



NES

Nonmetallic Gasket Materials for Automobiles

M 7076

Revised 1996

1. SCOPE

This Standard specifies nonmetallic gasket materials (hereafter referred to as gasket) for automobiles. However, the Standard does not apply to the following items: composite gasket which is used along with cylinder head gasket, fiber, rubber filled with no cork, asbestos and other mixed materials.

Remarks: The units and numerical values given in { } in this Standard are based on the traditional unit system and are appended for informative reference.

2. TYPE

The gasket material is classified into three types II, III and IV according to their main material composition, as shown in Table 1.

Table 1

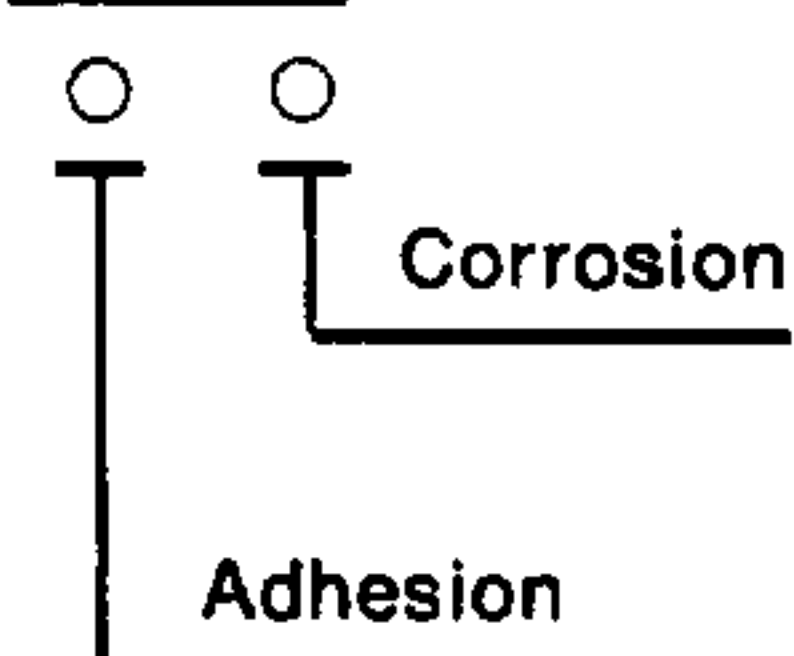
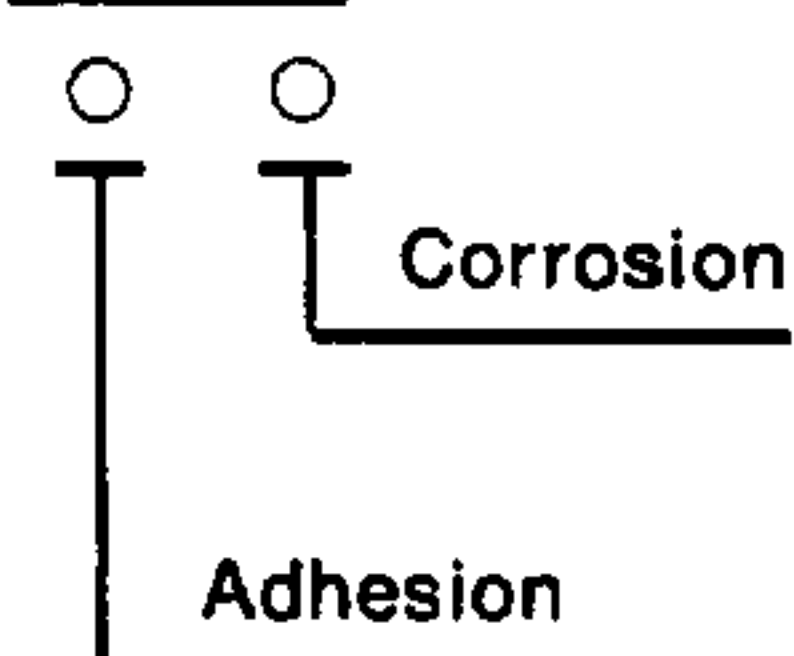
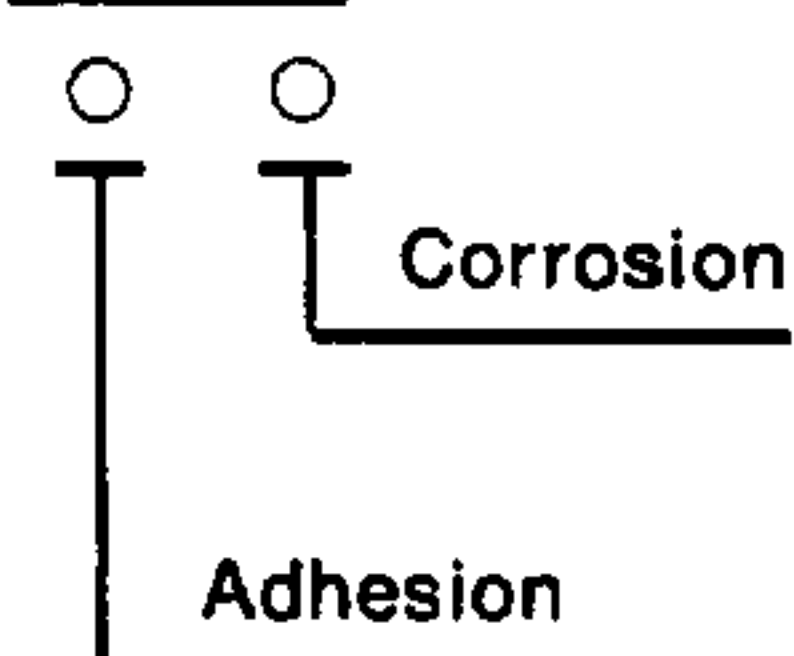
Type	Main Material	Designation ⁽¹⁾	Application Example
Type II	Cork	Cork & rubber	Oil pan
Type III	Cellulose or Organic fiber	Vulcanized fiber	
		Cellulose fiber (untreated)	
		Cellulose fiber (protein treated)	Oil seal retainer
		Cellulose fiber (rubber treated)	Oil strainer, oil pump
Type IV	Organic or inorganic fiber and these mixed materials	Joint sheet	Fuel pump, AAC valve, throttle chamber, intake manifold, oil pump, oil strainer, clutch housing, water pump, water inlet, water outlet, thermo housing
		Beater sheet	Oil pan
		Mill board	

