigerant.

参考的同时测试以确定胶管材料质量损失的DUT 是闭合的但是未加注制冷剂。

The hose lines must be tested with a leakage indicator with a display accuracy of 5 g/year at room temperature as per section 9.7 before the beginning of the test.

All hose lines are stored in the direction of the natural curvature of the hose at the respective test temperature.

开始试验前，在室温下，按9.7章节，管路用灵敏度为5 g/年的泄漏探测仪测试。

Molded hoses are tested without tension in the as-received condition. 成型胶管的收货条件中无拉力测试

The gas leak tightness is tested in the thermal cabinet at (90 ±2) °C over the corresponding, defined period of time. 在相当或超过(90 ±2) °加热箱进行气密性测试，确定时间周期

Evaluation of the rate of loss 损失率评价

The weight losses must be determined with an accuracy of 0,01 g as per the following formula.

质量损失精确到0.01g按下列公式定义：

Legend 说明

$$D = \frac{24}{t} * \frac{G - G_0}{L} \quad (2)$$

D Rate of loss per day (g/(m*d)) 质量损失比率

t Test time (hours) 测试时间

G Weight loss of the hose line filled with R134a (g) 加注胶管的质量损失

G₀ Weight loss of the reference line (g) 参考胶管的质量损失

L Free hose length of the test line or the reference line (m) 试验管或参考管的自由胶管长度

The maximum permissible refrigerant loss in (g/(m*d)) must not exceed the values of table 14. The permissible values specified there are applicable only if other requirements are not set by law.

最大允许制冷剂损失(g/(m*d))不超过表14的值。如法律上无其他要求规定，该允许值是可用的。

Table 14 – Refrigerant loss 制冷剂损失

Nominal width (mm) 名义直径	Max. permissible refrigerant loss 最大允许制冷剂损失	(g/(m*d))
	Rubber hose 橡胶管	Plastic film hose 带塑料膜胶管
6,0	1,5	0,3
8,0	2,0	0,5
10,0	2,0	0,5
13,0	2,0	0,5

16,0	3,0	0,8
17,5	-	0,8
19,0	4,0	1,0

9.8.3 Gas leak tightness test over 240 hours 240小时气密性测试

DUTs as per table 9, DUTs type b, and 1 reference line as per section 6.2 for each are required.

The gas leak tightness test for the basic release is performed over 240 hours as listed in section 9.8.1.

对于每种需求，DUTs按表9的b型，加一个参考管，按6.2章节。

基础认可的超过240小时的气密性测试按9.8.1章节所列。

For the evaluation of the measurement results, the value of the first 48 hours is not considered if it does not exceed twice the magnitude of the average value of the other measurements.

After every 48 hours, the weight loss for each line is determined as per table 14 after a cooling time of 30 min.

如其不超过其他测量的平均值的量级2倍，对于测量结果的评价，第一个48小时的值不考虑；

48小时后，冷却30分钟，每个管的质量损失按表14确定

9.8.4 Gas leak tightness test over 96 hours 超过96小时的气密性测试

DUTs as per table 9, DUTs type c, and 1 reference line as per section 6.2 for each are required.

对于每种需求，DUTs按表9的b型，加一个参考管，按6.2章节。

The gas leak tightness test after the individual vehicle safety inspections is performed over 96 hours as listed in section 9.8.1. 单独的车型上的安全检测后的超过96小时的气密性测试按9.8.1章节所列。

After every 24 hours, the weight loss for each line is determined as per table 14 after a cooling time of 30 min. 每个24小时后每个管子的质量损失按表14在冷却30分钟后确定。

9.9 Decompression test (only once for test release) 降压试验(仅认可试验时一次)

For this test, the wait time as per section 6.1 is not necessary. 对于该试验按6.1章节的等待时间是不需要的
3 DUTs as per section 9.8.1 are mounted in a dual-pressure system with high-pressure and lowpressure connections (high pressure = DUT, low pressure = container). The system is filled on the high pressure side and aged in a thermal cabinet for 1,5 hours at 80 °C.

