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Rubber hoses for automotive turbochargers — Specification

Tuyaux en caoutchouc pour turbocompresseurs automobiles — Spécifications

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

Rubber hoses for automotive turbochargers — Specification

1 Scope

This International Standard specifies requirements of rubber hoses used in the automotive turbocharger system to connect turbocharger, intercooler, and internal combustion engine at the working temperatures from −40°C to +250°C and the working pressures from −0,01MPa(−0,1bar) to 0,5MPa(5bar). Hoses covered by this International Standard may be straight or shaped.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 812, *Rubber, vulcanized or thermoplastic — Determination of low-temperature brittleness*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 1629, *Rubber and latices — Nomenclature*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

ISO 7233:2006, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

ISO 8033, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 8331, *Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance*

ISO 28702, *Rubber and plastics hoses and tubing — Textile-reinforced types — Sub-ambient temperature crush test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8330 and the abbreviated terms given in ISO 1629 apply.

4 Classification

4.1 Types and classes

The hoses are classified into three types as per the intended operating conditions.

— Type A: hose for connecting air filter and turbocharger, to transfer filtered atmospheric air. Working temperature from −40°C to +100°C, and vacuum pressure low to −0,01MPa(−0,1bar).

— Type B: hose for connecting turbocharger and intercooler, to transfer the pressurized and heated air. Working temperature from −40°C to +250°C.

Type B is subdivided into three subtypes as per working temperature and further classified into classes as per maximum working pressures. The subtypes and classes are shown in Table 1.

Table 1 — Subtypes and classes for Type B

Type	Working temperature °C	Class		
		1	2	3
		Maximum working pressure MPa(bar)		
B1	−40 approximately +180	0,16(1,6)	0,22(2,2)	0,28(2,8)
B2	−40 approximately +220	0,20(2,0)	0,28(2,8)	0,34(3,4)
B3	−40 approximately +250	0,30(3,0)	0,40(4,0)	0,50(5,0)

— Type C: hose for connecting intercooler and internal combustion engine, to transfer the pressurized and cooled air. Working temperature from −40°C to +140°C and maximum working pressure 0,3 MPa (3bar).

4.2 Grades

Type B and C of hose are classified into 2 grades as per fatigue resistance:

— Grade 200 — 200 000 impulse cycles;

— Grade 400 — 400 000 impulse cycles.

5 Materials and construction

5.1 Materials

The typical materials for the types of hoses are listed in Table 2.

Table 2 — Hose type and typical material

Dimensions in millimetres

Type	Lining	Reinforcement	Cover
A/C	EPDM	PET[a] PA[b] wire	EPDM
	CM		CM
	CR		CR
	ECO		ECO
	AEM		AEM
	ACM		ACM
	VMQ		VMQ
B1	AEM	PET[a] AR[c]	AEM
	ACM		ACM
	VMQ		VMQ
B2/B3	FKM	AR[c]	VMQ
	FVMQ		VMQ

NOTE — All the abbreviated words are defined in ISO 1629 excluded PET, PA, and AR.

[a] PET — poly(ethylene terephthalate) fibre

[b] PA — polyamide

[c] AR — Aramid

5.2 Construction

The hoses shall consist of:

— a flexible polymeric elastomers lining;

— a synthetic textile reinforcement or other reinforcements, applied by any suitable technique;

— a flexible polymeric elastomers cover.

Hose body may have a smooth or corrugated finish, and be further reinforced with wire at suitable positions, and may be covered with glass fibre cloth with aluminium-foil paper, or heat insulation or abrasion resistant jacket made of thermoplastic material on suitable position.

NOTE Type A may be rubber tubing without reinforcement.

6 Dimensions and tolerances

6.1 Inside diameter, wall thickness, and length tolerance

Unless otherwise specified, when measured in accordance with ISO 4671, inside diameters and wall thicknesses tolerances are given in Table 3 and length tolerances are given in Table 4.

