TOYOTA ENGINEERING STANDARD

NO. : TSM7100G

TITLE : GENERAL TEST METHOD FOR POLYURETHANE FOAMS

CLASS : C1

Established/Revised : Rev.8(Dec.2004)

This standard has been revised in consequence of the following changes:
(1) a statement has been added that conformance to prohibitions and restrictions for substances of environmental concern in TSZ0001G is required.
(2) terms and explanations have been changed in part.

Engineering Information
Planning Dept.
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TOYOTA MOTOR CORPORATION

TOYOTA ENGINEERING STANDARD | TSM7100G | CLASS C1

GENERAL TEST METHOD FOR POLYURETHANE FOAMS

1. Scope

This standard covers a general method for testing polyurethane foams (hereinafter referred to as "foams") to be used mainly for automotive seat pads and safety pads. The parts made of materials provided by this standard shall conform to prohibitions and restrictions for substances of environmental concern in TSZ0001G. Exempt uses specified by EU ELV Directive shall conform to the latest version of the Directive.

2. Classification of Test

The test shall be classified as shown in Table 1, according to its purpose and characteristics.

Table 1

Classification	Aim	Item to be measured (characteristic)
Density test	Density	Apparent density
Hardness test	Hardness	25% and 50% hardnesses
	Humidity dependence of hardness	25% hardness change rate
Compression load test	Deflection	Load-deflection curve and CI-value
	Damping characteristics	Static spring constant, microdisplacement spring constant, and hysteresis loss
Stress relaxation test	Stress relaxation characteristics	Stress relaxation rate
Tensile test	Strength	Tensile strength and elongation percentage
Tear test		Tear strength
Impact resilience test	Impact strength	Impact resilience
Compression set test	Durability	Compression set after heat resistance and humidity resistance
Repeated compression test		Compression set after repeated compression and change rates of 25% and 50% hardnesses
Temperature and humidity cycle test		Compression set after repeated heating, cooling, and humidification cycles
Thermal aging test		Change rates of tensile strength and elongation percentage
Wet heat aging test		Change rates of tensile strength and elongation percentage
Adhesive property test	Adhesive property	Adhesive strength
Staining test	Staining	Degree of staining
Permeability test	Permeability	Permeability
Odor test	Odor	Strength and degree of discomfort, nature of odor (pungent/fishy)
Fogging test	Fogging	Fogging rate
Flammability test	Flammability	Burning velocity

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3. General Test Conditions

3.1 Test Room Standard Conditions

The standard conditions of the test room shall be a temperature of 23 ± 2℃ and relative humidity of 50 ± 5%. If these temperature and humidity conditions are unavailable, the temperature and humidity used in the test shall be noted in the test results.

3.2 Preparation and Treatment of Test Specimens

Unless otherwise specified, sample a test specimen from a relatively thick portion at the center of the product[1]. Test specimens shall be sampled from products manufactured at least 24 h earlier[2]. Then, before testing, leave them to stand for at least 6 h[3] in the test room maintained under the standard conditions specified in Section 3.1.

Note: (1)

It is permitted to use a test mold only to prepare seat pad foam materials if the raw material is of the same composition (and the same density) as the product and foamed under the same conditions as used for the product. Sizes of test molds may be as shown in Table 2.

Table 2

---	Mold size (mm)			
	Cushion		Back	
	Thickness	Width × Length	Thickness	Width × Length
Standard	100	400 × 400	70	400 × 400
Others	30, 70, 150, 180	400 min. × 400 min.	30, 100	400 min. × 400 min.

Note: (2)

Inspect hourly changes in the hardness of seat pad foam materials immediately after molding to ensure that their hardness becomes stable within 24 h. Aging conditions shall be determined in consideration of annual changes in the operating environment (climatic changes between summer and winter). Instructions are specified elsewhere for seat pad foam materials that take 24 h or more for hardness to stabilize.

Note: (3)

Inspect hourly changes in the hardness of seat pad foam materials immediately after placing under standard conditions to ensure that their hardness becomes stable within 6 h. Instructions are specified elsewhere for seat pad foam materials that take 6 h or more for hardness to stabilize.

3.3 Test Specimens

Shapes, sizes, and quantities of test specimens are specified in Table 3 for each test.