3个DUT按9.8.1章节装在一个带高压和低压接头双压力系统上(DUT为高压，容器为低压)。系统在高压端加注，在80°C热试验箱内老化1.5小时。

Fill quantity 加注量: R134a 0,3 g/cm³ R1234yf 0,35 g/cm³

An absolute pressure of 0,02 bar is established on the low-pressure side. By connecting the highpressure and low-pressure sides by means of a gate valve, the excess pressure in the DUT is reduced in approx. 0,1 seconds to approx. 0,4 bar. Now the device is refilled, and the process specified above is repeated three times.

以0,02 bar绝对压力施加于低压端。高压、低压端连接是以阀门连接，DUT的超压下降到大约0,4 bar，0,1秒。设备重新加注，以上规定的过程重复进行3次。

Then, a temperature aging process is performed for 12 hours at 80 °C. 然后按80°C进行12小时老化。

Fill quantity for temperature aging 老化温度下的加注量: R134a: 0,6 g/cm³/R1234yf: 0,7 g/cm³

Then the decompression test is repeated again four times with the following fill quantities: R134a: 0,3 g/cm³/R1234yf: 0,35 g/cm³ 降压按下面的加注量重复4次

The lines have passed the test if the subsequent tests specified in the test plan table 19 were performed without complaints. 如管子已通过表19试验计划定的后续规试验无不良反馈，则通过。

9.10 Temperature cycle test

4 DUTs are prepared as described in section 9.8.1, Preparation. 按9.8.1准备4个DUTs。

R134a 0,12 g/cm³ R1234yf 0,15 g/cm³

The reference DUT to be tested at the same time for determining the weight loss of the hose material is closed, but not filled with refrigerant.

用于确定管路材料损失的、同一时间测试的参考的DUT，闭合，但不加注制冷剂。

The test is performed in the temperature cycle between $-30\text{ }^{\circ}\text{C}$, $-10\text{ }^{\circ}\text{C}$, and $125\text{ }^{\circ}\text{C}$ over a total period of 96 hours; see figure 9.

试验在 $-30\text{ }^{\circ}\text{C}$ 、 $-10\text{ }^{\circ}\text{C}$ 和 $125\text{ }^{\circ}\text{C}$ 温度间进行，总时间段超过96小时，见图9。

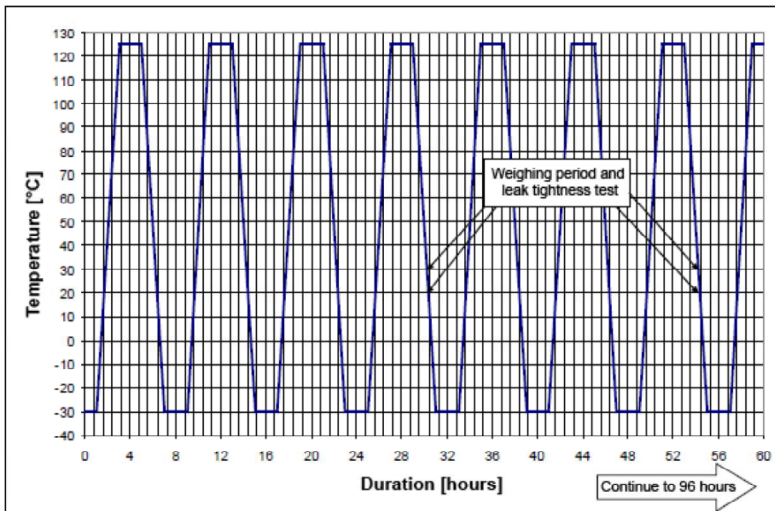
After each 24 hour period, when reaching $20\text{ }^{\circ}\text{C}$, the lines are removed from the temperature test chamber and examined with respect to leak tightness with a leak detector (display accuracy of 5 g/year). Then, the line is placed back in the temperature test chamber and the test passes through the temperature cycle; see figure 9.

