TEMISH

Z-PLUG-S

1. Outline

TEMISH is the PTFE (Polytetrafluoroethylene) porous membrane manufactured by NITTO DENKO.

This PTFE porous membrane has high air permeability, waterproof and dustproof due to millions of micropores per square centimeter. Furthermore, it has many excellent characteristics such as water repellency, heat resistance, chemical resistance, and electric insulation.

TEMISH Z-PLUG-S is an improved TEMISH a composite part which has reliability and workability of housing installation by making the molded part while show the above excellent performance.

By Z-PLUG-S excellent performance, electric component of automotive ECU is protected water and dust from outside.

2. Appearance and structure

Figs.1 and 2 show the structure and size.

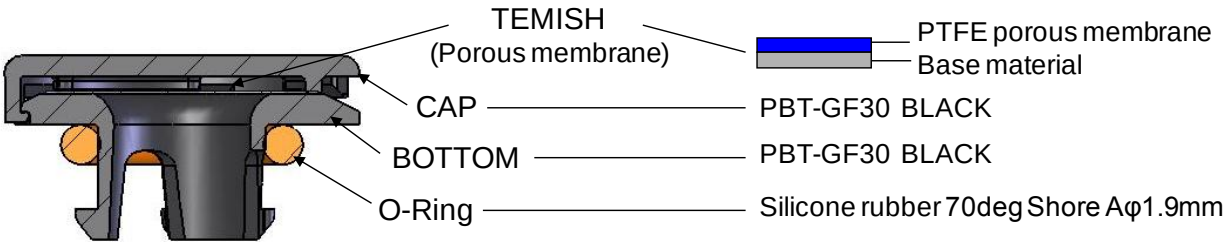


Fig.1 Structure

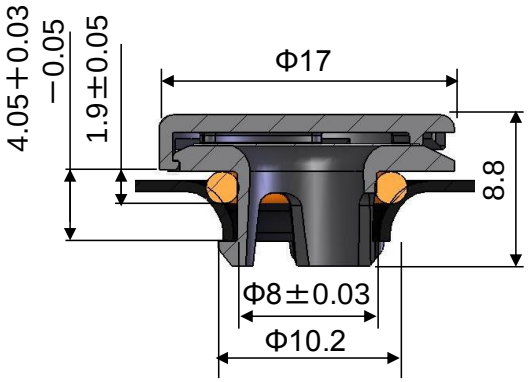


Fig.2 Dimension

3. Features

(1) Excellent features such as water resistance, dust resistance, durability and air permeability.

(2) Since Z-PLUG-S is the thin type, it achieves compactification because of the small protrusions while it inserted.

(3) Realize “one touch” insertion method by integrating membrane and parts, it achieves reduction of parts count and cost performance.

(4) Excellent in mechanical strength property and be handled easily.

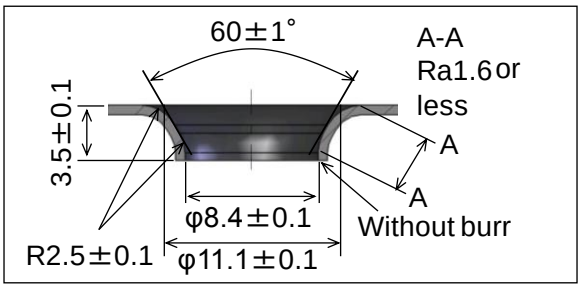
(5) Filter is protected by the cap to prevent direct damage to membrane.

4. Shapes of installation hole

Fig.3 shows the recommended shape of installation hole of Z-PLUG-S.

Left fig. is the processed metal plate housing. Right fig, is the other of metal plate housing such as die-cast based on our supposition.

Metal plate housing



Aluminum die-cast housing

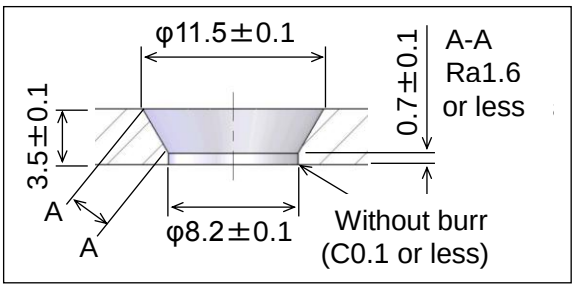


Fig. 3 Shapes of installation hole

5. Characteristic evaluation

5-1. Measuring methods and test conditions

・Air permeability

The air permeability is measured by 5kPa differential pressure. The value was converted into 1kPa per minute per product.

・Water entry pressure

The water pressures apply to TEMISH ventilation film from cap side. It is measured by JIS L 1092 which based on B method high water pressure.

・O ring seal pressure

The pressure which is caused by water leaked from the seal side of O ring is measured by applied the water from the bottom side under inserting of a processed metal plate (hole dia φ8.4, hole height φ3.5).

・Preservation conditions of durability test

The durability test was performed with inserted state to stainless insertion plate.

High temperature	125℃ X 3000hrs
Moist heat	85℃90%RH X 3000hrs
Heat cycle	(-40℃X half an hour⇔125℃X half an hour) X 3000cycles
Low temperature	-40℃X 3000hrs

5-2. Evaluation results

◆Initial characteristics

Table 1 shows the initial characteristics of air permeability, water entry pressure and O ring seal pressure.