Note ⁽¹⁾: Designation of gasket materials

1. Cork and rubber: Is a sheet gasket material made by mixing, kneading, heating, and pressurizing cork particles, with selected grain size, with a rubber compound.
2. Tag paper: Is a strong sheet gasket material with good bending resistance paper, i.e. manila paper, kraft paper, or vellum paper.
3. Chip board: Is paperboard made of used newspapers.
4. Vulcanized fiber: Is a sheet gasket material made of paper, i.e. cotton fiber or kraft pulp, treated with zinc chloride solution.
5. Cellulose fiber: Is a sheet gasket material made of paper, i.e. cotton fiber or kraft pulp, treated with protein or rubber.
6. Joint sheet: Is a dense gasket material made by mixing organic fiber, inorganic fiber, or these mixed materials with rubber, using the heating and pressurizing process.
7. Beater sheet: Is a sheet gasket material made by mixing organic fiber, inorganic fiber, or these mixed materials with rubber latex as a binder through the sanding method and the beater process.
8. Mill board: Is a sheet gasket material made of organic or inorganic fiber, and made by the sanding method, using a heat resistance binder.

Applicable and Reference Standards: See page 21.

Table 3 Supplementary Symbols

Symbols	Characteristic																																				
A9 (Sealing performance)	Per agreement between concerned parties																																				
B1 - B9 (Creep relaxation)	Creep relaxation after 22 hrs. shall not exceed the following values ⁽⁴⁾ B1 10% B4 25% B7 50% B2 15% B5 30% B8 60% B3 20% B6 40% B9 Specified separately ⁽²⁾																																				
D00 - D99 (Adhesion and corrosion resistance)	Adhesion shall not exceed the first figure of D and corrosion shall not exceed the second figure of D. Refer to Tables 16 and 17 for the criteria. <table><tr><th colspan="2">Adhesion</th><th colspan="2">Corrosion</th><th colspan="2">Example</th></tr><tr><td>D0</td><td>Not specified</td><td>D0</td><td>Not specified</td><td>D0</td><td></td></tr><tr><td>D1</td><td>1</td><td>D1</td><td>1</td><td></td><td></td></tr><tr><td>D2</td><td>2</td><td>D2</td><td>2</td><td></td><td></td></tr><tr><td>D3</td><td>3</td><td>D3</td><td>3</td><td></td><td></td></tr><tr><td>D9</td><td>Specified separately ⁽²⁾</td><td>D9</td><td>Specified separately ⁽²⁾</td><td></td><td></td></tr></table>	Adhesion		Corrosion		Example		D0	Not specified	D0	Not specified	D0		D1	1	D1	1			D2	2	D2	2			D3	3	D3	3			D9	Specified separately ⁽²⁾	D9	Specified separately ⁽²⁾		
Adhesion		Corrosion		Example																																	
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D1	1	D1	1																																		
D2	2	D2	2																																		
D3	3	D3	3																																		
D9	Specified separately ⁽²⁾	D9	Specified separately ⁽²⁾																																		
M1 - M9 (Tensile strength)	The test result shall be numerical value specified with each M symbol or more. (Minimum) ⁽⁴⁾ M1 0.7 MPa {7 kgf/cm ² } M6 13.7 MPa {140 kgf/cm ² } M2 1.8 MPa {18 kgf/cm ² } M7 20.6 MPa {210 kgf/cm ² } M3 3.4 MPa {35 kgf/cm ² } M8 27.4 MPa {280 kgf/cm ² } M4 6.9 MPa {70 kgf/cm ² } M9 Specified separately ⁽²⁾ M5 10.3 MPa {105 kgf/cm ² }																																				
S9 (Volume change in No. 1, No. 3, and fuel B)	Per agreement between concerned parties																																				
T (Flexibility)	No cracking																																				
Z (Other characteristics)	Per agreement between concerned parties.																																				

Example: F326139 B7 D11 M6

Tensile strength 13.7 MPa {140 kgf/cm²} min.

No adhesion or corrosion

Creep relaxation is 50% max.

Table 6 Type III Characteristics Table

Symbol	Basic characteristics ⁽⁵⁾				Supplementary characteristics ⁽⁶⁾				Reference characteristics ⁽⁷⁾		Material	
	Compressibility		Oil resistance No. 3 oil, 25 ± 5°C x 22h		Anti-freeze resistance 100 ± 2°C x 5h	Sealing per- formance A	Tensile strength M min. MPa {kgf/ cm ² }	Fuel resistance S Fuel B, 25 ± 5°C x 22h		Recovery (min.) %		Anti-freeze resistance 100 ± 2°C x 5h
	Surface pressure MPa {kgf/ cm ² }	Compres- sion %	Thickness increase %	Weight increase (max.) %	Weight increase (max.) %			Thickness increase %	Weight increase (max.) %			
F311000	6.9 {70}	0 - 10	—	—	—	—	41.2 {420}	—	—	70	—	Vulcanized fiber
F312000	6.9 {70}	5 - 15	—	—	—	—	29.4 {300}	—	—	60	—	
F313000	6.9 {70}	10 - 20	—	—	—	—	10.3 {105}	—	—	50	—	Tag paper
F314000	6.9 {70}	15 - 25	—	—	—	—	10.3 {105}	—	—	50	—	
F315000	6.9 {70}	20 - 30	—	—	—	—	5.2 {53}	—	—	40	—	Chip ball ⁽³⁾
F325138	6.9 {70}	20 - 30	0 - 15	20	100	—	13.7 {140}	5	20	40	35	Cellulosic fiber (pro- tein treat- ment)
F326128	6.9 {70}	25 - 40	0 - 15	15	100	—	13.7 {140}	5	15	40	30	
F326138	6.9 {70}	25 - 40	0 - 15	20	100	—	13.7 {140}	5	20	40	35	
F333135	6.9 {70}	10 - 20	0 - 15	20	40	—	29.4 {300}	15	30	25	20	Cellulosic fiber (rubber treatment)
F334126	6.9 {70}	15 - 25	0 - 15	15	60	—	34.3 {350}	15	20	25	20	
F335127	6.9 {70}	20 - 30	0 - 15	15	80	—	24.5 {250}	3	20	48	30	
F335136	6.9 {70}	20 - 30	0 - 15	20	60	—	21.6 {220}	15	30	40	30	
F335147	6.9 {70}	20 - 30	0 - 15	40	80	—	10.3 {105}	10	25	35	30	
F335167	6.9 {70}	20 - 30	0 - 15	20	80	—	10.3 {105}	10	25	35	30	Cellulosic fiber (rubber treatment)
F336146	6.9 {70}	25 - 40	0 - 15	30	60	—	18.6 {190}	5	20	50	30	

Remarks: Other test items than those specified in Table 6 shall be determined by agreement between the concerned parties.

6. NOTATIONS
In case of the gasket material shown in the drawings, the classified symbols of gasket material is described.

