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# VALFLON™ lined steel pipes

## Gasketless mechanism

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### 1. Introduction

VALFLON™ (PTFE) has anti-corrosive properties and does not elute of metal ions. VALFLON™ lined steel pipes are used for the transport of chemical solutions (strong acid, alkali, solvents, etc.) manufactured at chemical plants and in piping that handles high-purity items for the semiconductor industry. Other than VALFLON™ piping materials, lines with corrosive fluid that cannot be carried by metal tubes use glass lining pipes and karbates. However, these have low mechanical strength, and are easily damaged if used as scaffolding or receives impact during piping work. In addition, if there is a concentration of stress due to land subsidence or earthquakes, it has the disadvantage of possibly causing unanticipated accidents. VALFLON™ piping material, utilizing the superior flexibility of VALFLON™, is appropriate for these uses. Recently, in the semiconductor industry, VALFLON™ piping material is used for handling high purity chemical solutions.

As the connecting structure of such VALFLON™ piping material, flanges are installed at the connecting pipe ends and a gasket is placed between the flanges at the pipe connection to be tightened. In this report, we will introduce a “gasketless mechanism” that does not place a gasket in between the flanges.

### 2. Outline of gasketless mechanism

#### 2-1) Problem to be solved

1. There is no specific installation position for gaskets or seat for fixation
2. Misalignment of gasket may lead to decrease in sealability

3. Misalignment of gasket may lead to gasket protruding into the inner pipe and may adversely affect inner environment due to fluid accumulation
4. High-level skill (techniques) to precisely align gasket and transfer of those skills (techniques)

For connection of pipe components, to avoid misalignment within the flow route, the center axes of the connecting flanges need to be placed facing each other to allow flow, and also the center axis of the gasket that is the containment section must also be placed in alignment with the central axis of the flange. However, there is a problem that high skill (technique) is required for connecting the pipes with high precision alignment of flange and gasket. First, the flange that is formed as one with the piping component or fixed at the open end of the piping component, gaskets are a different material from pipe components and second, there is no gasket seat to fix the position or determine the alignment of gaskets on the flange flare surface.

For pipe installation devices, even if the pipe routes are connected through a central axis, if the gasket is installed misaligned, part of the open ends of the gasket bore would protrude into the tube. There is an issue that protrusions of the gasket would increase the flow resistance of the liquid within the pipet and substances that flow with the liquid may accumulate at the protrusions and lead to worsening of the inner environment. Other than this, piping connections that use conventional gaskets close the connecting section by placing each flange surface in contact with the opposite side of the gasket, and crushing the two gaskets from both sides by tightening the flanges. In other words, the two flange surfaces have a structure that do not come in

contact because of the gasket in between. Such connecting devices have issues because they may decrease in pipeline sealing properties due to reasons such as a gasket that is not installed in the appropriate position leading to uneven flange tightening.

Figure1 and 2 show a photograph and diagram of the pipe junction.

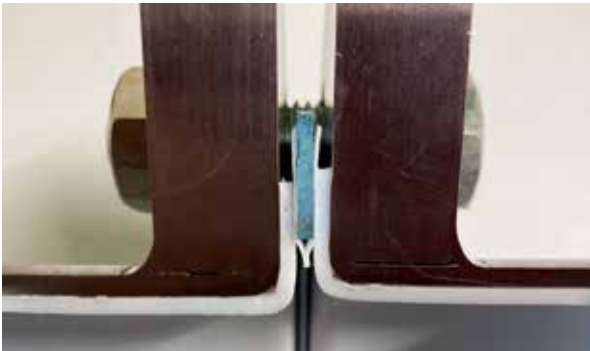


Figure1 Photograph of the pipe junction

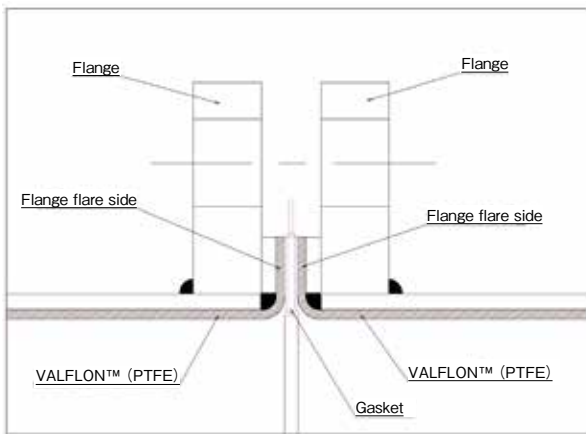


Figure2 Diagram of pipe junction

## 2-2) Measures to solve the issues

To solve the above issues, VALFLON™ (PTFE) that is used in sections of the flange No. 1 formed at the opening of the tube No. 1 and flange No. 2 formed at the opening of tube No. 2 is pressure bonded together and this has a metal touch junction that connects the metal of the flange flare that seals the surrounding area of the pipeline junction and the flange section that does not have VALFLON™ (PTFE) lining.

In the above piping device, the metal section of flange No. 1 and flange No. 2 have a concave-convex shape that is a structure that relieves misalignment of the pipes at the tightening section. Figure3 shows the junction.

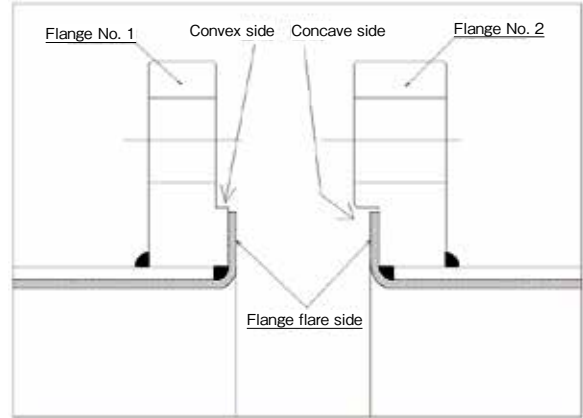


Figure3 Diagram of junction

After flange tightening, the lined junction is a structure that minimizes misalignment.

