

# Results of airtightness test after flange tightening training

## 1. Introduction

We are a facility that conducts plant maintenance of which there are not many within Nippon Express Co., Ltd., and working hard as the main contractor of daily maintenance tasks and periodic repair work (SDM work) to ensure the safety and stable operation in chemical plants.

In a chemical plant, there are many flange connections (hereinafter, abbreviated as “flange”) to connect the main parts of equipment (heat exchanger, reaction vessel, tanks, pumps, valves, etc.) and piping.

Tasks to open and tighten flanges account for a substantial proportion of daily maintenance tasks and periodic repair work, and as a long-term issue, the goal



Figure3 Inside view (2) of VALQUA Seal Training Center™

has been to eliminate leaking at airtightness tests. However, on-site confirmation (such as hammering) after implementation of work requires time and effort. There have been many times that we inconvenienced our clients because it took many days to successfully pass the airtightness test.

In addition, since it is a chemical plant, it is necessary to make the various operators aware about the importance of flange tightening because some inner fluids may be harmful and there is a possibility of a major disaster if there is a leak during plant operation. When we were starting to investigate measures for improvement, we were introduced by Toyo Sangyo, Co. Ltd. that VALQUA has training equipment. We visited VALQUA's Seal Training Center™ (STC) in Nara and experienced the training. Then, we considered the introduction of this training equipment hoping that it could be used to resolve our issues.

We handle a diverse range of gaskets, but we specified the one that is used the most, No. GF300 to be implemented.

This report is about the utilization status of “Flange tightening training” and its results.



Figure1 Outside view of the VALQUA Seal Training Center™ (Nara)



Figure2 Inside view (1) of VALQUA Seal Training Center™

## 2. Utilization of flange tightening training equipment (Settings for JIS10K 100A No.GF300)

### 2-1) Settings for evaluation criteria

Firstly, to utilize the flange tightening training equipment, proficiency was ranked into 3 levels using stars to clarify the proficiency judged by training results.

- “☆☆☆” Pass.....Can conduct flange tightening
- “☆☆” Level 2.....Can conduct tightening under the advice of a team leader
- “☆” Level 3.....Cannot conduct flange tightening

Criteria for each rank were as follows:

- “☆☆☆” .....Torque value of bolts ① to ⑧ is within  $90 \pm 5\text{N}\cdot\text{m}$ , and no tendency of uneven tightening according to the line graph.
- “☆☆” .....Torque value of bolts ① to ⑧ is between  $90 \pm 5\text{N}\cdot\text{m}$  and  $90 \pm 10\text{N}\cdot\text{m}$ , and no tendency of uneven tightening according to the line graph.
- “☆” .....Torque value of bolts ① to ⑧ is under  $80\text{N}\cdot\text{m}$  or over  $100\text{N}\cdot\text{m}$ .

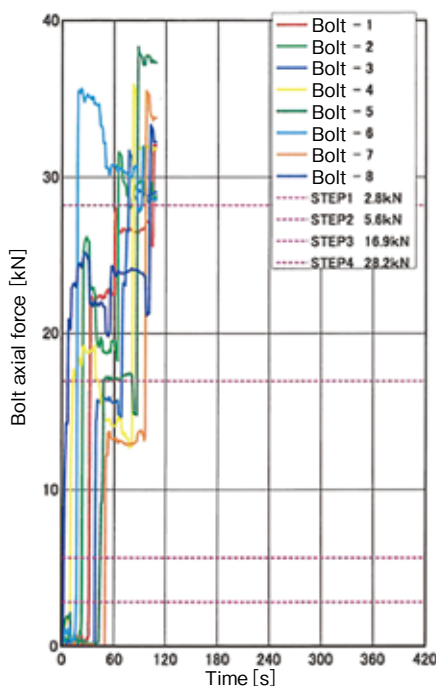


Figure4 Sheet gasket (No.GF300) tightening axial force over time

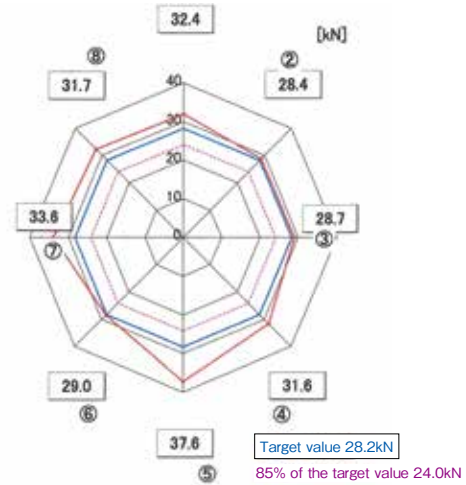


Figure5 Tightening axial force distribution of sheet gasket (No.GF300)

