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**Automotive parts—Rubber cups for
hydraulic braking cylinders using a
non-petroleum base hydraulic brake fluid**

ICS 43.040.40 ; 83.140.50

Reference number : JIS D 2605 : 2005 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Auto Parts Industries Association (JAPIA)/ Japanese Standards Association (JSA), with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS D 2605:1998** is replaced with this Standard.

This revision has been made based on **ISO 4928:1980** *Road vehicles—Elastomeric cups and seals for cylinders for hydraulic braking systems using a non-petroleum base hydraulic brake fluid (service temperature 120 degrees C max.)* and **ISO 6118:1980** *Road vehicles—Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic brake fluid (service temperature 70 degrees C max.)* for the purpose of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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Automotive parts—Rubber cups for hydraulic braking cylinders using a non-petroleum base hydraulic brake fluid

Introduction This Japanese Industrial Standard has been prepared based on the first editions of **ISO 4928** *Road vehicles—Elastomeric cups and seals for cylinders for hydraulic braking systems using a non-petroleum base hydraulic brake fluid (service temperature 120 degrees C max.)* and **ISO 6118** *Road vehicles—Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic brake fluid (service temperature 70 degrees C max.)* published in 1980 with some modification of the technical contents and the items not specified in the corresponding International Standards are complementarily provided (addition of Class 3 in the classification, etc.) as a part of Japanese Industrial Standard.

The portions given with solid lines or dotted underlines are the matters modified from the original International Standards.

A list of modifications with explanations is given in Annex 1 (informative).

1 Scope This Standard specifies moulded rubber cups and seals for master and wheel cylinders for automotive hydraulic brake systems using a non-petroleum-base brake fluid (hereafter referred to as “cup”).

Remarks : The International Standard corresponding to this Standard are follows:

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 4928 : 1980 *Road vehicles—Elastomeric cups and seals for cylinders for hydraulic braking systems using a non-petroleum base hydraulic brake fluid (service temperature 120 degrees C max.)* (MOD)

ISO 6118 : 1980 *Road vehicles—Elastomeric cups and seals for hydraulic brake actuating cylinders using a non-petroleum base hydraulic fluid (service temperature 70 degrees C max.)* (MOD)

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 7502 *Micrometer callipers*

JIS D 2603 *Automotive parts—Hydraulic brake master cylinders for hydraulic brake systems using a non-petroleum base hydraulic brake fluid*

JIS G 3141 *Cold-reduced carbon steel sheets and strips*

JIS G 3303 *Tinplate and blackplate*

JIS G 5501 *Grey iron castings*

JIS H 2201 *Zinc alloy ingots for die casting*

JIS H 3100 *Copper and copper alloy sheets, plates and strips*

JIS H 4000 *Aluminium and aluminium alloy sheets and plates, strips and coiled sheets*

JIS K 2228 *Rubber lubricant of non-petroleum base for motor vehicle brake systems*

JIS K 2233 *Non-petroleum base motor vehicle brake fluids*

Remarks: **ISO 4925 : 1978** *Road vehicles—Non-petroleum base brake fluid* is equivalent to the said standard.

JIS K 2503 *Testing method of lubricating oil for aircraft*

JIS K 2839 *Glasswares for testing apparatus of petroleum products*

JIS K 6250 *Rubber—General rules of physical testing methods*

JIS K 6251 *Rubber, vulcanized or thermoplastic—Determination of tensile stress-strain properties*

Remarks: **ISO 37 : 1994** *Rubber, vulcanized or thermoplastic—Determination of tensile stress-strain properties* is equivalent to the said standard.

JIS K 6253 *Hardness testing methods for rubber, vulcanized or thermoplastic*

Remarks: **ISO 48 : 1994** *Rubber, vulcanized or thermoplastic—Determination of hardness (hardness between 10 IRHD and 100 IRHD)* is equivalent to the said standard.

JIS K 6257 *Rubber, vulcanized or thermoplastic—Determination of heat ageing properties*

Remarks: **ISO 188 : 1998** *Rubber, vulcanized or thermoplastic—Accelerated ageing and heat resistance tests* is equivalent to the said standard.

JIS K 6258 *Rubber, vulcanized or thermoplastic—Determination of the effect of liquids*

Remarks: **ISO 1817 : 1999** *Rubber, vulcanized—Determination of the effect of liquids* is equivalent to the said standard.

