

Technical Specification

2014.05. VOL.01

DOUBLE PRESS™

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1 Mechanism for BENKAN Double press fitting

BENKAN Double press fitting has a rubber ring with lump and it is composed by specified crimping machine.

Pressing on the pipe insertion part (from middle of flared part till the edge) to reduce diameter to hexagon and oval shape, and that provides strong connection.

In addition, compressive deformation of rubber ring makes the watertight retention effect.

Double press has characteristic function. In case of forgetting pressing, special rubber ring with lump makes water leakage during hydrostatic test to indicate the fitting is not pressed.

The structure of connection with a tube is shown in Figure 1, and the rubber ring is in Figure 2-4.

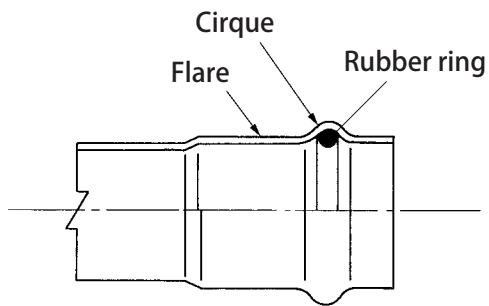


Fig 1 Structure, Double Press

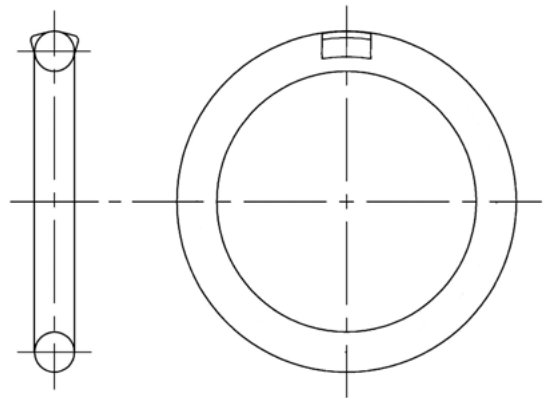


Fig 2 Schematic, Rubber Ring (13Su)

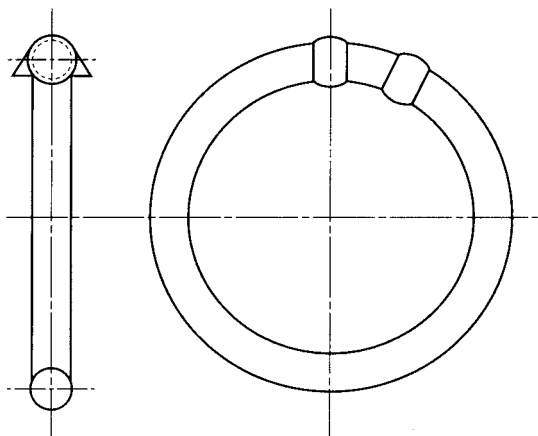


Fig 3 Schematic, Rubber Ring (20~50Su)

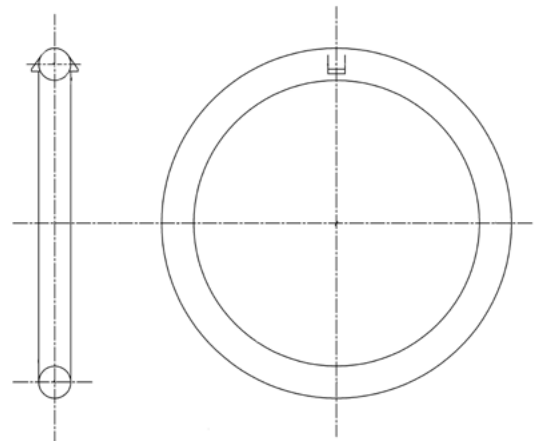


Fig 4 Schematic, Rubber Ring (60Su)

The structure of compressed fittings with tube is shown in Figure 5.

The confirmative testing is held with conditions of the insertion length L1 and L2.

The L1 is a sufficient insertion length and L2 is insufficient length but is minimum depth of watertight retention effect.

The insertion length for each diameter (13~60Su) on L1 and L2 are indicated in Table 1.

