

Multi-Purpose Gland Packing for Chemical Applications

1. Introduction

To date, various types of carbon-fiber products, which have heat and chemical resistance, have been used as gland packings for chemical applications. However, for a particular product, different types of packing should be used depending on how the product is used. When several types of packing are taken from stock and used, there is a risk that the wrong type of packing might be used, possibly causing damage to plant operation and incurring safety risks.

We have developed a new product based on carbon fiber like the conventional product, but when used in a single product, different types of packing are not required depending on how the single product is used. The new product can also be used under diverse conditions in a single product, and offers the same heat, pressure and chemical resistance. Therefore, the new packing improves the stability and safety of operation, and helps reduce inventory.

2. Composition

No. 6137 series is based on gland packing manufactured as follows: (1) Carbon fiber is treated with PTFE dispersion. (2) The cross section of the treated carbon fiber is braided into a square shape. (3) The shaped carbon fiber is finished with PTFE dispersion and graphite particulate. Both oil-containing and oil-free types are available. The three types, No. 6137, No. 6137-O, No. 6137-SO, can be selected depending on the application.

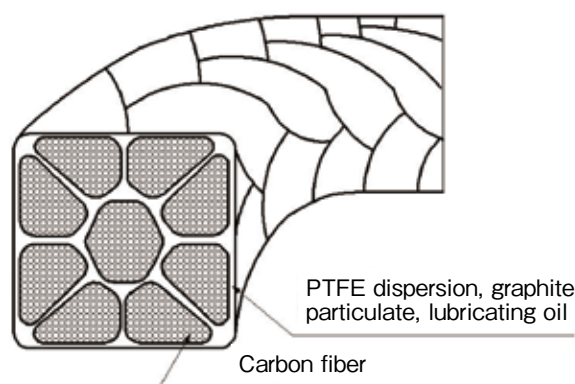


Figure1 Outline illustration of No. 6137 series



Figure2 External view of No. 6137 series

3. Characteristics

- ① No. 6137 series is suitable for a wide range of applications, including valves, pumps, equipment, and others.
- ② The main materials of No. 6137 series are carbon fiber and PTFE dispersion, which have excellent chemical resistance. Therefore, No. 6137 series can be used for most fluids except strongly oxidizing fluids.
- ③ No. 6137 series is suitable for a wide range of

applications, resulting in excellent cost performance (inventory reduction).

4. Applications

- Common applications of No. 6137 series
No. 6137 series can be used for valves, pumps, packings of seal devices, etc., all of which handle chemical fluids (except for oxidizing acids and oxidizing agents including concentrated sulfuric acid and concentrated nitric acid).
- No. 6137 can be used in valves and devices for applications designated as oil-free processing, requiring no contamination by lubricating-oil, and for prevent softening and loosening of the packing due to lubricating-oil reduction.
- No. 6137-O can be used for valves and devices as well as high-speed pumps including turbo pumps, all of which require low torque and gas-sealing performance. It can also be used as a substitute for No. 6232 and No. 6262 (thus reducing inventory through part-number integration).
- No. 6137-SO can be used for high-speed pumps such as turbo pumps, which need greater heat resistance than No. 6137-O in devices which require low torque and gas-sealing performance.

5. Usable range

Table1 Product specifications

Application	Valve	Pump	Device
Maximum service temperature	260 °C		
Maximum service pressure	15.5 MPa	1.6MPa	9.8MPa
ANSI rating	Class 900	—	—
Maximum service speed	—	20m/s ⁽¹⁾	5m/s ⁽¹⁾
PV tolerance	—	14.7MPa·m/s ⁽¹⁾	—
pH range	0~14		

Note (1) : Maximum service speed and PV tolerance are applicable to No. 6137-O and No. 6137-SO.

6. Specifications

Nominal dimension: □ 3.0-25.0 mm

Packing unit: 3 m (Ring-shape molding is also available.)

7. Results of functional tests

7-1) Evaluation of basic characteristics

Basic-characteristics tests are conducted to evaluate compressive-strain characteristics, sliding characteristics, sealing characteristics in valves, and use as gland packing.

Test conditions:

Table2 Test conditions

Gland packing	No.6137-O, No.6232 ⁽¹⁾
Test equipment	Refer to "Figure 3. Outline illustration of basic-characteristics test equipment." Evaluation of basic characteristics
Packing dimension	φ20×φ33×6.5 ^H
Packing qty	6 rings
Stem radial clearance	0.5mm
Packing stress	4.9~58.8 MPa
Fluid	Nitrogen gas
Fluid pressure	1.0~9.8 MPa

Note (1) : No. 6232 is used for valves and reciprocating equipment.

