



# Operation Manual

PRODUCT NAME

*Stainless Steel 316 Insert Fitting*

MODEL/ Series/ Product Number

*KFG2 series*

**SMC株式会社**

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# KFG2 Series Stainless Steel 316 Insert Fitting Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

- \*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.
- ISO 4413: Hydraulic fluid power -- General rules relating to systems.
- IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)
- ISO 10218: Manipulating industrial robots -Safety.
- etc.



## Caution

**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



## Warning

**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



## Danger

**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

## Warning

### **1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.**

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### **2. Only personnel with appropriate training should operate machinery and equipment.**

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### **3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.**

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### **4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.**

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# KFG2 Series Stainless Steel 316 Insert Fitting Safety Instructions

## **Caution**

### **1. The product is provided for use in manufacturing industries.**

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

## **Limited warranty and Disclaimer/Compliance Requirements**

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

### **Limited warranty and Disclaimer**

**1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)**

**Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.**

**2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.**

**This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.**

**3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.**

**\*2) Vacuum pads are excluded from this 1 year warranty.**

**A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.**

**Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.**

### **Compliance Requirements**

**1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.**

**2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.**

## **Caution**

**SMC products are not intended for use as instruments for legal metrology.**

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

## 2. Specific Product Precautions (1)

### Design/Selection

#### Warning

##### (1) Check the specifications.

The product in this catalog is designed to be used in compressed air systems (including vacuum) only. If the product is used in an environment where pressure or temperature is out of the specified range, damage and/or malfunction may result. (Refer to the specifications.)

Please consult with SMC when using a fluid other than compressed air (including vacuum). We do not guarantee against any damage if the product is used outside of the specification range.

##### (2) Do not disassemble the product or make any modifications, including additional machining.

It may cause human injury and/or an accident.

##### (3) Check if PTFE can be used in application.

PTFE powder (Polytetrafluoroethylene resin) is included in the sealant. Confirm that the use of it will not cause any adverse affect on the system.

#### Caution

##### (1) Keep the connection part of fittings and tubing from rotating or oscillating movement.

The fittings may be damaged if they are used in the above manner. Especially for swivel elbow, repeated load applied from the connected tubing may cause detachment from the stud.

##### (2) The tubing bending radius in the vicinity of the fitting should be at least the minimum bending radius of the tubing.

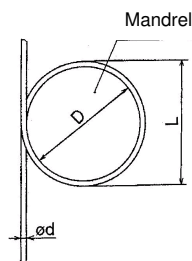
If the bending radius is less than the minimum value, fittings may be damaged, or tubing may crack or be crushed. The minimum bending radius of the FR soft nylon tubing (TRS series), FR double layer tubing (TRB series), antistatic soft nylon tubing (TAS series), polyolefin tubing (TPH series), soft polyolefin tubing (TPS series) is measured as following in accordance with JIS B8381. Tubing deformation ratio at the minimum bending radius is obtained through the following formula, based on tubing diameter and mandrel diameter by wrapping the same radius mandrel tube.

##### Tube deformation ratio at the minimum bending radius

$$\eta = \left(1 - \frac{L - D}{2d}\right) \times 100$$

Here,  $\eta$ : Deformation ratio (%)  
 $d$ : Tubing diameter (mm)  
 $L$ : Measured length (mm)  
 $D$ : Mandrel diameter (mm)  
 (Twice against the minimum bending radius)

Test temperature: 20  $\pm$  5°C  
 Relative humidity: 65  $\pm$  5%



##### (3) Do not use fluids other than listed on the specifications.

Applicable fluids are air, N<sub>2</sub>, water and steam. Please consult with SMC if using other fluids.

##### (4) When it is used with water, the fittings or tubing may be damaged depending on the surge pressure.

##### (5) Surge pressure must be under the maximum operating pressure. If the surge pressure exceeds the maximum operating pressure, it will result in damage to fittings and tubing.

##### (6) When using the swivel elbow, particles may be generated by rotation for positioning after connecting. If you are concerned about the effects on machinery and equipment, check the particle generation with your machine before use.

### Mounting/ Piping

#### Warning

##### (1) Operation manual

Install the products and operate them only after reading the operation manual carefully and understanding its contents. Also, keep the manual where it can be referred to as necessary.