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Table 3

Classification				Shape/size[6] (width × length)	Quantity	Skin, with/without[7]
Density test				100 × 100 mm; Thickness: 30 mm or 50 mm	3 min.	Both
Hardness test	ILD[3]			Larger than a circle 300 mm or more in diameter. Thickness shall be the same as product.	2 min.	With skin
	CLD[3]			100 × 100 mm; Thickness: 30 mm or 50 mm		Both
Compressive load test	ILD			Same as hardness test		With skin
	CLD					Both
Stress relaxation test						With skin
Tensile test	①			See Fig. 1. Thickness: 10 mm	4 min.	Both
	②			Dumbbell No. 5 specified in JIS K 6251 or ISO 37; Thickness: 10 mm		
Tear test	①			See Fig. 2. Thickness: 10 mm		
	②			Angular shape without notch, specified in JIS K 6252 or ISO 34-1; Thickness: 10 mm		
Impact resilience test				100 × 100 mm; Thickness: 30 mm or 50 mm	3 min.	
Compression set test				50 × 50 mm; Thickness: 30 mm		
Repeated compression test				100 × 100 mm or 50 × 50 mm; Thickness: 30 mm or 50 mm	2 min.	
Temperature and humidity cycle test				Same as compression set test	3 min.	Without skin
Thermal aging test				Same as tensile test	4 min.	Both
Wet heat aging test	Tensile					
	Hardness			Same as hardness test	2 min.	
Adhesive property test				25 × 150 mm; Thickness: 5 to 10 mm	4 min.	-----
Staining test				25 × 30 mm; Thickness: 13 mm	1 min.	With skin
Permeability test				180 × 180 mm; Thickness: 25 mm	3 min.	Both
Odor test				100 × 100 mm; Thickness: 20 mm	2 min.	With skin
Fogging test	Seat foam[8]	Method A	Solid material	φ65 × 40 mm	3 min.	Without skin
			Compound material	See Fig. 3.		With skin
		Method B	Solid material	φ80 × 40 mm		Without skin
			Compound material	See Fig. 3.		With skin
	Others	Method A	Solid material	50 × 100 mm; Same thickness as product (report)		Without skin
			Compound material			With skin
		Method B	Solid material	φ80 × same thickness as product (report)		Without skin
			Compound material			With skin
Flammability test				350 × 100 × 12 mm	5 min.	

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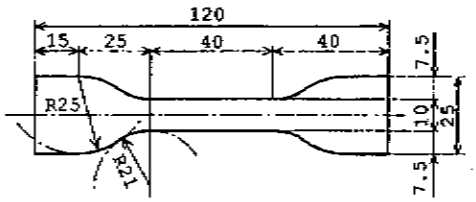

Fig. 1 (Unit: mm)

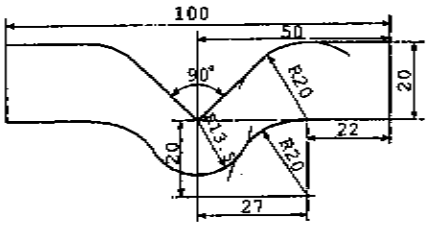

Fig. 2 (Unit: mm)

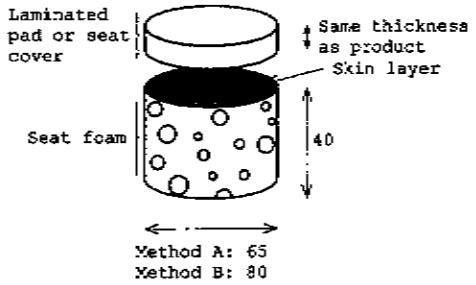

Fig. 3 (Unit: mm)

Note:(4)
ILD: Indentational Load Deflection
Note:(5)
CLD: Compression Load Deflection
Note:(6)
Where two thicknesses are specified, use the greater one in preference to the smaller one. Note the thickness in the test results to indicate which of the two was used.
Note:(7)
Skin layer conditions apply to the surface of foam material in contact with the lower mold at the time of molding.
Note:(8)
Center arm rest and headrest are included.

3.4 Arrangement of Test Results

Average the data obtained from the specified quantity of test specimens, and record the result. Use special formats for odor, fogging, and flammability tests.

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4. Test Method

4.1 Density Test

Measure the width, length, and thickness of the test specimen with a scale, vernier calipers, dial gage, and the like, while taking care not to deform the test specimen. Calculate its volume. Measure its mass and calculate the density by the following equation (1).

$\rho = W/V$ ------- (1)

where,

ρ: density (g/cm^3)

W: specimen mass (g)

V: specimen volume (cm^3)

4.2 Hardness Test

4.2.1 25% and 50% Hardnesses

Place the test specimen on a plate[9] that has many holes 6 mm in diameter bored at center distances of 19 mm so as to remove the air from the test specimen with ease. Depress the test specimen downward with a compression disk 200 mm in diameter, using an Instron-type compression tester equipped with an automatic recorder. To obtain ILD, use test specimens whose sizes are larger than a circle 300 mm in diameter and depress at the center of the test specimens (see Table 3). For CLD, use 100 × 100-mm test specimens (see Table 3) and depress all over the top surface. Apply a preload of 4.9 N to the test specimen for ILD and 1.5 N for CLD. Measure the test specimen's thickness[10] and record the result as the initial thickness. Following the above procedure, move the circular compression disk down by 75%[11] of the initial thickness at a rate of 50 mm/min. Immediately after this, return the compression disk to its initial position at the same rate of 50 mm/min. After holding the disk for 1 min at this position, move it down by 25% of the initial thickness and hold it at that position for 20 s. Read the load. Then continue to move it down to 50% of the initial thickness and hold it for 20 s. Read the load. Take the first and second results for the 25% and 50% hardnesses, respectively. Express these hardnesses in N/314 cm^2 for ILD, and in N/100 cm^2 for CLD.

