Standard Method of Testing Hose for Automobile

1. Scope

This standard covers standard method of testing hose and rubber tube (hereinafter called hose) for automobiles. Hose made of plastic, paper, or material other than rubber are excluded from this standard.
As a rule, this standard covers test method for straight hose. Bent hose and other special shaped hoses are covered by applicable individual standards.

Remark – Units and numerical values enclosed with { } herein have been appended for reference and conform to the System of International Units (SI).

2. Purpose

The purpose of this standard is to standardize the hose testing methods and terms and to substantiate the test methods.

3. Measurements, Test Types, and Test Items

Measurements, test types, and test items prescribed in this standard are as listed in **Table 1.**

Table 1

Measurement, Test Type and Test Item			Item No.
Hose Dimension Measurement	Inside diameter measurement	Method A	5.2(1)
		Method B	5.2(2)
	Outside diameter measurement		5.3
	Wall thickness measurement		5.4
	Length measurement		5.5
Hose Performance Test	Pressure withstanding test	Hydraulic press. test	6.1.2(1)
		Bursting test	6.1.2(2)
		Air pressure test A	6.1.2(3)(a)
		Air pressure test B	6.1.2(3)(b)
		Vacuum test	6.1.2(4)
	Low temperature test	Method A	6.2.2(1)
		Method B	6.2.2(2)
	Ozone deterioration test	Method A	6.3.2(1)
		Method B	6.3.2(2)
		Method C	6.3.2(3)
	Adhesion test	Method A	6.4.2(1)
		Method B	6.4.2(2)
		Method C	6.4.2(3)
	Bending test		6.5
	Tensile test		6.6
	Heat aging test	Method A	6.7.2(1)
		Method B	6.7.2(2)
		Method C	6.7.2(3)
		Method D	6.7.2(4)

Reference Standards: Refer to Page 11
Related Standards: Refer to Page 11

Table 1 (cont.)

Measurement, Test Type and Test Item			Item No.
Hose Performance Tests	Medium sealed aging test		6.8
	Salt spray test		6.9
	Fatigue test	Repeated pressure test	6.10.2(1)
		Repeated press. & vibration test	6.10.2(2)
		Rotating fatigue test	6.10.2(3)
	Expansion test		6.11
	End fitting gauge insertion test		6.12
Rubber ply Physical Tests	Rubber ply tension test		7.1
	Hardness test	Method A	7.2.2(1)
		Method B	7.2.2(2)
	Aging test		7.3
	Immersion test		7.4

4. General Test Conditions

4.1 Test Laboratory Standard Condition

Test laboratory shall be at temperature of 20^{+10}_{0} °C as a rule, and the test laboratory temperature shall be recorded on the test results.

4.2 Sample Standard Condition

The sample shall, as a general rule, be that in which at least 24 hours had elapsed after vulcanizing, and shall be allowed to stand at least one hour in standard condition room temperature prior to the test.

4.3 Test Temperature and Time

Test temperature and time regarding low temperature test, heat aging test, medium-sealed aging test, and rubber ply physical tests shall, as a rule, be selected from the condition in **Table 2** in accordance with the usage purpose of the product.

Table 2

Temperature (°C)	Time (h)
−40±2	$5^{+0.5}_{0}$
−30±2	24^{+1}_{0}
40±1	48^{+1}_{0}
70±1	70^{+2}_{0}
100±1	94^{+2}_{0}
120±1	166^{+2}_{0}
150±2	
175±2	

5. Hose Dimension Measurement

5.1 Purpose

Shall be performed to measure the hose inside diameter, outside diameter, wall thickness, and length.

5.2 Inside Diameter Measurement

Hose inside diameter measurement shall be made by either of the following methods. As a rule, measurement shall be made by Method A. In case, measurement is difficult with **Method A**, measurement shall be made by **Method B**.

(1) **Method A** – Measurement shall be made by inserting plug gauge or tapered into the hose end. Gauge shall be inserted such that empty space shall not remain around the hose inside permiter.

(2) **Method B** – Measurement shall be made at hose end with vernier calipers or inside calipers in two directions at nearly right angles to each other and the average value taken.

5.3 Outside Diameter Measurement

Hose outside diameter measurement shall be made with vernier calipers in two directions at nearly right angles to each other and the average value taken.
In case of corrugated hose, measurement shall be made to corrugation peak.

5.4 Wall Thickness Measurement

Hose wall thickness measurement shall be made with vernier calipers. In case of corrugated hose, measurement shall be made to corrugation peak.

5.5 Length Measurement

Hose length measurement shall be made with vernier calipers or metal straight scale.

6. Hose Performance Tests

6.1 Pressure Withstanding Tests

6.1.1 Purpose

The purpose of these tests is to investigate the hose pressure withstanding performance (leakage under specified pressure, hose outside diameter change rate, length change rate, bursting pressure, air tightness, and vacuum performance).

6.1.2 Test methods

(1) Hydraulic pressure test

(a) Test shall consist of having one end of the sample free, and after filling the sample with sufficient water, internal pressure shall be applied until the specified pressure is reached. After maintaining for specified time, examination shall be made for hose leakage, local expansion, and other defects.