Table 1 Initial characteristics

Item	Unit	Measured value	Standard value
Air permeability	cm3/(kPa・min)	130	36 or more
Water entry pressure	kPa	200	70 or more
O ring seal pressure	kPa	500	-

◆Durability properties

1. Figs. 4-7 show the air permeability after the durability test.

No significant decrease in air permeability according to the durability test.

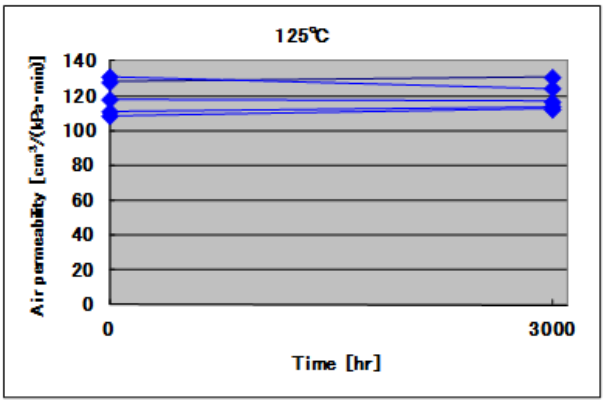


Fig.4 Preservation in high temperature

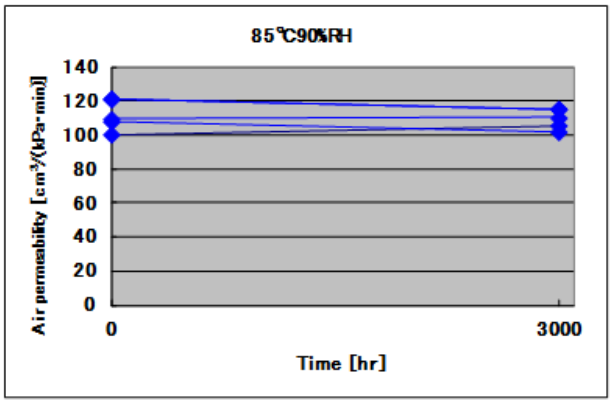


Fig.5 Preservation in moist heat

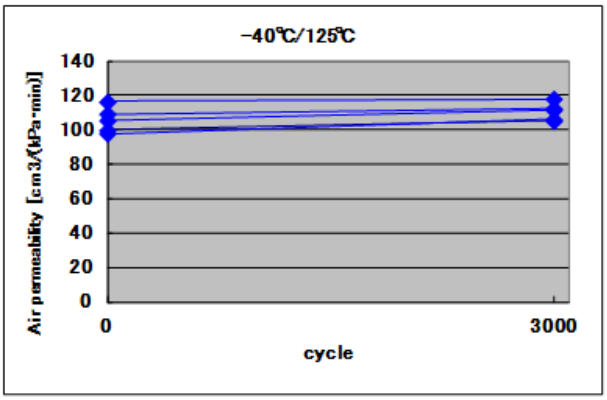


Fig.6 Heat cycle

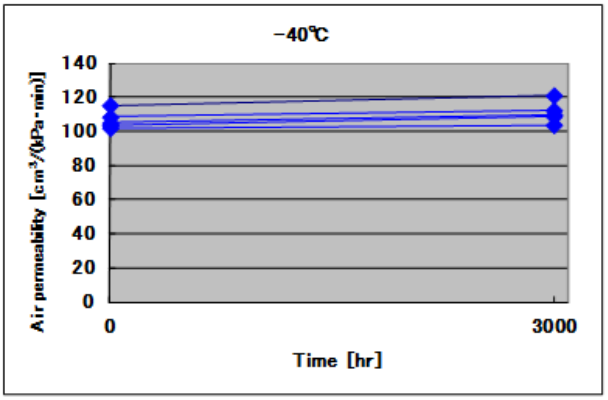


Fig.7 Preservation in low temperature

2. Figs. 8-11 show the water entry pressure after the durability test.

No significant decrease in water entry pressure according to the durability test.