JIS K 6262 *Permanent set testing methods for rubber, vulcanized or thermoplastic*

Remarks: **ISO 815 : 1991** *Rubber, vulcanized or thermoplastic—Determination of compression set at ambient, elevated or low temperatures* is equivalent to the said standard.

JIS R 6253 *Waterproof abrasive papers*

JIS Z 8401 *Guide to the rounding of numbers*

3 Classification

Cups shall be classified as given in table 1.

Table 1 Classification of cup

Division	Symbol	Application
Class 1	—	Suitable for operation at an ordinary temperature
Class 2	H	Suitable for operation at a high temperature
Class 3	S	Suitable for operation at an extra high temperature

Information : Application corresponding to Class 3 is not specified in International Standard.

4 Quality

4.1 Appearance The cup surface shall be well finished, and free from harmful blisters, flaws, burrs, foreign matters and the like.

4.2 Performance The performance of cups, when tested according to clause 6, shall meet the requirements given in table 2.

Table 2 Performance of cup

Item		Division			Test method
		Class 1	Class 2	Class 3	
Original state	Hardness (informative)	A 60 ± 5, A 65 ± 5, A 70 ± 5 or A 80 ± 5			According to 6.1
Aging property	Temperature ⁽¹⁾ °C	70 ± 2	120 ± 2	150 ± 2	According to 6.2
	Duration ⁽¹⁾ h	120 ± 2	70 ± 2		
	Hardness change (not mandatory)	A -5 to + 5			
	Condition	Cups shall be free from excessive tackiness and apparent abnormalities.			
Fluid resistance	Temperature ⁽¹⁾ °C	70 ± 2	120 ± 2	150 ± 2	According to 6.3
	Duration ⁽¹⁾ h	120 ± 2	70 ± 2		
	Test fluid ⁽¹⁾	Test fluid conforming to JIS K 2233			
	Volume change %	0 to 16		0 to 20	
	Lip diameter change %	0 to 5.75		0 to 5.75	
	Base diameter change %	0 to 5.75		0 to 5.75	
	Hardness change (not mandatory)	A -10 to 0		A -15 to 0	
	Condition	Cups shall be free from excessive tackiness and apparent abnormalities.			
Precipitation	Temperature ⁽¹⁾ °C	70 ± 2	120 ± 2	150 ± 2	According to 6.4
	Duration ⁽¹⁾ h	120 ± 2	70 ± 2		
	Test fluid ⁽¹⁾	The fluid conforming to JIS K 2233			
	Precipitation amount vol %	0.3 max.			
Metal corrosion	Temperature ⁽¹⁾ °C	70 ± 2	100 ± 2		According to 6.5
	Duration ⁽¹⁾ h	120 ± 2	120 ± 2		
	Test fluid ⁽¹⁾	The fluid conforming to JIS K 2233			

Table 2 (continued)

Item				Division			Test method
				Class 1	Class 2	Class 3	
Metal corrosion	Metal strips	Mass change mg/cm ²	Tinned iron	± 0.2			According to 6.5
			Steel	± 0.2			
			Aluminium	± 0.1			
			Cast iron	± 0.2			
			Brass	± 0.4			
			Copper	± 0.4			
			Zinc	± 0.4			
		Appearance	There shall not be any pitting or roughened surface discernible to the naked eye. However staining or discoloration is permitted.				
		Precipitation amount	vol %	0.2 max.			
		Base diameter change	% (not mandatory)	0 to 5.75			
	Hardness change	(not mandatory)	A -15 to 0				
	Appearance		There shall be no significant change in shape or surface conditions of rubber.				
Low-temperature resistance	Temperature (1)	°C	-43 to -40			According to 6.6	
	Duration (1)	h	22 ± 1				
	Low-temperature bend		Cups shall not crack and shall return to its approximate original shape within 1 min.				
Low-temperature leakage test	Temperature (1)	°C	-43 to -40			According to 6.7	
	Duration (1)	h	120 ± 2				
	Test fluid (1)		The fluid conforming to JIS K 2233				
	Condition		There shall be no leakage				
Stroking durability	Master cylinder cup	Test fluid (1)	The fluid conforming to JIS K 2233			According to 6.8	
		Temperature (1)	°C	70 ± 2 (fluid) or 70 ± 5 (atmospheric)	120 ± 2 (fluid) or 120 ± 5 (atmospheric) This may be 100 ± 2 (fluid) or 100 ± 5 (atmospheric) upon agreement between the parties concerned with delivery.		120 ± 2 (fluid) or 120 ± 5 (atmospheric)
		Duration (1)	h	120 ± 2	70 ± 2		
		Fluid pressure(1)	MPa	3.5 ± 0.3, but may be 7 ± 0.3 upon agreement between the parties concerned with delivery.	7 ± 0.3		