每个24小时后，当达到 $20\text{ }^{\circ}\text{C}$ ，管子从温度试验箱取走，以泄漏探测仪检查关于气密性(显示精度 5g/年)。然后，管子放回温度试验箱，试验通过图9的温度循环。

When room temperature is reached at the end of the temperature cycle, the weight loss for each line is determined as per section 9.8.2. 当达到室温时在温度循环的末尾，质量损失按9.8.2章节。

The maximum loss rate must not exceed half the value from table 14.最大质量损失值不能超过表14的一半。

Figure 9 – Test sequence - Temperature cycle test 测试次序-温度循环测试



The lines have passed the test if the subsequent tests specified in the test plan table 19 were performed without complaints.如果表19规定的其他后续试验无不良反馈的已执行，试验通过。

9.11 Low-temperature resistance耐低压

9.11.1 Preparation准备

The refrigerant lines to be tested, table 9, DUTs type b, must be provided with a closing piece on both sides; see table 10. One of the closing pieces must be equipped with a filling valve.

The refrigerant lines must be filled with refrigerant.

Leak tightness inspection with leak indicator (display accuracy 5 g/year) corresponding to section 9.7 表9的B型的DUTs,准备测试的制冷剂管，必须2端闭合，见表10.其中一端带加注阀。管内须充制冷剂。

Fill quantity加注量: R134a $0,6\text{ g/cm}^3$ R1234yf $0,7\text{ g/cm}^3$ 。气密性泄漏检测仪符合9.7章节(精度 5g/年)

9.11.2 Procedure流程

The refrigerant lines are positioned as per the natural curvature of the hose and aged for 48 hours at $(70 \pm 2)\text{ }^{\circ}\text{C}$.制冷剂管按自然弯方向放置在 $(70 \pm 2)\text{ }^{\circ}\text{C}$ 老化48小时。

After cooling to room temperature, they are stored horizontally in a refrigeration cabinet at $(-30 \pm 2)\text{ }^{\circ}\text{C}$ for 24 hours in the minimum bending radius, see table 2.

冷却至室温后，按最小弯曲半径，平放在一个 $(-30 \pm 2)\text{ }^{\circ}\text{C}$ 制冷箱内24小时，见表2。

Then the lines are placed in the refrigeration cabinet (or immediately after removal) within 4 to 8 seconds, positioned against the natural curvature of the hose by 180° and wound around a mandrel see table 7;

mandrel temperature (-30 +2) °C).

然后管路(移除后立即)放置在制冷箱4-8秒, 反自然弯方向180度放置, 绕在芯轴上(Ø,见表7, 芯轴温度(-30 +2) °C)。

The refrigerant lines must be aged for at least 30 min at room temperature and then tested for leak tightness with a leak indicator with a display accuracy of 5 g/year (see section 9.7).

制冷剂管路至少室温老化30分钟, 然后用泄漏探测仪测试密封性(精度为5g/年), 见9.7章节。

For molded hoses, straight DUTs made from production material must be used.

对于成型胶管, 直的DUTs采用其使用的生产原材料制成。

The lines have passed the test if the subsequent tests specified in the test plan table 19 were performed without complaints.如表19的试验计划的后续试验无不良反馈的执行的的话, 管路则通过该试验。

9.12 Compressive strength under heat 加热状态下的压缩强度

9.12.1 Preparation 准备

For the compressive strength under heat test, hose lines as per table 9, DUTs type b, plus 1 reference line as per section 6.2 for each nominal width are required. The lines are connected to a storage container (compressive strength at least 85 bar) that has a filling valve and a volume of (1 260 ±25) cm³. The opposite side is closed with closing pieces and must be tightened with the corresponding tightening torque; see table 10.