(b) To drive the length and outside diameter change rates, prior to applying pressure, 100 mm gauge lines as a rule shall be placed at the center of the sample filled with sufficient water. Outside diameter measurement shall be made at fixed point between these gauge marks.

After elapse of specified time under specified pressure, presence of water leakage and other defects shall be checked, after which the distance between gauge lines and outside diameter shall be measured. After pressure release measurements shall be made upon completing the under pressure measurements by lowering the internal pressure until the interior is completely pressure free and then after allowing 10 minutes to elapse, distance between gauge lines and outside diameter shall be measured.

The length and outside diameter change rates shall be calculated from the following equations.

Length change rate

$$\Delta L = \frac{L_2 - L_1}{L_1} \times 100$$

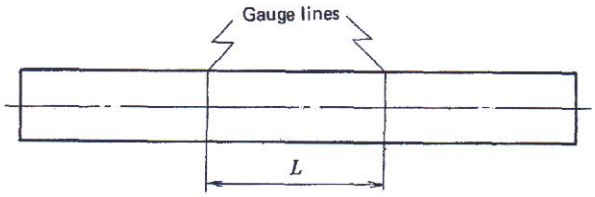
where ΔL: Length change rate %
L_1: Before-pressure distance between gauge lines mm
L_2: Under-pressure or after-pressure-release distance between gauge lines mm

Outside diameter change rate

$$\Delta D = \frac{D_2 - D_1}{D_2} \times 100$$

where ΔD: Outside diameter change rate %
D_1: Before-pressure outside diameter mm
D_2: Under-pressure or after-pressure-release outside diameter mm

Fig. 1



(2) Bursting test

Test shall consist of having one end of the sample free, and after filling the sample with sufficient water, internal pressure shall be applied at specified pressure application speed until the sample bursts, and the maximum pressure during this time measured.

The sample after completion of **6.1.2(1)** hydraulic pressure test may be used.

(3) Air pressure test

Test may be performed by either of following methods, with the method used recorded in the test results.

(a) Method A

Test shall consist of having one end of the sample free, and after applying specified pressure of air or inert gas, sample shall be immersed in water tank for specified time and examined for presence of the applied air or inert gas leakage.

(b) Method B

Sample shall be mounted on device equipped with pressure gauge and after applying specified pressure of air or inert gas, pressure application side valve shall be closed. After elapse of specified time, examination shall be made for drop in pressure.

(4) Vacuum test

Test shall consist of having one end of the sample free and the pressure reduced until the specified pressure is reached. After allowing the specified time to elapse, sample shall be examined for presence of peeling, construction, or other defects injurious to use.

In case, change rate is to be derived, method shall correspond to that for **6.1.2(1)** Hydraulic Pressure Test.

6.2 Low Temperature Test

6.2.1 Purpose

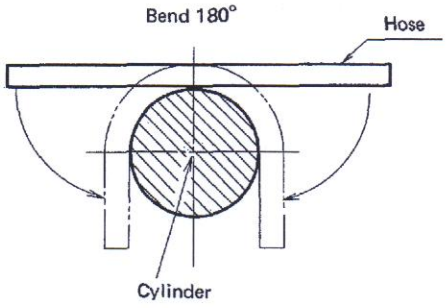
This test shall be performed for the purpose of investigating the low temperature property of hose.

6.2.2 Test method

Test shall be performed in accordance with either of the following methods and the method used shall be recorded in the test results. As a rule, Method A shall be applied to hose having inside diameter less than 25 mm and Method B to hose having inside diameter 25 mm and larger.

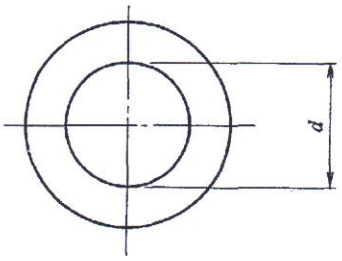
(1) **Method A**
Sample shall be placed in straight condition in constant low temperature tank at specified temperature and allowed to stand for specified time. Then, within the tank as a rule, the sample shall be bent 180° within the specified time along a cylinder of specified diameter in the manner indicated in **Fig. 2**, and examined for presence of leakage, local expansion, and other abnormalities.
The cylinder employed in the test shall be cooled similar to the sample.
If required, the sample shall be restored to room temperature and **6.1.2(1)** hydraulic pressure test performed under specified pressure for investigation of leakage, local expansion, and other defects.

Fig. 2

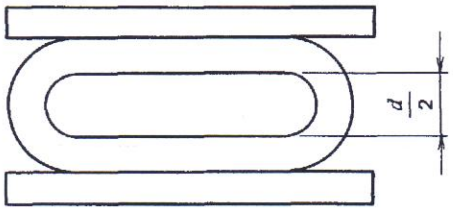


(2) **Method B**
Sample of approximately 25 mm length shall be placed in constant low temperature tank at specified temperature for specified time. Then, within the tank as a rule, the sample shall be placed between two flat plates as indicated in **Fig. 3** and subjected to sudden compression until the inside diameter becomes 50% in the direction at right angles to the axis. Sample shall then be examined for presence of cracks and other abnormal conditions.