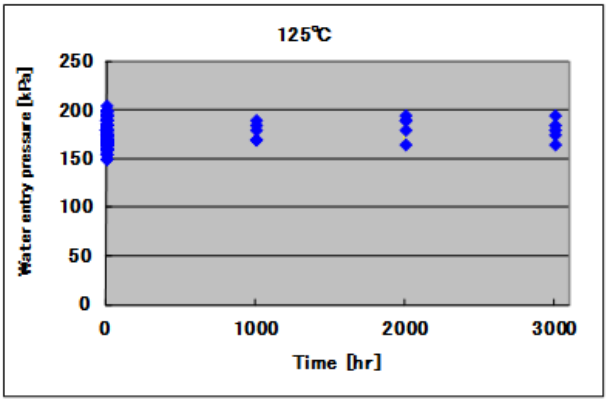


Fig.8 Preservation in high temperature

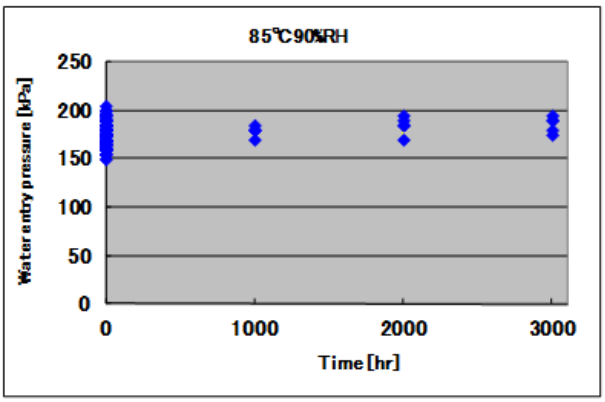


Fig.9 Preservation in moist heat

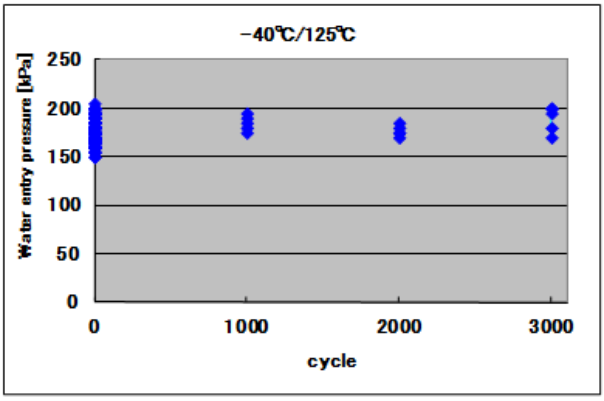


Fig.10 Heat cycle

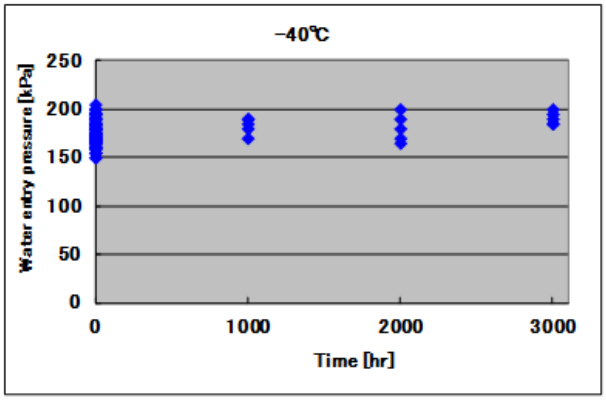


Fig.11 Preservation in low temperature

3. Figs. 12-15 show the O ring seal pressure after durability test.

No significant decrease in O ring seal pressure according to the durability test.

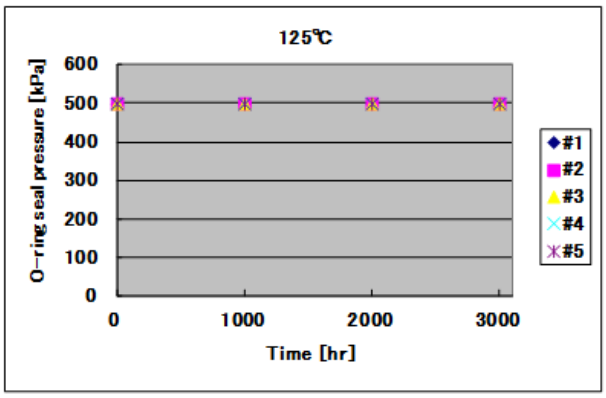


Fig.12 Preservation in high temperature

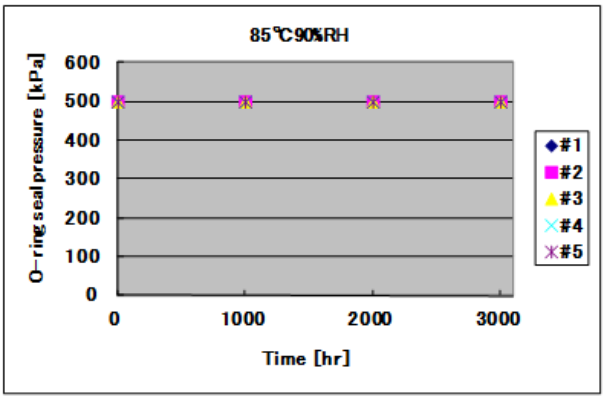


Fig.13 Preservation in moist heat

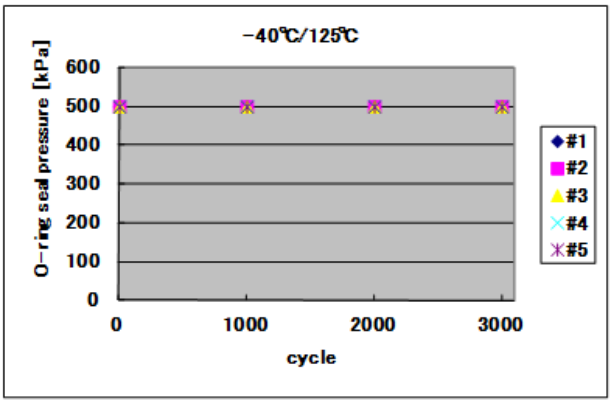


Fig.14 Heat cycle

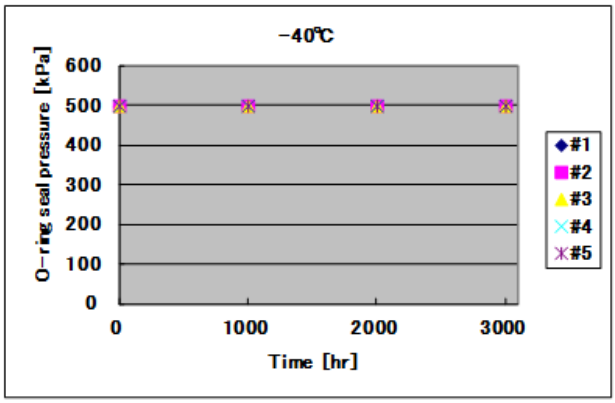


Fig.15 Preservation in low temperature

6. High pressure water resistant property

6-1. Test conditions

Sample: Z-PLUG-S

(It is a kind of metal plate housing parts manufacturing by Nitto.)

