Engineering Release Notice (ERN)	Location	Change Description	A = Added U = Deleted	W = Was	Document Release St	atus
		Changes from previo "CCCV" changed to ' §4.6 page 9: UP and test in stead of only 1 §4.10 page 12: tolera	us issue: 'CCV-C" IOT in Table 1 I0 kPa and roo ances for ramp	, referred to in m temp. (A) ing up/down in	Date	Modification Count
D-13033-52		pressure cykling (A)	-		2004-03-25	
TABLE OF	CONTEI	NTS				
1 PRERE	QUISITE	s.先决条件	••••••	•••••		2
1.1 Dra	WING INFO	RMATION图纸信息	3			2
1.2 VOL	VO STANDA	ardsvolvo标】	准			2
1.3 INDE	PENDENT S	STANDARDS				2
1.4 SUPP	PLEMENTAI	RY DOCUMENTS AND	INFORMATION			2
2 TECHN	ICAL RE	GULATION AND	TYPE APPR	OVAL技本法	规和类型的批准	<b>崖</b> 3
2.1 Аво	UT THIS TH	₹				3
2.2 TA -	TYPE APP	ROVAL PROCESS				3
2.3 IST $2.4$ Tran	AND ISA -	INITIAL SAMPLE TEST	TING AND APPE	ROVAL		4
2.4 IESI	KEPORI A	ND DOCUMENTATION	CESS CONTRO	т		4 5
3 FUNCT	IONAL E	NVIRONMENT (	6日环谙	L		5
			₩ # d Q: 4 :	••••••	•••••••••••••••••••••••	5
3.1 CAL 3.2 DESI	GN PROPER	ND I YPE APPROVAL . RTIES AND CATEGORY	CHARACTERI	STICS		
4 TESTIN	G – REO	UIREMENTS AND	RECOMM	ENDATIONS.	测试	7
4.1 Com	PRESSION	SET' STD 1024 1118	压缩			7
4.2 RESI	STANCE TO	LIOUID: STD 1024,1110	5131 耐液体			
4.3 Stre	ESS RELAX	ATION: ISO 3384:199	9(E)应力松	、弛		8
4.4 Adh	ESION BET	WEEN LAYERS: STD	1024,2811粃	合		8
4.5 COL	D IMPACT	ГЕST, ISO 812:1991.	低温穹田	古试验		9
4.6 COL	LAPSE RESI	STANCE TEST	/火リ にし			9
4.7 LEAL	AGE TEST ST TEST  塩	…登州注风巡 4. 成绩公				10
4.8 DUK 49 FLEX	ST LEST . M		 玉软管弹性			10
4.10 DYN	AMIC END	JRANCE TEST动力。	耐久试验			
4.11 TGA	: ISO 992	4-2, AND IR红外为	ć谱测试			13
The copying, distribution	on and utilization	n of this document as well as the	Document Title			
is prohibited. Offender	s will be held lial	ble for payment of damages. All	HOT & C			

rights reserved in the event of the grant of a patent, utility model or ornamental design registration.				
	Document Type TECHNICAL REGULA	ATION		
VOLVO	Owner Domain:Document Prefix			
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No
	20521081	02	01	1(13)

EDM-W 2000-04-01

#### PREREQUISITES

1

#### **1.1 Drawing information**

Drawing on actual hose including part documentation - Part Version Report – with Category, §3.2. Drawing on concerned master hose when applicable, see §2.2.2.

#### 1.2 Volvo standards

STD 100-0002 STD 100-0003 STD 1007,301 STD 1024,1118 STD 1024,2121 STD 1024,2811 STD 1027,6131 STD 5021,38 STD 5036,1 STD 5051,16 STD 5060,3 STD 5065,21	VOLVO black list - Chemicals that must not be used Volvo黑名单 VOLVO grey list Volvo灰色名单 General delivery specifications, Rubber materials 一般交货规格、橡胶 Compression set 永久压缩变形 Tensile strength 拉伸强度 Adhesion strength 粘合强度 Resistance of rubber materials to liquids 电阻 Product Approval (PA) 产品批准 Initial sample approval (ISA) 初始样品批准 Text marking on parts 文本标注部分 Classification of requirements 分类需要 Rules for measuring rubber parts 测量橡胶部件的方法	交材质
STD 5065,21 STD 5750,12 STD 7411,182	Rules for measuring rubber parts 测量橡胶部件的万法 List of colours 颜色列表 Bulge Standard for pipes (not for TBF) 管涨标准	
·		

And the standards referred to *inside* the standards listed here.