Fig. 3



Before compression



After compression

6.3 Ozone Deterioration Test

6.3.1 Purpose

This test is performed to investigate the resistance of hose to ozone.

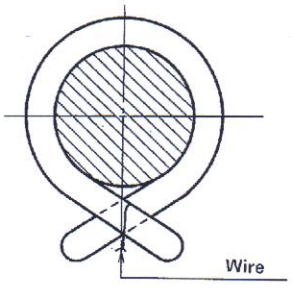
6.3.2 Test method

Ozone deterioration test shall be performed in accordance by any of the following methods.
The method employed shall be recorded in the test results. Test apparatus and ozone concentration (control) shall conform to **16.** (Ozone Deterioration Test) of **JIS K 6301.**

(1) Method A

As indicated in **Fig. 4,** the sample shall be wound around a cylinder of specified diameter, and after allowing to stand for 20 ~ 24 hours at room temperature, the sample shall, as a rule, be placed in a tank of ozone of 50±5 pphm concentration and 40±2°C temperature. After exposing for specified time, the sample shall be taken out from the test tank, and at the existing condition, the outside surface rubber ply bent part shall be observed and the outside surface rubber ply cracked condition shall be investigated in accordance with **16.4.6** (Observation of Deterioration) of **JIS K 6301.** Part ties with wire shall be excluded from the evaluation.

Fig. 4



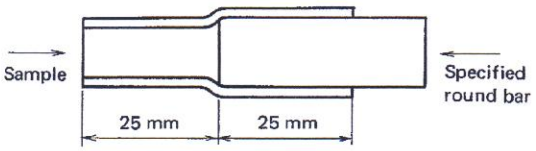
(2) Method B

Shall conform to **16.** (Ozone Deterioration Test) of **JIS K 6301.** Test piece shall, as a rule, be sampled from hose outside surface rubber ply, with the hose surface side free from wear.
Test piece shall be subjected to specified elongation and after standing at room temperature for 20 ~ 24 hours, it shall be exposed, as a rule, to ozone of 50±5 pphm concentration and 40±2°C temperature for specified time. It shall then be taken out from the test tank and hose exterior surface examined for cracked condition in accordance with **16.4.6** (Observation of Deteriorated Condition) of **JIS K 6301.**

(3) Method C

About 50 mm of sample shall be taken from the straight part of the hose and a round bar of specified diameter inserted as indicated in **Fig. 5.** After standing for 20 ~ 24 hours at room temperature, exposure shall be made, as a rule, to ozone of 50±5 pphm concentration and 40±2°C temperature for specified time. Hose exterior surface shall then be examined for cracked condition in accordance with **16.4.6** (Observation of Deteriorated Condition) of **JIS K 6301.**

Fig. 5



6.4 Adhesion Test

6.4.1 Purpose

This test is performed to measure or investigate the adhesive strength between the rubber hose plies.

6.4.2 Test method

Test for friction between hose plies shall be performed by any one of the following methods and the method used shall be recorded in the test results.
As a rule, test shall be made by Method A.
Method C shall be applicable only to dual layer hose consisting of inner and outer surface rubbers.

(1) Method A

Shall be in accordance with **7.** (Adhesion test) of **JIS K 6301.**

(2) Method B

Test piece and its installation shall conform to **7.2** (Test piece) and **7.4.1** (Test piece installation) of **JIS K 6301.** Specified load shall be hung and the peeled distance after one minute shall be measured and recorded.
If one minute test is difficult, test shall be carried out to maximum time permissible and conversion made to one minute time.

(3) Method C

A specimen about 25 mm long shall be taken from the straight part of hose and after immersing it in specified test liquid at specified temperature for specified time, presence of separation between the inner surface and outer surface rubbers shall be investigated.
Test liquid quantity shall be at least 15 times the sample volume.

6.5 Bending Test

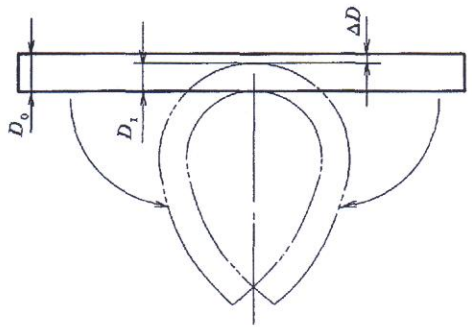
6.5.1 Purpose

This test is performed for the purpose of investigating the amount of crushing when the hose is bent.

6.5.2 Test method

Sample of specified length shall be taken from the product and as indicated in **Fig. 6**, the sample shall be bent until both ends contact and the amount of crush in the sample outside diameter at the sample center part shall be measured.
Outside diameter shall be measured at center line position in the direction indicated in **Fig. 6**, and the amount of crush calculated from the following equation.

Fig. 6



$$\Delta D = D_0 - D_1$$

where ΔD: Amount of crush mm
D_0: Outside diameter before bending mm
D_1: Outside diameter after bending mm

6.6 Tensile Test

6.6.1 Purpose

This test is performed for the purpose of measuring the tensile strength of the hose clamped part (1).

Note (1) – Clamped part is defined as the part where the end fitting is equipped by crimping or by use of clip or clamp.