Note: (9)
The shape and dimensions of the plate is shown in Fig. 4. Use the plate, ii, shown in Fig. 4 for seat pad foam materials formed in a test mold, unless otherwise specified.

Note: (10)
Measure the thickness at the center of the disk. Note the initial thickness in the test result.

Note: (11)
If it is difficult to compress the disk by 75%, re-determine the compression rate through discussion among departments concerned.

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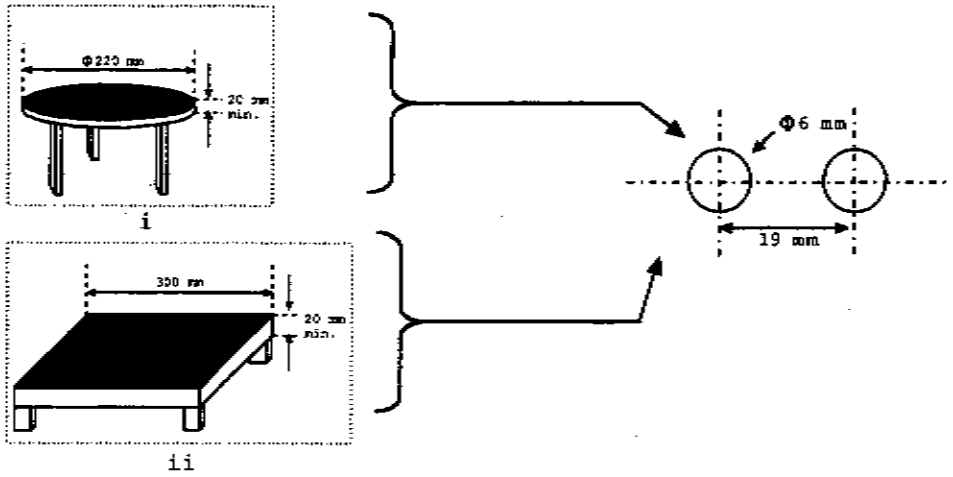

Fig. 4

4.2.2 25% Hardness Change Rate

Leave test specimens to stand in the three environments specified in Table 4 for 24 h continuously. Then, measure 25% hardnesses immediately, as specified in Section 4.2.1. Next, obtain 25% hardness percentages of the test specimens conditioned under relative humidities of 30% (condition 1), 50% (condition 2), and 70% (condition 3) using the 25% hardness determined in a 23℃ and 50% RH environment as the reference standard. Use the equations (2), (3), and (4) below for calculation. If it is difficult to set relative humidity to 30%, a relative humidity of 40% may be used as condition 1.

$$x_{(30)} = (\text{25\% hardness at 30\% RH}) / (\text{25\% hardness at 50\% RH}) \times 100 \quad \text{--- (2)}$$

$$x_{(50)} = (\text{25\% hardness at 50\% RH}) / (\text{25\% hardness at 50\% RH}) \times 100 \quad \text{--- (3)}$$

$$x_{(70)} = (\text{25\% hardness at 70\% RH}) / (\text{25\% hardness at 50\% RH}) \times 100 \quad \text{--- (4)}$$

where,

$x_{(30)}$ = 25% hardness percentage in 23℃ and 30% RH environment (%)

$x_{(50)}$ = 25% hardness percentage in 23℃ and 50% RH environment (%)

$x_{(70)}$ = 25% hardness percentage in 23℃ and 70% RH environment (%)

Further, plot a graph of 25% hardness percentages versus relative humidities at 23℃, obtained above, as shown in Fig. 5. Determine 25% hardness change rate from the slope of the regression line by obtaining the 25% hardness change rate per point in relative humidity at 23℃. If the reliability, R (RSQ), of the regression line is 0.99 or below, test results shall be discarded. If R is 0.99 or below, determine the humidty condition through actual measurement, and use the measured value for the horizontal axis of each plot.

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Table 4

	Condition 1	Condition 2	Condition 3
Temperature (℃)	23 ± 2		
Relative humidity (%)	30 (40) ± 5	50 ± 5	70 ± 5