(Change the housing size when installed.)

Test method: DIN40050 Teil9 IPX9K (see Fig.16)

Rotation speed of housing: 5rpm

Water temperature : 80℃

Water flow: 16L/min

Water pressure: 10MPa

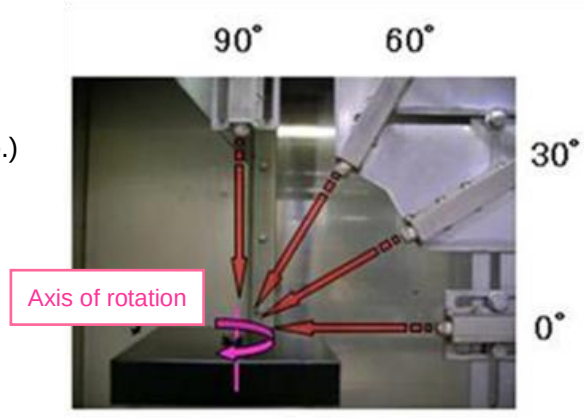


Fig.16 Test method

Angle/time of water injection: Take 30 seconds by 90°/60°/30°/0° each, total time are 120 seconds.

Table 2 Housing dimension

Item	Unit	Standard size	#1	#2	#3	#4	#5
Outer diameter	mm	11.1±0.1	11.2		11.1	11	
Height	mm	3.5±0.1	3.2		3.5	3.6	
Inner diameter	mm	8.4±0.1	8.3	8.5	8.4	8.3	8.5
Angle	°	60±0.1	59		60	61	

6-2. Test results

Table 3 shows the test results. The durability test was performed with installed the housing with different dimensions as shown in Table 2. No water ingress according to the high pressure water resistant test.

Table 3 Test result of high pressure water resistant test

Diameter of O ring mm	Housing No.	Number of cycle test					
		0	1000 cycles	1500 cycles	2000 cycles	2500 cycles	3000 cycles
1.85	#1	OK	OK	OK	OK	OK	OK
	#2	OK	OK	OK	OK	OK	OK
	#3	OK	OK	OK	OK	OK	OK
	#4	OK	OK	OK	OK	OK	OK
	#5	OK	OK	OK	OK	OK	OK
1.90	#1	OK	OK	OK	OK	OK	OK
	#2	OK	OK	OK	OK	OK	OK
	#3	OK	OK	OK	OK	OK	OK
	#4	OK	OK	OK	OK	OK	OK
	#5	OK	OK	OK	OK	OK	OK
1.95	#1	OK	OK	OK	OK	OK	OK
	#2	OK	OK	OK	OK	OK	OK
	#3	OK	OK	OK	OK	OK	OK
	#4	OK	OK	OK	OK	OK	OK
	#5	OK	OK	OK	OK	OK	OK

7. Pulse test after the durability test

7-1. Test conditions

Sample : Passed 3000 cycles of heat cycle test.

Air pressure: 40kPa, 70kPa, 100kPa

Cycle : 3000 cycles

(1 cycle = Pressure holding time: 1.0 sec / Off time of pressure holding: 1.0 sec

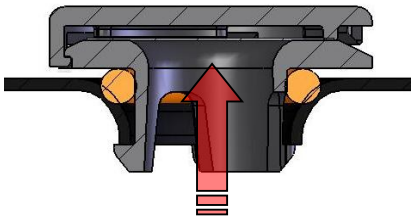


Fig. 17 Pressure direction

7-2. Test results

Table 4 shows the test results. No significant decrease in characteristic even in 100kPa, 3000 cycles.

Table 4 Test result of the pulse test

Pulse pressure	Air permeability cm3/(kPa･min)							Water entry pressure kPa
	0	500	1000	1500	2000	2500	3000	
40kPa	121	122	122	122	121	121	122	165
	132	133	132	133	132	132	133	155
	132	133	132	133	132	132	133	165
	115	116	116	115	116	115	116	185
	122	123	121	121	122	122	121	175
70kPa	132	132	130	132	131	131	132	165
	132	132	132	132	133	132	133	170
	139	141	139	140	139	140	140	150
	136	137	137	137	137	137	136	150
	126	127	126	126	127	127	126	160
100kPa	130	130	130	131	131	131	131	180
	123	124	123	124	124	124	123	185
	127	129	128	128	127	128	128	190
	142	144	143	142	142	143	142	175
	122	123	122	122	122	123	122	170

8. Muddy water cycle test

8-1. Test conditions

Mud: 8 types of Kanto loam layer The muddy water concentration: 25wt%

Test methods

1. Keep stirring the muddy water until precipitation eliminated.
2. Place the membrane surface to downside and is dipped for 2 seconds.
3. Put it in a high temperature hot air furnace and keep it the furnace with 80℃ for an hour.