对于加热状态下的压缩强度试验, 每种名义直径的需求, 管路按表9的DUTs的b型, 加一个参考管, 按6.2章节。管路连接至一个带加注阀存储容器(压力强度至少85bar), 容积(1 260 ±25) cm³。

PAG oil is filled into the container assembly (10 ±1) cm³.容器总成内加注PAG油(10 ±1) cm³。

The container assembly is evacuated and filled with refrigerant R134a/R1234yf as per table 15 (this corresponds to 30 bar during the temperature peaks).

容器内排空, 加注制冷剂R134a/R1234yf按表15(在温度峰值时相当于30 bar)。

The container assembly is examined for leak tightness by means of a leak indicator with a display accuracy of 5 g/year at room temperature. The leak tightness is guaranteed if no leaks are indicated.

The container assembly is agitated so that the oil is distributed and all inner surfaces are wetted.

The initial weight must be determined with an accuracy of 0,1 g.

容器总成室温下用精度5g/年泄漏探测仪对于气密性检测。如无泄漏指示, 则气密性得以保证。摇动容器总成以分散油品使内表面全湿。初始重量按0.1g精度确定。

Table 15 – Filling level 加注水平

Hose type 胶管类型	R134a filling level 加注水平	R1234yf filling level 加注水平
Normal temperature hose 常温胶管	0,116 g/cm ³	0,147 g/cm ³
High-temperature hose 高温胶管	0,100 g/cm ³	0,123 g/cm ³

9.12.2 Procedure 流程

The aging temperature and period must be taken from table 16 and/or figure 10 for each design type.

老化温度和周期按表16和或图10, 对于每种设计类型

Table 16 – Thermal resistance test temperature 耐热性试验温度

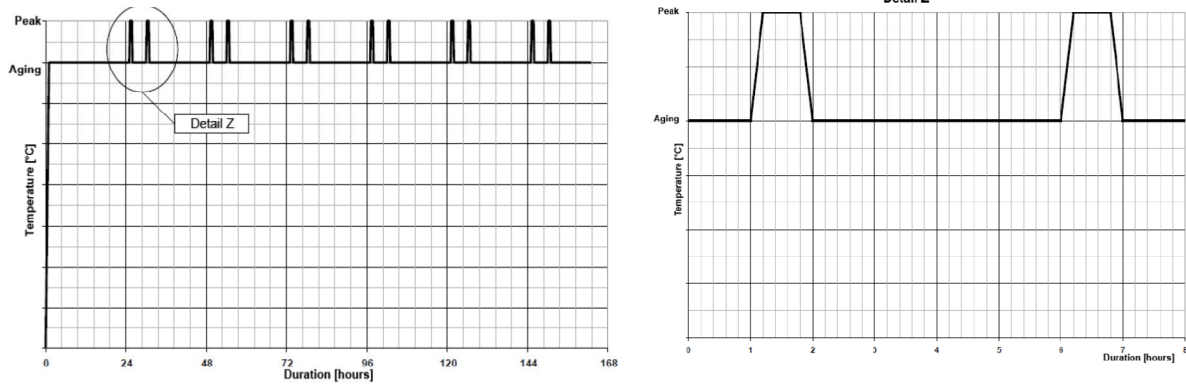
Hose type	Aging temperature	Peak temperature
Normal temperature hose	+110 °C	+130 °C
High-temperature hose	+140 °C	+160 °C

After the thermal test, the weight loss must be determined after a cooling period of 30 min. The leakage rate must not exceed twice the value as per table 14.

进行加热试验后, 质量损失在冷却30分钟后确认。泄漏不超过表14中的值得2倍。

Figure 10 – Compressive strength under heat temperature curve 加热温度曲线-压缩强度

Figure 11–Compressive strength under heat temperature curve, detail Z 加热温度曲线-压缩强度, Z部放大



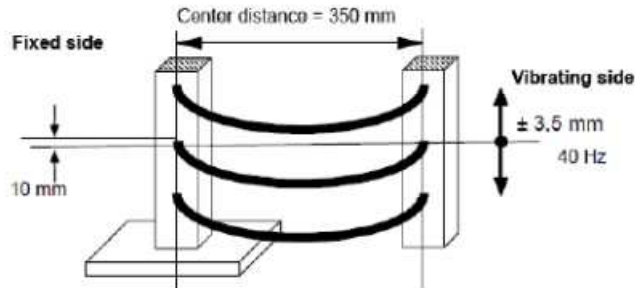
The lines have passed the test if the subsequent tests specified in the test plan table 19 were performed without complaints. 如果表19规定的其他后续试验已无不良反馈的执行，试验通过。

9.13 Vibration test 振动试验

The hose lines are mounted horizontally in a U-shaped arc between a fixed support and a vibrating, hanging support at a spacing of 350 mm; see figure 12.