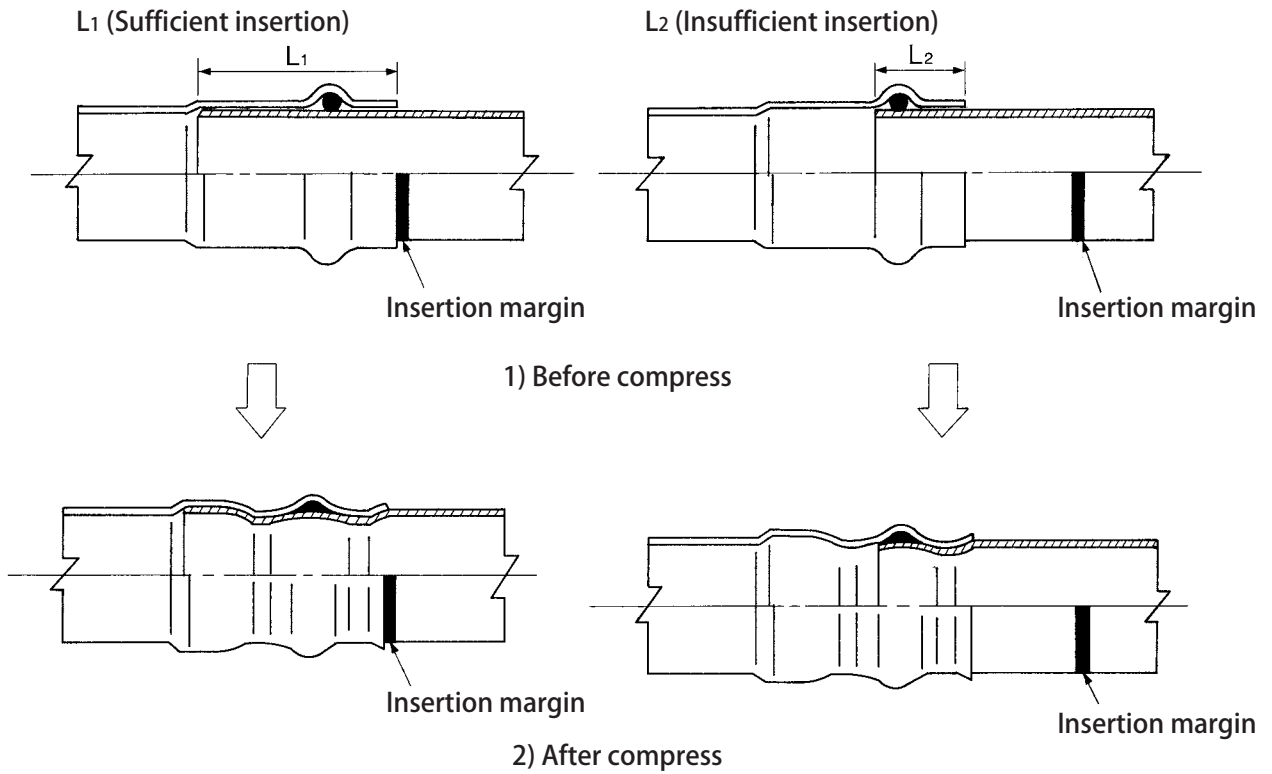


Fig 5 Cmpressed fittings with tube

Table 1 Insertion Length

Unit : mm

Nominal diameter	13Su	20Su	25Su	30Su	40Su	50Su	60Su
L1	28	32	36	53	61	68	78
L2	13	15	19	25	27	30	31

2 Negative pressure test (conforming to SAS 322)

A tube of 250mm or more in length shall be connected to the tube fitting (Refer to Figure 6). The pressure shall be decreased to -96kPa {-720mmHg} with a vacuum pump and maintained for two (2) minutes. No suction or other failure shall be acceptable.

The result for each size is no suction or other failure. (Refer to Table 2)

Table 2 Unit : kPa {mmHg}

Nominal diameter (Su)	Test pressure	Test result
13	-96 { -720 }	Normal
20	-96 { -720 }	Normal
25	-96 { -720 }	Normal
30	-96 { -720 }	Normal
40	-96 { -720 }	Normal
50	-96 { -720 }	Normal
60	-96 { -720 }	Normal