Start to evaluate after repeated above step 1 to 3 by 5 cycles. In addition, the characteristics were measured under the condition that the cap was removed.

8-2. Test results

After the test, Fig.18 shows the appearance, Table 5 and 6 show the characteristics.

No significant decrease in characteristic according to the muddy water cycle test. It also was confirmed that no muddy left on the membrane surface.

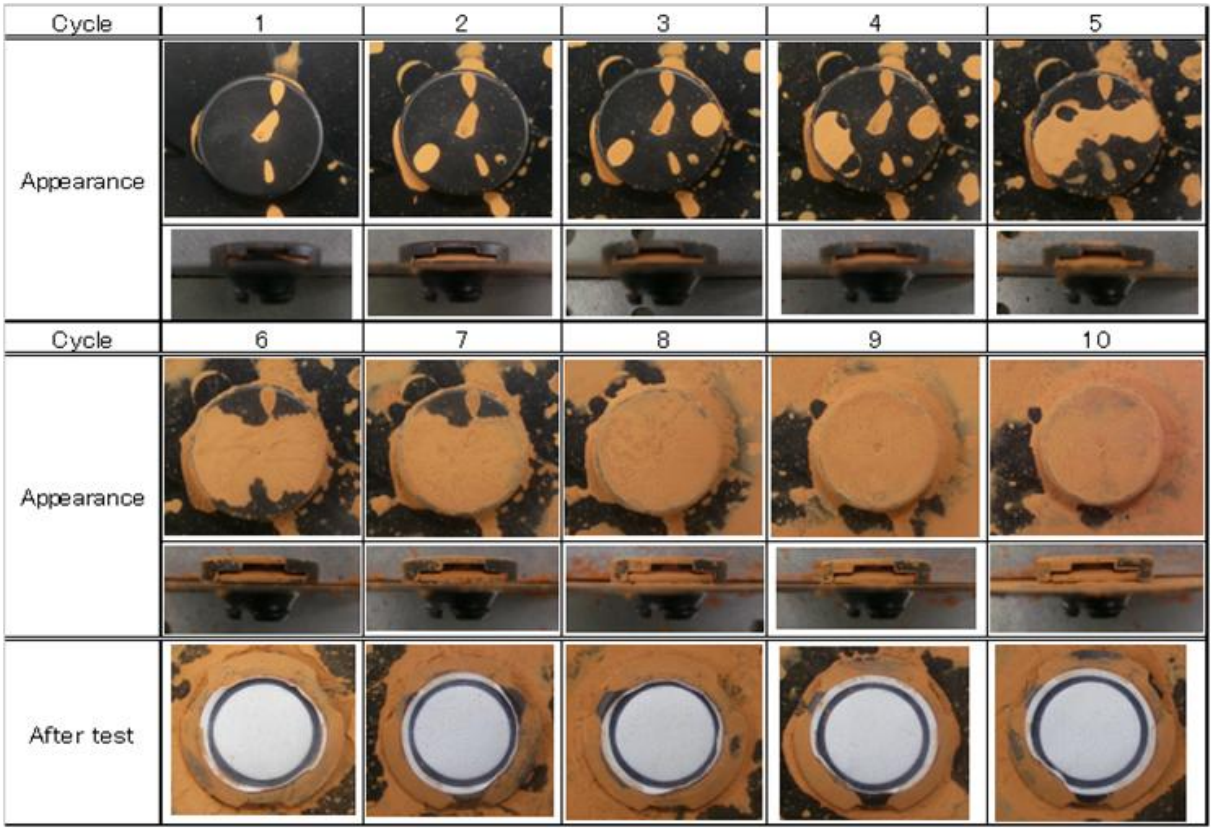


Fig.18 Appearance after the test

Table 5 Air permeability after the test

Sample No.	Air permeability [cm3/(kPa･min)]		
	0	5cycles	10cycles
1	132	130	130
2	115	114	114
3	119	118	117
4	112	111	110
5	108	107	107

Table 6 Water enter pressure after the test

Sample No.	Water entry pressure kPa	O-ring seal pressure kPa	Mud adhesion on membrane
1	170	>500	Not found
2	165	>500	Not found
3	170	>500	Not found
4	185	>500	Not found
5	170	>500	Not found

9. Dust ingress test (IP6X)

9-1. Test methods

1. Place the tube which set with a sample in a sealed container and circulate the test particles (Talc: average diameter 75 um) in the container. (Fig.19)

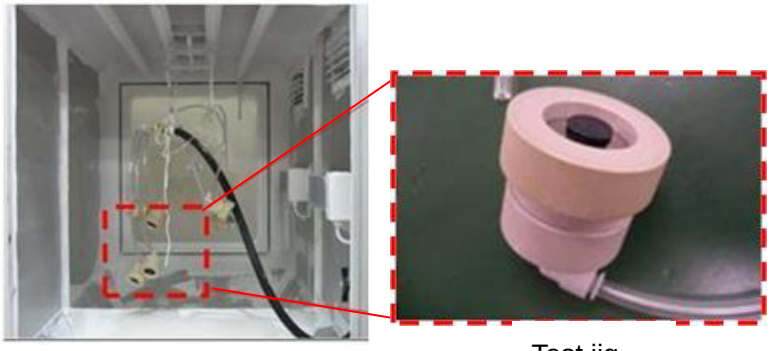
2. Suck by 2 kPa differential pressure.

