# Installation Instructions

2009 Volume, Rev 02

PM451

# SYGEF® Standard
# SYGEF® Plus
# PVDF Flanges

+GF+

GEORG FISCHER
PIPING SYSTEMS

**Please read all instructions before attempting to install flanges.**

# Introduction

## When to Use a Flange

Flanges may be used when

- the piping system may need to be dismantled
- the installation is temporary or mobile
- transitioning between dissimilar materials that can not be cemented together
- the installation environment is not conducive to fusion joining

## Why Choose a Flange?

All SYGEF PVDF flange adapters in combination with GF flange rings, pipe and fittings, are lightweight, and easy to install. However, PVDF has different physical properties than metals, and therefore special care is required to ensure that your PVDF flange connections have a long, reliable service life. Installers should study these instructions and follow them carefully in every installation in order to ensure satisfactory performance and enjoy the full benefits of the GF warranty.

When using a PVDF flange, ensure that the entire system is well-supported and that the flange does not bear the weight of a massive, unsupported system component such as a cast iron valve. See support instructions in the GF Technical Manual online: http://www.gfpiping.com/downloads/engbook/engbook.pdf

# Materials

## Polyvinylidenefluoride (PVDF) Flange Adapters

Visually inspect flange adapters for cracks, deformities, and other obstructions on the sealing surfaces.

## Flange Seals

A seal must be used between the flange adapter faces in order to ensure a good seal. The seal can be a flat gasket or SYGEF Plus gasket for high purity applications.

The SYGEF Plus Gasket is the premier solution for Semiconductor UPW and Hot UPW applications. Manufactured from EPDM rubber with a TFM (modified PTFE) covering exposed to the fluid stream, the SYGEF gasket combines excellent compression (low torque) with simple installation (self-centering).

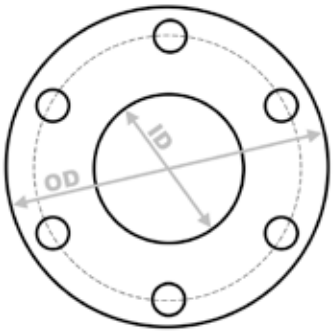
Select the seal material based on the chemical resistance and purity requirements of your system. For applications with maximum 90 PSI (6 bar) working pressure, the flat gaskets can be used.

Full-face gaskets with shore A scale hardness of 70 ±5 should be used. All recommended torque values in tables 4 and 5 are based on this gasket hardness. For other hardness requirements, contact GF Technical Service.

At increased working and testing pressure, the SYGEF Plus gasket or a profile flange gasket may be required. (Please contact GF for design assistance).

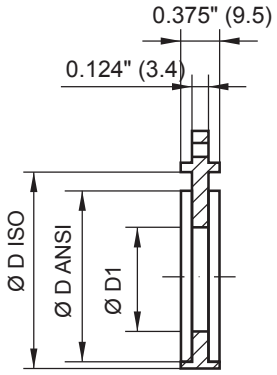
The SYGEF Plus Gaskets have the following advantages.

- TFM (mod. PTFE) coated for high temperature
- High purity
- Low torque design
- Excellent memory, allows multiple installations
- Self centering




## Table 1
## ANSI Class 150 Flat Flange Gasket Dimensions
**(Recommended only up to maximum operating pressure of 90 PSI)**

| Size | | OD | | ID | | Thickness | |
|---|---|---|---|---|---|---|---|
| in | mm | in | mm | in | mm | in | mm |
| ¾ | 25 | 3.88 | 99 | 1.06 | 27 | 0.12 | 3 |
| 1 | 32 | 4.25 | 108 | 1.31 | 33 | 0.12 | 3 |
| 1¼ | 40 | 4.63 | 118 | 1.66 | 42 | 0.12 | 3 |
| 1½ | 50 | 5.00 | 127 | 1.90 | 48 | 0.12 | 3 |
| 2 | 63 | 6.00 | 152 | 2.38 | 60 | 0.12 | 3 |
| 2½ | 75 | 7.00 | 178 | 2.88 | 73 | 0.12 | 3 |
| 3 | 90 | 7.50 | 191 | 3.50 | 89 | 0.12 | 3 |
| 4 | 110 | 9.00 | 229 | 4.50 | 114 | 0.12 | 3 |
| 6 | 160 | 11.00 | 280 | 6.63 | 168 | 0.12 | 3 |
| 8/9 | 200/225 | 13.50 | 343 | 8.63 | 219 | 0.12 | 3 |
| 10 | 250 | 16.00 | 407 | 10.75 | 273 | 0.12 | 3 |
| 12 | 315 | 19.00 | 483 | 12.75 | 324 | 0.12 | 3 |