Table 3 — Inside diameter, wall thickness tolerance

Dimensions in millimetres

Inside diameter and tolerance		Tolerance of wall thickness	
Inside diameter	**Tolerance**	**Extruded hose**	**Wrapped hose**[a]
≤ 35	+0,5 −1,3	±0,3	±0,5
> 35 and ≤ 50			
> 50 and ≤ 80	+0,5 −1,3	±0,8	±1,0
> 80 and ≤ 110	+0,8 −1,7		
> 110 and ≤ 150	+1,2 −2,0	±1,0	±1,2
> 150	+1,6 −2,5		

[a] Overlap zone excluded

Table 4 — Length tolerance

Dimensions in millimetres

Length	Tolerance
≤ 300	±3
> 300 and ≤ 600	±4,5
> 600	±1 %

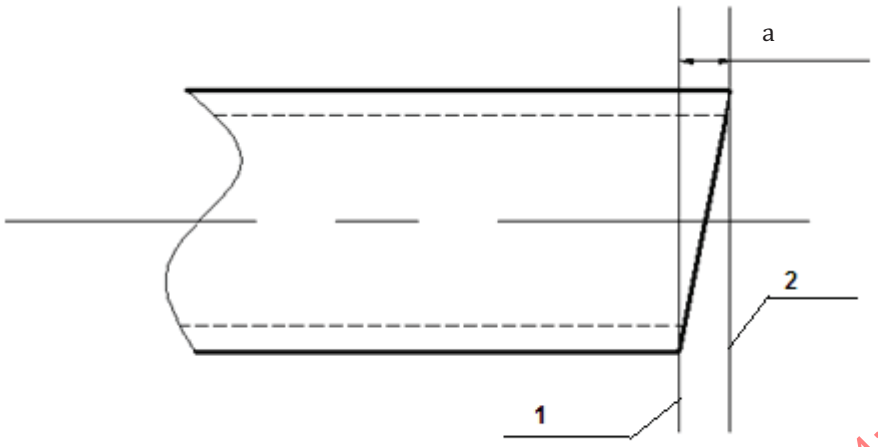
6.2 Hose end squareness

All the points on the end surface of a hose shall be in the tolerance zone, given in Table 5, which is defined by two planes vertical to the longitudinal axis of the hose (see Figure 1).

Table 5 — Hose end squareness

Dimensions in millimetres

I.D.	Tolerance zone
< 25,4	2,5
≥ 25,4	10 % of I.D.



Key

1 plane
2 plane
a Tolerance zone.

Figure 1 — Hose end squareness

7 Physical properties

7.1 Rubber compounds

Physical properties of rubber compounds used for the lining, cover and tubing shall conform to the values given in Table 6, Table 7, Table 8, Table 9, and Table 10. Tests shall be carried out on samples (taken from the hose or from moulded sheets of rubber compound, 2 mm thick or moulded test pieces) in all cases vulcanized to the same cured state as the production hose.

Table 6 — Lining, cover, and tubing for type A

Property	Requirement	Test method
Heat aging resistance, 100 °C × 168 h		
Change in hardness, shore A	±10	ISO 188
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Oil resistance[a], IRM 901 Oil, 100 °C × 70 h		
Change in hardness, shore A	±10	ISO 1817
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Change in volume, %	±10	
Brittleness temperature, at −40 °C	No brittleness	ISO 812
Ozone resistance, 100pphm × 40 °C × 72 h × 20 %	No cracks	ISO 1431-1
[a] not applicable for EPDM		

Table 7 — Lining, cover, and tubing for type B1

Property	Requirement	Test method
Heat aging resistance, 180 °C × 168 h		
Change in hardness, shore A	±10	ISO 188
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Oil resistance, IRM 901 Oil, 150 °C × 70 h		
Change in hardness, shore A	±10	ISO 1817
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Change in volume, %	±10	
Brittleness temperature, at −40 °C,	No brittleness	ISO 812
Ozone resistance, 100pphm × 40 °C × 72 h × 20 %	No cracks	ISO 1431-1

Table 8 — Lining, cover, and tubing for type B2

Property	Requirement	Test method
Heat aging resistance, 220 °C × 168 h		
Change in hardness, shore A	±10	ISO 188
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Oil resistance, 150 °C × 70 h, IRM 901 Oil excluding lining, IRM 903 Oil for lining		
Change in hardness, shore A	±10	ISO 1817
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Change in volume, %	±10	
Brittleness temperature, at −40 °C	No brittleness	ISO 812
Ozone resistance, 100pphm × 40 °C × 72 h × 20 %	No cracks	ISO 1431-1

Table 9 — Lining, cover, and tubing for type B3

Property	Requirement	Test method
Heat aging resistance, 250 °C × 168 h		
Change in hardness, shore A	±10	ISO 188
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Oil Resistance, 150 °C × 70 h, IRM 901 Oil excluding lining IRM 903 Oil for lining		