6.6.2 Test method

Hose of specified length shall be taken as sample and mounted on the tensile testing machine where it shall be pulled at specified tensile speed until broken down.

The maximum value of the tensile strength until the hose pulls out from the clamped part or until the hose severes shall be measured.
The sample after being equipped at clamped shall, as a rule, be allowed to stand at least 24 hours at room temperature of standard condition.

6.7 Heat Aging Test

6.7.1 Purpose

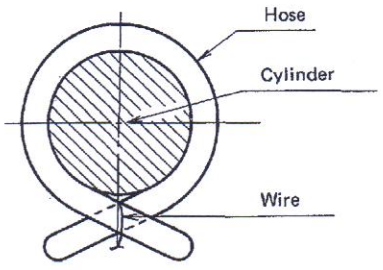
This test is performed for the purpose of investigating the heat aging property of hose when heated.

6.7.2 Test method

Heat aging test shall be performed by one of the following methods and the method utilized shall be recorded in the test results.
As a rule, **Method A** and **Method C** shall be applicable to hose of inside diameter under 25 mm, and **Method B** to hose of inside diameter 25 mm and above.

(1) **Method A**
A straight hose shall be wound around a cylinder of specified outside diameter as indicated in **Fig. 7** and by method corresponding to that specified in **6.3** (Air Heating Aging Test) of **JIS K 6301**, the hose shall be aged at specified temperature for specified time and then allowed to stand at room temperature for 3 hours or longer.
After this, the hose shall be straightened and the hose inside and outside surfaces shall be examined for development of cracks and presence of other defects.
The part ties by wire shall be excluded from evaluation.

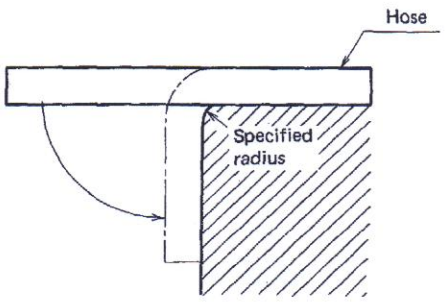
Fig. 7



(2) **Method B**
A sample about 25 mm long shall be taken from the straight part of the hose and by the method corresponding to that in **6.3** (Air Heating Aging Test) of **JIS K 6301**, the sample shall be aged at specified temperature for specified time. After allowing to stand at room temperature for at least 3 hours, the sample shall be inserted between two flat plates indicated in **Fig. 3** and rapidly compressed until the inside diameter becomes 50% in axial and right angle directions. Hose shall then be examined for development of cracks and presence of other defects.

(3) **Method C**
A straight hose, by the method corresponding to that in **6.3** (Air Heating Aging Test) of **JIS K 6301**, shall be aged at specified temperature for specified time. After standing at room temperature for at least 3 hours, the hose shall rapidly bent approximately 90° as shown in **Fig. 8** and examined for presence of cracks developing in hose inside and outside surfaces and other defects.

Fig. 8



(4) **Method D**
Sample hose shall, by the method corresponding to that specified in **6.3** (Air Heating Aging Test) of **JIS K 6301**, be aged at specified temperature for specified time. After allowing to stand at room temperature for at least 3 hours, hydraulic pressure test of **6.1.2(1)** (a) or air pressure test of **6.1.2(3)** shall be performed. On those having clamped part, tensile of **6.6** shall be performed.

6.8 Medium Sealed Aging Test

6.8.1 Purpose

This test is performed for the purpose of investigating development of defects and change in performance in case the hose interior surface is contacted by a medium.

6.8.2 Test method

Specified medium shall be sealed in sample hose, and after maintaining this state at specified temperature for specified time, the hose shall be allowed to stand at room temperature for at least 3 hours. The medium shall be removed from the hose, as a rule, and the hose examined for presence of defects. Immediately after this, hydraulic pressure test of **6.1.2(1)** (a) or air pressure test of **6.1.2(3)** shall be performed.
On those with clamped part, tensile test of **6.6** shall be performed.

6.9 Salt spray test

6.9.1 Purpose

This test is performed for the purpose of investigating rust-proofness of hardware on hose equipped with end fitting.

6.9.2 Test method

Hose shall be exposed for specified time by method corresponding to **JIS Z 2371** (Methods of Salt Spray Testing), after which the hose and fitting external surface shall be examined for presence of abnormal condition.

6.10 Fatigue test

6.10.1

This test is performed for the purpose of investigating dynamic durability in the hose body and clamped part under repeated pressure and pressure application state.