## Table 2a
## ANSI Class 150 SYGEF Plus Gasket Dimensions

| Size | | D ANSI | | D1 | |
|---|---|---|---|---|---|
| in | mm | in | mm | in | mm |
| ¾ | 25 | 2.13 | 54 | 0.91 | 23 |
| 1 | 32 | 2.48 | 63 | 1.18 | 30 |
| 1¼ | 40 | 2.87 | 73 | 1.50 | 38 |
| 1½ | 50 | 3.23 | 82 | 1.81 | 46 |
| 2 | 63 | 4.02 | 102 | 2.32 | 59 |
| 2½ | 75 | 4.80 | 122 | 2.64 | 67 |
| 3 | 90 | 5.24 | 133 | 3.15 | 80 |
| 4 | 110 | 6.22 | 158 | 3.86 | 98 |
| 6 | 160 | 8.35 | 212 | 5.83 | 148 |
| 8/9 | 200/225 | 10.55 | 268 | 8.23 | 209 |
| 10 | 250 | 12.60 | 320 | 9.84 | 250 |

## Table 2b
## ANSI Class 150 ePTFE HP Gasket Dimensions

| Size | | D ANSI | | D1 | |
|---|---|---|---|---|---|
| in | mm | in | mm | in | mm |
| 12 | 315 | 15.98 | 406 | 11.80 | 300 |

For 12"/315mm, we recommend using an ePTFE HP Gasket with the above dimensions. Thickness 0.12"/3mm.

## Fasteners

It is critical to avoid excessive compression stress on a flange. Therefore, only low-friction fastener materials should be used. Low-friction materials allow torque to be applied easily and gradually, ensuring that the flange is not subjected to sudden, uneven stress during installation, which can lead to cracking.

Either the bolt or the nut, and preferably both, should be zinc-plated to ensure minimal friction. If using stainless steel bolt and nut, lubricant must be used to prevent high friction and seizing. In summary, the following fastener combinations are acceptable:

- zinc-on-zinc, with or without lube
- zinc-on-stainless-steel, with or without lube
- stainless-on-stainless, with lube only

No lubricants can be used for high purity applications, only zinc-on-zinc or zinc-on-stainless steel fastener combinations are acceptable.

Cadmium-plated fasteners, while becoming more difficult to obtain due to environmental concerns, are also acceptable with or without lubrication. Galvanized and carbon-steel fasteners are not recommended. Use a copper-graphite antiseize lubricant to ensure smooth engagement and the ability to disassemble and reassemble the system easily.

Bolts must be long enough that two complete threads are exposed when the nut is tightened by hand. Using a longer bolt does not compromise the integrity of the flange connection, although it wastes material and may make tightening more difficult due to interference with nearby system components.

Table 3
Steel Flange Fastener Specifications

| Flange Size (in) | No. of Bolts | Length[1] (in) | Bolt Size (in) & Type | Washer Size (in) & Type[2] |
|---|---|---|---|---|
| ¾ | 4 | 2.50 | ½-13-UNC | ½ SAE |
| 1 | 4 | 3.00 | ½-13-UNC | ½ SAE |
| 1¼ | 4 | 3.25 | ½-13-UNC | ½ SAE |
| 1½ | 4 | 3.25 | ½-13-UNC | ½ SAE |
| 2 | 4 | 3.50 | ⅝-11-UNC | ⅝ SAE |
| 2½ | 4 | 3.50 | ⅝-11-UNC | ⅝ SAE |
| 3 | 4 | 4.00 | ⅝-11-UNC | ⅝ SAE |
| 4 | 8 | 4.00 | ⅝-11-UNC | ⅝ SAE |
| 6 | 8 | 4.75 | ¾-10-UNC | ¾ F436[4] |
| 8 and 9 | 8 | 5.50 | ¾-10-UNC | ¾ F436 |
| 10 | 12 | 5.25 | ⅞-9-UNC | ⅞ F436 |
| 12 | 12 | 5.25 | ⅞-9-UNC | ⅞ F436 |

1 Suggested bolt length for flange-to-flange connection with flat or SYGEF Plus flange gasket. Adjust bolt length as required for other types of connections.