Outline of the test method:

- ① Mount the gland packing in a test jig.
- ② Fasten the packing under a given contact pressure using a compression tester.
- ③ Measure the height and stem torque of the packing.
- ④ Load fluid pressure on the packing and measure the leak rate.
- ⑤ Increase the packing stress in a stepwise fashion, and repeat steps ② to ④.

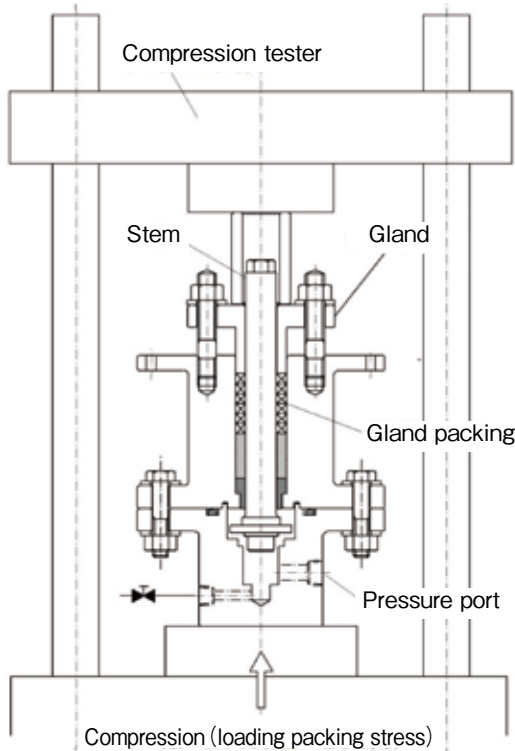


Figure3 Outline illustration of basic-characteristics test equipment

Test results:

The results of the basic-characteristics evaluation are shown in Figures 4 to 7.

No. 6137-O had a slightly lower compression ratio, weaker stem resistance, which is a sliding characteristic, and improved performance than the conventional product No. 6232. Regarding sealing properties, both specimens showed equivalent results.

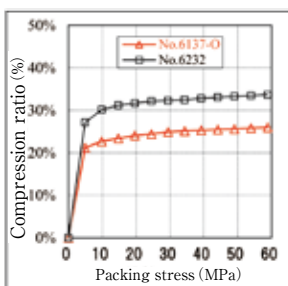


Figure4 Compression characteristics

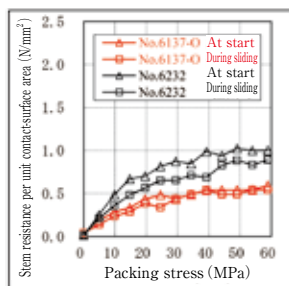


Figure5 Sliding characteristics

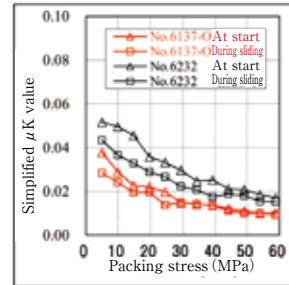


Figure6 Sliding characteristics(μk value)

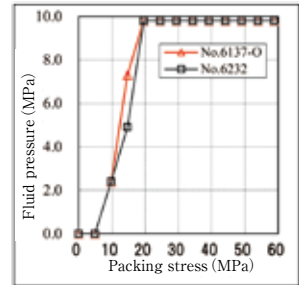


Figure7 Sealing properties

7-2) Reciprocation-tolerance test

Reciprocation-tolerance tests are conducted to evaluate the sliding-resistance characteristics and sealing characteristics against reciprocating motions of the gland packing for valves.

Table3 Test conditions

Gland packing	No.6137-O, No.6232 ⁽¹⁾
Test equipment	Refer to "Figure 9. Outline illustration of a reciprocation-tolerance tester."
Packing dimension	φ20×φ33×6.5 ^H
Packing qty	8 rings (2 rings + lantern ring + 6 rings)× 2
Packing arrangement	
Fluid	Water and heated water
Test temperature	260°C
Stem radial clearance	0.7 mm (inner diameter = φ21.4)
Sliding number	1000 reciprocations × 3 cycles (3000 reciprocations)
Packing stress	Initial packing stress: 39.2 MPa Additional packing stress: 39.2 MPa
Stem operating conditions	Stem stroke: 50 mm Stem speed: 25 mm/sec Stem stop: 1 sec
Fluid pressure	On heating: 10.2 MPa When withstanding pressure at room temperature: 11.0 MPa

Note (1) : No. 6232 is used for valves and reciprocating equipment.