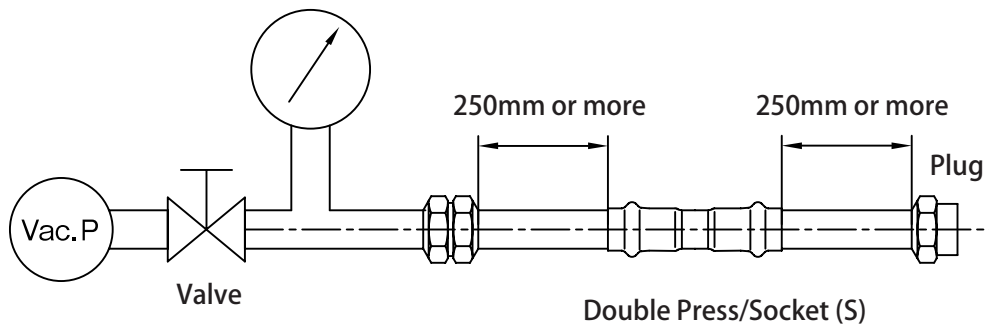


Fig 6 Negative pressure test apparatus

3 Hydrostatic pressure test (conforming to SAS 322)

A tube of 250mm or more in length shall be connected to the tube fitting (Refer to Figure 7). The hydrostatic test pressure shall be applied 3.5MPa {35.7kgf/cm²} and maintained for two (2) minutes. No leakage, breakage, disconnection or other failure shall be acceptable.

The result for each size is no leakage, breakage, disconnection or other failure. (Refer to Table 3)

Table 3 Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test pressure	Test result
13	3.5 { 35.7 }	Normal
20	3.5 { 35.7 }	Normal
25	3.5 { 35.7 }	Normal
30	3.5 { 35.7 }	Normal
40	3.5 { 35.7 }	Normal
50	3.5 { 35.7 }	Normal
60	3.5 { 35.7 }	Normal

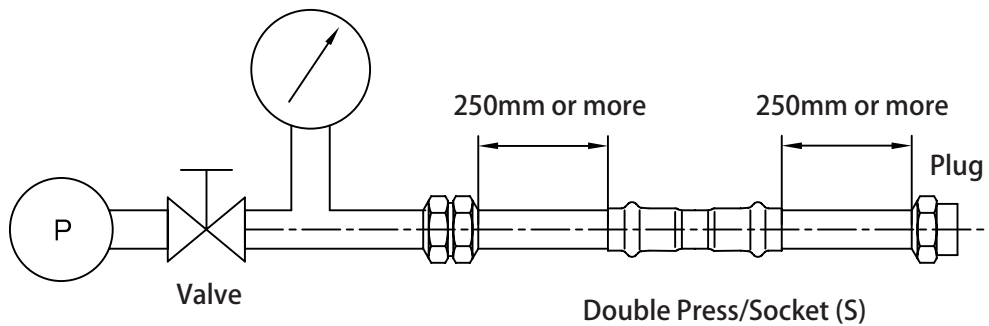


Fig 7 Hydrostatic pressure test apparatus

4 Pull-out test (conforming to SAS 322)

A tube of 250mm or more in length shall be connected to the tube fitting.

While pulling out the tube at a pulling speed of 2mm/min with an air pressure of 0.2MPa {2.0kgf/cm²} applied internally, the maximum load shall be measured until air starts to leak.

It obtains as the pull-out resistance pressure.

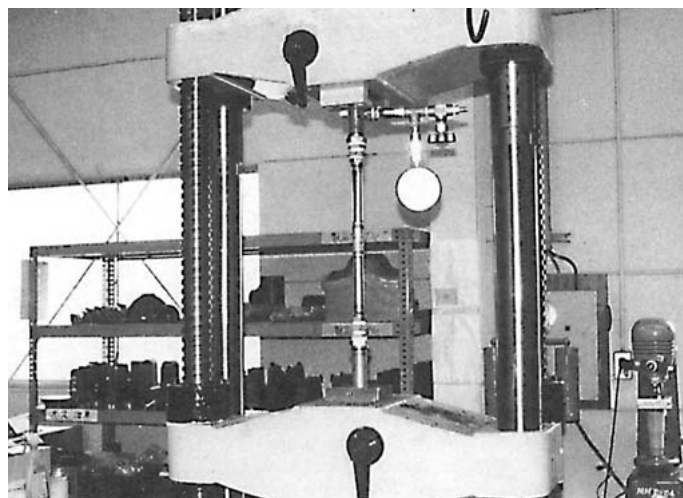
The result for each size passed the specified criteria. (Refer to Table 4 and 5)

Table 4 L₁ (Sufficient insertion length) Unit : kN {kgf}

Nominal diameter (Su)	Pull-out pressure	SAS322 standard
13	5.49 { 560 }	2.2 { 224 }
20	9.31 { 949 }	3.8 { 387 }
25	12.1 { 1,234 }	4.9 { 500 }
30	33.3 { 3,396 }	7.0 { 714 }
40	35.7 { 3,640 }	8.8 { 897 }
50	37.4 { 3,814 }	10.1 { 1,030 }
60	30.9 { 3,151 }	15.8 { 1,611 }

Table 5 L₂ (Insufficient insertion length) Unit : kN {kgf}

Nominal diameter (Su)	Pull-out pressure	SAS322 standard
13	2.43 { 248 }	2.2 { 224 }
20	5.35 { 546 }	3.8 { 387 }
25	3.88 { 396 }	4.9 { 500 }
30	12.2 { 1,244 }	7.0 { 714 }
40	12.2 { 1,244 }	8.8 { 897 }
50	16.4 { 1,672 }	10.1 { 1,030 }
60	13.3 { 1,356 }	15.8 { 1,611 }



Pic 1 Pull-out test apparatus

5 Vibration test (conforming to SAS 322)

A tube shall be connected to the tube fitting and mounted on the test apparatus as shown in Figure 8.