3. Test time is 2 hours.

9-2. Test results

After the test, Fig.20 shows the appearance, Table 7 shows the characteristics.

No dust adhered to inside of jig after the test. And, it's also no significant decrease in characteristic according to the dust ingress test.



Test jig

Fig.19 Equipment of dust ingress test

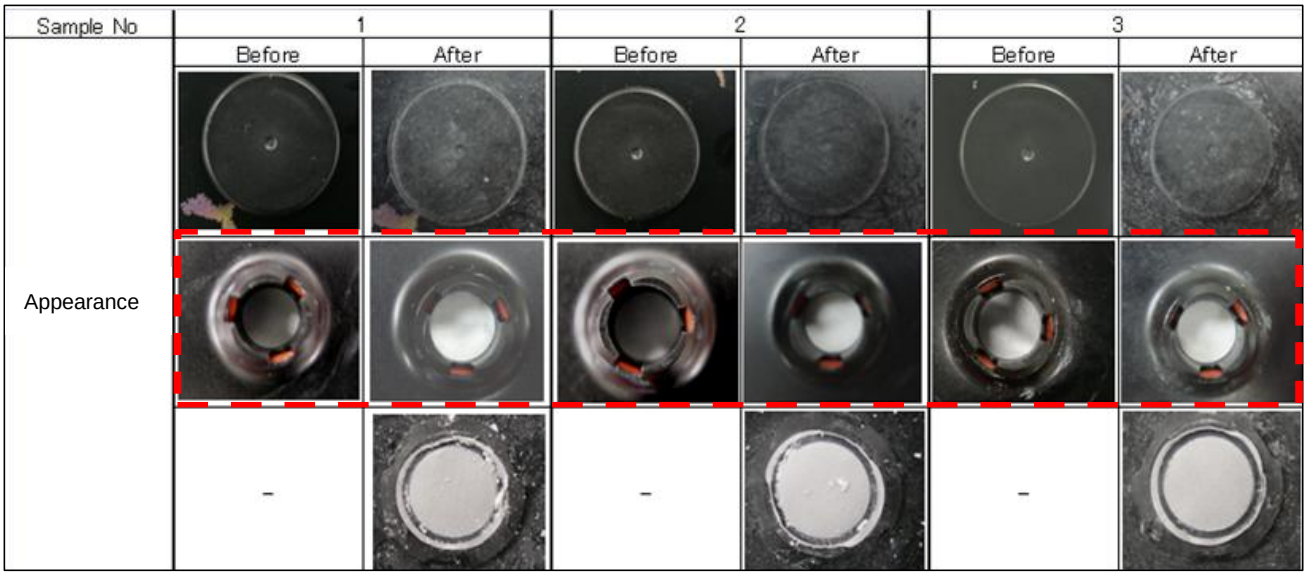


Fig.20 Appearance before and after the test

Table 7 Detailed characteristics before and after the test

	Sample No.	Before	After
Air permeability cm3/(kPa･min)	1	104	103
	2	111	110
	3	104	102
Water entry pressure kPa	1	>70	150
	2	>70	175
	3	>70	185

10. Chipping test

10-1. Test conditions 1

Using crushed stone: 2-5 mm

Discharge pressure: 0.4MPa

Distance : 350mm

Throwing angle : 0, 30, 60, 90°

10-2. Test conditions 2

Using crushed stone: 0.1-1 mm

Discharge pressure: 0.4MPa

Distance : 350mm

Throwing angle : 0, 30, 60, 90°

10-3. Test results

Table 8 and Fig. 21 show the test result of test condition 1. Table 9 and Fig. 22 show the test result of test condition 2. No significant decrease in characteristic according to the either of following conditions. And, the caps didn't come off.

Table 8 Detailed characteristics after the test (Condition 1)

Throwing angle	Air permeability cm3/(kPa･min)		Water entry pressure kPa	O-ring seal pressure kPa
	Before	After		
0°	113	113	190	>500
30°	120	120	180	>500
60°	125	125	175	>500
90°	111	110	180	>500

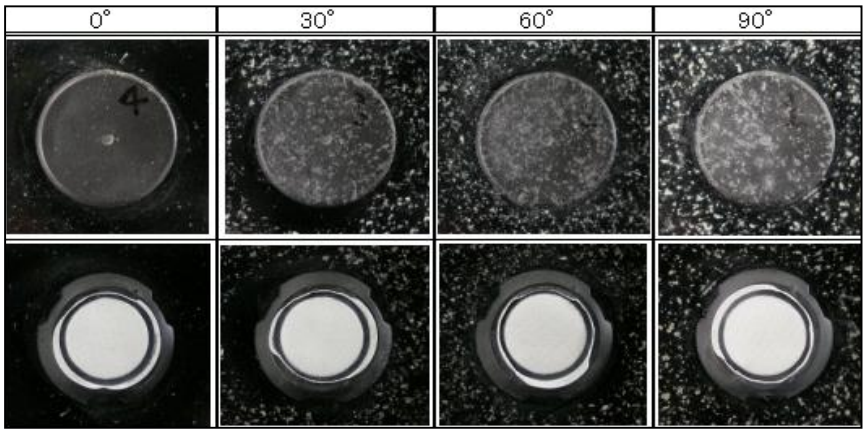


Fig. 21 Appearance after the test (Condition 1)