Table 9 *(continued)*

Property	Requirement	Test method
Change in hardness, Shore A	±10	ISO 1817
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Change in volume, %	±10	
Brittleness temperature, at −40 °C	No brittleness	ISO 812
Ozone resistance, 100pphm × 40 °C × 72 h × 20 %	No cracks	ISO 1431-1

Table 10 — Lining, cover, and tubing for type C

Property	Requirement	Test method
Heat aging resistance, 140 °C × 168 h		
Change in hardness, shore A	±10	ISO 188
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Oil resistance[a], IRM 901 Oil, 100 °C × 70 h		
Change in hardness, shore A	±10	ISO 1817
Change in tensile strength, %	±30	
Change in elongation at break, %	±40	
Change in volume, %	±10	
Brittleness temperature, at −40 °C	No brittleness	ISO 812
Ozone resistance, 100pphm × 40 °C × 72 h × 20 %	No cracks	ISO 1431-1
[a] not applicable for EPDM		

7.2 Hose

7.2.1 Appearance

When checked with 1x magnification, hose cover and bore surface shall show no visible defects such as kinking, porosity, blister, foreign inclusions, damages, and scratches. Marks such as wrapper marks on the cover surface may be acceptable. Reinforcement shall not be exposed other than on the end surfaces of hose.

Delivery hoses shall be clean and qualified, free from impurity, grease, or any contamination that may affect the function of the hose.

7.2.2 Vacuum resistance (only for Type A)

When tested in accordance with method C in ISO 7233:2006, the change in hose length (ΔLt) shall be 0~5 %, and the change in OD (ΔDt) shall be 0~-8 %, measured while vacuum pressure maintained at −0,015 MPa for 10 min.

The lines A and B should be at 25 mm apart from ends of the hose if the length of the hose to be tested is less than 500 mm.

7.2.3 Proof pressure (for Type B and C)

When tested in accordance with ISO 1402 at the proof pressures given in Table 11, no leakage or other signs of weakness nor abrupt twisting shall be shown.

7.2.4 Minimum burst Pressure (for Type B and C)

When tested in accordance with ISO 1402, the minimum burst pressures for the hoses of Type B and C shall be in accordance with the values given in Table 11.

Table 11 — Maximum working pressure, proof pressure, and minimum burst pressure

Type	Class	Maximum working pressure MPa(bar)	Proof pressure MPa(bar)	Minimum burst pressure MPa(bar)
B1	1	0,16(1,6)	0,32(3,2)	0,64(6,4)
	2	0,22(2,2)	0,44(4,4)	0,88(8,8)
	3	0,28(2,8)	0,56(5,6)	1,12(11,2)
B2	1	0,20(2,0)	0,40(4,0)	0,80(8,0)
	2	0,28(2,8)	0,56(5,6)	1,12(11,2)
	3	0,34(3,4)	0,68(6,8)	1,36(13,6)
B3	1	0,30(3,0)	0,60(6,0)	1,20(12,0)
	2	0,40(4,0)	0,80(8,0)	1,60(16,0)
	3	0,50(5,0)	1,00(10,0)	2,00(20,0)
C	—	0,30(3,0)	0,60(6,0)	1,20(12,0)

7.2.5 Adhesion

When tested in accordance with ISO 8033, adhesion between layers shall be no less than 1,0 kN/m.

7.2.6 Fatigue resistance (for Type B and C)

When tested in accordance with Annex A and subjected to the impulse cycles given in Table 12, the hoses shall show no leakage, cracking, and other evidence of failure. Burst pressure and adhesion values after fatigue resistance shall be in accordance with the agreement between the customer and manufacturer.

Table 12 — The impulse cycles for Type B and C

Grade 200	Grade 400
200 000	400 000

7.2.7 Sub-ambient crush resistance

When tested in accordance with ISO 28702, if required and applicable, at −40 °C ± 2 °C or at the test temperature agreed by customer and manufacturer, any abnormalities such as cracks, fractures, or separation of layers on interior and exterior of the test piece shall not be observed.

8 Frequency of testing

Type tests and routine tests shall be as specified in Annex B.

Type tests are those tests required to confirm that a particular hose or hose assembly design, manufactured by a particular method from particular materials, meets all the requirements of this International Standard. The tests shall be repeated at a maximum of one year intervals, or whenever a change in the method of manufacture or materials used occurs. They shall be performed on all sizes, and on all types except those of the same size and construction.