Table 2 (continued)

Item		Division			Test method											
		Class 1	Class 2	Class 3												
Stroking durability	Master cylinder cup	Condition	a) ~~Not to cause pressure drop due to fluid leakage past the primary or pressure cup.~~			According to 6.8										
			b) There shall not be two or more drops of fluid leakage past the secondary cup of single master cylinder or that of primary piston side of tandem master cylinder.													
			c) The excess over bore after test on the secondary cup of single master cylinder or that of primary piston side of tandem master cylinder shall be as follows:													
			<table><tr><th>Cylinder bore mm</th><th>Excess over bore mm</th></tr><tr><td>~~19.05~~ or under</td><td>~~0.30 min.~~</td></tr><tr><td>Over ~~19.05~~ to and incl. 25.40</td><td>0.40 min.</td></tr><tr><td>Over 25.40 to and incl. 38.10</td><td>0.50 min.</td></tr><tr><td>Over ~~38.10~~</td><td>0.65 min.</td></tr></table>				Cylinder bore mm	Excess over bore mm	~~19.05~~ or under	~~0.30 min.~~	Over ~~19.05~~ to and incl. 25.40	0.40 min.	Over 25.40 to and incl. 38.10	0.50 min.	Over ~~38.10~~	0.65 min.
			Cylinder bore mm	Excess over bore mm												
	~~19.05~~ or under	~~0.30 min.~~														
	Over ~~19.05~~ to and incl. 25.40	0.40 min.														
	Over 25.40 to and incl. 38.10	0.50 min.														
	Over ~~38.10~~	0.65 min.														
	d) Cups shall be free from harmful deformation, abrasion and other defects.															
e) There shall be no corrosion discernible to the naked eye on the portions of the piston or the cylinder inside wall which were in contact with or adjacent to the cup. But slight staining or discoloration is permitted.																
Hardness change (not mandatory)	A -10 to 0		A -15 to 0													
Wheel cylinder cup	Temperature (1) °C	70 ± 2 (fluid) or 70 ± 5 (atmospheric)	120 ± 2 (fluid) or 120 ± 5 (atmospheric)	150 ± 2 (fluid) or 150 ± 5 (atmospheric)												
	Duration (1) h	120 ± 2	70 ± 2													
	Fluid pressure (1) MPa	3.5 ± 0.5 May be 7 ± 0.3 upon agreement between the parties concerned with delivery.	7 ± 0.3 ~~May be 10 ± 0.5 upon agreement between the parties concerned with delivery.~~													
	Condition	a) Two or more drops of fluid leakage shall not be found at any end.														
		b) The interference after test on cups shall be as follows:														
<table><tr><th>Cylinder bore mm</th><th>Excess over bore mm</th></tr><tr><td>~~19.05~~ or under</td><td>~~0.40 min.~~</td></tr><tr><td>Over ~~19.05~~ to and incl. 25.40</td><td>0.50 min.</td></tr><tr><td>Over 25.40 to and incl. 38.10</td><td>0.65 min.</td></tr><tr><td>Over ~~38.10~~</td><td>0.75 min.</td></tr></table>				Cylinder bore mm	Excess over bore mm	~~19.05~~ or under	~~0.40 min.~~	Over ~~19.05~~ to and incl. 25.40	0.50 min.	Over 25.40 to and incl. 38.10	0.65 min.	Over ~~38.10~~	0.75 min.			
Cylinder bore mm		Excess over bore mm														
~~19.05~~ or under		~~0.40 min.~~														
Over ~~19.05~~ to and incl. 25.40	0.50 min.															
Over 25.40 to and incl. 38.10	0.65 min.															
Over ~~38.10~~	0.75 min.															
c) Cups shall be free from harmful deformation, abrasion and other defects.																
d) There shall be no corrosion discernible to the naked eye on the portions of the portions or the cylinder inside wall which were in contact with or adjacent to the cup, while slight staining or discoloration is permitted.																
Hardness change (not mandatory)		A -10 to 0		A -15 to 0												