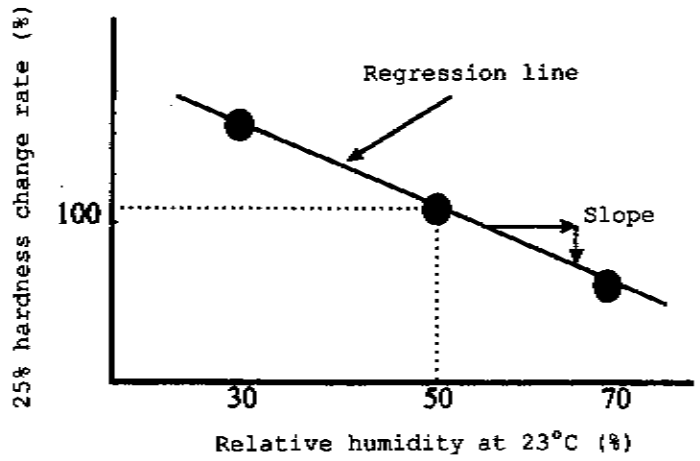

Fig. 5

4.3 Compression Load Test

Place the test specimen on the plate provided with many small holes in the same manner as in Section 4.2.1. Apply a preload and measure the initial thickness with the 200-mm diameter disk attached to the Instron-type compression tester, as specified in Section 4.2.1. Following the procedure above, move the disk down by 75% of the initial thickness at a rate of 50 mm/min. Then, immediately, remove the load to relieve the test specimen to its initial thickness and leave to stand for 1 min. Repeat the same sequence. At the third compression, record the hysteresis loop, as shown in Fig. 6. Calculate the CI-value, static spring constant[12], and hysteresis loss using the following equations (5), (6), and (7). Compress the test specimen again as the fourth cycle, during which the load shall be lifted in a prescribed load range. Apply the load again to record a local hysteresis loop, as shown in Fig. 7 (lift the load at point b and reapply at point c). Calculate the microdisplacement spring constant[12] by the equation (8).

Note: (12)
Plot deflections on the axis of abscissas to obtain static spring and microdisplacement spring constants, as shown in Figs. 6 and 7.

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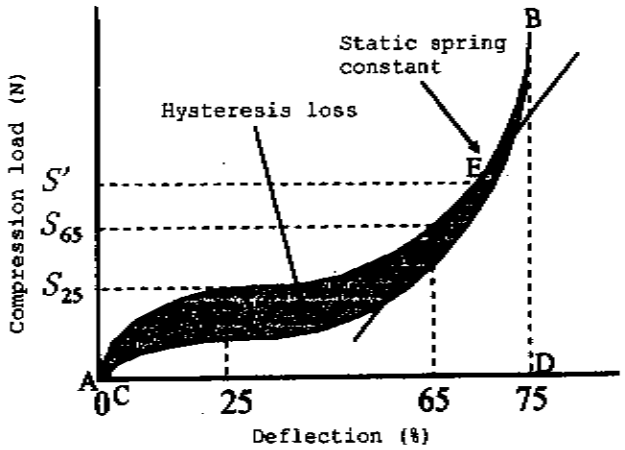

Fig. 6

Calculation of CI-value:

CI = S_{65}/S_{25} -------- (5)

where,

CI: Comfort Index

S_{65}: load required for 65% compression (N)

S_{25}: load required for 25% compression (N)

Calculation of hysteresis loss:

Hysteresis loss (%) = (Area of figure ABC)/(Area of figure ABD) × 100 ---- (6)

Reference: Calculation of static spring constant

Static spring constant at compression load S' (N/cm) = Slope of approximate line drawn near point E on line AB ----- (7)

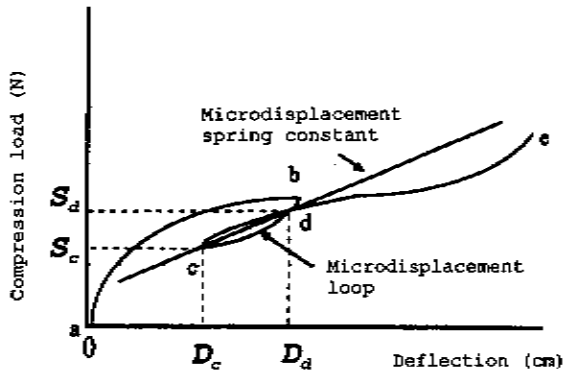

Fig. 7

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Calculation of microdisplacement spring constant

$K_{Sc\text{-}Sb} = (S_d - S_c)/(D_d - D_c)$ ----- (8)

where,

$K_{Sc\text{-}Sb}$: microdisplacement spring constant in prescribed load range S_c - S_b (N/cm)

S_c: load at lowest end of microdisplacement loop (N)

S_d: load at highest end of microdisplacement loop (N)

D_c: deflection at lowest end of microdisplacement loop (cm)

D_d: deflection at highest end of microdisplacement loop (cm)

4.4 Stress Relaxation Test

Place the test specimen on the plate provided with many small holes in the same manner as in Section 4.2.1. Apply a preload and measure the initial thickness with the 200-mm diameter disk attached to the Instron-type compression tester, as specified in Section 4.2.1. Following the procedure above, move the disk down by 75% of the initial thickness at a rate of 50 mm/min. Then, immediately, remove the load to relieve the test specimen to its initial thickness and leave to stand for 1 min. Apply the load again, and stop the disk when a load of 196 N has been reached. Read the load after leaving the specimen for 5 min and 1 h, and determine stress relaxation rate using the equations (9) and (10).