管路U形水平安装在固定支架和振动悬架之间(检具350mm，图12)

Figure 12 – Vibration test setup 振动试验装置



The hose lines as per table 9, DUTs type c, are screwed in place with closing pieces as per table 10 and then filled with refrigerant as a function of the internal hose volume.

表9的C型的DUTs制冷剂管，按表10用锁紧件锁紧，然后根据胶管内部容积加注制冷剂。

Fill quantity 加注量: R134a 0,6 g/cm³ R1234yf 0,7 g/cm³

A reference line as per section 6.2 must also be tested in the same position.

按6.2章节的参考管按同样位置测试。

At a climatic chamber temperature of (90 ±2) °C or (-30 ±2) °C, the hose lines are each loaded to vibrate for 100 hours with a vertical amplitude of ±3,5 mm and a frequency of 40 Hz.

在人工气候箱(90 ±2) °C至 (-30 ±2) °C，管路施加振动100小时，纵向振幅±3,5 mm，频次Hz。

After the vibration test, the weight loss must not be greater than as per table 14, as per (2) Rate of loss.

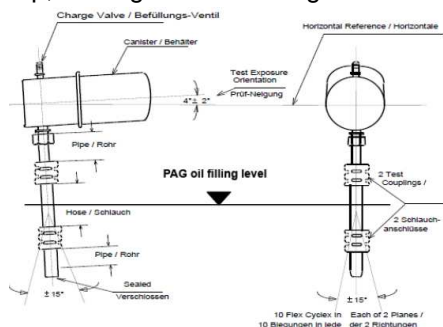
振动试验后，质量损失

9.14 Leak tightness of fittings 接头密封性

Hose connections with connected storage volume 带连接存储容积的胶管接头

9.14.1 Preparation 准备

Figure 13 – Test setup, leak tightness of fittings 接头密封性测试机构



The refrigerant lines as per table 9, DUTs type d, and a reference line as per section 6.2 are each connected to a reservoir (compressive strength at least 85 bar) that has a volume of $(1\ 260 \pm 25)$ cm³. The opposite side is closed and provided with a safety guide for longitudinal and lateral movement. The storage container must have a supply connection.

表9的D型的DUTs制冷剂管，和一个参考管按6.2章节，分别连接到容量 $(1\ 260 \pm 25)$ cm³储液罐(压力强度至少85bar)。相对的另一端密闭，装备横纵向移动的导向。储液罐带一个连接端。

9.14.2 Filling 加注

PAG refrigerant oil must be filled into the tank assembly. Make sure that the hoses are filled halfway with PAG oil; see figure 13. The container is evacuated and filled with (103 ± 1) g refrigerant R134a or (115 ± 1) g R1234yf. The assembly is examined for leak tightness by means of a leak indicator with a sensitivity of 5 g/year.

PAG制冷油必须加注到储存罐内。确保胶管加入一半PAG油，见表13。容器排空，加入 (103 ± 1) g制冷剂R134a或 (115 ± 1) g R1234yf。该总成用灵敏度5g/年的泄漏检测仪检查气密性。

The initial weight is recorded with an accuracy of 0,1 g. This measurement and subsequent weight measurements are performed at room temperature.

初始重量以0.1g精度记录。该测量结果和后续的重量测量在室温下进行。

After being filled, the container assembly is agitated so that the oil is distributed and all inner surfaces are wetted.