#### 1.3 Independent Standards

ISO 1629	Rubber and latex – Nomenclature 橡胶术语
ISO 4661-1	Rubber, vulcanized or thermoplastic –Preparation of test samples and
	test pieces. 样件 试片
ISO 3384:1999(E)	Determination of stress relaxation in compression at ambient and at
	elevated temperatures
ISO 812:1991(B)	Brittleness at cold temperatures 低温脆性
ISO 9924-2	TGA, Thermogravimetric analysis 热失重分析

And the standards referred to *inside* the standards listed here.

#### 1.4 Supplementary documents and information 补充文件和信息

Contact the responsible design department for any clarifications or supplementary information.

Volvo Truck Corporation	Document No 20521081	Issue Index 02	Volume No	Page No <b>2(13)</b>		
VOLVO	Document Type	<b>ΙΙ ΑΤΙΟΝ</b>				
	Document Title CHARGE AIR HOSES					

## 2 TECHNICAL REGULATION AND TYPE APPROVAL 技术法规和类型的批准

#### 2.1 About this TR

This TR states the test methods, performance requirements and delivery specifications which normally applies. In case of deviations, the drawing and part documentation - PVR - applies.

The purpose with the TR is to assure high durability and well performing charge air hoses by means of a selection of tests based on the functional environment described in §3, and to document material, construction and manufacturing methods of the hoses that fulfil the durability and performance requirements for future references.

The TR is developed for internally reinforced flexible charge air hoses that supply gas, air or mixture of air and exhaust gas, between the various components in the turbo and charge air cooler system of the engine in heavy and medium duty trucks.

#### 2.2 TA - Type approval process

The responsible design department at Volvo Group (VG) gives type approvals. 负责的设计部门在沃尔

The supplier provides VG design department with a test report (§2.4) and the reducted tested material after completion of the type approval test. The supplier is also requested to send 12 new production hoses or other quantity agreed upon to design department for evaluation. These hoses must be produced in the same material and with the same manufacturing method as the tested hoses. VG reviews the documentation and results and may request corrections or additional information. VG confirms the test results by making selective tests and analyses. VG normally also verify the hose quality in field tests and engine test cells. TA per Category is described in §3.1.



#### Type Approval procedure 型式验证程序

#### 刑的测试 要表现的 22 Type approval test 定型试验,型式试验

TA testing covers complete testing and documentation according to the TR. Also read §3.1. Documentation should be stored for at least 5 years. Unless otherwise agreed, type test shall be performed when any of following applies:

- New supplier 新供应商
- Current approved supplier, but changed process, new hose quality, new material, new or untested master hose, etc 改变工艺、变更材质等
- On regular basis by the supplier in order to assure the consistency of the process and product定期由供
- On request from design department at Volvo Group.设计部门要求

#### 2.2.2 Master hose

产品的 A master hose is a hose representative for one or several hose categories according to Table 1. The purpose with master hoses is to reduce the amount of testing without jeopardising quality. Th 数件 master hose is normally selected among the hoses intended for serial production at the concerned supplier. Note that for comparative test - the same master hose must be used.

A hose considered to be exposed to tougher conditions is selected as master hose. The hose is chosen by Volvo Group design department on a case-by-case basis, agreed together with the supplier. A master hose may be exchanged at introduction of a new hose, e.g. shorter, larger diameter, or other more complex shape than the previously approved master hose.