Test results:

Figure 10 shows the results of the reciprocation-tolerance tests.

No. 6137-O had a weaker stem resistance, which is a sliding characteristic, and improved performance than the conventional product No. 6232. Regarding sealing properties, both specimens showed equivalent results.

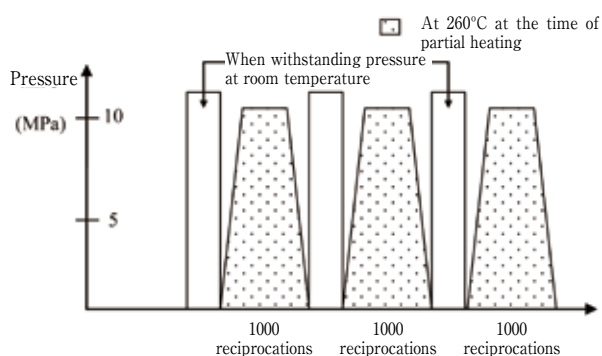


Figure 8 Outline of test cycles

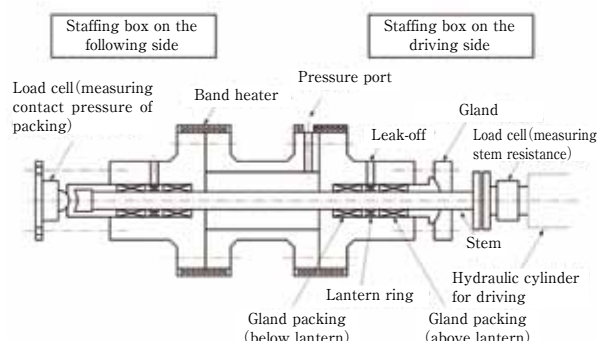


Figure 9 Outline illustration of a reciprocation-tolerance tester

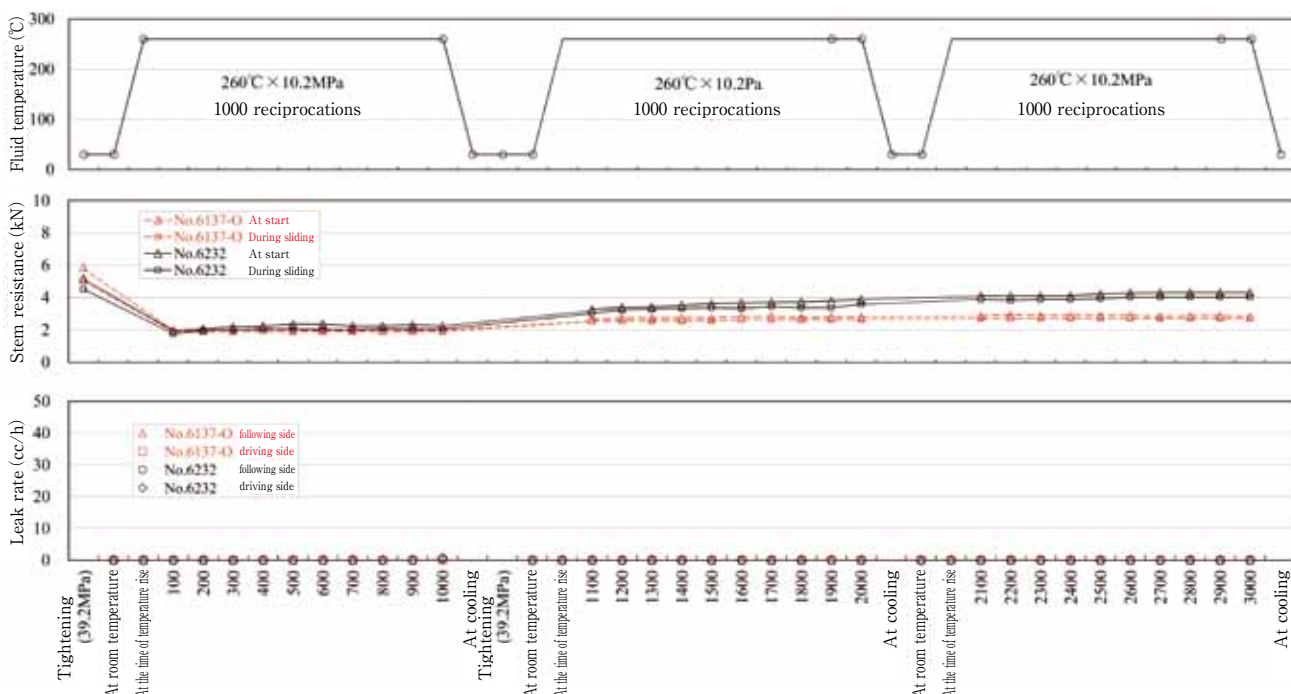


Figure 10 Results of reciprocation-tolerance tests

7-3) Large-bore pressure test

Large-bore pressure tests are conducted to evaluate the pressure tightness of a gland packing.