Table 2 (concluded)

Item		Division			Test method
		Class 1	Class 2	Class 3	
Storage corrosion	Exposure condition (1)	Taking one cycle as that expose to a temperature of (46 ± 2) °C at (95 ± 2) % humidity for (16 ± 1) h and further expose to a temperature of (21 ± 2) °C at (95 ± 2) % humidity for (8 ± 1) h, repeat it for 12 cycles.			According to 6.9
	Test fluid (1)	A lubricant conforming to JIS K 2228 or lubricant containing mainly non-petroleum base lubricating oil agreed between the parties concerned with delivery.			
	Condition Master cylinder Wheel cylinder	There shall be no corrosion discernible to the naked eye on the portions of the piston or the cylinder inside wall which were in contact with or adjacent to the cup, while slight staining or discoloration is permitted. Corrosion and other abnormalities generated in the portions apart from those in contact with or adjacent to the cup shall not be cause for rejection.			

Note ⁽¹⁾ This item indicates the test condition.

5. **Material properties** The properties of the material used for cups, when tested according to clause 7, should be as given in table 3.

Table 3 Properties of material

Item			Division			Test method
			Class 1	Class 2	Class 3	
Original state	Hardness		A 60 ± 5, A 65 ± 5, A 70 ± 5 or A 80 ± 5			According to 7.1
	Tensile strength	MPa	10 min.			
	Elongation	%	300 min. 200 min. for the material of A70 ± 5 hardness and 130 min. for that of A80 ± 5 hardness			
Aging property	Temperature (1)	°C	70 ± 2	120 ± 2	150 ± 2	According to 7.2
	Duration (1)	h	120 ± 2	70 ± 2		
	Hardness change		A -5 to + 5		A -5 to + 10	
	Tensile strength change (decrease)	%	30 max.	40 max.		
	Elongation change (decrease)	%	30 max.	40 max.		
Compression set	Temperature (1)	°C	70 ± 2	120 ± 2	150 ± 2	According to 7.3
	Duration (1)	h	22 ± 1			
	Compression set	%	30 max.			
Fluid resistance	Temperature (1)	°C	70 ± 2	120 ± 2	150 ± 2	According to 7.4
	Duration (1)	h	120 ± 2	70 ± 2		
	Test fluid (1)		The fluid conforming to JIS K 2233			
	Hardness change		A -10 to 0	A -15 to 0		
	Tensile strength change (decrease)	%	30 max.	40 max.		
	Elongation change (decrease)	%	30 max.	40 max.		
	Volume change	%	0 to 16	0 to 20		

Note ⁽¹⁾ This item indicates the test condition.

6 Test methods

6.1 Original state test (informative)

6.1.1 Test specimen Two cups shall be used for the hardness determination.

6.1.2 Apparatus The apparatus shall be as follows:

- a) The hardness tester shall be a Type A durometer specified in clause 5 of **JIS K 6253**.

Alternatively, a micro size international rubber hardness tester for M method specified in clause 4 of **JIS K 6253** may be used upon agreement between the parties concerned with delivery.

- b) The rubber anvil shall have a hardness in the same range as a cup being tested. An example of the shape is shown in figure 1.



Figure 1 Rubber anvil (example)

6.1.3 Procedure The test procedure shall be as follows:

- a) For determination of type A durometer hardness, with the cup fitted in the rubber anvil, holding the tester vertically, bring the pressing surface of the pressing needle in contact with the cup surface being measured, with the axis of the pressing needle being perpendicular to the measured surface, and immediately read the indicator.
- b) For the hardness determination with the international rubber hardness tester, 4.5.2 of **JIS K 6253** shall be applied.

6.1.4 Expression of test results For the expression of test results, take the medium⁽²⁾ of the values determined at five points to express in a whole number through rounding in accordance with **JIS Z 8401**, as specified in 5.6 or 4.6 of **JIS K 6253**. The average of the values on two cups shall be reported.

Note ⁽²⁾ The value positioning at middle for an odd number of determined values, or the mean of the two middle values for an even number, when they are arranged in order of magnitude.