7. TESTING METHOD

7.1 Classification of testing method
The classification of testing methods is divided into eight categories shown in Table 8 in principle and also applicable examples as reference.

Table 8

Classification of gasket materials			Classification of testing methods												
			Thickness measurement	Compression test	Immersion test				Leakage test	Creep relaxation test	Adhesion, Corrosion test	Tension test	Flexibility test		
Number of method of testing item	Applicable example (for reference)	Type II	F220000 system	F310000 system	F320000 system	F330000 system	F410000 system	F420000 system	F430000 system	○	○	○	○	○	
		Type III	○	○	○	○	○	○	○	○	○	○	○	○	○
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Remarks: ○ mark shall perform test, (○) mark shall perform test according to if necessary only, X mark shall not perform test.

7.2 Test conditions

7.2.1 Standard condition of testing room

The standard temperature of testing room is $25 \pm 5^\circ\text{C}$ in principle. And the test results must be recorded with test temperature and humidity.

7.2.2 Pre-treatment of specimen

The specimen shall perform test without delay after performing pretreatments in principles as follows:

- (1) Type II
The specimen shall release as it is for 46 hours and over in a testing room or an air-tight container circulated slowly air having $25 \pm 5^\circ\text{C}$ temperature and relative humidity 50 to 55% therein.
- (2) Type III
The specimen shall dry in an air-tight container holding at $25 \pm 5^\circ\text{C}$ temperature with drying agent in preliminary. Air in the air-tight container must be slowly circulated. Therefore it is transferred in a testing room or an air-tight container holding at $25 \pm 5^\circ\text{C}$ temperature and 50~55% relative humidity and shall be released as it is for 20 hours and over. Air in the testing room or the air-tight container must be circulated in the same manner.
- (3) Type IV
Leave the specimen in the furnace at a temperature of $100 \pm 2^\circ\text{C}$ for one hour, and then cool it in the desiccator at a temperature of $25 \pm 5^\circ\text{C}$.

Remarks: If it is difficult to maintain 50 to 55% relative humidity mechanically, it is better to place on the pan saturated solution of magnesium nitrate [$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$]. If the measurement performs at a place without the specified humidity, the specimen shall be taken out from the container one by one in case of need.

7.2.3 Sampling of specimen

The specimen shall be taken from a suitable rectangular sheet and indicated the fiber-direction thereof with an arrow mark. More than three pieces of specimens for each testing item shall be prepared.