Then, vibration shall be applied 1,000,000 times under the following conditions :-

Hydrostatic pressure : 2.45MPa {25.0kgf/cm²}

Vibration amplitude : ± 2.5mm

Vibration frequency : 600 times/minutes

The result for each size is no leakage, breakage or other failure. (Refer to Table 6)

Table 6

Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test pressure	Test result
13	2.45 { 25.0 }	Normal
20	2.45 { 25.0 }	Normal
25	2.45 { 25.0 }	Normal
30	2.45 { 25.0 }	Normal
40	2.45 { 25.0 }	Normal
50	2.45 { 25.0 }	Normal
60	2.45 { 25.0 }	Normal

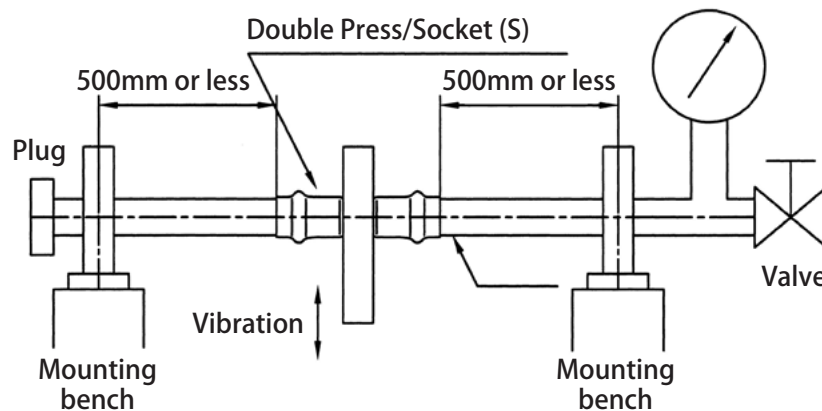


Fig 8 Vibration test apparatus

6 Hot/cold cycle test (conforming to SAS 322)

A tube shall be connected to the tube fitting in Figure 9. Hot water at temperatures of 80°C or more and cold water at ordinary temperatures shall be passed through the assembly alternately every 10 minutes. After repeating this process for 1,000 cycles, the hydrostatic pressure 3.5MPa {35.7kgf/cm²} shall be applied at ordinary temperatures.

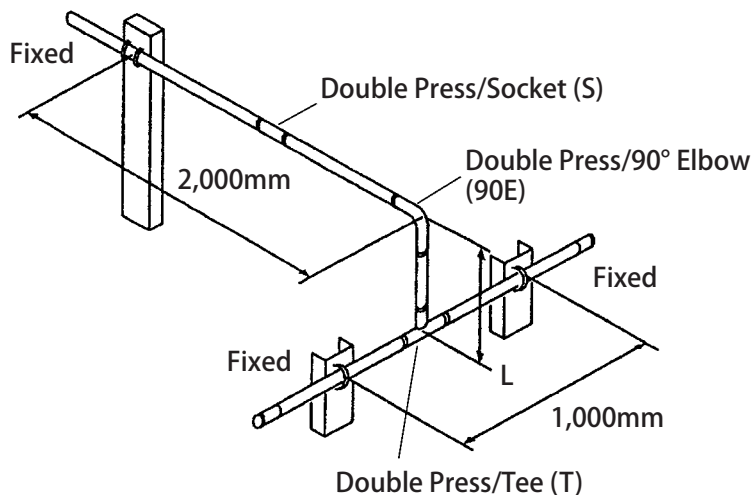
No leakage or other failure shall be acceptable.

The result for each size is no leakage or other failure shall be acceptable. (Refer to Table 7)

Table 7

Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test pressure	Test result
13	3.5 { 35.7 }	Normal
20	3.5 { 35.7 }	Normal
25	3.5 { 35.7 }	Normal
30	3.5 { 35.7 }	Normal
40	3.5 { 35.7 }	Normal
50	3.5 { 35.7 }	Normal
60	3.5 { 35.7 }	Normal



Value of L

Nominal diameter (Su)	L (mm)
13~25	250
30~50	300
60	350

Fig 9 Piping arrangement for hot/cold water cycle testing

7 Internal pressure cycle test (conforming to SAS 322)

A tube of 250mm or more in length shall be connected to the tube fitting.