Table 9 Detailed characteristics after the test (Condition 2)

Throwing angle	Air permeability cm3/(kPa･min)		Water entry pressure kPa	O-ring seal pressure kPa
	Before	After		
0°	125	124	180	>500
30°	103	102	185	>500
60°	113	113	175	>500
90°	115	115	170	>500

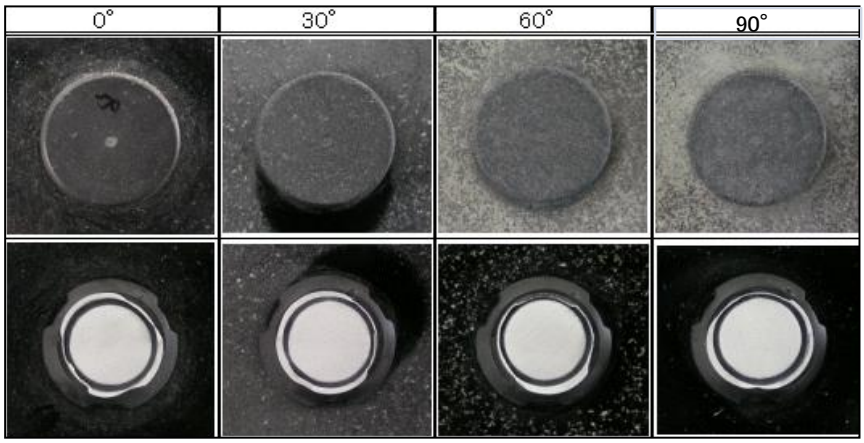


Fig. 22 Appearance after the test (Condition 2)

11. Oleophobic test

11.1. Test methods

Drop the test chemical liquid to PTFE membrane surface to confirm the penetration.

11.2. Test results

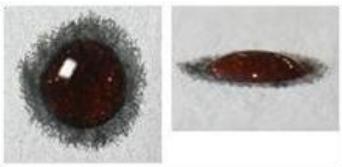
Table 10 shows the test results.

As for the oleophobic test, it is no penetration of chemical liquid.

Table 10 Test result of oleophobic test

Test liquid	Oleophobic	Test liquid	Oleophobic
Brake oil	○	Wax remover	○
Power steering oil	○	Grease	○
Mission oil	○	Engine cleaner	○
Engine oil	○	Neutral detergent	○
Differential oil	○	Transmission oil	○
LLC	○	CVT oil	○
Defrosting washer fluid	○	Diesel	○
Windshield washer fluid	○	Kerosene	○
Concentrated cleaning wax	○	Battery acid(10%H2SO4aq)	○
Wheel cleaner	○		

O: No penetration　　X: Penetration



12. Chemical resistance test

12-1. Test methods

Drop the test chemical liquid volume enough to cover Z-PLUG-S, after keep it under the each environment for 150 hours, it confirmed the characteristic at the timing of keeping it at regular temperature for 2 hours. In addition, the characteristics were measured under the condition that the cap was removed.

Test environments

Room temperature: Gasoline, Battery Acid (10% H_2SO_4aq)

125℃　　: Engine oil, ATF, Brake oil, LLC, Windshield washer fluid, Power steering oil

12-2. Test results

After the test, Fig. 23 shows the appearance and Table 11 shows the characteristics.

No significant deterioration such as penetration or swelling of chemical liquid. And, it's also no significant decrease in characteristic.