7.2.4 Rules for rounding off of test result numerical values

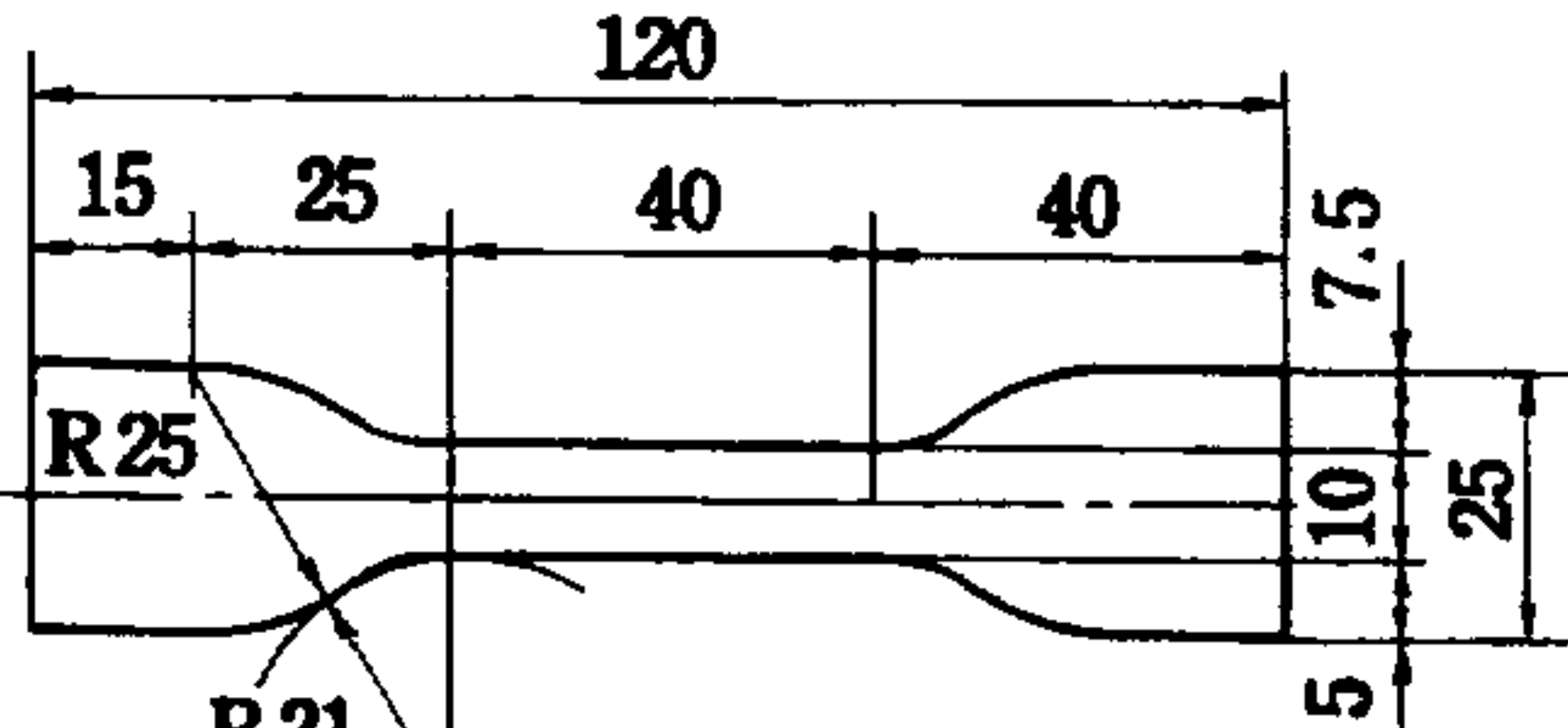
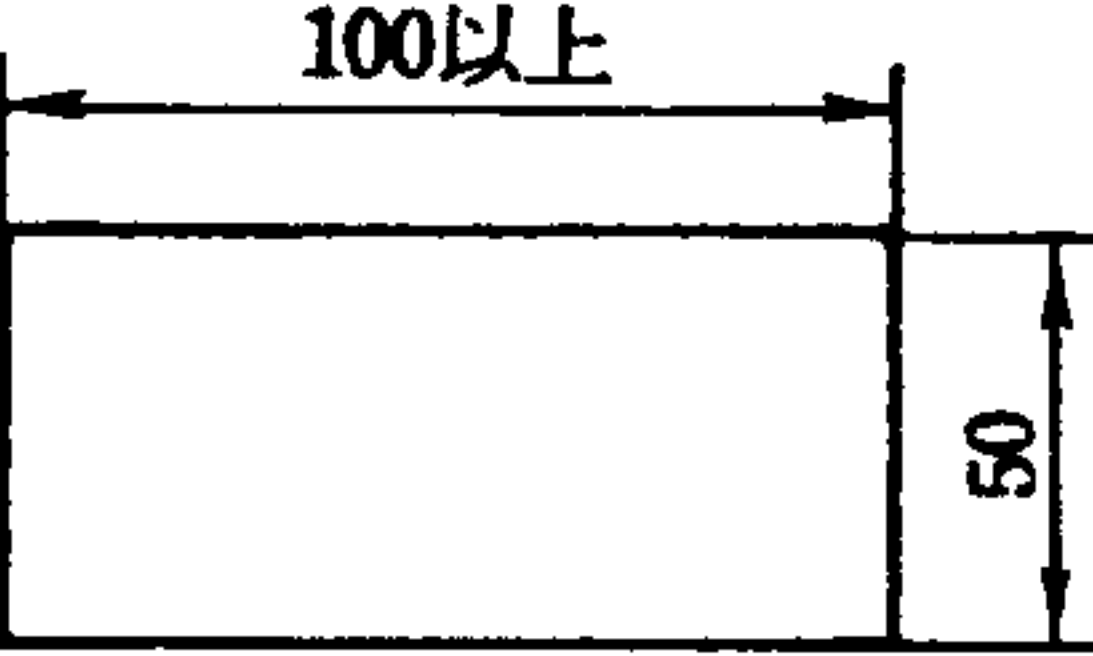