Calculation of stress relaxation rate after 5 min

$\alpha_5 = (F_0 - F_5)/F_0 \times 100$ ---------- (9)

where,

α_5: Stress relaxation rate (%)

F_0: Load at the stop of disk (N/314 cm^2) (= 196 N/314 cm^2)

F_5: Load after leaving the specimen for 5 min (= N/314 cm^2)

Calculation of stress relaxation rate after 1 h

$\alpha_5 = (F_0 - F_{60})/F_0 \times 100$ ---------- (10)

where,

α_5: Stress relaxation rate (%)

F_0: Load at the stop of disk (N/314 cm^2) (= 196 N/314 cm^2)

F_{60}: Load after leaving the specimen for 1 h (= N/314 cm^2)

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4.5 Tensile Test

Draw 40 mm distant gage marks accurately and clearly at the center of the parallel section of the test specimen. Clamp the test specimen by the chucks (chuck distance: 80 to 90 mm) of the Instron type tensile tester, taking care not to deform the test specimen. Apply tension to it at a rate of 200 mm/min until it breaks. Measure the maximum load and gage length at the time of fracture. Determine the tensile strength and elongation percentage, using the following equations (11) and (12):

$T_B = F/(W \times t)$ ----- (11)

where,

T_B: tensile strength (kPa)

F: maximum load to fracture (N)

W: width of test specimen (cm)

t: thickness of test specimen (cm)

$E_B = (I_1 - I_0)/I_0 \times 100$ ----- (12)

where,

E_B: elongation percentage (%)

I_0: gage length before test (mm)

I_1: gage length at breakage (mm)

4.6 Tear Test

4.6.1 Method A

Clamp the test specimen by the chucks set at a distance of 40 mm using the tensile tester specified in Section 4.5. Apply tension to the test specimen at a rate of 200 mm/min until it breaks. Measure the load at the time of fracture. Determine the tear strength by the equation (13).

$T_R = F/t$ ----- (13)

where,

T_R: tear strength (N/cm)

F: maximum load to fracture (N)

t: thickness of test specimen (cm)

4.6.2 Method B

Make a 40 mm long slit in the test specimen as illustrated in Fig. 8. Clamp the test specimen by the chucks set at a distance of 40 mm with the tensile tester specified in Section 4.5. Apply tension to the test specimen at a rate of 200 mm/min until it breaks. Determine the maximum load at the time of fracture. Take this load for the tear strength (N/25 mm).

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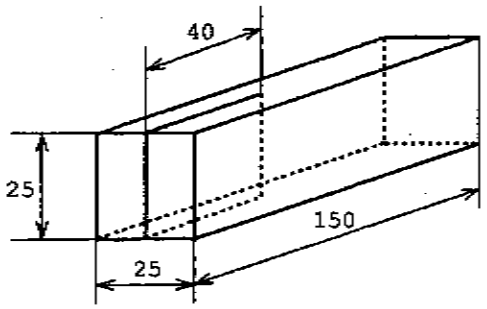

Fig. 8 (Unit: mm)

4.7 Impact Resilience Test

Compress the test specimen preliminarily 10 times with the palm of the hand to a depth of approximately 75% of the thickness of the test specimen. Leave it to stand for at least 1 min. Drop a steel ball[13] by gravity from an elevation of 460 mm above the test specimen. Measure the maximum vertical height of rebound. (Be sure to place the test specimen on a horizontal base.) Determine the impact resilience by the equation (14).

$R = D_1/D_0 \times 100$ ------ (14)

where,

R: impact resilience (%)

D_0: free fall distance of steel ball (mm)

D_1: maximum vertical height of rebound (mm)

Note: (13)
The diameter and mass of the steel ball shall be 16 mm and 16.29 g.

4.8 Compression Set Test

4.8.1 Compression Set after Heat Resistance

Compress the test specimen 10 times preliminarily with the palm of the hand to the depth of approximately 75% of its thickness. Leave it to stand for at least 1 min. Measure the thickness of the specimen accurately, as specified in Section 4.1. Compress the test specimen to 50% of its thickness using two parallel compression plates made of metal. Hold this state[14] and heat the test specimen in a thermostatic chamber controlled at 70 ± 2℃ for 22 h continuously. Then, take the test specimen out of the thermostatic chamber and remove the compression plates immediately. Measure the thickness after leaving the test specimen for 30 min in an environment specified in Section 3.1[15]. Determine the compression set by the following equation (15).

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$C = (t_0 - t_1)/t_0 \times 100$ ----- (15)

where,

C: compression set (%)

t_0: initial thickness of test specimen (mm)

t_1: thickness of test specimen after test (mm)

Note: (14)
Clearance between test specimens shall be at least 25 mm.
Note: (15)
Take care to prevent condensation on the surfaces of test specimens by placing paper or rag on a wooden table.

