

Sheet Gaskets for High-Temperature Use VALQUA HEAT RESIST SHEET™ No. HRS

1. Introduction

Under high-temperature conditions in petroleum refining and petrochemistry industries, spiral wound gaskets, metal jacketed gaskets, ring joint gaskets, and rubber-coated woven fabric gaskets are used. Appropriate gaskets are selected depending on the pressure classes. Among such gaskets, rubber-coated woven fabric gaskets are used under low-pressure conditions and are not dense, so they cannot provide adequate sealing properties. Furthermore, due to material deterioration, they carry risks regarding medium- to long-term sealing properties. In addition, refractory ceramic fiber (RCF), which is a constituent material of the rubber-coated woven fabric gasket, was categorized as a Group-2 substance and specified chemical substance to be controlled under the Ordinance on the Prevention of Hazards Due to Specified Chemical Substances in November 2015, and so we could not source RCF from the material manufacturers. Although RCF was replaced with biosoluble fiber (BSF), the heat resistance of BSF is inferior to that of RCF, and it is difficult to use BSF above 1,000°C.

To solve these challenges, VALQUA significantly improved the sealing properties compared with those of the conventional rubber-coated woven fabric gasket to develop VALQUA HEAT RESIST SHEET™ No. HRS, a sheet gasket which can be used at temperatures up to 1,200°C. No. HRS solves the problems of gaskets used at high temperature and low pressure. This article introduces the characteristics of VALQUA HEAT RESIST SHEET™.

2. Composition and characteristics

2-1) Composition

No. HRS is a white sheet consisting of inorganic materials. Like foamed carbon sheet No. VF-35E, No. HRS is made by fixing a sheet material on both surfaces of a stainless-steel thin plate (thickness : 0.05 mm). Figure1 is a photograph of the exterior and Figure2 shows the composition.

2-2) Characteristics

- ① Compared with the conventional rubber-coated woven fabric gasket, No. HRS offers significantly improved sealing properties, effectively reducing the discharge of environmental contaminants including NOx and SOx in combustion gas.
- ② No. HRS minimizes the content of organic constituents including rubber binder. In addition, No. HRS contains inorganic fiber which has excellent heat resistance, and so can be used at temperatures of up to 1,200°C.
- ③ No. HRS has less sticking to flanges than rubber-coated woven fabric gaskets, so cleaning is easier.



Figure1 Exterior of VALQUA HEAT RESIST SHEET™ No. HRS

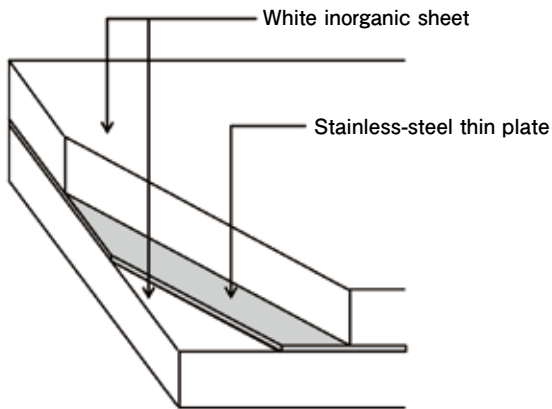


Figure2 Product composition

3. Intended use

No. HRS is suitable as a sealant for places such as devices' manholes and exhaust ducts having the following characteristics: 1) Although the inside fluid is at low pressure, the flange's strength is weak, and 2) Although the inside fluid is at low pressure, a large tightening force cannot be applied. Also, No. HRS can be used as a sealant for oil burners, high-temperature wafers, and the access doors of heat-recovery lines. Although No. HRS has much better sealing properties than the conventional rubber-coated woven fabric gasket, it suffers greater leakage volume than sheet gaskets including joint sheets, so care is required.

4. Product specifications

4-1) Standard size

Table1 shows the standard sizes of No. HRS. Two sizes, 1.5 mm and 3.0 mm in thickness, are available; the maximum outer diameter is 900 mm. Since No. HRS is a sheet gasket, it can be processed into various shapes.

Table1 Standard size (Unit : mm)

Thickness		Maximum outer diameter
1.5	3.0	900

4-2) Service temperature range

The service temperature ranges from -200 to $1,200^{\circ}\text{C}$. No. HRS is designed for use under low-pressure conditions including exhaust ducts. Therefore, metal gaskets and semi-metal gaskets are recommended for use under high-pressure conditions of 1 MPa or higher.

4-3) Recommended tightening contact pressure and maximum allowable tightening contact pressure

Table2 shows recommended tightening contact pressures.

Table2 Recommended tightening contact pressures

Fluid	Recommended tightening contact pressure (MPa)
Liquid	20
Gas	20

Note : The recommended tightening contact pressure is that which is necessary under general conditions. It is set without taking the fluid pressure into account. It is the contact pressure regarding the gasket's contact area.

5. Evaluation of characteristics

5-1) Sealing properties at room temperature

Figure3 shows the results of evaluating the sealing properties at room temperature. The leakage volume is 1/100 or less compared with that of the conventional rubber-coated woven fabric gasket, showing that No. HRS has significantly improved sealing properties. In addition, its leakage volume is small even at tightening contact pressures between 10 and 20 MPa. Therefore, No. HRS provides good sealing even at locations where a large tightening force cannot be applied due to the flange's strength.