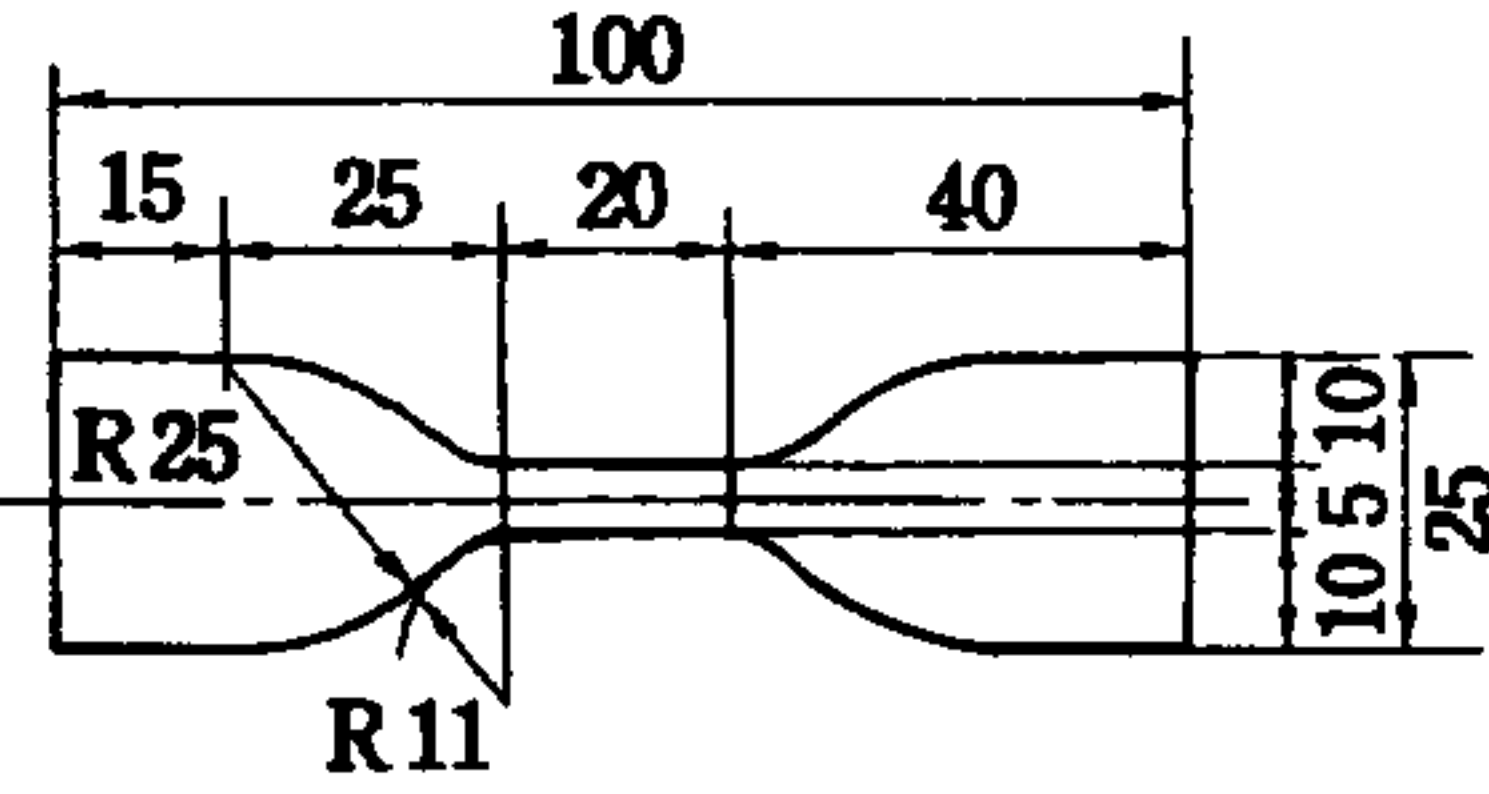
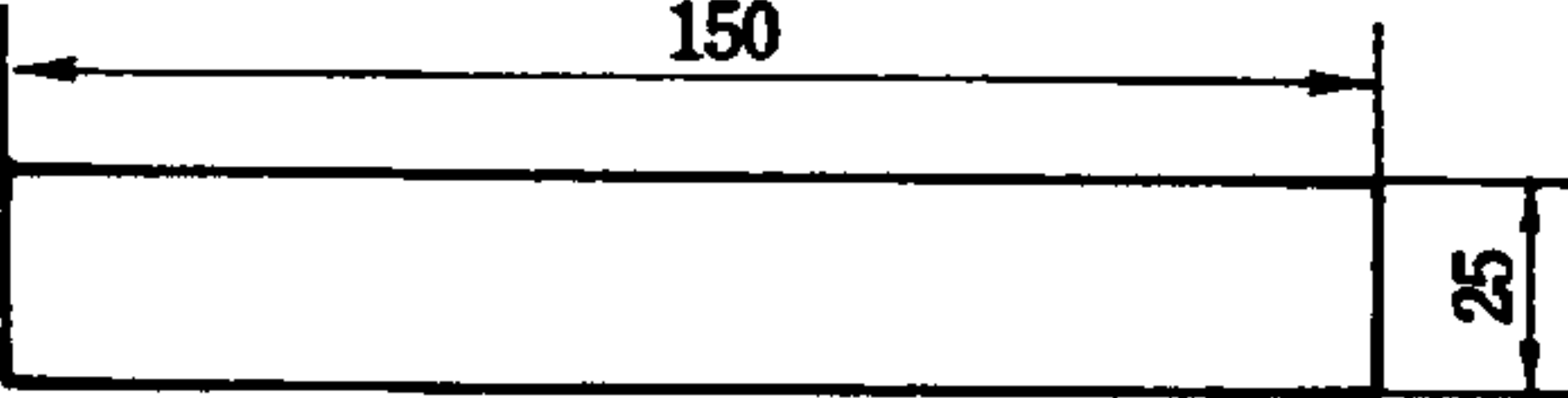
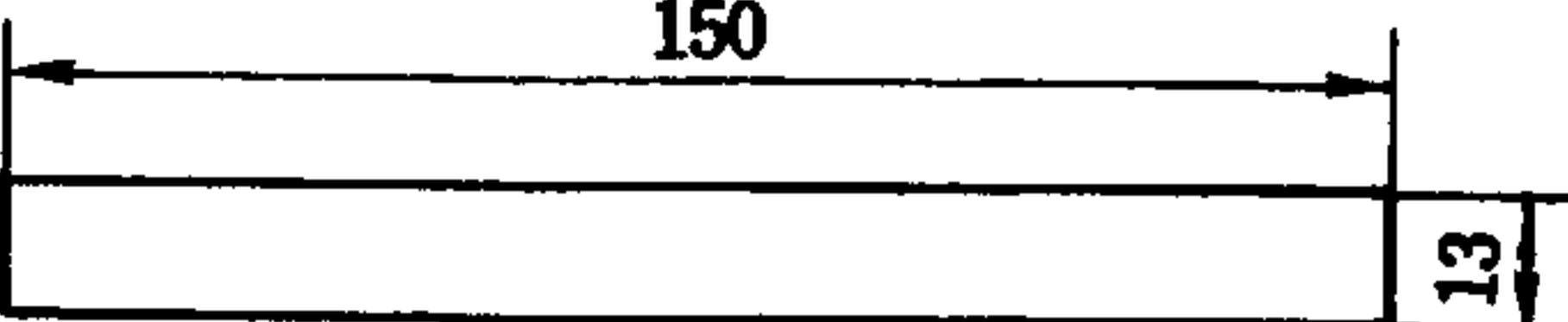
Rules for rounding off of test result numerical values shall be given in JIS Z 8401 (Rules for rounding off of numerical values).