#### 2.3 IST and ISA - Initial sample testing and approval初始样品检验和批准

Hoses for series production may not be delivered until the initial sample has been approved (ISA) according to STD 5036,1. Initial sample test is done on type approved hoses and the initial sample tests must in all respects agree with possible future series deliveries and must include at a minimum the following:

Confirmation of:

• the existence of a Type Approval

Determination of:

- Marking
- Dimensions and tolerances according to drawing 根据图纸尺寸和公差
- Surface properties表面特性
- Cleanliness and transport handling清洁和运输
- Burst pressure 爆破压力
- Adhesion: rubber-rubber / rubber-reinforcement / rubber-inner liner粘合
- Assembly performance 装配性能 Flexibility of the hose at room temperature 曲挠性 室温

#### Test report and documentation 测试报告文件 2.4

The documentation should be so complete that it would be possible to repeat the tests and evaluations at any time in the same way and at the same conditions. The TR test report is only for use within the Volvo Group. Report contents is described next to each test below and in the concerned standards and serves as a minimum specification of what the TR test report shall include. Use STD 1007.301 for reporting. The report must also include:

- 1. TR number and issue
- 2. Supplier identification number and supplier's designation 供应商身份号码和供应商的名称
- 3. Test object: Hose part number, issue and Description of the design 测试对象:软管零件号、表述等
- 4. Type test. If used: Master hose part number and issue
- 5. Reason for TR test (example: new supplier, new construction of the hose etc)
- 6. TR reviewed together with VG design department (date+reference/No)
- 7. Assessment of test equipment and evaluation methods by Volvo Group (date+reference/No)
- 8. Main test laboratory
- 9. Date, signature and clarification of signatur

	Document Title					
	CHARGE AIR HOS	SES				
VOLVO	Document Type					
	TECHNICAL REGULATION					
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No		
	20521081	02	01	4(13)		

ìFì

应商以保

The following shall also be documented for each test in this TR:

- Test equipment
- Test object references (e.g. clamps, spigots) when applicable
- Test method
- Test laboratory if other than main test laboratory (acc. to above)
- Date of the test
- Any other pertinent details of the entire test and any relevant comments and observations

#### 2.5 Delivery specifications and process control 交付规范和过程控制

All hoses referring to this TR shall be fully equivalent in all characteristics to those upon which Type Approval was originally granted. The supplier must have a process control that includes appropriate statistical tools used to analyse process production data and assure a highly consistent processing of the product.

No changes of the product after TA, such as material changes or production method changes, etc, are allowed on any hose without agreement and approval from Volvo Group. Nor may location of production and subsupplier be changed before authorised Volvo approval.

Volvo Group may request an evaluation of the manufacturing process according to the 'Rubber Index' (RI) model, which is set up particularly for evaluation of rubber part production. Volvo Group reserves the rights to request protocols from the process control, such as material property identification or other, at any time to check that the values are consistent and equivalent to the values given in the TR test report.

#### **3 FUNCTIONAL ENVIRONMENT**

The hoses are exposed to all types of climates and road conditions and exposed to heat from the powertrain. Externally, the hose is exposed to air and ozone, oil, grease, engine cleaning agents and salt spray from the road. Besides vibrations induced by the road through the chassis the hoses are exposed to vibrations generated by the truck itself, e.g. vibrations generated by the engine or power transmission relative to the chassis frame. Hoses exposed to relative movement are provided with arrow(s) on the drawing. Hoses installed with CCV-C – closed crank case ventilation – require inner liner resistant to crank case gas condensate and engine oil.

The hoses are used mainly in 3 typical areas, see Figure 2. Category characteristics and properties are defined in Table 1.



• hot side: between turbo and charge air pipe

- hot side: between charge air cooler and charge air pipe
- cold side: between charge air cooler and charge air pipe

Figure 2: Schematic installation example

### 3.1 Categories and Type Approval 种类和类型批准

Category characteristics apply when referred to and nothing else is specified on drawing. Type approval of a hose in one Category normally give automatic TA for all other hoses in the same Category or Categories with lower number, if hose design/construction is identical. Also read §2.1.