6.2 Aging test

6.2.1 Test specimen Two cups shall be used as test specimens.

6.2.2 Apparatus The apparatus shall be as follows:

- a) For the test oven, the forced-circulation oven aging tester (cross wind type) speci-

fied in 7.2 of JIS K 6257 shall be used.

b) The hardness tester shall be in accordance with 6.1.2.

6.2.3 Test condition Test condition shall be as given in table 4.

Table 4 Aging test condition

Division	Test temperature °C	Duration h
Class 1	70 ± 2	120 ± 2
Class 2	120 ± 2	70 ± 2
Class 3	150 ± 2	

6.2.4 Procedure The test procedure shall as follows:

- a) **Hardness determination** After measuring the hardness before test (H_0) in accordance with 6.1.3, carry out the test of aging by the method specified in 6.4.2 of JIS K 6257 under the conditions given in table 4, and after the test measure (H_1) by the method similar to before test.
- b) **Condition** After testing according to a), examine the cup surface for stickiness or other abnormalities.

6.2.5 Calculation (informative) The hardness change shall be calculated as follows:

$$A_H = H_1 - H_0$$

where, A_H : change in hardness
 H_1 : hardness before aging
 H_0 : hardness after aging

6.2.6 Expression of test results For the hardness change, express the values obtained from the calculation of 6.2.5 in a whole number, and report the mean value of the two measurements.

6.3 Fluid resistance test

6.3.1 Test specimens Two cups shall be used as test specimens.

6.3.2 Apparatus The apparatus shall be as follows:

- a) **Test oven** Test oven, capable of maintaining the test temperature as given in table 5.
- b) **Test container** Test container, consisting of a weighing bottle and a pressure tight vessel. An example of the configuration and dimensions is shown in figure 2.
- c) **Hardness tester** Hardness tester, being in accordance with 6.1.2.
- d) **Dimension measuring device** Dimension measuring device, which is a reading microscope capable of measuring the cup dimensions to the nearest 1/100 mm, or an instrument at least equal to it.

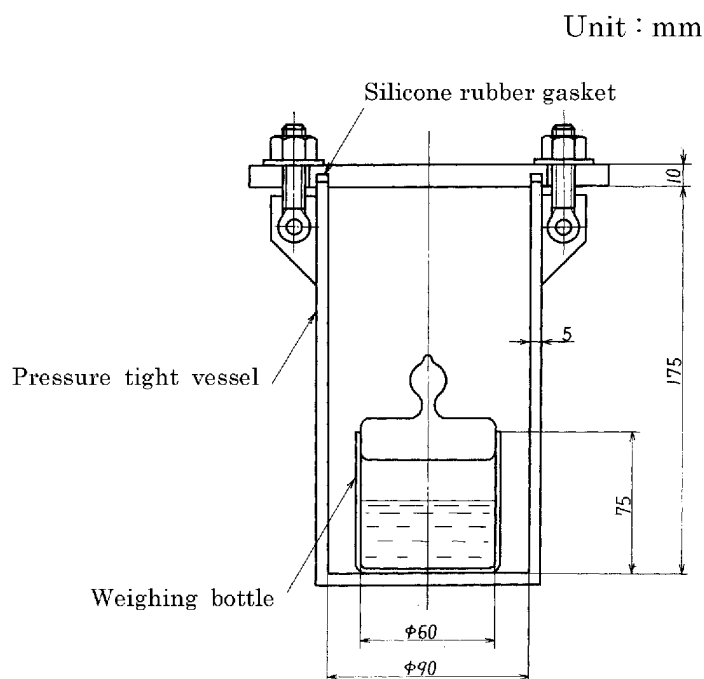


Figure 2 Test container for fluid resistance test (example)

6.3.3 Test conditions Test conditions shall be as given in table 5.

Table 5 Fluid resistance test conditions

Division	Test temperature ℃	Duration h	Test fluid
Class 1	70 ± 2	120 ± 2	The fluid conform- ing to JIS K 2233
Class 2	120 ± 2	70 ± 2	
Class 3	150 ± 2		