7.3 Specimen

7.3.1 Classification of specimen

Classification of specimen shall conform to the Table 9.

Table 9

Unit: mm			
Classification	Shape · Dimension	Applied test	Remark
No. 1 specimen		Tension (Type II and IV)	Correspond to 3.2 of JIS K 6301
No. 2 specimen	Rectangle width 50 mm x length 100 mm Min. 	Tension (Type II)	
No. 3 specimen		Tension (Type IV)	Correspond to 3.2 of JIS K 6301
No. 4 specimen	Rectangle width 25 mm x length 150 mm 	Tension (Type III and IV)	Punching along with fiber direc- tion of sample
No. 5 specimen	Rectangle width 13 mm x length 150 mm 	Flexibility (Type II and IV)	Punching along with fiber direc- tion of sample

7.4 Thickness measuring method

7.4.1 Objective

To measure thickness of gasket.

7.4.2 Equipment

Dial thickness gauge: Equivalent to JIS B 7503 (Dial gauges) (Use the diameter of measuring rod in 6.4 ± 0.1 mm and diameter of anvil is larger than the diameter of measuring rod).

7.4.3 Specimen

Material of gasket

7.4.4 Test condition

The total load being charged on the measuring rod is as follows:

Type II 1.13 ± 0.196 N {115 $\pm$ 20 gf}

Type III 1.77 ± 0.196 N {180 $\pm$ 20 gf}

Type IV 2.55 ± 0.196 N {260 $\pm$ 20 gf}

7.4.5 Procedure

- (1) The specimen is placed on the anvil of dial thickness gauge and charged the specified load and held for about five seconds, thereafter the scale of dial shall be read up to the second decimal place (0.01 mm).
- (2) The above operations shall be performed at different five portions of specimen and found the mean value thereof.