填充后，摇动容器以使有分散至内表面变湿。

9.14.3 Exposure test 暴露试验

The container assembly is oriented so that the axis of the container lies $(4 \pm 2)^\circ$ above the horizontal(see figure 13), which guarantees that the liquid phase always runs into the coupling assemblies to be tested. The test comprises eight exposure intervals. After each interval, a leak tightness test is performed and, if necessary, a refilling step is performed before the next exposure test.

压力容器定向以使容器躺放的轴向 $(4 \pm 2)^\circ$ 在水平之上(图13)，保证流体阶段总是流进连接对配端进行测试。试验包含8个曝露间隔。每个间隔后，进行一次密封性检测。如必要，下次暴露试验前重新加注。

9.14.4 Test cycle 试验循环

The eight exposure intervals are performed one after the other as follows:

如下其他步骤完成后进行8个暴露间隔

1. 96 hours at 125 °C 96小时125 °C
2. 48 hours thermal cycle from -30 °C to 125 °C (see figure 9 Test sequence, temperature cycle test). 48小时热循环从-30°C到125°C(见图9 试验次序、温度循环测试)
3. Repeat step 1, above 重复以上步骤1
4. Repeat step 2, above 重复以上步骤2
5. Repeat steps 1 to 4, above 重复以上步骤1-4

Every working day, the assemblies must be agitated at room temperature so that the oil is distributed and all inner surfaces are wetted.每个工作日，试验总成室温下摇动以使油分散湿透内壁。

9.14.5 Leak tightness evaluation 气密性评价

At the end of each exposure interval, an evaluation is performed as follows after reaching room temperature:每个暴露间隔的末尾，室温下，做如下评价：

- Measure weights and record weight loss in grams for each interval.
每个间隔测量重量，记录质量损失g数
- If the weight loss for any interval is greater than 3 g, then the test must be stopped.
如果每个间隔的质量损失超过3g，停止试验。
- The coupled unit on the container is subjected to a bending test by $\pm 15^\circ$. 10 bending cycles are performed in approx. 10s in each of the two vertical planes on a coupling assembly. Immediately

afterwards, the leak tightness is evaluated at each coupling as follows:

容器上的连接对配件经受 $\pm 15^\circ$ 的弯曲试验。10个弯曲循环大约10s，在对配总成的纵向2个平面。然后立即按如下进行气密性评价：

1. With a leak indicator, check whether the leak tightness is greater than 5 g/year.

泄漏探测仪检测密封性是否超过5g/年

2. Check for oil leaks. The test must be stopped if one of the couplings exhibits one of the states listed above. 检查油的泄漏，以上所述连接对配端如有泄漏必须停止试验。

– d) After the bending test, measure the weights again and perform the next exposure interval if the weight is within a tolerance of 4 g relative to the initial weight. If this is not the case, refill up to the initial weight before continuing the test. Maintaining the weight within a tolerance of 4 g relative to the initial weight guarantees that the initial pressure of the R134a in the container assembly is not less than 20,7 bar at 125 °C.

– d) 弯曲试验后，再次测量重量，进行下一个暴露间隔(如重量损失相对初始重量偏差4g以内)。否则在继续试验前，重新加注到初始重量。维持重量损失和初始重量在4g以内是为保证R134a在容器总成内的压力不小于20.7bar，125°C。

9.14.6 Acceptance of the test 试验的验收

For all four of the bending loads, after the intervals there must be no visible oil loss and the refrigerant leakage rate must not be greater than 5 g/year at any point on the coupling assembly.

对于所有4个弯曲负载，间隔后，在对配连接点无明显油损失和制冷剂泄漏比率不大于5g/年

Table 17 – Permissible weight losses 允许的质量损失

Nominal width (mm) 名义直径	Maximum permissible refrigerant loss after 8 intervals 8个间隔后允许最大制冷剂损失
6,0	2,0 g
8,0	3,0 g
10,0	3,0 g
13,0	3,0 g
16,0	6,5 g
17,5	8,0 g
19,0	10,0 g

9.15 Long-term aging 长期老化

DUTs as per table 9, DUTs type c, and storage containers – preparation as under section 9.14.2 – are exposed to the same cycle as under section 9.14.4 with additional, subsequent temperature aging up to a total of 720 test hours.