	Document Title					
	CHARGE AIR HOSES					
VOLVO	Document Type					
	TECHNICAL REGULATION					
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No		
	20521081	02	01	5(13)		

#### 3.2 Design properties and Category characteristics 设计性能和范畴的特点

The hoses are mounted with connections that fit turned back flange (TBF) solutions and solutions using crimped metal sleeves with sealing rings. In these cases, V-profile clamps are necessary, and a clamp with 3 or more sectors with T-bolt fastener is strongly recommended. The hoses can also be mounted straight onto pipes with interference fit, which require worm screw/band clamp with elastic spring function to compensate for relaxation. Rig installation, spigots, connections and clamps for test purposes shall be agreed with responsible design department.

#### Key to Table 1 below, describing hose category properties:

- A = open crank case ventilation 开放式曲轴箱通风管
- B = closed crank case ventilation, CCV-C
- C = Cold side
- H = Hot side

#### Examples:

- reference in drawing is Category 2BC = charge air hose for cold side installation with CCV-C that manage 250kPa operating pressure with 110°C internal operating temperature.
- reference in drawing is Category 2AH = charge air hose for hot side installation that manage 260kPa operating pressure with 220°C internal operating temperature.

	OP: Op Pres (atm. overp	<b>erating</b> <b>sure</b>	Vibrations 力 <u>R</u> esu	s / Amplitude ultant vector	(X/Y/Z) ⇒振ź [mm] 合成矢	力/振幅 <b>Temp</b> 量  Continou Peak=	p <b>erature</b> 温度 usly=hours 不间断 =minutes 最高								
Cate-	с	н	с	H (Short)	H (Long)	IOT: Internal o	operating (cont.)								
gory					( C/	C	Н								
1Δ			5Hz /	5Hz /	5Hz /		190°C (cont.)								
	200kPa	210kPa	$(5/20/20) \rightarrow$	$(3/3/3) \rightarrow$	$(7/15/20) \rightarrow$	80°C	220°C (peak)								
1B	20010 0	2 rola a	R = 29	R=5	R= 26	00 0	200°C (cont.)								
ы			11 20		11 20		230°C (peak)								
24			5U7 /	5U7 /	547 /		220°C (cont.)								
28	250kPa	260kPa	(10/23/23) (3	$(3/3/3) \rightarrow$	(10/20/23)	anoc	240°C (peak)								
28		20081 8	20011 0	20011 0	20081 8	20081 8	20081 8	20081 8	20081 8	20081 8	20081 a	$\rightarrow R=33$	$(3/3/3) \rightarrow B=5$	$\rightarrow R=32$	90°C
20			_/ IX= 33	IX- 5	_/ IX= 32		250°C (peak)								
2 ^				두니ㅋ /	5U-7 /		240°C (cont.)								
JA	270kPa	290kDo	5HZ / (12/25/25)		0⊓∠ / (10/23/25)	100°C	260°C (peak)								
20	27061 a	20081 a	$\rightarrow R=37$	$(3/3/3) \rightarrow$ R= 9	$\rightarrow R=35$	100 C	250°C (cont.)								
JD			→ IX= 57	IX- 3	_/ I\- 35		270°C (peak)								
		rorossuro				Temperatu	re at Start-up 启动								
211	UF. Unde 贝			directions in (	drawing	-40°C	to 60°C								
all	10kP2	5kPa	(^/1/2)		awing	External/Am	bien erating								
	IUKFa	JAFd	100°C to 160°C				to 160℃ 环境温度								

Table 1: Functional properties per Category typical for Volvo FH/FM installation.

## 3.2.1 Material compounds 资料化合物

The supplier is requested to suggest appropriate material and after agreement with Volvo Group design department, the material can be stated in the PVR. Hoses for CCV-C must have inner liner, a layer or equal resistant to CCV-C which contains oil and crank case condensates.

#### 3.2.2 Colours 颜色

The hoses shall be black or dark grey if nothing else is stated in drawing or PVR. Inner liner material for CCV-C applications must be provided with significant colour - red is recommended - clearly deviating from the rest of the hose to avoid mix-up.