4.8.2 Compression Set after Humidity Resistance

Comply with Section 4.8.1. For this test, however, use a thermo-hygrostatic chamber controlled at a temperature of 50 ± 2℃ and a relative humidity of 95 ± 5%, in place of 70 ± 2℃ thermostatic chamber.

4.9 Repeated Compression Test

Measure the initial thickness of the test specimen with a scale, vernier calipers, dial gage, and the like, while taking care not to deform the test specimen. Measure the 25% and 50% CLD hardnesses of the test specimen as specified in Section 4.2.1. After the measurement, place the test specimen between the parallel flat plates of the compression tester. Compress the test specimen by 50% of its thickness 80000 times consecutively at a rate of 60 times a minute. After 80000 times of compression, remove the test specimen from the tester and leave it to stand for 30 min. Then, measure its thickness. Then, after leaving the test specimen again for 24 to 48 h, measure its 25% and 50% CLD hardnesses. Calculate the repeated compression set and the CLD hardness change rate by the following equations (16) through (18).

$C = (t_0 - t_1)/t_0 \times 100$ ----- (16)

where,

C: repeated compression set (%)

t_0: initial thickness of test specimen (mm)

t_1: thickness of test specimen after test (mm)

$P_{25} = (H_{25-0} - H_{25-1})/H_{25-0} \times 100$ ----- (17)

where,

P_{25}: 25% CLD hardness change rate (%)

H_{25-0}: 25% CLD hardness before test (N/100 cm^2)

H_{25-1}: 25% CLD hardness after test (N/100 cm^2)

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$P_{50} = (H_{50-0} - H_{50-1}) / H_{50-0} \times 100$ ----- (18)

where,

P_{50}: 50% CLD hardness change rate (%)

H_{50-0}: 50% CLD hardness before test (N/100 cm^2)

H_{50-1}: 50% CLD hardness after test (N/100 cm^2)

4.10 Temperature and Humidity Cycle Test

Expose the test specimen three times to the conditions specified in Table 5. Test it as specified in Section 4.8.1. Then, determine the compression set.

Table 5

Sequence	1	2	3	4
Condition	Thermostatic chamber 80 ± 2℃	Room temperature	Cold chamber -30 ± 2℃	Room temperature
Time (h)	15.5	0.5	7.5	0.5
Sequence	5	6	7	8
Condition	Thermo-hygrostatic chamber 50 ± 2℃ 95 ± 5%RH	Room temperature	Cold chamber -30 ± 2℃	Room temperature
Time (h)	15.5	0.5	7.5	0.5

4.11 Thermal Aging Test

Age the test specimen thermally in a thermostatic chamber controlled at 80 ± 2℃ for 400 h. Leave it to stand at room temperature for at least 6 h. Then, conduct a tensile test, as specified in Section 4.5. Measure the tensile strength and elongation percentage. Calculate change rates of tensile strength and elongation percentage resulting from the thermal aging test, by the equations (19) and (20).

$C_T = (T_1 - T_0) / T_0 \times 100$ ----- (19)

where,

C_T: change rate of tensile strength (%)

T_0: tensile strength before aging (kPa)

T_1: tensile strength after aging (kPa)

$C_E = (E_1 - E_0) / E_0 \times 100$ ----- (20)

where,

C_E: elongation percentage change rate (%)

E_0: elongation percentage before aging (%)

E_1: elongation percentage after aging (%)

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4.12 Wet Heat Aging Test

4.12.1 Tensile Strength and Elongation

Comply with Section 4.11. For this test, however, use a thermo-hygrostatic chamber controlled at a temperature of 50 ± 2℃ and a relative humidity of 95 ± 5%, in place of 80 ± 2℃ thermostatic chamber.

4.12.2 Hardness

Dry the test specimen in a thermostatic chamber controlled at 80 ± 2℃ for 3 h. Leave it to stand at room temperature for at least 6 h. Then, measure its 25% and 50% hardnesses, as specified in Section 4.2. Next, heat and compress the test specimen for 3 h in an autoclave controlled at a temperature of 103 to 108℃ and vapor pressure of 7.4 to 27.4 kPa. Remove the test specimen from the autoclave. Dry it in a thermostatic chamber controlled at a temperature of 80 ± 2℃ for 3 h. After leaving the test specimen to stand at room temperature for at least 6 h, measure its 25% and 50% hardnesses, as specified in Section 4.2. Indicate the results in hardness change rates, as in Section 4.9.

4.13 Adhesion Property Test

Cut test specimens 10 mm in thickness, 25 mm in width, and 150 mm in length out of the product including the product skin. Peel the skin from the foam by approximately 50 mm. Separate the skin from the foam at a rate of 200 mm/min using the tensile tester specified in Section 4.5. Obtain the maximum, minimum, and mean effective loads. Indicate the adhesion strength (N/25 mm) by the average of mean effective loads. The product skin and adhesive shall be determined separately, through discussions among parties concerned.