7.4.6 Report

Record the test result in mm and round off the values to the nearest whole number to the second place of decimal.

7.5 Compression test method

7.5.1 Objective

To measure the compression rate and recovery of gasket material.

7.5.2 Equipment

Compression testing machine

Remarks: The conditions of testing machine that should be possessed are as follows:

1. Anvil (base plate): Diameter 32 mm and over and is finished by face quenching and grinding.
2. Penetrator (compression plate): Round bar which is end face quenching and grinding and the diameters thereof are given in Table 11. The tolerance of diameters are ± 0.02 mm.
3. Measuring device of thickness: It indicates the thickness of specimen at measuring and is measured by the dial gauge equivalent to JIS B 7503.
4. Preliminary load: It is the weight of penetrator itself and the added necessary load which must be within the $\pm 1\%$ range of the values shown in Table 11 in total.
5. Pressure loading device: The principal load is to add to the preliminary load and the method of loading may be applied by one of dead load, water pressure or air pressure. The principal load must be within $\pm 1\%$ range of values shown in Table 11.

7.5.3 Specimen

No. 6 specimen. Three pieces. But the thickness of specimens shall conform to Table 10.

Table 10 Thickness of Specimen

Unit: mm

Classification	Thickness ^(a)
Type II	3.0 and over
Type III	1.5 and over
Type IV	1.5 and over

Note ^(a): The specimens are piled up so as to become specified thickness.

7.6.2 Equipment

- (1) Constant temperature controlled chamber
- (2) Testing container: Glass container shall be used. In case of fear of volatilization of testing fluid, the test tube shall be used attached with a reflex cooler.

7.6.3 Specimen

To gain the thickness increase rate, the weight increase rate and the volume changing rate, No. 10 specimen is used, and to gain the decrease rate of tensile strength, the same kind of specimen as used in tensile strength test shall be used.

7.6.4 Test condition

The immersion conditions shall conform to Table 12. The oil specified in the items, 4.4.1 and 4.4.2 of JIS K 6258, and 12.3.1 of JIS K 6301, shall be used as test oil. The antifreeze shall be solution of LLC 50% (volume) as specified in NES M 5059 (Engine Antifreeze).

Table 12 Immersion Condition

Immersion fluid		No. 1 oil	No. 3 oil	Fuel B	Antifreeze
Classification	Type II	100 ± 2°C 70h	100 ± 2°C 70h	25 ± 5°C 22h	100 ± 2°C 5h
	Type III		25 ± 5°C 22h	25 ± 5°C 22h	100 ± 2°C 5h
	Type IV		150 ± 2°C 5h	25 ± 5°C 5h	100 ± 2°C 5h

Remarks: The specimens shall be separately immersed in different containers. Immersing operations shall be performed in the place out of direct rays of sun. Further, immersing fluid shall be renewed at each testing.

7.6.5 Procedure

- (1) In the case of gaining thickness increase rate (Type III, IV).
 - 1) Thickness of the specimen before immersing shall be measured according to the item 7.4 (Measuring method of thickness).
 - 2) A specimen after measuring its thickness shall be put into the test container filling test liquid, corked lightly or equipped with reflux cooling pipe at need, the test liquid shall be held in air bath or liquid bath to become conditioned as in Table 12.
 - 3) After finishing immersion, the specimen is cooled immersed in the new testing fluid of same kind for 30 to 60 minutes. And then the excess testing fluid is taken off from the specimen by suitable method ⁽⁹⁾.
 - 4) After taking off excess testing fluid, thickness of the specimen is measured at the same point before immersion without delay, according to the paragraph 7.4, and the thickness increase rate shall be gained by following equation.

$$\text{Thickness increase rate (\%)} = \frac{d_2 - d_1}{d_1} \times 100$$

where, d_1 : Thickness before immersion (mm)

d_2 : Thickness after immersion (mm)

Note ⁽⁹⁾: In the case of testing fluid having low viscosity and large volatility, the excess fluid shall be lightly wiped off with filter paper and in case of testing fluid having high viscosity and small volatility, the specimen shall be immersed in a suitable volatile fluid such as acetone and taken out immediately and then the excess fluid shall be lightly wiped off with filter paper.