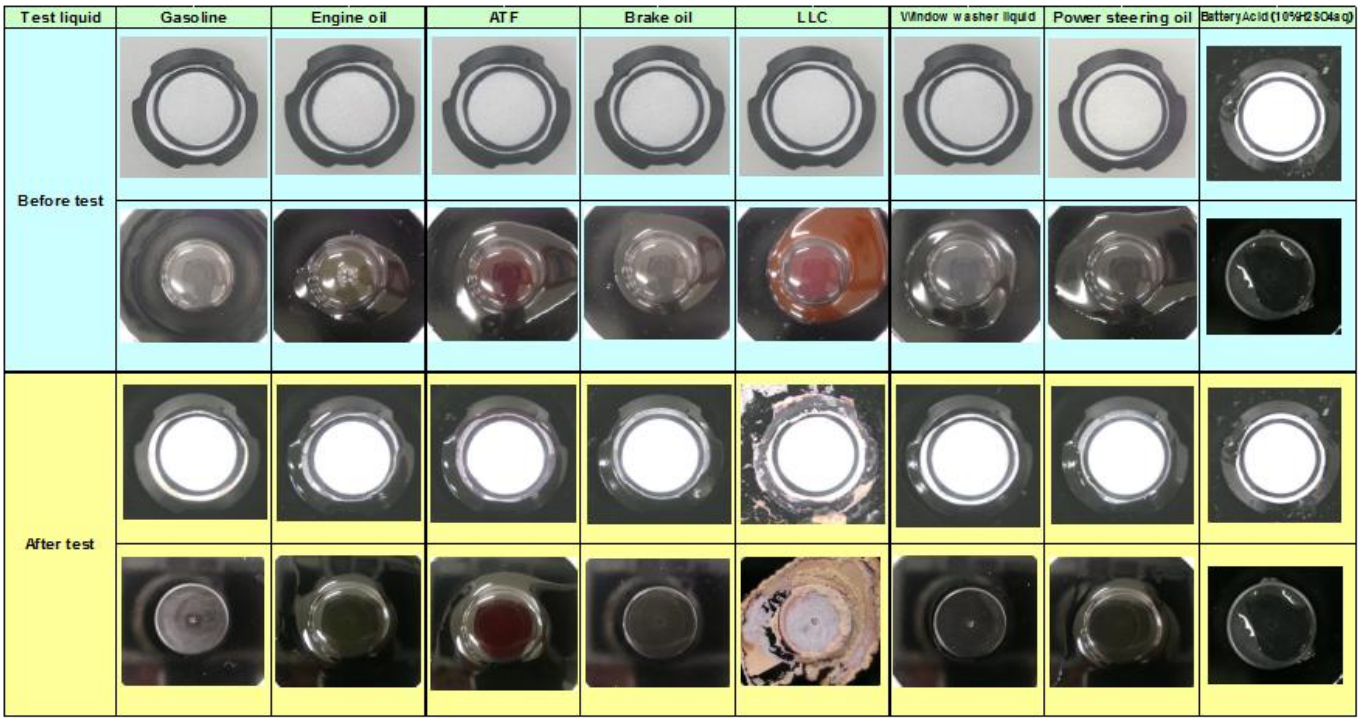


Fig. 23 Appearance before and after the test

Table 11 Detailed characteristics before and after the test

	Before	After		
	Air permeability cm3/min(kPa)	Air permeability cm3/min(kPa)	Water entry pressure kPa	O-ring seal pressure kPa
Gasoline	118	118	190	>500
Engine oil	116	117	170	>500
ATF	103	108	190	>500
Brake oil	102	109	170	>500
LLC	96	105	190	>500
Windshield washer fluid	96	104	185	>500
Power steering oil	101	109	185	>500
Battery acid(10%H2SO4aq)	127	127	180	>500

13. Freezing test

13-1. Test methods

Sample: Z-PLUG-S

Temperature condition: One cycle (-40℃×1 hour → 30℃×1 hour) was repeated with specified number of times.

Number of cycles: 10 cycles

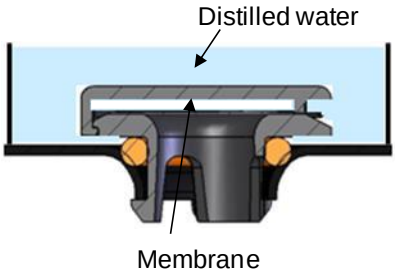


Fig.24 Freezing test

13-2. Test results

Table 12 shows the test results. As for the freezing test, it is no significant decrease in characteristic.

Table 12 Detailed characteristics after the test

Sample No.	Air permeability cm3/(kPa·min)		Water entry pressure after test kPa	O ring seal pressure kPa
	Before	After		
1	98	99	180	>500
2	101	104	165	>500
3	105	107	180	>500
4	101	103	170	>500
5	113	113	180	>500

14. Insertion method

To recommend the lid height (A) of Z-PLUG-S is 3.3+0.12/0mm and the insertion height (B) is 3.3mm or less.

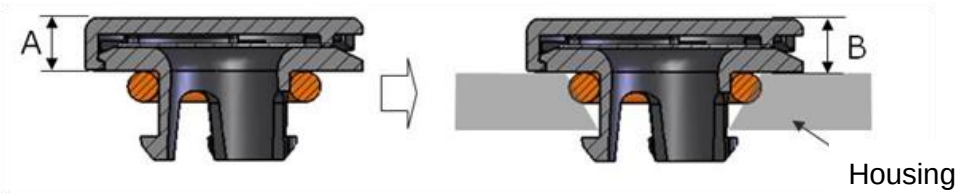


Fig. 25 The height while the insertion

In addition, as the method of insertion, insert Z-PLUG-S vertically for the product as refer to Fig.26.

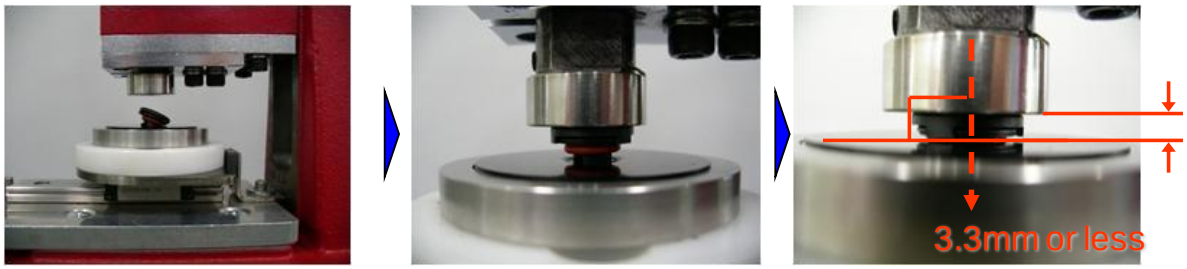


Fig. 26 Example of insertion method