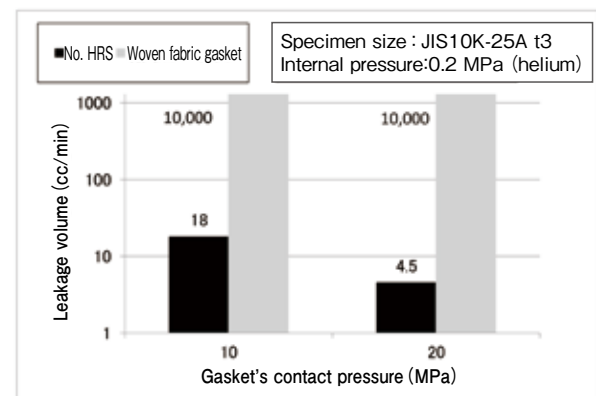
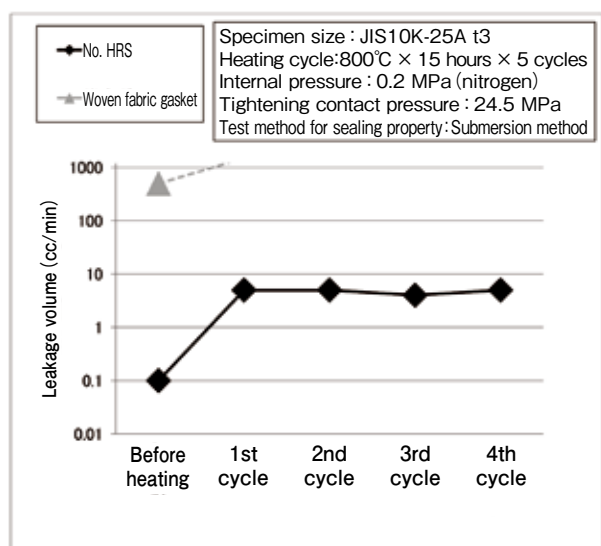


Figure3 Sealing properties at room temperature

5-2) Heat-cycle sealing properties

The sealing properties of No. HRS were evaluated as follows: 1) No. HRS was heated while connected to a flange. 2) The heating/cooling process was repeatedly applied to No. HRS. 3) After cooling, the sealing properties at room temperature were evaluated. Figure4 shows the results. No. HRS has a smaller leakage volume than the conventional rubber-coated woven fabric gasket even after heating, and maintains strong sealing properties even after repeated cycles.



(Heating-cycle conditions)

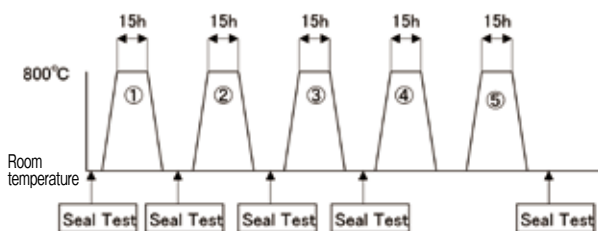


Figure4 Heat-cycle sealing properties

5-3) Sealing properties of joining products at room temperature

The maximum outer diameter of No. HRS is 900 mm. However, joining through dovetail-groove processing (Figure5) enables No. HRS to handle products with larger diameters. In that case, joining is only conducted at the construction site.



Figure5 Dovetail-groove processing

We evaluated the sealing properties of gaskets with or without dovetail grooves. Figure6 shows the results. Joining ① is without paste application. In Joining ②, gasket paste No. 6M is applied to the surfaces of the joining ends. The difference in leakage volume between no joining and joining ① is insignificant; the two conditions have similar sealing properties. For safer usage, we recommend applying paste No. 6M to the surfaces of joining ends when joining products are used.

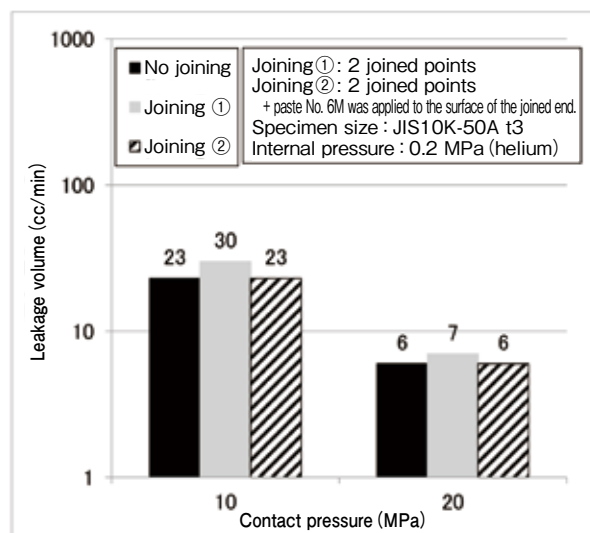


Figure6 Sealing properties of joining products at room temperature

5-4) Heat resistance

To evaluate heat resistance, we evaluated the shape-retention characteristics after heating. Figure7 shows the gaskets' appearance after heating in air at 1,000°C and 1,200°C. Even after heating, No. HRS had no deformation or powdering; it kept its original shape.