6.3.4 Procedure The test procedure shall be as follows:

- a) **Cleansing of specimens** Rinse the specimens in isopropyl alcohol or ethyl alcohol (both hereafter referred to as “alcohol”) to remove adhered dirt, test fluid and the like, and wipe off the alcohol with a dry cloth. In rinsing the specimens, do not leave them in alcohol for more than 30 s.
- b) **Immersion test** Putting each specimen cup into the weighing bottle given in b) of 6.3.2, pour 75 ml of test fluid, cap and place the bottle in the pressure tight vessel. Sealing up the pressure tight vessel, place the vessel in the oven to hold under the conditions given in table 5. After this immersion, place the specimens in new test fluid of the same kind as used above (room temperature) to keep them immersed for a further duration of about 30 min, and then let them cool.
- c) **Determination of volume change** After cleansing by the method of a), weigh the cups in air (m_1) to the nearest 1 mg. Next, weigh the cups immersed in distilled

water at room temperature to gain the apparent mass (m_2), rinse again by **a)**, successively subject to the immersion test of **b)**, after rinse by **a)** immediately weigh each cup in air (m_3), and further weigh it immersed in distilled water at room temperature to gain the apparent mass (m_4).

- d) **Testing for lip and base diameter change** Measure the lip and base diameters before immersion. Next, after carrying out the immersion test of **b)**, measure the lip and base diameters after immersion. For the lip and base diameters, measuring to the nearest 1/100 mm, take the average of two readings at right angles to one another.

The base diameter shall be measured at the position as near to the base surface as measurable.

- e) **Hardness determination** Determine the hardness of the test cups before immersion by the method of 6.1.3. Next, carry out the immersion test of **b)** and, after cleansing by **a)** determine the hardness according to 6.1.3.
- f) **Condition** After completion of immersion test of **b)**, observe the cup surface condition to examine for stickiness and other abnormalities.

Remarks 1 The determinations and observations in **c)**, **d)**, **e)** and **f)** shall be made within 60 min of cleansing with alcohol after completion of immersion.

2 The tests **c)**, **d)**, **e)** and **f)** may be made on the same specimen.

6.3.5 Calculation The calculations shall be as follows:

- a) **Volume change** The volume change shall be calculated from the following formula.

$$\Delta V_{100} = \frac{(m_3 - m_4) - (m_1 - m_2)}{(m_1 - m_2)} \times 100$$

where, ΔV_{100} : volume change (%)

m_1 : mass in air before immersion (mg)

m_2 : apparent mass in water before immersion (mg)

m_3 : mass in air after immersion (mg)

m_4 : apparent mass in water after immersion (mg)

- b) **Lip and base diameter changes** The lip and base diameter changes shall be calculated from the following formula.

$$\Delta l_{100} = \frac{l_1 - l_0}{l_0} \times 100$$

where, Δl_{100} : lip or base diameter change (%)

l_0 : lip or base diameter before immersion (mm)

l_1 : lip or base diameter after immersion (mm)

- c) **Hardness change (informative)** The hardness change shall be calculated from the

following formula.

$$A_H = H_1 - H_0$$

where, A_H : hardness change
 H_1 : hardness before test
 H_0 : hardness after test

6.3.6 Expression of test results The test results shall be expressed as follows:

- a) **Volume change** For the volume change, express the value obtained from the calculation of 6.3.5 a) in a whole number through rounding in accordance with JIS Z 8401, and report the average of the two values.
- b) **Lip and base diameter changes** For the lip or base diameter change, express the value obtained from the calculation of 6.3.5 b) through rounding to two decimal places in accordance with JIS Z 8401, and report the average of the two values.
- c) **Hardness change** For the hardness change, express the value obtained from the calculation of c) of 6.3.5 in a whole number, and report the average of the two values.

6.4 Precipitation test

6.4.1 Test specimen From two or more cups to be tested, obtain a mass of (4.0 ± 0.5) g as test specimen.

6.4.2 Apparatus The apparatus shall be as follows:

- a) **Test oven** The test oven shall be capable of maintaining the test temperature given in table 6.
- b) **Test container** Use a test container as specified in b) of 6.3.2.
- c) **Centrifuge tube** Use a centrifuge tube as given in figure 105 of JIS K 2829.
- d) **Centrifuge separator** The centrifuge separator shall be as specified in (2) of 4.3 of JIS K 2503.