2 Minimum spec. Use of a stronger or thicker washer is always acceptable as long as published torque limits are observed.

3 Also known as Type A Plain Washers, Narrow Series.

4 ASTM F436 required for larger sizes to prevent warping at high torque.

A washer must be used under each bolt head and nut. The purpose of the washer is to distribute pressure over a wider area, reducing the compression stress under the bolt head and nut. Failure to use washers voids the GF warranty.

## Torque Wrench

Compared to metals, plastics are relatively flexible and deform slightly under stress. Therefore, not only must bolt torque be controlled in order to avoid cracking the flange, but continuing to tighten the bolts beyond the recommended torque levels may actually make the seal worse, not better.

Because bolt torque is critical to the proper function of a flange, a current, calibrated torque wrench accurate to within ±1 ft-lb must be used.

Experienced installers may be tempted to forgo the use of a torque wrench, relying instead on "feel." GF does not endorse this practice. Job-site studies have shown that experienced installers are only slightly better than new trainees at estimating bolt torque by feel. A torque wrench is always recommended.

**Never use an impact wrench to install a flange.**

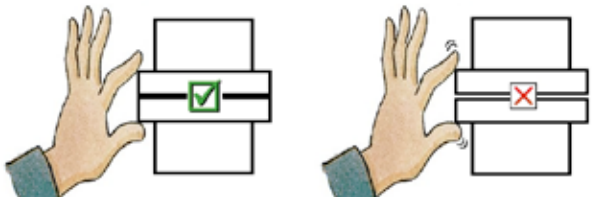
Refer to Tables 4 and 5 for recommended fastener torque settings.

# Installation

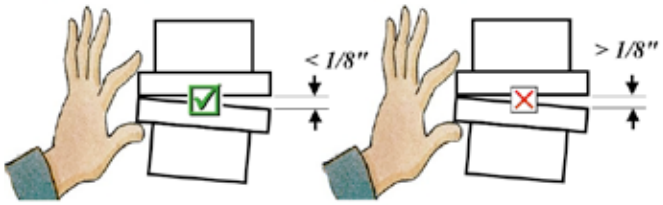
## Checking System Alignment

Before assembling the flange, be sure that the two parts of the system being joined are properly aligned. GF has developed a "pinch test" that allows the installer to assess system alignment quickly and easily with minimal tools.

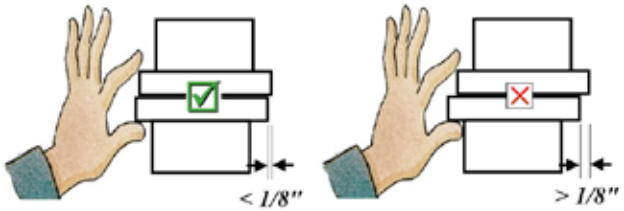
First check the gap between the flange adapter faces by pinching the two mating components toward each other with one hand as shown below. If the faces can be made to touch, then the gap between them is acceptable.



Next check the angle between the flange adapter faces. If the faces are completely flush when pinched together, as shown above, then the alignment is perfect, and you may continue installation. Otherwise, pinch the faces together so that one side is touching, then measure the gap between the faces on the opposite side. The gap should be no more than 1/8".




To assess high-low misalignment, pull the flange faces flush together. If the faces are concentric within 1/8", then the high-low misalignment is acceptable.




If the gap between the mating components can not be closed by pinching them with one hand, or if the angle or high-low misalignment between them is too large, then using the bolts to force the components together will result in excessive stress and possible failure during or after installation. In this case, inspect the system to find the greatest source of misalignment and refit the system with proper alignment before bolting.

The pinch test is a good rule of thumb, but always use common sense as well. If it seems difficult or awkward to pull the flange faces together, then stop the installation and either refit the system or consult your GF representative before proceeding.

## Bolt Hole Alignment

Orientation of bolts should be outside of main axis. Horizontal pipelines should have the shown orientation of the bolts. This will avoid medium drops on the bolts in case of a leak.

To align the bolt holes of a fixed flange, use standard two-holing procedure.