##### (2) Ensure sufficient space for maintenance activities.

When installing the products, allow access for maintenance.

##### (3) Adhere to the thread tightening method.

When installing the products, refer to "Connection Thread Tightening Method".

##### (4) There may be cases of the tubing detaching from the fitting and thrashing around uncontrollably due to tubing degradation or fitting breakage.

To prevent the situation from becoming uncontrollable, fit the tubing with a protective cover or fix it in place.

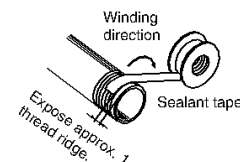
#### Caution

##### (1) Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

##### (2) Winding of sealant tape

When screwing together pipes and fittings, etc., be certain that chips from the pipe threads and sealant do not get inside the pipe. Also, when the sealant tape is used, leave approximately 1 thread ridge exposed at the end of the threads.



## 2. Specific Product Precautions (2)

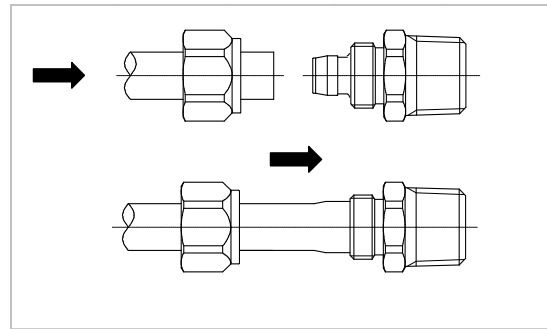
### Mounting/ Piping

- (3) **Check the model, type and size before installation.** Also, confirm that there are no scratches, gouges or cracks on the product.
- (4) **When connecting the tubing, take pressure or possible changes to the tubing length into account, and allow a sufficient margin.**  
Failure to do so may result in fitting breakage or detachment of the tubing. Refer to the recommended piping conditions.
- (5) **Do not apply unnecessary forces such as twisting, pulling, moment loads, vibration and impact, etc. on fittings or tubing.**  
This will cause damage to the fittings and will crush, burst or release tubing.
- (6) **Tubing, with the exception of coiled tubing, requires stationary installation. Do not use standard tubing (non-coiled) in applications where tubing is required to travel inside the flexible protection tube. Tubing that travels may sustain abrasion, extension, or severance due to tensile force, or may result in removal of tubing from fitting. Use caution prior to use for proper application.**
- (7) **To install the fitting, screw the fitting in using the hexagonal face of the body, and tighten with an appropriate wrench.**  
Affix the wrench at the base of the thread. If the size of hexagonal face and wrench do not match, or tightening takes place near the tube side, it may cause collapse or deformation of the hexagonal face, or damage to the equipment. After installing, confirm that there is no damage to the fitting, etc.
- (8) **The swivel elbow rotation is only for positioning after mounting the product.**  
It is not intended for repeated rotation or oscillation, which will cause wear, resulting in metal particles which may enter the operating fluid or cause fitting damage.

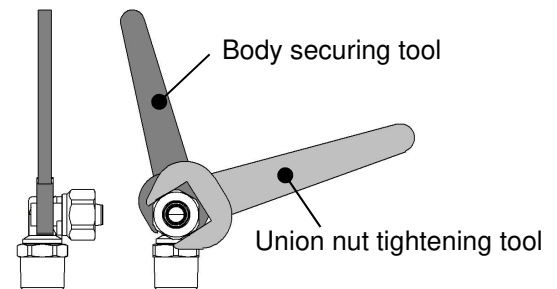
### Piping Method

#### **Caution**

- (1) **Take a tube having no flaws on its periphery and cut it off at right angles.** (Use SMC's tube cutter TK-1, 2, 3, 5 or 6 for cutting. Do not use pinchers, nippers or scissors, etc.)  
The tubing might be cut diagonally or flattened, making installation impossible or causing problems such as disconnection and leakage.
- (2) **Insert the tube into the union nut with the union nut removed. Grab the tube and gently push it throughly into the fitting.**



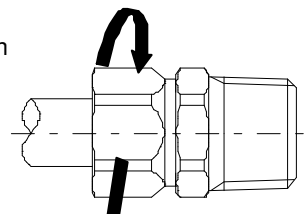
- (3) **After insertion, tighten the union nut temporarily by hand.**
- (4) **Fix the body with a tool. Tighten the union nut to the end surface of the body using a suitable wrench.**  
Hex. across flats may be deformed, if using an improper wrench for hex. across flats. If the body is not secured with a tool, this may cause breakage. (In particular, for the swivel elbow, the stud may come off).