6.10.2 Test method

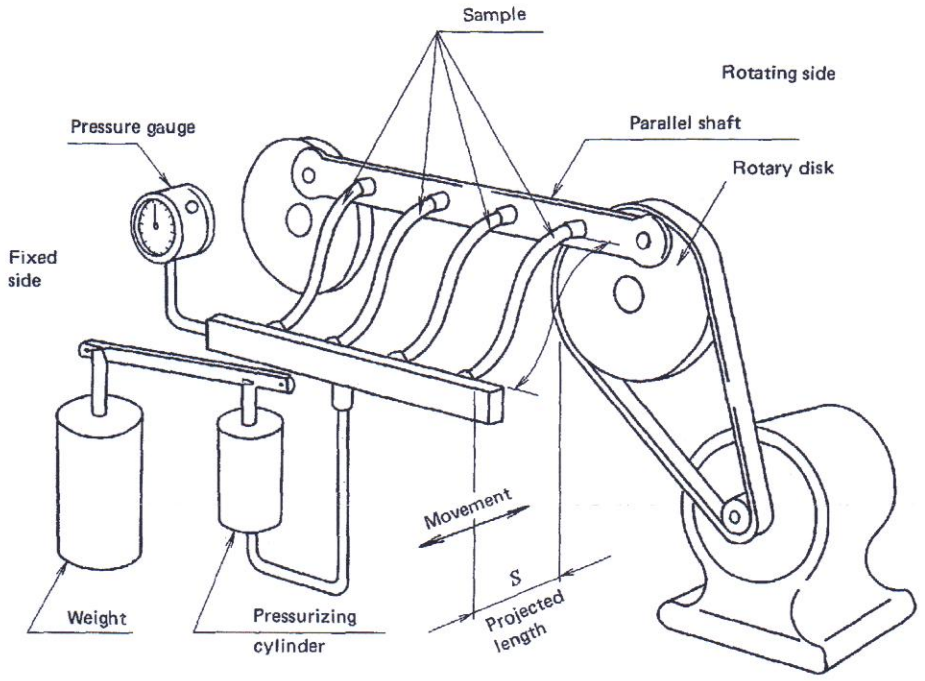
Fatigue test shall be performed by one of the following methods and the method utilized recorded in the test results.

(1) **Repeated pressure test**
The product shall be used as sample and installed in hose installed condition insofar as possible and while subjecting to dynamic impacts under specified conditions (test fluid, fluid pressure, pressure application cycle, fluid temperature, atmospheric temperature, etc.), pressure is repeatedly applied for specified time or number of times, and investigation made for hose rupture, localized rise, and leakage detrimental to usage.

(2) **Repeated pressure and vibration test**
The product shall be used as sample and one and fixed with the hose in installed condition insofar as possible. Utilizing a device capable of vibrating the other end, test shall be performed under the specified test conditions (test fluid, fluid pressure, pressure application cycle, fluid temperature, atmospheric temperature, vibration amplitude, vibration number, etc.) and investigation made for hose rupture, localized rise, leakage, and others detrimental to usage.

(3) **Rotating fatigue test**
Samples shall be mounted on rotating fatigue tester shown in **Fig. 9** and the other ends adjusted so as to perform circular motion under the specified conditions (fluid pressure, No. of revolutions, rotating diameter, sample length *(L)*, installed distance *(S)*. Test shall be performed in this state until the pressure drops or until the specified time, and investigation made for hose rupture, localized rise, leakage, and presence of other defects detrimental to usage.

Fig. 9



6.11 Expansion test

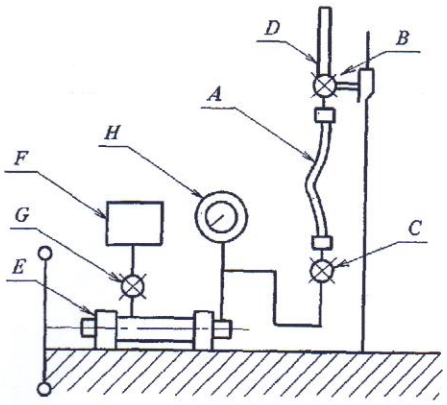
6.11.1 Purpose

This test is performed for the purpose of measuring the amount of the volumetric expansion of hose equipped with end fitting when under pressure.

6.11.2 Test method

In a tester such as shown in **Fig. 10**, the sample (*A*) shall be mounted vertically, free from twisting and with slight reserve provided in the length. Prior to starting measurements, air bubbles shall be completely removed from the liquid pressure system.
With valve (*B*) closed, pressure cylinder (*E*) shall be operated and liquid pressure applied to the hose interior at specified pressure application speed until the specified pressure is reached.
Valve (*C*) is then closed and valve (*B*) opened, to enable measuring the expansion quantity by the rise in liquid level in the burette (*D*). This measurement shall be repeated three times and the average value taken.
Then expansion quantity of the device itself under the same pressure shall be derived beforehand and this value subtracted from the above average expansion quantity shall be taken as the hose internal volume change.
Maximum expansion of the device itself shall not exceed 0.08 cm^3 at 105 kgf/cm^3 {10.3 MPa}.

Fig. 10



A: Sample
B: Valve
C: Valve
D: Burette
E: Pressure cylinder
G: Tank
G: Valve
H: Press. gauge

6.12 End Fitting Gauge Insertion Test

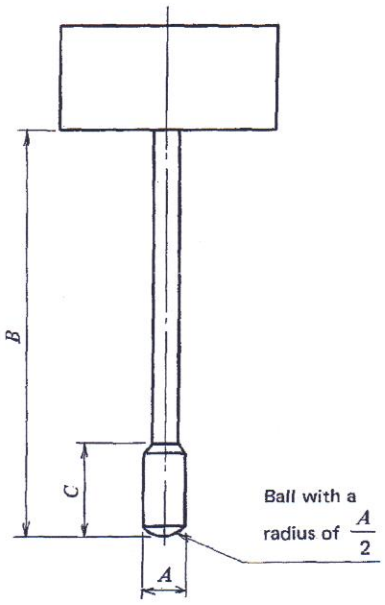
6.12.1 Purpose

This test is performed for the purpose of investigating the inside diameter of the hose after tightening the end fitting of a hose equipped with end fitting.