DUTs按表9的C型，加存储容器-按9.4.2章节准备-额外的，按9.14.4章节做暴露循环，随后的温度老化至总共720小时。

In addition, a DUT is also aged as a reference corresponding to section 6.2.

另外DUT也会将一个参考管老化，按6.2章节。

These DUTs are exposed only to the respective temperatures over the entire test duration of 720 hours.

The oil wetting is performed as in the test procedure under section 9.14.4.

720小时期间，DUT暴露在各自的温度。按9.14.4试验规程进行油湿试验

9.15.1 Filling 加注

PAG refrigerant oil must be filled into the tank assembly. Make sure that the hoses are filled halfway with PAG oil; see figure 13. The container is evacuated and filled with refrigerant (quantity as per table 18).

The assembly is examined for leak tightness by means of a leak indicator with a sensitivity of 5 g/year.

The initial weight is recorded with an accuracy of 0,01 g. This measurement and subsequent weight measurements are performed at room temperature.

PAG制冷剂油须加注到容器中。确保胶管一半充入PAG油。见图13.容器排空以制冷剂加注(数量按表18)。该测试总成用灵敏度5g/年的泄漏探测仪检查密封性。初始重量以0.01g精度记录。该测量及之后的重量测量均是在室温下进行。

After being filled, the assembly is agitated so that the oil is distributed and all inner surfaces are wetted.加注后，摇动试验总成以使油分散至所有内表面变湿。

Table 18 – Filling quantities and test temperatures加注后数量和试验温度

DUT	Temperature (for subsequent aging)后续老化温度	R134a filling quantity 加注量	R1234yf filling quantity 加注量
Normal temperature hose 常温胶管	120 °C	0,116 g/cm3	0,147 g/cm3
High-temperature hose 高温胶管	150 °C	0,100 g/cm3	0,123 g/cm3

9.15.2 Test cycle

As per section 9.14.4, but with subsequent temperature aging for a total of 720 hours.

按9.14.4章节，但为后续720小时温度老化

10 Coupling plan 对配连接计划

For the coupling plan, see table 19 对配连接计划见表19.

Table 19 – Test plan (by the supplier)试验计划(供应商)

老化 aging 9.2		第一次连接 1st coupling	第二次连接 2nd coupling	压力测试9.5.4 Pressure test	气密性测试9.7 Leak tightness	裂缝测试9.3 Crack test	部件数量 Number of parts
	旋转能力9.1 ability to rotate						所有功能 性测试后 After all functional tests
	外观检测 Visual inspection						所有
	尺寸检测3.7 ; 6.2.1 Dimension inspection	截面收缩 3.3					1
	弯曲刚度5.1 Flexural strength						2
	纵向弯曲 稳定性 5.2 Kink resistance						2
	耐真空性5.3 Dimensional stability under a vacuum				2	2	2
	长度和角度变化 5.4 Change in length and angle						2
	体积膨胀5.5 volume expansion						2
	含水量 8.1 Water content						1
	内表面洁净度 8.2 inner surface purity						1
	水渗透性8.3 Water permeability						6
	腐蚀试验PV1209 8.4.2 Corrosion test	腐蚀试验Corrosion test PV1209 8.4.3		5每个	5每个		10
	拉伸强度9.4.1 tensile strength						3
	抗压强度(2X)9.5.2 compressive test	抗压强度(2X)9.5.3 compressive test		4		4	4
X	脉冲试验(1X)9.6.1 Pulse test 拉伸试验(1X)9.4.2 tensile strength	振动试验 9.13(6+1ref.a)) vibration test	气密性试验9.8.4 (3+1ref.a)) gas leak tightness	在所有的单独测试 以后 After all individual tests	9X	10X	10X