- (5) **Fix the body with a tightening tool. Tighten the union nut to the end surface of the body using a suitable wrench.**  
Hex. across flats may be deformed, if using an improper wrench for hex. across flats. Tighten the union nut with the proper tightening torque shown below.

Fitting size	Proper tightening torque [N · m]
KFG2□01	2 to 3
KFG2□03	
KFG2□04	
KFG2□06	3 to 4
KFG2□07	
KFG2□08	5 to 6
KFG2□09	
KFG2□10	8 to 10
KFG2□11	
KFG2□12	10 to 12
KFG2□13	
KFG2□16	16 to 18

Union nut tightening direction



## 2. Specific Product Precautions (3)

### Air Supply



### Warning

#### (1) Type of fluids

Please consult with SMC when using the product in applications other than compressed air.

Regarding products for general fluids, please contact SMC concerning applicable fluids.

#### (2) When there is a large amount of drainage.

Compressed air containing a large amount of condensate can cause the malfunction of pneumatic equipment. An air dryer or water droplet separator should be installed upstream from the filters.

#### (3) Drain flushing

If condensate in the drain bowl is not emptied on a regular basis, the bowl will overflow and this may cause the malfunction of pneumatic equipment. If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.

For details on the above compressed air quality, refer to SMC's Best Pneumatics catalog.

#### (4) Use clean air.

Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.



### Caution

#### (1) Install an air filter.

Install an air filter at the upstream side of valve. Select an air filter with a filtration degree of 5µm or finer.

#### (2) Install an after cooler, air dryer or water droplet separator, etc.

Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer or water droplet separator.

#### (3) Ensure that the fluid and ambient temperature are within the specified range.

If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals and leading to equipment malfunction. Therefore, take appropriate measures to prevent freezing.

For details on the above compressed air quality, refer to SMC's Best Pneumatics catalog.

### Operating Environment



### Warning

#### (1) Do not use in an atmosphere having corrosive gases, chemicals, sea water, water, water steam, or where there is direct contact with any of these.

Refer to each construction drawing on the fittings and tubing material.

#### (2) Do not expose the product to direct sunlight for an extended period of time.

#### (3) Do not use in a place subject to heavy vibration and/or shock.

#### (4) Do not mount the product in locations where it is exposed to radiant heat.

#### (5) Do not use the ordinary fittings and tubing in locations where static electricity would be problematic.

It may result in the system failure and trouble. In such places, use of antistatic fittings (KA series) and antistatic tubing (TA series) are recommended.

#### (6) Do not use the ordinary fittings and tubing in locations where spatter is generated.

Spattering may result in a fire hazard. In such a place, use of flame resistant fittings (KR/KRM series) and flame resistant tubing (TRS/TRB/TRBU/TRTU series) are recommended.

#### (7) Do not use in an environment where the product is directly exposed to cutting oil, lubricant, coolant oil, etc.

Please contact SMC if using for an environment exposed to cutting oil, lubricant or coolant oil, etc.

#### (8) Take note that if nylon tubing, soft nylon tubing and antistatic tubing are used in a clean room.

The antioxidant on the surface of the soft nylon tubing may come off, thereby lowering the cleanness level.

#### (9) Do not use in environments where foreign matter may stick to the product or get mixed in the product's interior.

This may cause leakage or disconnection of the tubing.

#### (10) Avoid installing and using fittings inside a food zone.

- Not installable

Food zone: An environment where food which will be sold as merchandise, directly touches the fitting components.

- Installable

Splash zone: An environment where food which will not be sold as merchandise, directly touches the fitting components.

Non-food zone: An environment where there is no contact with food.

## 2. Specific Product Precautions (4)

### Maintenance

#### Warning

- (1) **Perform maintenance inspections according to the procedures indicated in the operation manual.**

If handled improperly, malfunction and damage of machinery of equipment may occur.