### 2-2) Training method

- ① Explanation of tightening method  
Explain the method of tightening in a diagonal pattern and increasing the torque in 3 steps.
- ② Explanation of evaluation criteria  
Explain 2-1, and explain why under  $80\text{N}\cdot\text{m}$  is considered as a failure.
- ③ Training procedure  
After each trainee acquires the sense of torque values using the torque-sensor training device (See photograph), they are tested on the flange-tightening training device (Photograph attached) and when this is completed, the results are printed out on the spot for evaluation.

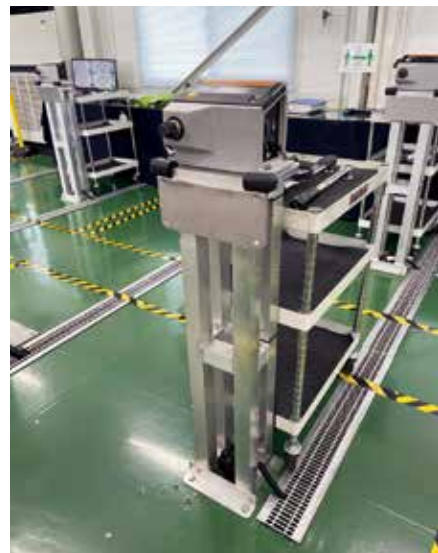


Figure6 Torque-sensor training device



Figure7 Flange-tightening training device



Figure10 Scene from training (3)



Figure11 Scene from training (4)



Figure8 Scene from training (1)



Figure9 Scene from training (2)

### 3. Results of flange-tightening training

#### 3-1) Situation of the operators' skill level

Table1 Training pass rate

Year	No. of trainees	No. of successful trainees	Pass rate
2017	568	224	39.5%
2018	559	240	43.0%
2019	562	264	47.0%
2020	557	267	48.0%
2021	563	284	50.5%

Five years have passed since we implemented flange-tightening training. It started with a test format as shown in Table1, but in the beginning, rather than find operators that passed, we looked for those that



didn't and restricted them from conducting flange tightening. This led to a significant drop in the number of leakage sites.

Prior to implementation, we asked operators to work on flange tightening based on their years of experience or an estimation based on how the flange looked, but being able to "visualize" with the training was one of the outcomes that were achieved immediately after implementing the training.

This will continue to be part of the education program before the start of periodic repair works.

### 3-2) Transition in number of leakage sites at periodic repair works

Table2 shows how the number of leakage sites at periodic repair works changed from before training implementation until now.

Table2 Transition of number of faulty airtightness sites

Year	No. of tightening sites	No. of faulty airtightness sites	Pass rate
2017	8500	400	95.0%
2018	8500	400	95.0%
2019	8500	280	96.7%
2020	8500	240	97.2%
2021	8500	180	97.9%

## 4. Conclusion

Further issues for the future would be that while the test for the training is conducted under good conditions for conducting tightening tasks regarding the site and position, in the actual field, tightening tasks at such good conditions would be less than half the total. There is an advantage that flange leaks at bad conditions stand out and places that require caution become clear, but to reduce the number of leakage sites, we feel that it is necessary to create an environment similar to the actual field for the training equipment and build up the skills of each operator.

In addition, we would like to focus on the status of the flanges (rusted, surface corrosion, distorted flanges, etc.) and of the bolts and nuts (the screw of the bolt is rusted, etc.) and consult with the client to aim to improve the quality of our work and increase customer satisfaction.

The target number of people receiving training is about 300 each for the spring periodic repair works and autumn periodic repair works, respectively. This requires more discussion on how to secure the days and times.

In closing, I would like to thank VALQUA, Ltd. for manufacturing this equipment and conducting maintenance every year, and offering us an opportunity to report, along with the staff in connection with distributor Toyo Sangyo Co., Ltd. We wish for continued cooperation in solving issues in the future as well.



**Shinya Kiriya**

Nippon Express Co. Ltd.  
Shunan Branch, Heavy Machinery & Construction Section