X	气密性试验9.8.3(5+1ref.a) gas leak tightness	降压(2X)9.9 decompression		在所有的单独测试以后 After all individual tests	4	6	6
X	温度交变试验9.10(4+1ref.a) Temperature cycle test			5	3	5	5
X	耐低温9.11 Low-temperature resistance	拉伸试验9.4.2 Tensile test		在所有的单独测试以后 After all individual tests	8	8	8
X	加热后耐压强度9.12(5+1ref.a) Compressive strength under heat			在所有的测试以后 After all tests	4	6	6
X	接头气密性9.14(6+1ref.a) Leak tightness of fittings			在所有的测试以后 After all tests	4	7	7
	长期老化9.15(5+1ref.a) Long-term aging	脉冲实验 9.6.3(3X)Pulse test	拉伸试验 9.4.2(1X)tensile strength	在所有的测试以后 After all tests		6	6
	长期老化(5+1ref.a)	加热后耐压强度 (3X)9.13 Compressive strength under heat		在所有的测试以后 After all tests	2	6	6

a)Ref.=参考部件

11 Applicable documents 相关文件

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

下列文件引用标准对其应用来说是必须的。

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.

部分引用文件是从德文版原始文件翻译过来的。德文条目的翻译会在标准、术语的使用中有一定差异。

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.

给出德文标题的标准，仅适用德文。其他语言的版本由发行机构公布的是有效的。

PV 1208 Heat Exchangers of Al Alloys; Corrosion Test (SWAAT) 铝合金的热交换；腐蚀试验

PV 1209 Condensers, Radiators, and Charge Air Coolers Made of Aluminum Alloys; Corrosion Test (Environmental Corrosion Cycle Test)

铝合金的冷凝器，散热器和增压空气冷却器；腐蚀试验(环境腐蚀循环试验)

PV 6240 Connecting Hoses (Engine Area); Acceptance Requirements 连接胶管(发动机区域)；验收要求

TL 52535 Lubricating Oils for Refrigerant Compressors; Lubricant Requirements

制冷压缩机润滑油；润滑油要求

VW 50170 Hoses for Refrigerant Lines in Air Conditioning Systems; Material Requirements

空调系统制冷剂胶管；材料要求

DIN 51777-1 Testing of mineral oil hydrocarbons and solvents; determination of water content according to Karl Fischer; direct method 矿物油烃类试验和溶剂；根据卡尔菲舍法测定含水量；直接方式。

DIN 51777-2 Testing of Mineral Oil Hydrocarbons and Solvents; Determination of Water Content according to Karl Fischer; Indirect Method

矿物油烃类试验和溶剂；根据卡尔菲舍法测定含水量；间接方式。

DIN 53508 Testing of rubber - Accelerated ageing 橡胶测试-加速老化

DIN 7716 Rubber products; requirements for storage, cleaning and maintenance

橡胶产品；存储、清洁和维护的要求

DIN 8905-1 Tubes for refrigerating systems with hermetic and semi-hermetic compressors; outside diameter up to 54 mm; technical delivery conditions

密封与半密封压缩机的制冷剂系统管路；外径至54mm；供货技术条件

DIN 8960 Refrigerants - Requirements and symbols 制冷剂-要求和符号

DIN 8964-1 Circuit components for refrigerating systems - Part 1: Testing

制冷系统循环回路组件-第一部分：试验

DIN EN ISO 18279 Brazing - Imperfections in brazed joints 钎焊-钎焊接头缺陷

ISO 554 Standard atmospheres for conditioning and/or testing; Specifications

条件和试验用标准大气；要求

SAE J2099 Standard of Purity for Recycled R-134a (HFC-134a) and R-1234yf2(HFO-1234yf) for Use in Mobile Air-Conditioning Systems

用于汽车空调系统中可回收的R-134a (HFC-134a) and R-1234yf2(HFO-1234yf)纯度

SAE J639 Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems

汽车制冷剂蒸发压缩系统安全标准