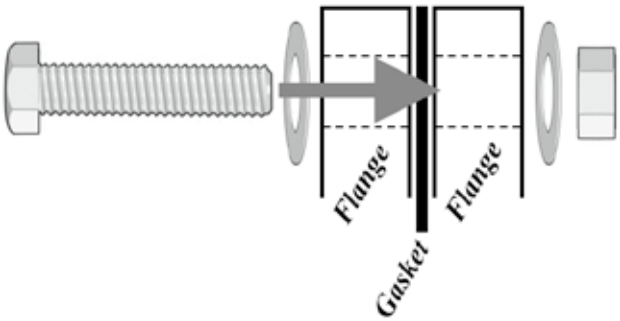
## Placing the Gasket

Center the gasket between the flange adapter faces, with the bolt holes at the outer edge of the gasket. A gasket cut to the specified dimensions (see Tables 1 and 2) should come just to the inner edge of the flange adapter face near the flow path, or overlap the edge slightly.

## Inserting the Bolts

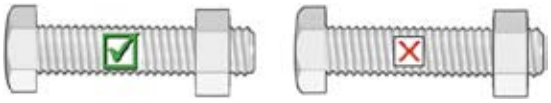
If using copper-graphite antiseize lubricant as recommended, apply the lubricant evenly with a brush directly to the bolt threads, and to the nut if desired. Cover the bolt from its tip to the maximum extent to which the nut will be threaded. No lubricants can be used for high purity applications, only zinc-on-zinc or zinc-on-stainless steel fastener combinations are acceptable.

Insert bolts through washers and bolts holes as shown:




Tighten all nuts by hand. As you tighten each nut, the nuts on the other bolts will loosen slightly. Continue to hand-tighten all of the nuts until none remain loose. Now the flange assembly will remain in place as you prepare to fully tighten it.

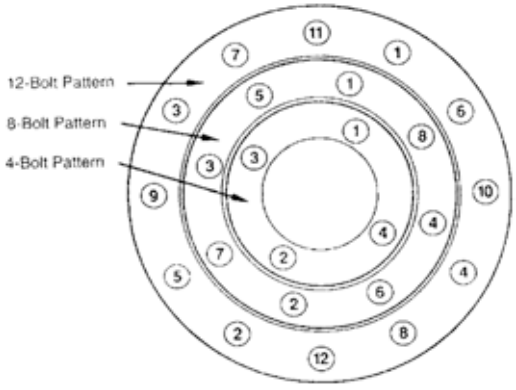
Again, when hand-tightened, at least two threads beyond the nut should be exposed in order to ensure permanent engagement. If less than two threads are exposed, disassemble the flange and use longer bolts.



## Tightening the Bolts

Plastic flanges require gradual, even bolt tightening. Tightening one bolt to the maximum recommended torque while other bolts are only hand-tight, or tightening bolts in the wrong order, produces uneven stresses that may result in cracking or poor sealing.

To ensure even distribution of stresses in the fully-installed flange, tighten the bolts in a star pattern as described in ANSI B16.5:




The torque required on each bolt in order to achieve the best seal with minimal mechanical stress has been carefully studied in laboratory and field installations, and is given in Tables 4 and 5.

To ensure even distribution of stresses and a uniform seal, tighten the bolts to the first torque value in the sequence, using a star pattern, then repeat the star pattern while tightening to the next torque value, and so on up to the maximum torque value.

A final tightening after 24 hours is recommended, when practical, to ensure that any bolts that have loosened due to relaxation of the polymer are fully engaged.

If a flange leaks when pressure-tested, retighten the bolts to the full recommended torque and retest. Do not exceed the recommended torque before consulting an engineer or GF representative.

### Table 4
### Flat Gasket Multiple-Pass Bolt Torque
**(Values based on a 70 ± 5 Shore A hardness)**

| Size (in) | Torque Sequence (ft-lb, lubed*) | | | | Torque Sequence (ft-lb, unlubed**) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 1st | 2nd | 3rd | 4th |
| ½ | 5 | 10 | - | - | 8 | 15 | - | - |
| ¾ | 5 | 10 | - | - | 8 | 15 | - | - |
| 1 | 5 | 10 | - | - | 8 | 15 | - | - |
| 1¼ | 5 | 10 | - | - | 8 | 15 | - | - |
| 1½ | 5 | 10 | - | - | 8 | 15 | - | - |
| 2 | 5 | 15 | 25 | - | 8 | 15 | 30 | - |
| 2½ | 8 | 15 | 32 | - | 8 | 15 | 38 | - |
| 3 | 10 | 30 | 35 | - | 10 | 30 | 40 | - |
| 4 | 8 | 15 | 25 | - | 8 | 15 | 30 | - |
| 6 | 10 | 20 | 35 | 45 | 20 | 30 | 40 | 50 |
| 8 | 20 | 30 | 40 | 50 | 20 | 30 | 40 | 55 |
| 10 | 20 | 30 | 45 | 50 | 20 | 30 | 45 | 60 |
| 12 | 15 | 30 | 50 | 66 | 20 | 45 | 60 | 75 |