After filling the inside of the assembly with water, the pressure shall be increased from 0MPa to 5.0MPa {51.0kgf/cm²} and then decreased to 0MPa with a cycle time of 4seconds.

This process shall be repeated for 10,000 times.

No leakage or other failure shall be acceptable.

The result for each size is no leakage or other failure shall be acceptable. (Refer to Table 8)

Table 8

Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test pressure	Test result
13	5.0 { 51.0 }	Normal
20	5.0 { 51.0 }	Normal
25	5.0 { 51.0 }	Normal
30	5.0 { 51.0 }	Normal
40	5.0 { 51.0 }	Normal
50	5.0 { 51.0 }	Normal
60	5.0 { 51.0 }	Normal

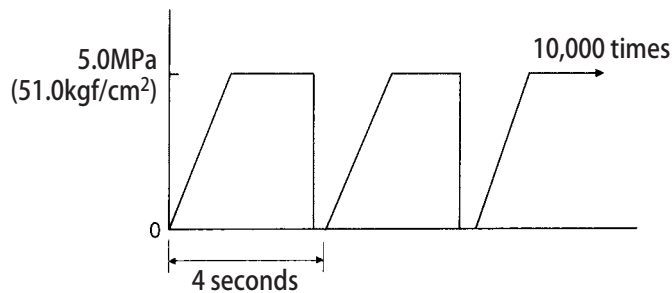
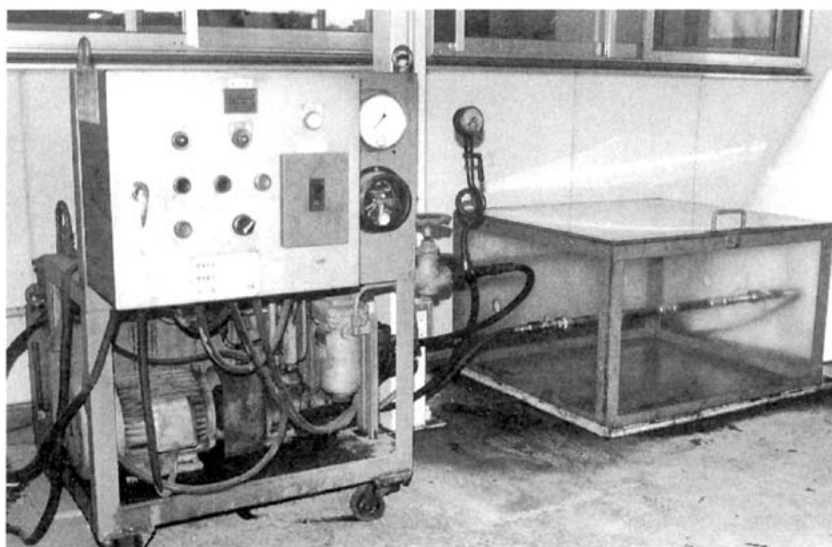


Fig 10 Internal pressure cycle



Pic 2 Internal pressure cycle test apparatus

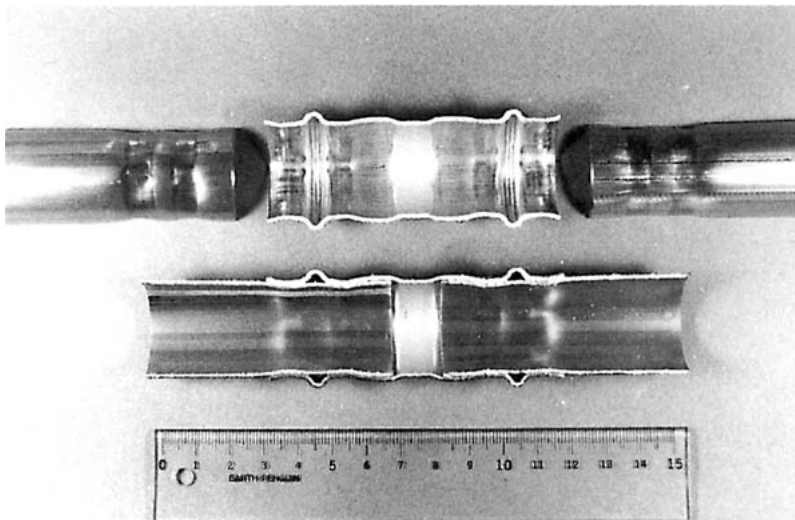
8 Corrosion test (conforming to SAS 322)

The tube fitting connected with a tube shall be immersed in test solution under the condition giving in Table 9. No harmful pitting, crevice corrosion, or stress corrosion cracking in the tube fittings or tubes shall be acceptable.