6.12.2 Test method

Sample hose (with fitting) shall be maintained vertically and the specified plug gauge (**Fig. 11**) dropped from the end fitting. The time until the plug gauge is inserted completely to dimension *B* by its own weight shall be measured. Test shall be performed on the end fittings at both ends.
In case the plug gauge cannot be used due to the end fittings being complicated, a steel ball of the same diameter as the plug gauge shall be utilized and by applying specified air pressure, the speed at which the steel ball passes through the hose interior shall be measured.

Fig. 11



7. Rubber Ply Physical Tests

7.1 Rubber Ply Tension Test

7.1.1 Purpose

This test is performed for the purpose of measuring the tensile strength and elongation of the hose rubber ply.

7.1.2 Test method

Test method shall consist of measuring the tensile strength and elongation by the method specified in **3.** (Tensile Test) of **JIS K 6301.**

7.2 Hardness Test

7.2.1 Purpose

This test is performed for the purpose of measuring the hardness of rubber ply.

7.2.2 Test method

Hardness test shall be performed by either of the following methods and the test method applied shall be recorded in the test results.

(1) **Method A**
Shall be performed as specified in **5.2** (Spring type hardness test) of **JIS K 6301.**

(2) **Method B**
Shall be performed as specified in **ASTM D 1415-68** (Test for International Hardness of Vulcanized Rubber)(2).

Note (2) – Summary of **ASTM D 1415-68** test is as follows.
This test is for measuring the indentation produced in rubber by entry of ball at end of push pin by applying load on the push pin, and is a method for deriving the hardness from the difference between the indentations produced by applying primary and secondary loads on the push pin.
Tester shall differ with the test piece. Standard tester shall be used when test piece thickness is 4 mm and over, and micro tester when under 4 mm. Tester shall be of the construction capable of applying primary and secondary loads, be provided with push pin at lower end for indenting the test piece, and equipped with measuring part for mechanical, electrical, and optical measurement of the indentation and a part for eliminating friction by lightly vibrating the apparatus.
Load, push pin diameter and the like relative to the measuring part differ with tester and test pice. The details are indicated in **ASTM D 1415-68 Table 1.**
In case the tester scale is in metric or inch graduations, conversion to IRHD hardness shall be made by application of **ASTM D 1415-68 Table 3 Fig. 1,** except for micro test indentation which shall be the value of indentation obtained by measurement multiplied by 6.

7.3 Aging Test

7.3.1 Purpose

This test is performed for the purpose of investigating the heat aging property of hose rubber ply.

7.3.2 Test method

After heating under the specified condition in accordance with the method in **6.3** (Air heating aging test) of **JIS K 6301,** investigation shall be made for change in hardness, tensile strength, and elongation from those prior to test.

7.4 Immersion Test

7.4.1 Purpose

This test is performed for the purpose of investigating the oil resistance and liquid resistance of hose rubber ply.

7.4.2 Test method

After immersion under the specified *conditions* in accordance with the method specified in **12.** (Immersion test) of **JIS K 6301,** investigation shall be made for change in hardness, tensile strength, and elongation relative to that prior to the test.

8. Test Result Rounding off Method

Test results shall be rounded off in accordance with **JIS Z 8401** (Rules for Founding Off of Numerical Values) and expressed by the number of digits in **Table 3.** The number of digits for test results other than in **Table 3,** shall be in accordance with **2.3** of **JIS K 6301** (Physical Testing Methods for Vulcanized Rubber).

9. Records

Test method and conditions utilized shall be recorded in the test results.

Table 3

Test Type and Item	Measured Value	For Test Result
Inside diameter mm	1 place after decimal point	1 place after decimal point
Outside diameter mm	1 place after decimal point	1 place after decimal point
Wall thickness mm	1 place after decimal point	1 place after decimal point
Length mm	Integral number	Integral number
Bursting strength kgf/cm^2 [kPA or MPa]	Integral number	Integral number
Length change rate %	1 place after decimal point	1 place after decimal point
Outside diam. change rate %	1 place after decimal point	1 place after decimal point
Adhesion test Method A kgf/cm [N/cm]	1 place after decimal point	1 place after decimal point
Adhesion test Method B mm	Integral number	Integral number
Bending test	1 place after decimal point	1 place after decimal point
Tension test kgf [N]	Integral number	Integral number
Rotating fatigue test h	Integral number	Integral number
Impulse test h, rev.	Integral number	Integral number
Expansion test cm^3	3 places after decimal point	3 places after decimal point
End fitting insertion test s	1 place after decimal point	1 place after decimal point
End fitting insertion test mm/s	1 place after decimal point	1 place after decimal point

Reference Standards:

JIS K 6301	(Physical Testing Methods for Vulcanized Rubber)
JIS Z 2371	(Salt Spray Test Methods)
JIS Z 8401	(Rule for Rounding Off of Numerical Values)
ASTM D 1415-68	(Test for International Hardness of Vulcanized Rubber)

Related Standards:

JIS K 6330	Rubber Hose Testing Methods
JASO M 301-77	Air Brake Hose for Automobiles
JASO M 302-76	Water Hose for Automobiles
JASO M 316-80	Fuel Hoses for Automobiles
JASO M 318-78	Blow-bye Gas Rubber Hose for Automobiles
JASO M 320-77	Vacuum Hose for Brake
JASO M 321-77	Hoses for Automobile Coolers
JASO M 322-77	High Temperature and Low Temperature Test of Rubber Parts
JASO M 326-80	Power Steering Hose and Hose Assemblies for Automobiles

Explanation Note
on
JASO M 319-80 Standard Method of Testing Hose for Automobile

The following are explanatory notes on the items which supplementary explanations could be thought as being necessary. (Item numbers are the same as in the text).

1. Scope

Hoses made of rubber, plastics, paper, and the like are used in automobiles but as it would be difficult to specify same general rules for hoses differing in material, only the rubber hose has been made the objective. In the standard methods herein, test methods have been specified with the straight tube hose taken as the objective. Since the test methods would become special for special shape hoses such as bent tubing, it was decided to specify them under individual standards.

4. General Test Conditions

4.3 Test Temperature and Time

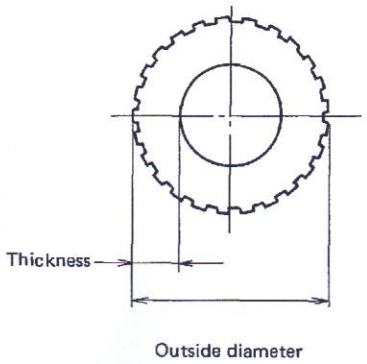
Actual conditions were investigated and it was decided, as a rule, to have the test temperature and time selected from the conditions in **Table 2** to conform with the usage objective of the product.

5. Hose Dimension Measurement

5.3 Outside Diameter Measurement and 5.4 Wall Thickness Measurement

The corrugated hose mentioned in outside diameter and wall thickness measurement items is defined as a hose having corrugations on entire perimeter of hose outside surface that extend in lengthwide direction as shown in **Explanatory Figure.** Hose provided with corrugation for identification purpose shall not be called corrugated hose. Since measurement of various parts are difficult in the case of corrugated hose, the outside diameter and wall thickness shall be measured up to the corrugation peak.

Explanatory Note Figure



6. Hose Performance Tests

6.1 Pressure Withstanding Test

6.1.2 Test methods

(a) Method A

Depending on the hose construction, there is danger that when pressure is applied, the air leaking from the braided fabric layer could be mistaken for leakage of pressure air from hose interior, mkaing it desirable to consider the air pressure application time to allow removal of air from the braided fabric layer.

Explanatory Notes Attached Table (cont.)

	Test item specified in standard method	Test condition \ Name and standards No. of hose	Air brake hose (JASO M 301-77)	Water hose (JASO M 302-76)	Fuel rubber hose (JASO M 316-80)	Blow-by gas hose (JASO M 318-78)	Brake vacuum hose (JASO M 320-77)	Air condition hose (JASO M 321-77)	Power steering hose (JASO M 326-80)	Hydraulic brake hose (JIS D 2601-77)
Hose Performance Test	Repeated press. & vibration test	No. of pressure applications cpm		2						
		Circulating fluid fluid		Water & ethylene glycol 50:50				R12 Gas		
		Circulating fluid temp. °C		95±5						
		Atmospheric temperature °C						100±5 | 60±2		
		Testing time h		250				100		
	Rotating fatigue test	Applied pressure kgf/cm²								16-18
		Rotational speed rpm								800±10
		Circular motion radius mm								$100^{+2.5}_{0}$
		Hose free length mm								200-600
		Slack mm								Specified by hose free length
	Expansion test	Pressure application speed kgf/cm²/min.							1,750±700	1,750±700
		Applied pressure kgf/cm²							80 90 105	70 | 105
	End fitting gauge insertion test	–	Gage insertion or steel ball by 2 kgf/cm² air pressure							Gage insertion
Rubber Ply Physical Tests	Tension test	–		○		○				○
	Hardness test	–		○		○				
	Aging test	Ageing temperature °C		120±1		Inside surface rubber 100±1 | Outside surface rubber 120±1			Rubber ply physical test shall be by agreement between the parties concerned.	
		Aging time h				70^{+2}_{0}				
	Immersion test	Immersion	No. 3 Oil	Water & ethylene glycol 50:50 No.1 oil	Fuel oil / No. 3 oil	No. 3 oil		No. 3 oil		Working fluid (Decided by parties concerned)
		Immersion temperature °C	100±1	Boiling | 100±1	40±1 / 100±1	100±1		100±1		70±5
		Immersion time h	70^{+2}_{0}	70	48^{+1}_{0} / 70^{+2}_{0}	70^{+2}_{-0}		70		96

Remarks: 1. ○ mark indicates there is specification for test item.
2. Numerical values indicate specified value of test condition.