	Document Title CHARGE AIR HOSES					
VOLVO	Document Type TECHNICAL REGULA	TION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No		
	20521081	02	01	6(13)		

#### 4 TESTING – REQUIREMENTS AND RECOMMENDATIONS 测试-要求和建议

It is strongly recommended to review the TR in detail together with the responsible design department at Volvo Group at an early stage before initiating any tests. The supplier must present to Volvo Group design department the appropriate test equipment and evaluation methods in order to meet TR requirements. The same applies if the supplier decides to perform tests at a third party. An assessment of the suppliers testing capabilities is recommended by means of a TR review and a visit to the supplier by authorized Volvo Group design representative.

#### CCV-C - closed crank case ventilation

Hose Category in Table 1 determine if CCV-C resistant inner liner is necessary. Inner liner material quality is verified in §4.2. 表1中的软管类别确定是否需要耐CCV-C内层。内胆材料质量在§4.2中得到验证

#### Required test material, total:

Recommendation: summon test material early to save lead time. Table can be used for planning.

Test material 试验材	料	Lead time	Planned arrival	Ready to use	Comments 注释
Hoses		设产准备	畜阶段		
Spigots or pipe ends					
V-profile clamps					
Worm screw / band clamp					
Rubber material test pieces					
Hose test pieces					

Table 2: Test material planning

# 4.1 Compression set: STD 1024,1118 <sup>压缩永久变形</sup>

Scope: to determine basic material performance before initiating more advanced tests.

#### 4.1a Performance requirements性能要求

According to Standard. 根据标准

#### 4.1b Materials and equipment

According to Standard: use 'Small test piece' 根据标准:用"小测试片"

4.1c Test procedure 试验方法 试片直径12+/-0.5mm,厚6+/-0.2mm,温度150+/-3度,时间70h和1000h 2种压变

According to Standard, but with Temperature = 150±3°C for Time = 70h and 1000h.

#### 4.1d Test report 试验报告

Use STD 1007,301 and see §2.4.

#### 4.2 Resistance to liquid: STD 1027,6131 耐液体性

Scope: Verify quality of inner liner for CCV-C hose applications.

#### 验证闭合式曲轴箱通风管内胶层质量

#### 4.2a Performance requirements

Maximum decrease of tensile strength 30%. 拉伸强度下降 30%

#### 4.2b Materials and equipment

According to STD 1027,6131 and STD 1024,2121 but liquid(s) must be agreed with design department.

20521081

#### 4.2c Test procedure

According to STD 1027,6131 and STD 1024,2121 测试温度及时间无要求



Volvo Truck Corporation

# Document Title CHARGE AIR HOSES Document Type

TECHNICAL REGULATION
Document No
Issue Inc

Issue Index	
02	

Volume No Page No 7(1

7(13)

#### 4.2d Test report

According to STD 1007,301 and §2.4.

#### 4.3 Stress relaxation: ISO 3384:1999(E) 应力松弛

Scope: Sealing performance 范围:密封性能

#### 4.3a Performance requirements 性能要求

The minimum counterforce value between 480 min and 660 min at the 6<sup>th</sup> cold cycle obtained after stress relaxation test at constant compression is min 33N at the conditions given below.

#### 4.3b Materials and equipment

Test equipment according to ISO 3384:1999(E), but with a test chamber with possibility to vary the temperature from  $-40^{\circ}$ C to  $+175^{\circ}$ C in cycles, and compression plates. Also see 4.3c.

#### 4.3c Test procedure 试验方法

Test procedure according to ISO 3384:1999(E), method A, with following deviations and additions: Minimum 3 'measurement units' must be tested and reported. A measurement unit consists of 2 cylindrical test pieces cut out from the hose,  $\emptyset$ 16 mm ± 0,5mm × actual thickness of the hose stacked in order to obtain sufficient sample height.





在室温下压缩测量单元,使反力为(250+0/-5)N(压缩约15%),并在整个测试期间 保持这个压缩水平。根据上图1所示的温度循环在测量单元安装后20分钟开始(在 房间温度初始松弛后)。测试时间为6个温度循环(≥72h)。连续测量反力至少每5分 钟一次。重复测试,直到所有测量单元都测试完毕

#### 4.3d Test report

See STD 1007,301 and §2.4. Report the measured counterforce.

#### 4.4 Adhesion between layers: STD 1024,2811 层间附着力

Scope: Performance of the hose as composite material. Manufacturing process control.