The result for each size is no harmful pitting, crevice corrosion, or stress corrosion cracking.

Table 9

Test solution	The sodium chloride of special grade (reagent) as specified in JIS K 8150 shall be dissolved in distilled water or deionized water to obtain a chloride ion (Cl^-) concentration of $200 \pm 20\text{mg/L}$.
Test temperature	$80 \pm 2^\circ\text{C}$
Test period	30 days. The test solution shall be replaced every 15 days.



Pic 3 Corrosion test apparatus and result

9 Accelerated degradation test using actual parts (conforming to SAS 322)

Specimens shall be made by connecting tubes to tube fittings, filled with an adequate amount of tap water, and heated in a thermostatic chamber using the test apparatus as shown in Figure 11. The chamber temperature shall be controlled to keep the in-tube temperature at 150°C in 115 days. After heating using the appropriate test condition given in hydrostatic pressure of 0.02MPa {0.2kgf/cm²} shall be applied and maintained for two (2) minutes. No leakage, disconnection or other failure shall be acceptable.

The result for each size is no leakage, disconnection or other failure shall be acceptable. (Refer to Table 10)

Nominal diameter (Su)	Test pressure	Test result
13	2.0 { 20.4 }	Normal
20	2.0 { 20.4 }	Normal
25	2.0 { 20.4 }	Normal
30	2.0 { 20.4 }	Normal
40	2.0 { 20.4 }	Normal
50	2.0 { 20.4 }	Normal
60	2.0 { 20.4 }	Normal

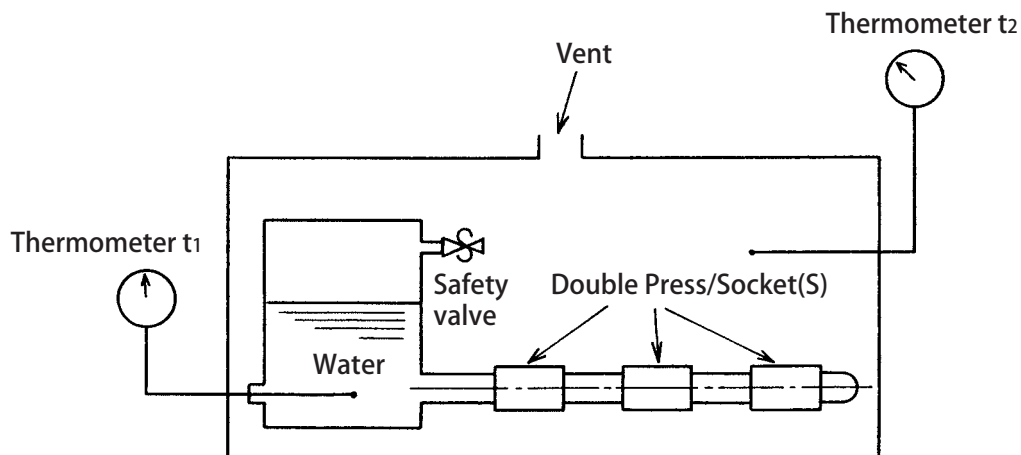


Fig 11 Apparatus for accelerated degradation testing using actual parts

10 Hydro-fracturing test

A tube of 250mm or more in length shall be connected to the tube fitting (Refer to Figure 12). The hydrostatic pressure shall be applied 0.05MPa{0.5kgf/cm²}, 0.5MPa{5.1kgf/cm²}, 1.75MPa{17.8kgf/cm²}, 2.5MPa{25.5kgf/cm²}, 3.5MPa {35.7kgf/cm²} and maintained for two (2) minutes each time. After confirming no leakage and disconnection, increase the hydrostatic pressure until leakage or breakage occur.

Table 11 and 12 show pressures that leakage or breakage occurred.