6.4.3 Test condition Test conditions shall be as given in table 6.

Table 6 Precipitation test conditions

Division	Test temperature ℃	Duration h	Test fluid
Class 1	70 ± 2	120 ± 2	The fluid conform- ing to JIS K 2233
Class 2	120 ± 2	70 ± 2	
Class 3	150 ± 2		

6.4.4 Procedure The test procedure shall be as follows:

- a) **Cleansing of specimens** To be in accordance with a) of 6.3.4.
- b) **Immersion test** Putting the specimen cups in the weighing bottle specified in b) of

6.3.2, pour 75 ml of test fluid, cap and place the bottle in the pressure tight vessel. Sealing up the lid, leave the vessel in the test oven under the conditions given in table 6.

After completion of the immersion, immerse the cups into a fresh test fluid of the same kind for approximately 30 min to cool at room temperature for (24 ± 1) h.

- c) **Determination of sediment** Agitate the fluid to homogenize the suspended particles, transfer them to a centrifuge tube from the weighing bottle and determine the sediment according to the procedure specified in 4.5 of JIS K 2503.

6.4.5 Calculation For the precipitating amount, read the volume of the solid sediment at the bottom of centrifuge tube to obtain the volume percentage.

6.5 Metal corrosion test

6.5.1 Test specimens Test specimens shall be as follows:

- a) **Metal test pieces** Two sets of the following metal test pieces shall be used.

Tinned iron	Hot-dipped tinplate of <u>JIS G 3303</u> (SPTH)
Steel	SPCC-B of <u>JIS G 3141</u>
Aluminium	A2024P of <u>JIS H 4000</u>
Cast iron	FC 200 of <u>JIS G 5501</u>
Brass	C2801P of <u>JIS H 3100</u>
Copper	C1100P of <u>JIS H 3100</u>
Zinc	Class 1 of <u>JIS H 2201</u>

Each metal test piece shall have a total surface area between 20 cm² and 30 cm² (approximately 80 mm × 13 mm), and shall have a drilled hole between 4 mm and 5 mm in diameter at 6 mm from one end. The holes shall be filed smooth.

- b) **Cup** Two cups cleansed by rinsing in alcohol.

6.5.2 Apparatus The test apparatus shall be as follows:

- a) **Test oven**, capable of maintaining the temperature for the duration as given in table 7.
- b) **Reading microscope**, on the market but calibrated to the nearest 1/100 mm.
- c) **Hardness tester**, as specified in 6.1.2.
- d) **Centrifuge**, as specified in (2) of 4.3 of JIS K 2503.
- e) **Micrometer callipers**, as specified in JIS B 7502.
- f) **Centrifuge tube**, as specified in figure 105 of JIS K 2839.
- g) **Glass jar with screw-in lid** (hereafter referred to as “glass jar”.) Two of that as specified in figure 16 of JIS K 2839 shall be used. The jar lids shall be of tinned iron, without organic coating, vented in the centre with a hole (0.8 ± 0.1) mm in diameter.
- h) **Waterproof abrasive paper** Waterproof abrasive paper, Aw or Cw of No. 320 speci:

fied in JIS R 6253.

i) **Steel wool** Steel wool of No. 00 on the market.

6.5.3 Test condition Test conditions shall be as given in table 7.

Table 7 Metal corrosion test conditions

Division	Test temperature ℃	Duration h	Test fluid
Class 1	70 ± 2	120 ± 2	The fluid conforming to JIS K 2233
Class 2	100 ± 2		
Class 3			

6.5.4 Procedure The test procedure shall be as follows:

a) **Preparation of metal test pieces** With the exception of the tinned iron pieces, abrade every test piece with waterproof abrasive paper applying alcohol until flaws and dents are removed. For each different metal test piece new piece of abrasive paper shall be used. Next, polish with No. 00 steel wool, wash with alcohol, dry in dry air, and place them in a desiccator at room temperature for 1 h or more. After polishing the test pieces shall be handled with forceps. Weigh each metal test piece to the nearest 0.1 mg, and assemble into each set, on an uncoated steel bolt through the holes drilled at each one end, in the order tinned iron, steel, aluminium, cast iron, brass, copper and zinc so that the test pieces are in contact directly, as shown in figure 3. Then, spread the assembled metal pieces other than the cast iron piece so that there is separation of approximately 3 mm between adjacent pieces at approximately 50 mm from their free ends as shown in figure 3 and tighten the bolt to prevent them from slipping out of place. After washing the metal test piece assemblies by rinsing in alcohol, dry with compressed air and place them in a desiccator at room temperature for 1 h or more.