Explanatory Notes Attached Table

	Test item specified in standard method	Test condition \ Name and standards No. of hose	Air brake hose (JASO M 301-77)	Water hose (JASO M 302-76)	Fuel rubber hose (JASO M 316-80)	Blow-by gas hose (JASO M318-78)	Brake vacuum hose (JASO M 320-77)	Air condition hose (JASO M 321-77)	Power steering hose (JASO M 326-80)	Hydraulic brake hose (JIS D 2601-77)
Hose Dimension Measurement	Inside diameter measurement	–	○	○	○	○	○	○	○	○
	Outside diameter measurement	–						○		
	Wall thickness measurement	–		○	○	○				
	Length measurement	–	○		○	○	○	○	○	
Hose Performance Test — Pressure withstanding test	Hydraulic press. test	Applied pressure kgf/cm²	1 → 14	1 | 5 | 3	0.5 | 2 | 5			45 | 22.5	As table	200 → 300 | 210
		Applied time min.	within 1	0.5-5 (length change measured)	0.5-5			5 (length change measured)	2	1 → 2 1
	Bursting test	Pressurizing speed kgf/cm²/min.	70	Agreement between persons concerned.			70	70	1,750±700 70±15	1,750±700
	Air pressure test	Applied pressure kgf/cm²	14			1		30 | 15		
		Applied time min.	3			3		5		
	Vacuum test	Applied pressure mmHg		−100	−250	Decide from among −50, −150, −660	−660	−610	−400 (Only 2 class)	
		Applied time min.		5	0.5	0.5	5	2	2	
	Low temperature test (A) (B)	Method	(A)	(B)	(A)	(A)	(A)	(A)	(A)	(A)
		Cooling temperature °C	−40±3	-30^{0}_{-5}	−30±2	−30±2	−35±2 | −40±2	-30^{+2}_{0}	−40±2 | −30±2	-40^{0}_{-5}
		Cooling time h	70^{+2}_{0}	Above 5 " 10 min.	5	$5^{+0.5}_{0}$	70	5 with refrigerant sealed in)	24^{+1}_{0}	70
		Bending diameter (A) mm	Specified from hose inside diameter		10 times hose outside diameter	Specified hose inside diameter	Same as left	4 times hose outside diameter	8 times hose outside diameter	Specified hose inside diameter
		Compressibility (B) %		50						
	Ozone deterioration test (A) (B) (C)	Method	(A)	(A) (B) (C)	(A) (B)	(A) (C)	(C)	(A)	(A) (B)	(A)
		Deteriorating time h	70^{+2}_{0}	70	70^{+2}_{0}	70^{+2}_{0}	70^{+2}_{0}	70	70^{+2}_{0}	70
		Bending diameter (A) mm	8 times hose outside diameter	Same as left (Standard)	5 times hose outside diameter		8 times hose outside diameter	6 times hose outside diameter	7 times hose outside diameter	8 times hose outside diameter (Std.)
		Elongation ration (B) %		20					20	
		Inside diameter expansion (C)		Insert round bar 1.2 times larger	Decided by parties concerned	Insert round bar 1.2 times larger				
	Adhesion test (A) (B) (C)	Method	(A)	(A)	(A)	(C)	(A)		(A)	
		Peeling speed mm/min.	25-30	25	25±1.5	25	25		25±1.5	
		Immersion liquid				Fuel oil O				
		Immersion temperature °C				40±1				
		Immersion time h				$5^{+0.5}_{0}$				
	Bending test	–					○			
	Tensile test	Tensile speed mm/min.	25-30					25	30±2	About 30
	Heat aging test (A) (B) (C) (D)	Method	(A)	(B) (C)	(A)	(A)	(A)	(A)		
		Aging temperature °C	100±1	120±1	120±1	120±1	100±1	120±5 | 100±5		
		Aging time h	70^{+2}_{0}	70	70^{+2}_{0}	70^{+2}_{0}	70^{+2}_{0}	168		
		Bending diameter (A) (C) m	Specified from hose inside diameter	Bend 90°C	Specified from hose inside diameter	Same as left	Same as left	8 times hose outside diameter		
		Compressibility (B) %		50						
	Meadium sealed aging test									
	Salt water spray test	Spraying time h	24					24	24^{+1}_{0}	24
	Repeated pressure test	Oil temperature °C						100±5	135±2 | 120±2	
		Atmospheric temperature °C						100±5	100±10	
		Cycles cpm						35-70	30-40	
		Pressure raising time s							0.2±0.1	
		High press. holding time s							0.65±0.2	
		Pressure lowering time s							0.2±0.1	
		Pressure kgf/cm²						0^{+30}_{-0} | 0^{+15}_{-0}	Specified by working press.	
		Test oil							Decided by parties concerned.	
	Repeated press. & vibration test	Method		Repeated press. & vibration				Repeated press. & vibration		
		No. of vibration cpm		1,000				30		
		Amplitude mm		8				3.2		
		Pressure kgf/cm²		$0^{+1.5}_{-0.2}$				30 | 50		

In the event of any doubt, the original
standards in Japanese should be referred.

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