Table 11 L₁ (Sufficient insertion length) Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test condition	Fracture pressure	Test result
13	No-leakage	23.0 { 235 }	Leakage
20	No-leakage	20.6 { 210 }	Leakage
25	No-leakage	16.2 { 165 }	Leakage
30	No-leakage	26.3 {268 }	Leakage
40	No-leakage	16.3 { 166 }	Leakage
50	No-leakage	15.9 { 162 }	Leakage
60	No-leakage	7.5 { 76 }	Leakage

(Reference)

Table 12 L₂ (Insufficient insertion length) Unit : MPa {kgf/cm²}

Nominal diameter (Su)	Test condition	Fracture pressure	Test result
13	No-leakage	13.7 { 140 }	Leakage
20	No-leakage	12.3 { 125 }	Leakage
25	No-leakage	5.9 { 60 }	Leakage
30	No-leakage	15.1 { 154 }	Leakage
40	No-leakage	9.3 { 95 }	Leakage
50	No-leakage	8.8 { 90 }	Leakage
60	No-leakage	5.0 { 51 }	Leakage

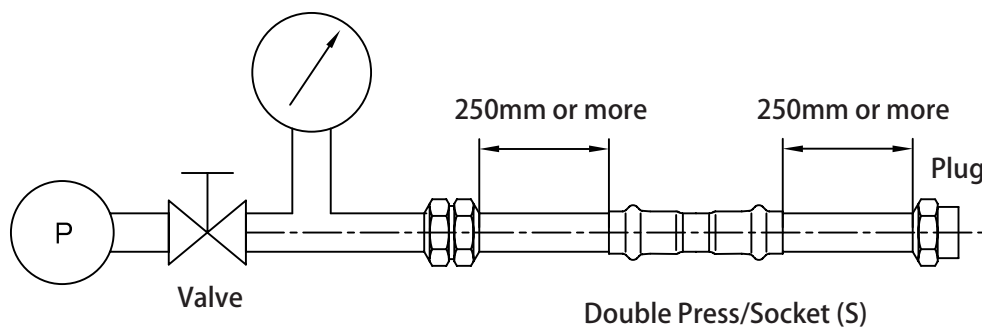


Fig 12 Hydro-fracturing test apparatus

11 Hydraulic bending test

Tube shall be connected to the tube fitting (Refer to Figure 13).

Apply hydrostatic pressure of 2.5MPa{25.5kgf/cm²} by hydraulic pump, and press the center of tube fittings by Amsler universal test machine. Measure maximum bending angle and load when leakage occurs.

Table 13

Unit : kN {kgf}

Nominal diameter (Su)	Bending angle (°)	Max. load
13	>30	0.22 { 22 }
20	>30	0.63 { 64 }
25	>30	0.91 { 93 }
30	>30	1.71 { 174 }
40	>30	2.72 { 277 }
50	>30	3.57 { 364 }
60	>30	6.13 { 625 }

※The bending angle, >N is measurable limit. The test stops at N degree.
(No leakage)

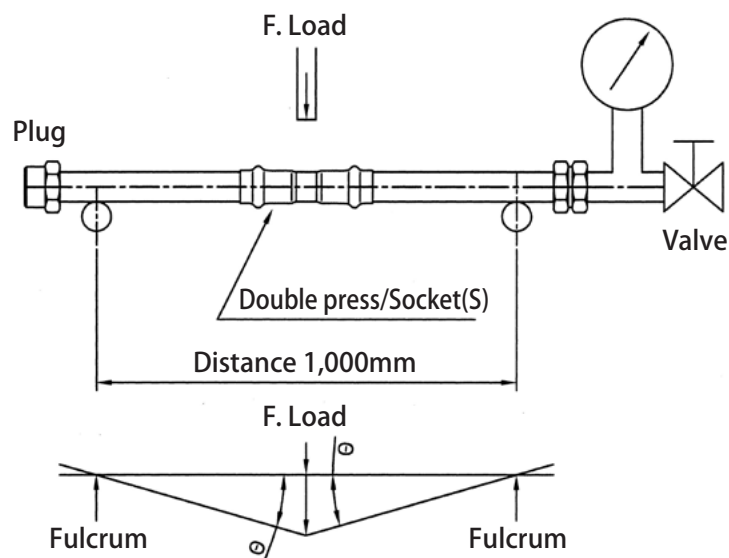
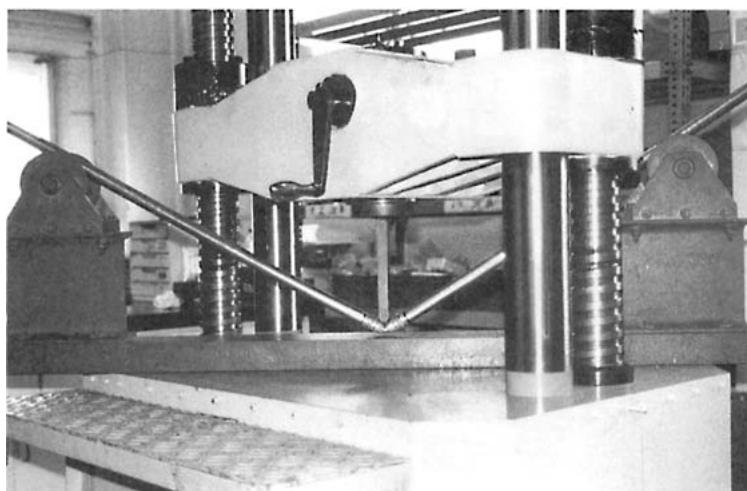