#### 4.4a Performance requirements 性能要求

The minimum adhesion strength is 2,0 kN/m between any of the various layers in the hose. 最小的附着强度是2.0 kN /米

#### 4.4b Materials and equipment

4 separate test pieces with the strip width 25±0,5 mm cut out from the hose. 宽度25 ± 0.5 mm Equipment required as per Volvo STD 1024,2811

#### 4.4c Test procedure

As per Volvo STD 1024,2811: Rate of travel: 100±10 mm/minute 速度: 100 ± 10mm/min



Volvo Truck Corporation

Document Title			
CHARGE AIR HOSES	3		
Document Type			
TECHNICAL REGULA	TION		
Document No	Issue Index	Volume No	Page No
20521081	02	01	8(13)

#### 4.4d Test report

- As per STD 1007,301 and §2.4
- Adhesion strength for each test piece and each pair of layers.
- Document tested samples by means of photos so that the correct test piece size and position of extraction from the hose can be confirmed.

#### 4.5 Cold Impact test, ISO 812:1991 低温撞击试验

Scope: Brittleness at cold start-up.

#### 4.5a Performance requirements

Visual examination according to Standard. 按标准目视检查

## 4.5b Material and equipment 试,根据标准,有4个A型试样,但从软管上剪下:厚度与软管相

According to Standard with 4 test pieces as Type A but cut out from hose: thickness as in hose.

#### 4.5c Test procedure

根据标准ISO 812:1991方法B According to Standard ISO 812:1991 Method B. Test temperature -40 ±2°C. 试验温度为-40° ±2C

#### 4.5d Test report

According to standard

#### 4.6 Collapse resistance test 负压试验

**Scope:** Limit the flow restriction at low pressure levels, and preventing delamination.

#### 4.6a Performance requirements

### |负压下外径减小小干等于20%|

The smallest cross-sectional measurement must not be less than 80% of the nominal dimension of the hose within the marked area at an atmospheric underpressure of UP and IOT, see Table 1. No delamination, leakage, cracks or other defects may occur. 在UP和IOT的常压下,最小的横截面测

#### 4.6b Material and equipment

Underpressure test equipment, pressure medium: air. Tape measure & marking pen. 5 Hoses, hose clamps and pipe ends or spigots. Oven or heat chamber

#### 4.6c Test procedure

Mount the hose on correct test pipe ends or spigots so that the hose ends obtain their theoretically correct relative position according to the drawing. Secure the hose with hose clamps and connect it to the underpressure equipment in the oven and heat it to IOT according to Table 1.

Reduce the internal pressure until the hose collapses at its weakest area and mark that area. Unload to atmospheric pressure. Measure the hose circumference at the marked position after 5 minutes at atmospheric pressure.

Reduce pressure to atm. underpressure level UP, see Table 1, and keep it constant. Measure the circumference at the mark after 5 minutes and calculate reduction of cross-section dimension.

#### 4.6d Test report

- As per STD 1007,301 and §2.4
- Cross section dimension reduction in % per hose and mean value.
- Document the weakest position, preferably by a photo of the marked hose.
- Any remarks on clamps.

	Document Title				
VOLVO	CHARGE AIR HOSES				
	Document Type				
	TECHNICAL REGULATION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No	
	20521081	02	01	9(13)	

量不得小于该软管标称尺寸的80%。不 会出现分层、渗漏、裂缝或其他缺陷

#### 4.7 Leakage test 泄漏试验

Scope: Tightness at internal overpressure considering clamps and spigots

#### 4.7a Performance requirements

Demand: Maximum leakage 2.5 cm<sup>3</sup>/s. 最大泄漏2.5 cm3 /秒

#### 4.7b Materials and equipment

Pressure test equipment with calibrated pressure gauges, pressure media: air. Soap water. Minimum 5 hoses, hose clamps, test spigots. 至少5根 Hose plug or sealed test spigot.

#### **4.7c Test procedure** 表1中工作压力 ± 10% 空气温度25 ± 5

Pressurize hose with air using OP±10% according to Table 1. Air temperature +25±5°C.