Routine tests are those tests required to be carried out on each length of finished hose prior to dispatch.

Production tests are non-mandatory and the recommended frequencies are given in Annex C for guidance only.

9 Marking

The hose shall be continuously, indelibly, and legibly marked, with at least the following information:

a) the manufacturer's name or mark (and serial No. if applicable), e.g. MAN;

b) the number and year of this standard, i.e. ISO 17324:2014;

c) hose type, class, and grade, e.g. B1-1-200;

d) ID of the hose, e.g. 35;

e) maximum working pressure, MPa(bar), e.g.0,3MPa(3bar);

f) quarter and year of manufacture, e.g.2Q14.

EXAMPLE MAN/ISO 17324:2014 /B1–1-200/35/0,3MPa/2Q14

10 Storage

Recommendations for storage are detailed in ISO 8331.

Annex A
(normative)

Fatigue resistance test

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

A.1 General

This method simulates the practical operating condition at ambient temperature of 100°C ± 10°C, and subjects a hose to alternate pressures of 0MPa(0bar) and 0,25MPa(2,5bar) (or 133 % maximum working pressure) and simultaneously to vibration of a certain amplitude and frequency by using a cycle pump and an actuator.

A.2 Test rig

A.2.1 An impulse-vibration test can be carried out on the test rig. If vibration is not required, only impulse test shall be carried.

A.2.2 A protective device, capable of interrupting the test immediately when leakage, burst, or any other failures happen.

A.2.3 A pressure-cycle pump for gas cycling. Cycling medium is the compressed air flowing continuously in the hose.

A.2.4 An actuator, capable of providing vibration.

A.2.5 A temperature-control device, allowing medium and ambient temperature to be controlled.

A.2.6 A recorder, capable of recording the impulse cycle number and vibration.

A.3 Procedure

A.3.1 Attach a hose to the test rig, adjust the clamp and torque to keep a tightly sealed state.

A.3.2 Rise the temperature of the cycling compressed air to the value given in Table A.1.

Table A.1 — Cycling gas temperature

Type	Test temperature
B1	180 °C ± 5 °C
B2	220 °C ± 5 °C
B3	250 °C ± 5 °C
C	140 °C ± 5 °C

A.3.3 Raise ambient temperature to 100 °C ± 10 °C.

A.3.4 Regulate the pressure cycle (and vibration) frequency to the specified value.

A.3.5 Start the pressure cycle pump and apply pressure cycles as following sequence to the specified cycle number:

— from 0MPa to 0,25MPa(2,5bar) (or 133 % maximum working pressure) in 1 s;

— maintain 0,25MPa(2,5bar) (or 133 % maximum working pressure) for 2 s;

— from 0,25MPa(2,5bar) (or 133 % maximum working pressure) to 0MPa(0bar) in 1 s;

— maintain 0 MPa(0bar) for 2 s.

The duration of one cycle shall be 6 s.

Continue the test until the failure occurs.

A.3.6 If vibration is required, start vibration at the same time (A.3.5). Vibration amplitude and frequency shall conform to the agreement between the customer and manufacturer.

A.3.7 Check the hose for failures when completing the specified cycles (and vibration) and continue the test till failure occurs.

A.3.8 Record the number of cycles completed to failure.

A.3.9 Leakage may occur because of the hose clamp. In this case, test results shall be ignored.

A.3.10 At least three test pieces shall be tested.

A.4 Test report

The test report shall include at least the following information:

a) a reference to this International Standard (i.e. ISO 17324:2014);

b) type of the tested hose;

c) test temperature;

d) test pressure, MPa(bar);

e) pressure cycle rate, vibration amplitude and frequency;

f) number of test for undamaged hose;

g) details of any failures which affect the test results.

Annex B
(normative)

Type and routine tests

Type tests and routine tests are given in Table B.1.

Table B.1 — Type and routine tests

Property	Type tests	Routine tests
Rubber compounds		
Heat aging resistance	×	N/A
Oil resistance	×	N/A
Brittleness temperature	×	N/A
Ozone resistance	×	N/A
Hose		
Inside diameter	×	×
Wall thickness	×	×
Length	×	×
Hose end squareness	×	×
Appearance	×	×
Vacuum resistance	×	N/A
Proof pressure	×	×
Burst pressure	×	N/A
Adhesion	×	N/A
Fatigue resistance	×	N/A
Sub-ambient crush resistance	×	N/A
× Test shall be carried out.		
N/A Test not applicable.		