Fig 13 Hydraulic bending test apparatus



Pic 4 Hydraulic bending test apparatus

12 Rubber ring material test

The rubber ring material of BENKAN Double press fitting meets the standard of Japan Water Works Association (JWWA G 116), Annex C (rubber for Stainless steel tube coupling for water service).

The material of rubber is IIR (Isobutylene Isoprene Rubber).

Table 14

Test	Quality item	Criteria
1. Hardness test	1.1 Durometer hardness	HA 85±5
2. Tensile test	2.1 Tensile strength	10MPa or more
	2.2 Elongation	100% or more
3. Ageing test	3.1 Durometer hardness changes	HA 0~+10
	3.2 Elongation change	-40%~+10
	3.3 Tensile strength change	within -20%
4. Compression set test	Compression set rate	35% or less
5. Fracture test	Fracture strength	Over 15N/mm
6. Liquid resistance test	Mass change	0~+7%
7. Ozone degradation test	No defect	No defect
8. Leaching test	Leaching properties	Refer to Table 15

Table 15 Leaching properties

	Quality item	Criteria
Common item	Taste	Normal taste
	Odor	Normal odor
	Chromaticity	5 degrees or less
	Turbidity	2 degrees or less
By material	Organic matter (Total organic carbon/TOC)	3mg/L or less
	Zinc and its compounds	Zinc content : 1.0mg/L or less
	Phenols	Phenol content : 0.005mg/L or less

13 Heat-resistant life span for Rubber ring

For evaluation of the heat-resistant life span, reaction kinetics by T. W. Dakin and accelerated degradation method based on reaction rate equation by Arrhenius are pertinent and widely used.

$$2.303 \log K = -E/RT + C$$

K : Reaction rate constant

E : Activation energy

R : Gas constant

T : Absolute temperature

In the equation above, degradation reaction of rubber can be considered primary reaction, and variation value of compression set can be used for K value. Take value of compression set rate 50% for characteristic value of life judgment, and set 2 as the safety factor, then heat-resistant life estimate shall be like Figure 14. From the calculation, durable years in condition of continuance use in 80°C will be 87 years.

This is theoretical estimate based on experiment and does not guarantee durable years of practical plumbing. However, the rubber ring of Double press is made of IIR, which has been used for BENKAN Molco Joint since 1975, and its superior durability has been proved for many years with the actual plumbing in the actual sites.

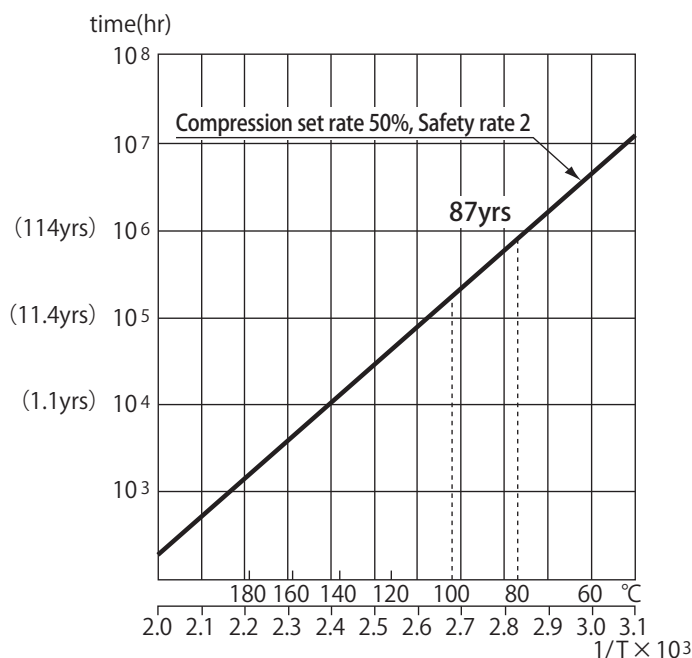


Fig 14 Heat-resistant life span



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