#### 4.7d Test report

- As per STD 1007,301 and §2.4
- Leakage in [cm<sup>3</sup>/s]
- Document where leakage occurs using soap water.
- Any remarks on clamps or spigots.

#### 4.8 Burst test

**Scope:** Resistance to over speed and peak pressure, investigation of material degradation, and possibility to follow up hose performance in the field. Evaluation of the hose/clamp/spigot joint.

#### 4.8a Performance requirements 最小爆破压力 3.5倍

New hose: minimum overpressure  $3,5 \times OP$  in Table 1 for the concerned hose category without leakage, cracks or other defects. After §4.6 Dynamic Endurance test: min  $2 \times OP$ .

#### 4.8b Material and equipment

Pressure test equipment with calibrated pressure gauges, pressure media: air. Minimum 5 hoses, hose clamps, test spigots. Hose plug or plugged test spigot.

#### 4.8c Test procedure

- 1. Mount the hose onto appropriate spigots with one hose end plugged and free to move while the other hose end is kept fixed and connected to the pressure test equipment.
- 2. Assemble the hose clamps.
- 3. Insert pressure medium near the fixed hose end. Check leakage. 1MPA/MIN
- 4. Increase the overpressure at a constant rate of 1 MPa/minute until the hose bursts, cracks or start leaking and note the pressure level at which this occurs. The burst pressure is defined by the maximum obtained pressure value at the test.

Repeat for all hoses. Pre-shaped hoses: the free hose end must be the same at every test.

#### 4.8d Test report

- As per STD 1007,301 and §2.4
- Max required overpressure resistance.
- Pre-shaped hose: document which hose end that was kept fixed during the test.
- Max burst pressure for each hose and the mean value.
- Any remarks on clamps

	Document Title				
VOLVO	CHARGE AIR HOSES				
	Document Type TECHNICAL REGULATION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No	
	20521081	02	01	10(13)	

#### 4.9 Flexibility of pressurized hose 软管弹性

Scope: to indicate the level of load transmitted by the hose

#### 4.9a Performance requirements

Compressing the hose by 10mm 压缩10mm max change 350N Extending the hose by 10mm 拉伸10mm max change 250N For short hoses < 100 mm long 小于100mm长的胶管 野设钟部门协商 department

#### 4.9b Materials and equipment

Tensile test machine Minimum 5 hoses, hose clamps, test spigots. Hose plug or plugged test spigot.

#### 4.9c Test procedure

1. Mount the hose onto the load measuring test equipment in designed condition of assembled length and alignment, using clamps and spigots as for vehicle installation.

- 2. Pressurise hose to OP, see Table 1.
- 3. Record the Change in force resulting from moving from the installed position.

#### 4.9d Test report

- as per §2.4
- Change in force when compressing the hose by 10mm
- Change in force when extending the hose by 10mm

#### 4.10 Dynamic endurance test 耐久试验

**Scope:** Decreasing performance of the hose at elevated gas temperature under simultaneous pressure and movement cycles. CCV-C: delamination between layers inner liner/ rubber.

#### 4.10a Performance requirements 性能要求

The hoses must pass the endurance test without any leakage, visible cracks or other defects. Burst pressure minimum 2 x OP (Table 1) according to §4.8c after passing the endurance test. Compare decreasings in Leakage, Burst pressure, Brittleness in cold, and Adhesion between layers.

# 4.10b Materials and equipment 准备,设备、工具

5 hoses, 10 clamps, 10 pipe ends or spigots Hose plugs, assembly fixture Calibrated ageing oven with controlled and evenly distributed temperature. Pressure test equipment Pressure/Vibration/Temperature (PVT) cycling test facility.

#### 4.10c Test procedure 步骤

- Pre-ageing Attach the spigots or pipe ends to hose ends. Pre-age in oven at +175±2°C for 500 hours.
- ◆ Pressure-Vibration-Temperature 允许冷却到室温

Allow the hoses to cool down to room temperature and install them as test units in the rig. Do not 不雅拆卸软管嵌onnect the hose/clamp spigot during the test. The test unit must be assembled so that the hose ends obtains their theoretically correct relative position given by the hose drawing. For hoses that take up a relative movement, arrow(s) on the drawing indicates directions. A fixture is recommended for a correct installation.