### Table 5
### SYGEF Plus Gasket Multiple-Pass Bolt Torque
**(Values based on a 70 ± 5 Shore A hardness)**

| Size | | Torque Sequence (ft-lb, unlubed**) | | | |
|---|---|---|---|---|---|
| inch | mm | 1st | 2nd | 3rd | 4th |
| ¾ | 25 | 5 | 10 | – | – |
| 1 | 32 | 6 | 13 | – | – |
| 1¼ | 40 | 8 | 16 | – | – |
| 1½ | 50 | 8 | 19 | – | – |
| 2 | 63 | 10 | 23 | – | – |
| 2½ | 75 | 10 | 25 | – | – |
| 3 | 90 | 10 | 20 | 30 | – |
| 4 | 110 | 10 | 19 | – | – |
| 6 | 160 | 10 | 20 | 36 | – |
| 8/9 | 200/225 | 10 | 20 | 35 | 48 |
| 10 | 250 | 10 | 20 | 35 | 46 |
| 12 | 315 | 15 | 30 | 50 | 73 |

* Assumes the use of SS, zinc- or cadmium-plated bolt and/or nut along with copper-graphite antiseize lubricant brushed directly onto the bolt threads.

** Assumes the use of zinc- or cadmium-plated bolt, nut, or both. Never use unlubricated, uncoated bolts and nuts with flanges, as high friction and seizing lead to unpredictable torque and a high incidence of cracking and poor sealing.

Note that the torques listed in Tables 4 and 5 are for flange adapter to flange adapter connections. For other types of connections, such as between a flange and a butterfly valve, where the full face of the flange is not in contact with the mating component, less torque will be required. Do not apply the maximum listed torque to the bolts in such connections, which may cause deformation or cracking, since the flange is not fully supported by the mating component. Instead, start with approximately two-thirds of the listed maximum torque and increase as necessary to make the system leak-free after pressure testing.

# Documentation

## Keep Instructions Available

Provide a copy of these instructions to every installer on the job site prior to beginning installation. Installers who have worked primarily with metal flanges often make critical mistakes when installing PVDF flanges. Even experienced installers will benefit from a quick review of good installation practices before starting a new job.

## Installation Tags

Best practices include tagging each flange with

- installer's initials
- installation date
- final torque value (e.g., "29.2-31.5")
- confirmation of 24-hour torque check ("y" or "n")

This information can be recorded on pre-printed stickers, as shown below, and placed on each flange immediately after installation.


Experience has shown that installation tags speed up the process of resolving system leaks and product failures, improve communication between the contractor and distributor or manufacturer, highlight training opportunities, and promote worker diligence.

# Common Questions and Concerns

Q: Will my warranty be voided if these instructions are not followed precisely?

A: Not necessarily. We recognize that not every installation occurs under perfect conditions, and our flanges are designed to withstand reasonable variations in operating conditions and stress. If there is any doubt about the cause of a failure, contact your GF representative. We'll work with you to find a solution.

Q: What if the specified materials aren't available?

A: We perform our testing with the most commonly available bolts, lubricants, and gasket materials whenever possible. If you must use a material or component not mentioned in these instructions, call your GF representative to ask about acceptable substitutions.

Q: Can I purchase installation materials from GF?

A: We offer the SYGEF Plus gaskets, which are designed for our PVDF flange adapters. GF does not offer bolts and lubricants. However, we will gladly review the materials you intend to use prior to installation.

Q: Is it possible to tell if a flange was installed incorrectly?

A: Yes, usually. Bolt torque is easy to verify with a torque wrench, and excessive force, rough handling, or use of non-specified components are often apparent from marks, indentations, discoloration, the microscopic appearance of cracks, etc. When in doubt, your GF representative can put you in touch with a factory expert who can help determine whether a flange has been installed correctly.

Q: I installed a flange as instructed, and it still leaks. Do I have to replace the flange?

A: First you should loosen and inspect the flange. Make sure there are no cracks, the gasket is in good condition, the bolts are well-lubricated (if applicable) and the system is properly aligned. Then reassemble the flange according to these instructions and test the system again. If you still have a problem, contact your GF representative for help.

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