Therefore, there is little risk in high-temperature usage of, for example, gasket breakage due to internal pressure.

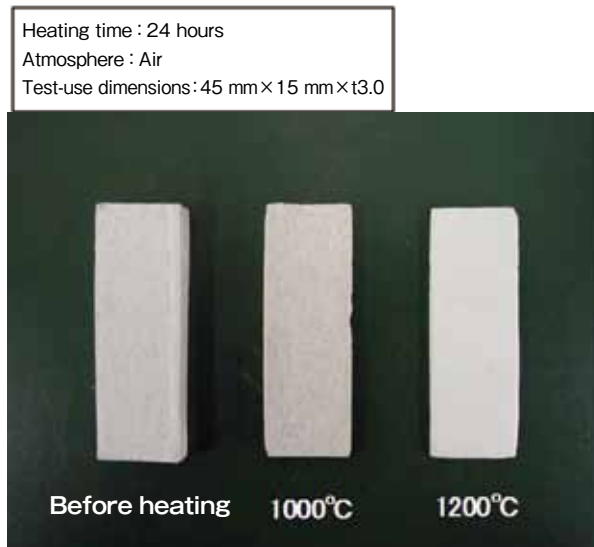


Figure7 Results of evaluating shape retention after heating

5-5) Sticking tendency

In high-temperature environments, gaskets strongly stick to flanges, and so time and labor are required for removal. Figure8 shows the sticking tendency to flanges after repeated heating cycles. In No. HRS, the amount of rubber binder is reduced to the minimum, and very smooth inorganic filler is used. Therefore, No. HRS sticks to flanges much less than the conventional rubber-coated woven fabric gasket, which facilitates flange cleaning and reduces man-hours in construction.

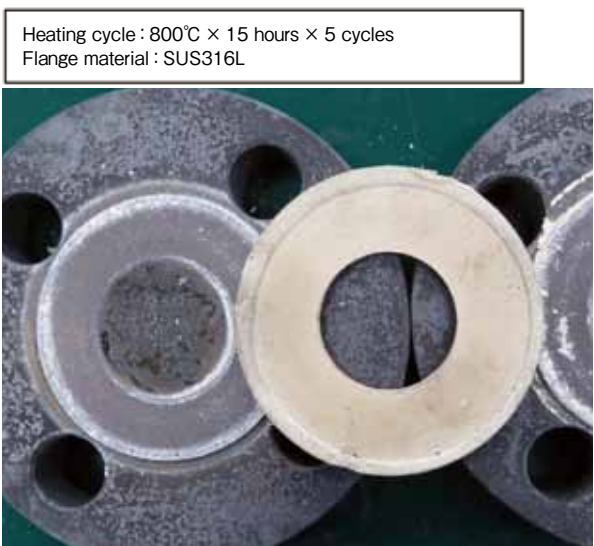


Figure8 Sticking to flanges

5-6) Resistance to crushing

When an excessive tightening force is applied to gaskets, they can break. In an experiment, No. HRS was subjected to a contact pressure of 100 MPa, as shown in Figure9. Even after this tightening contact pressure was applied, the gaskets did not suffer compression fracture.

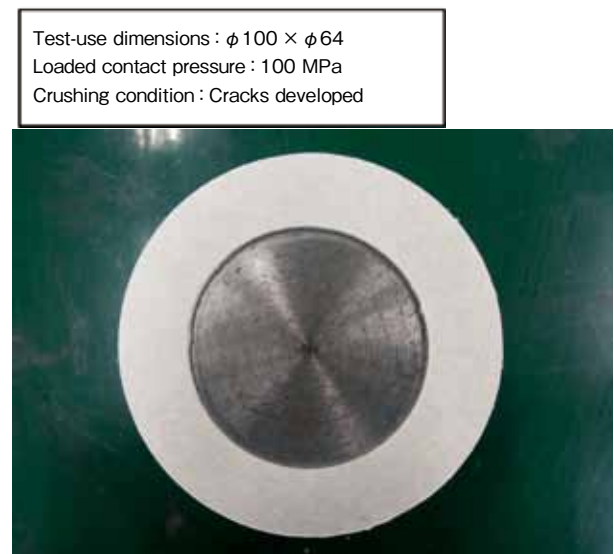


Figure9 Appearance of gasket after application of contact pressure of 100 MPa

6. Conclusion

This article introduced VALQUA HEAT RESIST SHEET™ No. HRS. No. HRS has significantly better sealing properties and heat resistance than conventional rubber-coated woven fabric gaskets, which have been used for high-temperature and low-pressure applications. This product ensures long-term safety. Some customers have already conducted actual evaluations, and some have already introduced No. HRS. Environmental regulations will get stricter in future. We hope you will use No. HRS gaskets which comply with environmental regulations.



Satomi Takahashi

Corporate Research and Development Group
Product Development Division I