Figure4 and 5 show a photograph and diagram of the junction after tightening.



Figure4 Photograph of junction after tightening

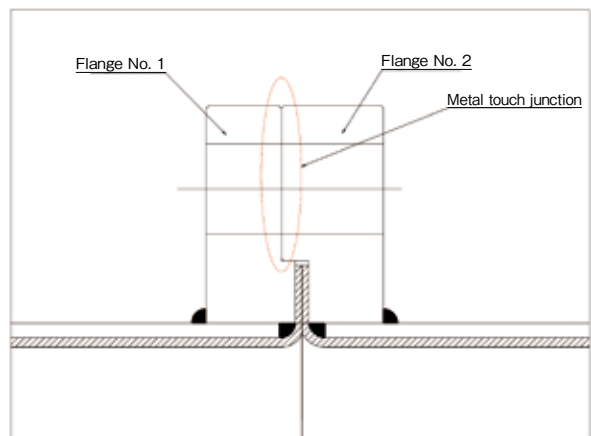


Figure5 Diagram of junction after tightening

### 3. Effect anticipated for gasketless steel pipes

- (1) By connecting flange surfaces without a gasket in between the flanges, the occurrence of variability in the tightening state at the flange surface due to tightening tasks can be lowered and tightening precision can be improved.
- (2) The housing section that was formed in a section of the flange houses the lining used for a section of the flange surface, and the lining that is pressure bonded due to the tightening of the flanges seals the area around the pipeline connecting section and realizes a piping device that has simple installation procedures while maintaining the sealability of flanges.
- (3) Regarding the connection of pipes, by not having a separate component such as gaskets, it is unnecessary to determine the position of the gasket against the flange surface or maintain that state until tightening. Therefore, work efficiency improves and it is possible to improve the precision of tightening tasks without depending upon the assembly operator's skill (technique).
- (4) Gasketless mechanism can prevent flow resistance within the pipeline by gaskets that were tightened in a misaligned position and prevent the accumulation of substances that are contained in the fluid.
- (5) After connection of pipes, by not having a gasket in between, it is unnecessary to do retightening to maintain sealability.
- (6) Metal touch mechanism can reduce the loosening of bolts due to vibration because there is no gasket in between.

### 4. Sealing performance

#### 4-1) Pressure resistance and leakage tests

Standard tests and inspections for lined pipes were confirmed for gasketless mechanism. Table1 shows the pressure resistance and leakage test conditions and Figure6 shows a diagram of pressure resistance and leakage tests. It was confirmed that it is possible to

maintain sealability with no problems without gaskets.

Table1 Pressure resistance/leakage test conditions

Pressure (MPa)	Retention time (min)	Fluid	Pinhole inspection
1.5	10	Water	AC15KV

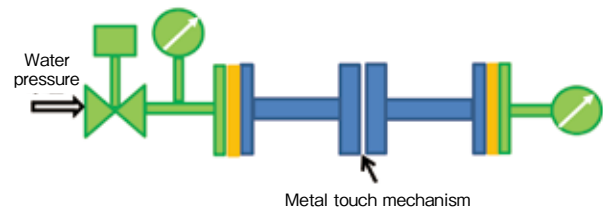


Figure6 Diagram of pressure resistance/leakage test

#### 4-2) Heat cycle test

After connecting the pipes, the heat cycle was repeated to confirm whether leakage may occur due to stress relaxation of the sealing surface. Table2 shows the conditions for the heat cycle test and Figure7 is a diagram of the heat cycle test.

As a result of the heat cycle test, it was confirmed that sealability could be maintained without any problems.

Table2 Conditions for heat cycle test

	Pressure (MPa)	Retention time (min)	Fluid
①	0.6MPa	30	165°C saturated steam
②	0.6MPa	15	Water at room temperature

※ Test is implemented by 100 repeats of ①→② as 1 SET

Confirmation of sealability after test

Pressure (MPa)	Retention time (min)	Fluid	Pinhole inspection
1.5	10	Water	AC15KV

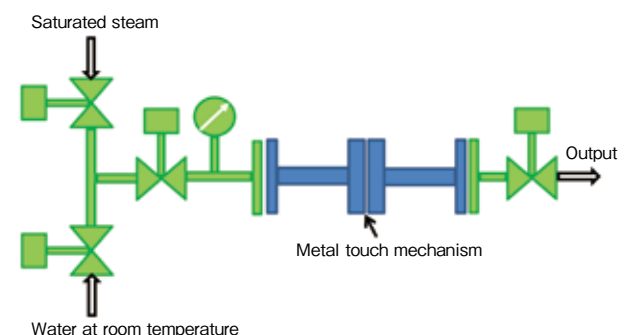


Figure7 Diagram of heat cycle test

## 5. Conclusions

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VALFLON™ lined pipes with gasketless mechanism is a product that was produced with the customer's viewpoint, such as pipe installation and flange tightening control in consideration. In addition, it has the safety features because of its fire-safe property that would minimize the possibility of spreading fire. In the future,

with further improvements, we aim to complete products that would be a mainstay of lined pipes and make products that our customers are satisfied with.

## 6. References

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- 1) Valqua Handbook Technology Edition (Piping material products)



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