Table 4 Test conditions

Gland packing	No.6137-0
Test equipment	Refer to "Figure 11. Outline illustration of large-bore pressure tester."
Packing dimension	$\phi 80 \times \phi 112 \times 16.0^H$
Packing qty	6 rings
Stem radial clearance	1.2 mm (inner diameter = $\phi 82.3$)
Packing stress	39.2 MPa
Temperature	Room temperature
Fluid	Water
Fluid pressure	15.5 MPa, 19.4 MPa, 23.3 MPa (Maximum, ANSI Class 900 \times 1.5)

Outline of the test method:

- ① Mount the gland packing in a test jig.
- ② Use a torque wrench to tighten the gland packing to a given packing stress.
- ③ Apply a given fluid pressure to the sample using a water-pressure booster.
- ④ After keeping the pressure for 30 minutes, check whether the fluid penetrates through the packing or leaks.
- ⑤ Increase the fluid pressure in a stepwise fashion, and repeat the check of step ④.

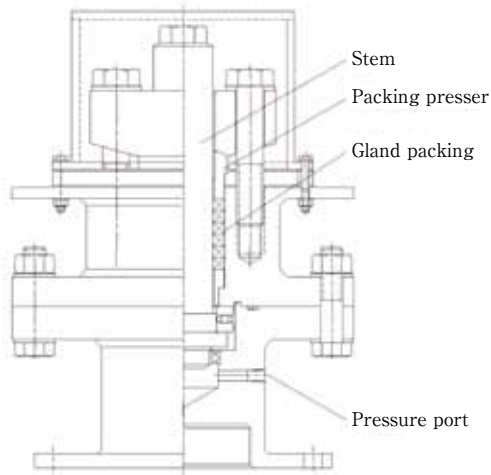


Figure11 Outline illustration of a large-bore pressure tester

Test results:

Table 5 shows the results of the large-bore pressure test.

Pressure tightness was improved from the diameter of ANSI Class 600 for the conventional product No. 6232; No. 6137-O can be used at the diameter of up to ANSI Class 900.

Table5 Results of large-bore pressure tests

Fluid pressure (MPa)	19.4	23.3
ANSI rating	Class 900 × 1.25	Class 900 × 1.5
Penetrating	None	None
Leakage	None	None

7-4) Test to evaluate long-term durability against inverter using an actual equipment pump

In inverter-tolerance tests, the rotation of a rotary pump's motor is switched alternately between 60 Hz and 30 Hz using an inverter in the pump of actual

Table6 Test conditions

Test equipment	Refer to "Figure 13. Outline illustration of a long-term inverter-tolerance tester."	
Gland packing	No.6137-O, No.6262 ⁽¹⁾	
Packing dimension	φ 35 × φ 51 × 8 ^H (4 rings)	
Fluid	Water	
Temperature	Course of events	
Pushing pressure	0.5MPa	
Test frequency	60Hz	30Hz
Rotation	1800rpm	900rpm
Peripheral speed	3.30m/s	1.65m/s
Discharge pressure	0.8MPa	0.6MPa
PV value	2.64MPa · m/s	0.99 MPa · m/s

Note (1) : No. 6262 is used for rotary pumps and rotary devices.

equipment. Through the alternate switching, the peripheral speed and discharge pressure are varied, creating much more severe conditions than under regular operation. Under such conditions, the leak rate and stem-torque characteristics were evaluated.