(2) **Maintenance work**

If handled improperly, compressed air can be dangerous. The assembly, handling, repair, and element replacement of pneumatic systems should be performed by a knowledgeable and experienced person.

(3) **Drain flushing**

Remove drainage from air filters regularly.

(4) **Removal of equipment and supply/exhaust of compressed air**

When components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.

When the equipment is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

#### Caution

- (1) **Be certain to wear safety glasses at all times during periodical inspections.**

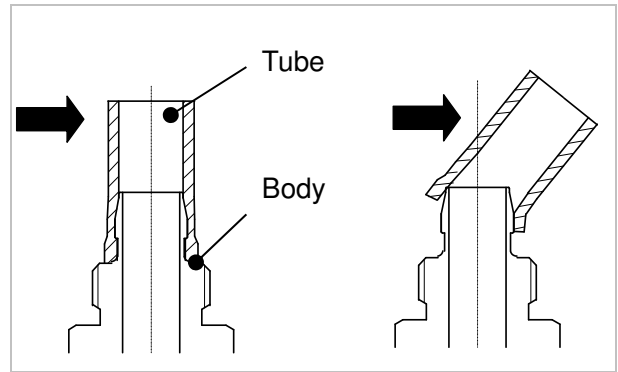
- (2) **During regular maintenance, check for the following and replace any components as necessary.**

- a) Scratches, gouges, abrasion, corrosion
- b) Leakage
- c) Flattening or distortion of tubing
- d) Hardening, deterioration or softness of tubing
- e) Loosening of the union nut

- (3) **Do not repair the fittings or patch the tubing for reuse.**

- (4) **After operation at a high temperature, leakage may occur due to time dependent change of the tube material. If leakage occurs, remove the tube, cut off the connecting part of the tube, and connect to the piping again.**

Check if the tube dimension accuracy is within the recommended tolerance. If it is difficult to take the tube out of the body, bend the tube to the side to remove.



### Connection Thread Tightening Method

#### Caution

- (1) Fittings with sealant: R, NPT
- 1) First, tighten the fitting by hand, then use a wrench appropriate for the hexagon flats of the body to tighten it a further two or three turns. For a tightening torque guide, see the table below.  
If the fitting is tightened with excessive torque, the fitting may break. In particular, for the swivel elbow, the stud may come off.

Connection thread size	Tightening torque [N · m]
NPT, R1/8	3 to 5
NPT, R1/4	8 to 12
NPT, R3/8	15 to 20
NPT, R1/2	20 to 25

- 2) If the fitting is tightened with excessive torque, a large amount of sealant will seep out. Remove the excess sealant.
- 3) Insufficient tightening may cause seal failure, or loosen the threads.
- 4) Reuse
  1. Normally, fittings with a sealant can be reused 2 to 3 times.
  2. To prevent air leakage through the sealant, remove any loose sealant stuck to the fitting by blowing air over the threaded portion.
  3. If the sealant no longer provides effective sealing, wrap sealing tape over the sealant before reusing. Do not use the sealant in any form other than a tape type.
  4. Once the fitting has been tightened, backing it out to its original position often causes the sealant to become defective. Air leakage will occur.



## Precautions for use with non-SMC



### Caution

- (1) When using the KFG2 series with tubing other than those from SMC, the products are not subject to warranty.

## 3. Specifications

### Specifications

Fluid	Air, N <sub>2</sub> , Water, Steam <sup>Note 2)</sup> <sup>Note 3)</sup> , Turbine oil class1 (ISO VG32)
Operating pressure range <sup>Note 1)</sup>	-100 kPa to 1 MPa <sup>Note 4)</sup>
Proof pressure	3 MPa
Ambient and fluid temperature	-65 to 260°C (No freezing) <sup>Note 4)</sup> [Swivel elbow and with sealant types: -5 to 150°C]
Lubricant	Grease-free
Seal on the threads	Without sealant (With sealant type compatible) <sup>Note 5)</sup>

Note 1) Avoid using in a vacuum holding application such as a leak tester, since there is leakage.

Note 2) Consult with SMC regarding applicable tubing separately.