Perform the endurance test starting with phase one, continuing with phase two, etc according to the test plan given in Table 3, Diagram 2 and 3. The ambient temperature is  $(+175 \pm 2)^{\circ}$ C.

	Document Title				
VOLVO	CHARGE AIR HOSES				
	Document Type				
	TECHNICAL REGULATION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No	
	20521081	02	01	11(13)	

Р ц	PRESSURE 压力		MOVEMENT 运动			TEMPERATURE 温度	<u>ب</u>
A	Pressure	ssure Pressure Amplitude Frequency Movement		Ambient temp环境温度	orox. ation		
E	levels [kPa]	cycles	s [mm] 振幅峰值] cycles		m] 振幅峰值 <sup>[]</sup> cycles		App dur
1	90→OP→90	≥ 43.200	≥ R/6	≥5	≥ 4.320.000	IOT ± 2	240
2	90→OP→90	≥ 21.600	≥ R/5	≥5	≥2.160.000	IOT ± 2	120
3	90→OP→90	≥ 16.200	≥ R/4	≥5	≥1.620.000	IOT ± 2	90
4	90→OP→90	≥ 7.200	≥ R/2	≥5	≥720.000	IOT ± 2	40
5	90→OP→90	≥ 1.800	≥R	≥5	≥180.000	IOT ± 2	10
	Total: ≥ 90.0	00 cycles	Total	:≥9.000.000	cycles		Total: 500

<u>Table 3</u> Endurance test after pre-ageing. Duration approx. 500h. OP=operating pressure, R=movement vector and IOT=internal operating temperature according to Table 1.

Additional descriptions of endurance load cycles in diagrams below. Please contact design departments for any questions or comments before initiating test.







Diagram 3. Vibration amplitudes in Table 1

#### After Phase 5, follow-up by performing:

✓ Leakage泄漏

Verify and compare according to §4.7b/c without disassembling the clamps/spipgots. Use all 5 hoses from 4.10 above.

✓ Burst pressure 爆破压力

Allow the hose to cool down to room temperature and verify Burst pressure according to §4.8b/c without disassembling the clamps/spipgots. Use 4 hoses of the hoses above.

- ✓ Cold Impact test 低温撞击试验 Verify and compare according to §4.5b/c. Cut out 4 test pieces from 1 hose fom 4.10.
- ✓ Adhesion between layers 层间附着力 Verify and compare according to §4.4b/c. Cut out 4 test pieces from 1 hose, same as above.

	Document Title				
VOLVO	CHARGE AIR HOSES				
	Document Type TECHNICAL REGULATION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No	
	20521081	02	01	12(13)	

#### 4.10d Test report测试报告

- As per STD 1007,301 and §2.4
- Leakage: in [cm<sup>3</sup>/s] and reduction (in %) compared with new hoses.
- Burst pressure reductions (in %) compared with new hoses.
- Cold impact: describe changes.
- Change in adhesion (in%)
- CCV-C: describe with text and photo any cracks, splits, delamination or other defects on the inner liner.
- Any remarks on clamps.

#### 4.11 TGA: ISO 9924-2, and IR

**Scope:** Material identification. Rubber compound (IR for type of material, TGA for contents) The supplier is requested to make an infrared (IR) and a thermogravimetric analysis (TGA) of the rubber compounds in the hose

#### 4.11a Performance requirements

Document the content of softener, polymer and ash for the rubber materials.

#### 4.11b Materials and equipment

According to Standard.

#### 4.11c Test procedure

According to Standard.

#### 4.11d Test report

- As per STD 1007,301 and §2.4
- IR spectra, and Thermograms (TGA).
- Size and date of manufacture of test samples.
- Vulcanisation time, temperature and pressure when producing the test samples.

VOLVO	Document Title CHARGE AIR HOSES				
	Document Type TECHNICAL REGULATION				
Volvo Truck Corporation	Document No	Issue Index	Volume No	Page No	
	20521081	02	01	13(13)	