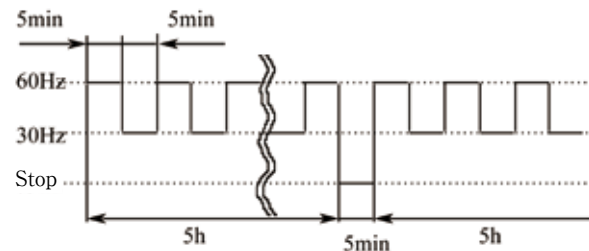


Figure12 Inverter activation cycle

Test pump : General-purpose, single-suction centrifugal pump
 Motor : 4-phase, 200 V (60 Hz) , 4 poles, 5.5 kW
 Pump bore : 65 × 50

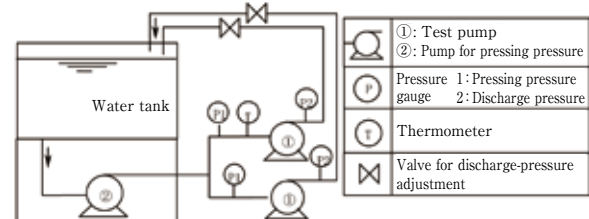


Figure13 Outline illustration of a long-term inverter-tolerance tester

Test results:

Tables 7 and Figure 14 show the results of the inverter-tolerance tests.

In the tests, varying pressures and peripheral speeds were applied to the samples through inverter operation of a rotary pump of actual equipment. Under varying pressures and peripheral speeds, No. 6137-O showed stable tolerance and had equivalent leak rate and sliding resistance to the conventional product No. 6262.

Table7 Results of inverter tests

Operation time	Approximately 1000 hours			
Fluid temperature ⁽¹⁾	Course of events			
Gland packing	No.6137-O		No.6262 ⁽³⁾	
Frequency	60Hz	30Hz	60Hz	30Hz
Leak rate ⁽²⁾ (cc/min)	Minimum value	6	6	9
	Maximum value	18	15	90
	Average	14	13	26

Note (1) : Fluid temperature fluctuates depending on packing's frictional heat and piping resistance.
 (2) : Leak rate just after inverter activation
 (3) : Test results do not include time for running-in and initial adjustment.

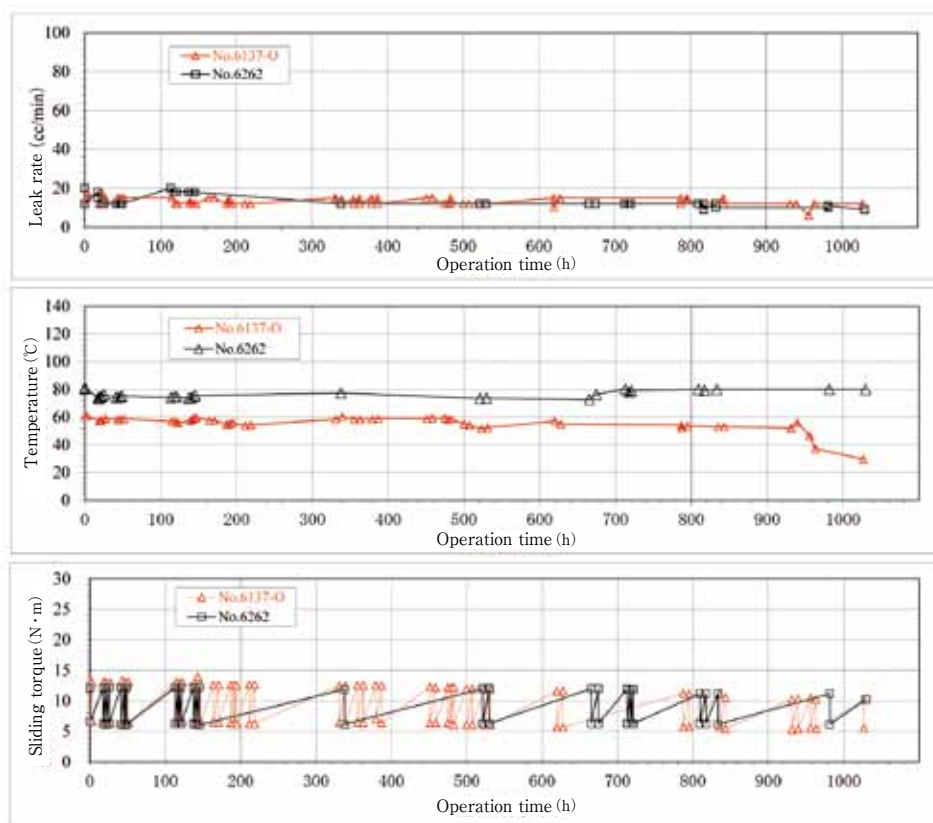


Figure14 Results of inverter tests

8. Conclusion

With the products described here, different types of products do not need to be selected depending on the application, thus improving the efficiency of the

inventory management and reducing the risk associated with product mis-selection.

We will continue to develop new products to satisfy the varying needs of individual users.



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