4.14 Staining Test

Insert the test specimen between two 50 × 50 mm plates to be stained[16], as illustrated in Fig. 9. Place a weight 500 g in mass on them and leave to stand in a thermostatic chamber controlled at a temperature of 80 ± 2℃ for 72 h. Remove the plates from the thermostatic chamber. Investigate the degree of staining.

Note: (16)
The plates to be stained are specified elsewhere as agreed upon by the parties concerned.

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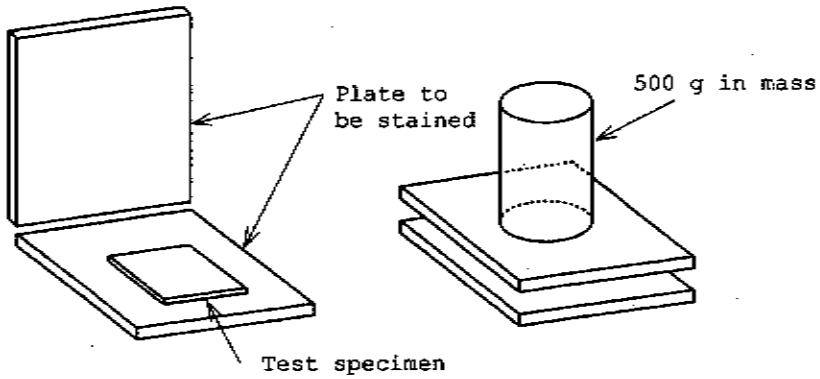

Fig. 9

4.15 Permeability Test

Attach the test specimen to one end of the cylinder of a permeability tester[17], as shown in Fig. 10. Adjust the suction fan with a rheostat so that the tilting type pressure gage reads 124.5 Pa Aq. Determine the air volume ($mL/cm^2 \cdot s$) passing through the test specimen from the pressure indicated by the vertical type pressure gage and the type of the air orifice used, referring to the calculation table supplied with the tester.

Note: (17)
It is permissable to use a different type of permeability tester. The test method and the units of the test data shall then be clearly noted.

Ex.: ASTM D1564-71; Unit: L/min

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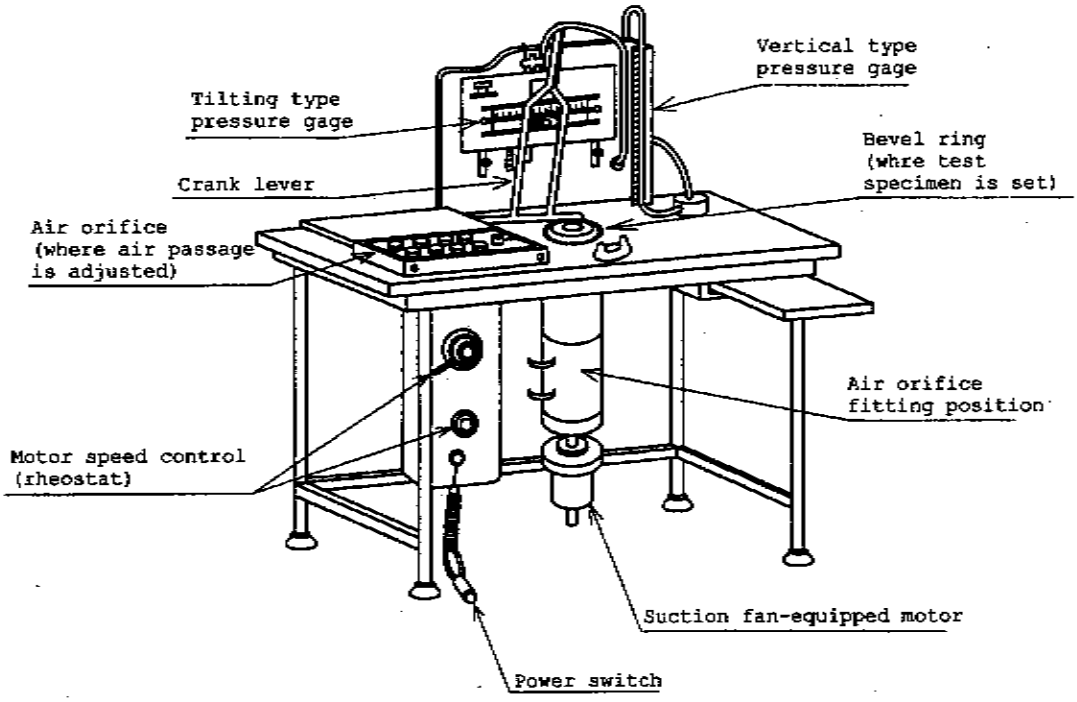

Fig. 10

4.16 Odor Test

Comply with TSM0505G. However, the temperature shall be 80℃.

4.17 Fogging Test

Comply with TSM0503G. For this test, however, the temperature shall be 80℃ and the time shall be 20 h for solid materials and 72 h for compound materials.

4.18 Flammability Test

Comply with TSM0500G.