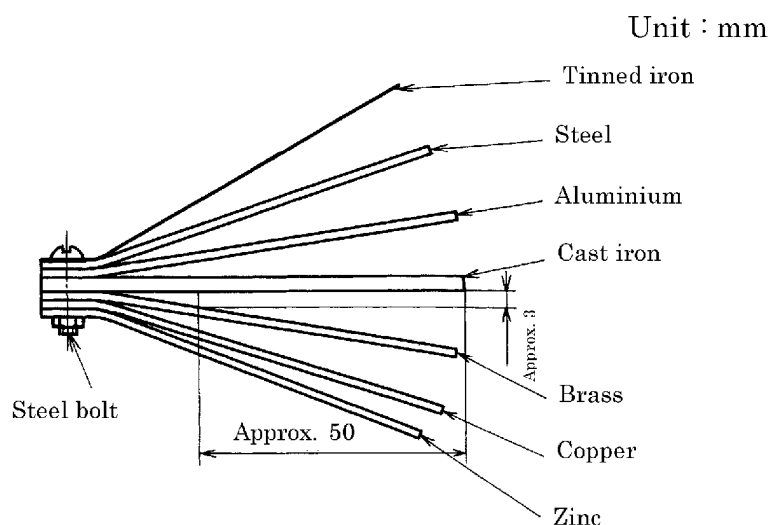


Figure 3 Metal test piece assembly

- b) **Immersion test** Place a metal test piece assembly in each glass jar so that the pinned end is resting on the hollow of cup as shown in figure 4. Mix 760 ml of test fluid with 40 ml of water, and pour 375 ml of the mixture into each glass jar to attain a depth of at least 10 mm above the tops of every connected metal piece.

Tighten the lids and, after holding the glass jars under the temperature condition as given in table 7, allow them to cool at $(23 \pm 5)^\circ\text{C}$ for 60 min to 90 min.

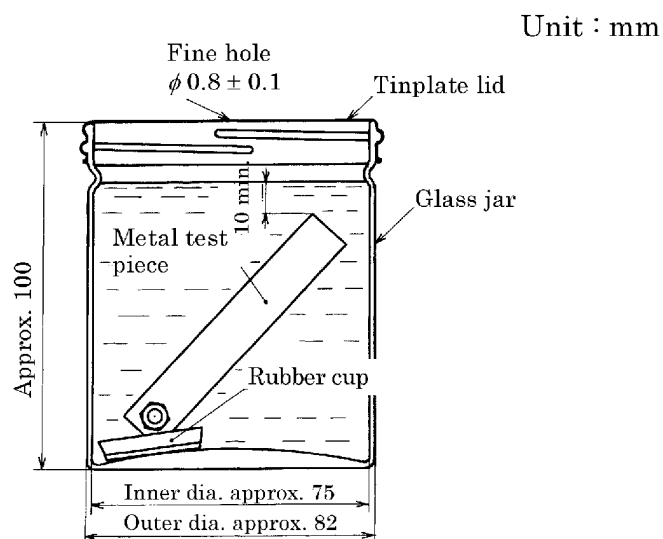


Figure 4 Immersion of metal test pieces

- c) **Mass change determination of metal test pieces** Following completion of the test, take out the metal test pieces from the glass jars, remove adhering fluid by flushing with water, and disassemble the individual metal pieces. Remove adhering matters by wiping with a gauze dipped in alcohol. For wiping, non-abrasive soap water or a solvent may be used, but using such a rough abrasive as wire brush and steel wool shall be avoided. After dipping in water and then in alcohol dry the metal pieces with dry air and examine the appearance. Place them in a desiccator at room temperature for at least 1 h, and then weigh each metal piece to the nearest 0.1 mg.
- d) **Determination of sediment** Agitate the fluid to uniformly disperse the sediment, transfer a 100 ml portion of this fluid from each glass jar to a centrifuge tube, and determine the sediment amount according to 4.5 of JIS K 2503.
- e) **Examination of cup condition** After sweeping the adhered sediment off the cup in the fluid by use of forceps, remove the cup from the fluid, rinse in alcohol and dry air. Examine the cup on the surface condition for stains, stickiness, blisters and failings.
- f) **Determination of base diameter of cup** The cup base diameter shall be determined according to 6.3.4 d) before and after immersion.
- g) **Determination of cup hardness** Determine the hardness before immersion by the