Established/ 8 Revised:
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Applicable Standards

TSM0500G	Flammability Test Method for Interior Non-Metallic Materials
TSM0503G	Fogging Test Method for Non-Metallic Materials
TSM0505G	Test Method for Smell of Non-Metallic Materials
TSZ0001G	Control Method for Substances of Environmental Concern
ISO 34-1	Rubber, Vulcanized or Thermoplastic -- Determination of Tear Strength -- Part 1: Trouser, Angle and Crescent Test Pieces
ISO 37	Rubber, Vulcanized or Thermoplastic -- Determination of Tensile Stress-Strain Properties
JIS K 6251	Rubber, Vulcanized or Thermoplastic -- Determination of Tensile Stress-Strain Properties
JIS K 6252	Rubber, Vulcanized or Thermoplastics -- Determination of Tear Strength

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Dec.2004

TSM 71006 TMC

FILE COPY

TECHNICAL INSTRUCTION SHEET

NUMBER 01304-9A003-

1. PROTOTYPE (2. MASS PRODUCTION)

TITLE

from E. Peiffer on June 22nd, 01

TIS, 028W 2" BALL HARDNESS TEST → Non Destructive test

APPLICATION RANGE (VEHICLE OR ENGINE)

APPLIES TO HEADRESTS FOR 028W PADS.

This is for 028W program → Need TMC to issue similar TIS sheet for 483N to address H/R and A/R

T'burg → needs to generate correlation data

SUMMARY

INSTRUCTIONS FOR MEASURING HARDNESS.

S M S	ISS	REVISION RECORD	E.C. NO.	DATE	REVISER
	/	NEW ADOPTION	028WB0093	91593	JN

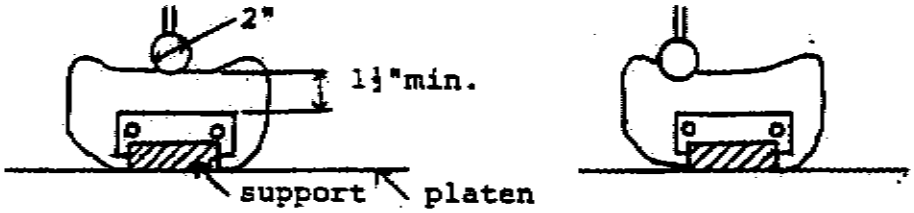
INVOLVED DEPTS	APPROVED	APPROVED	CHECKED	DRAWN	STAFF CODE
K. Otsuka 10/1/93	H. Hata Oct. 14 '93		10-15-93	10-1-93	TU200

HISTORY

DISTRIBUTION	QTY				
22M	1	PED	1		
MED	1	TMC 28B	1	TOTAL	4

TECHNICAL INSTRUCTION SHEET		NUMBER 01304-9A003-		
ISS	REVISION RECORD	E.C. NO.	DATE	REVISER
/	NEW ADOPTION	028WB0093	91593	JN

One preferred test method for headrests utilizes a 2" (50.8mm) diameter test ball which requires only a small test area. The test area must be well supported by means of foam design or a support fixture. It is important that the test area be chosen so that the ball uniformly indents the foam (Figures 1 and 2) and a minimum of 1½" (38mm) of foam exists directly below the test location.



correct test location
Figure 1

incorrect test location
Figure 2

The test is performed as follows:

1. The test ball is positioned above the test area of the sample (Figure 3) on the load cell as indicated on the drawing.

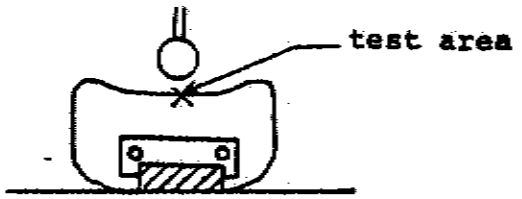


Figure 3

2. A 0.2# (0.1kg) load is applied to the sample and a reference point is determined (Figure 4).

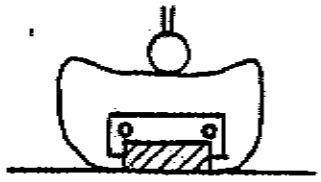


Figure 4

TECHNICAL INSTRUCTION SHEET	NUMBER 01304-9A003-		

ISS	REVISION RECORD	E.C. NO.	DATE	REVISER
/	NEW ADOPTION	028WB0093	9/15/93	JW

3. From the reference point, the sample is deflected ½" (12.7mm) and the load ceil is allowed to stabilize for 5 seconds (Figure 5).

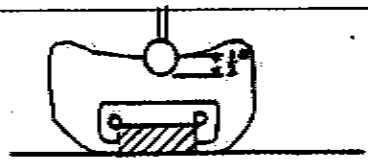


Figure 5

4. After the 5 second delay, a direct reading of the residual force is obtained.

Providing the test area meets the minimum thickness requirement and the test area is adequately supported, this test method is generally repeatable.