Note 3) Using special FKM that is resistant even when steam is used.

Note 4) Check the operating pressure range and operating temperature range of the tube.

Note 5) With sealant: Suffix "S" to the end of part number.

Note 6) Union nut is shipped together.

### Applicable tubing

Tubing material <sup>Note)</sup>	FEP, PFA, Modified PTFE, 2-layer soft fluoropolymer, Nylon, Soft nylon, Polyurethane, Hard polyurethane, Soft polyurethane, Polyolefin, Soft polyolefin, Wear Resistant Tubing, Antistatic soft nylon, Antistatic polyurethane
Tubing size	$\phi$ 4x $\phi$ 2.5, $\phi$ 4x $\phi$ 3, $\phi$ 6x $\phi$ 4, $\phi$ 8x $\phi$ 6, $\phi$ 10x $\phi$ 7.5 $\phi$ 10x $\phi$ 8, $\phi$ 12x $\phi$ 9, $\phi$ 12x $\phi$ 10, $\phi$ 16x $\phi$ 13 $\phi$ 1/8"x $\phi$ 0.086", $\phi$ 5/32"x $\phi$ 0.098", $\phi$ 1/4"x $\phi$ 5/32" $\phi$ 5/16"x $\phi$ 0.236", $\phi$ 3/8"x $\phi$ 1/4", $\phi$ 1/2"x $\phi$ 3/8"

Note) For soft nylon tubing, soft polyurethane tubing, hard polyurethane tubing, antistatic polyurethane tubing, water cannot be used.

### Table of applicable tubings (metric size)

Series	Tubing material	Tubing O.D. x I.D. (mm)								
		$\phi$ 4x $\phi$ 2.5	$\phi$ 4x $\phi$ 3	$\phi$ 6x $\phi$ 4	$\phi$ 8x $\phi$ 6	$\phi$ 10x $\phi$ 7.5	$\phi$ 10x $\phi$ 8	$\phi$ 12x $\phi$ 9	$\phi$ 12x $\phi$ 10	$\phi$ 16x $\phi$ 13
TH	FEP	●	-	●	●	●	●	●	●	-
TL	Super PFA	-	●	●	●	-	●	-	●	-
TLM	PFA	●	●	●	●	●	●	●	●	●
TD	Modified PTFE	●	-	●	●	●	-	●	-	-
TQ	Special fluoropolymer	●	-	●	●	-	●	●	-	-
T	Nylon	●	●	●	●	●	-	●	-	●
TS	Soft nylon	●	-	●	●	●	-	●	-	-
TU	Polyurethane	●	-	●	-	-	-	-	-	-
TPH	Polyolefin	●	-	●	●	●	-	●	-	-
TUS	Soft polyurethane	●	-	●	-	-	-	-	-	-
TUH	Hard polyurethane (High pressure)	●	-	●	-	-	-	-	-	-
TUZ	Wear Resistant Tubing	●	-	●	-	-	-	-	-	-
TPS	Soft polyolefin	●	-	●	-	-	-	-	-	-
TAS	Antistatic soft nylon	●	-	●	-	-	-	-	-	-
TAU	Antistatic polyurethane	●	-	●	-	-	-	-	-	-

**Table of applicable tubings (inch size)**

Series	Tubing material	Tubing O.D. x I.D. (mm)					
		$\phi$ 1/8" x $\phi$ 0.086"	$\phi$ 5/32" x $\phi$ 0.098"	$\phi$ 1/4" x $\phi$ 5/32"	$\phi$ 5/16" x $\phi$ 0.236"	$\phi$ 3/8" x $\phi$ 1/4"	$\phi$ 1/2" x $\phi$ 3/8"
		( $\phi$ 3.18x $\phi$ 2.18)	( $\phi$ 4x $\phi$ 2.5)	( $\phi$ 6.35x $\phi$ 3.95)	( $\phi$ 8x $\phi$ 6)	( $\phi$ 9.53x $\phi$ 6.35)	( $\phi$ 12.7x $\phi$ 9.53)
TH/TIH	FEP	●	●	●	●	●	●
TL/TIL	Super PFA	●	-	●	●	●	●
TLM/TILM	PFA	●	●	●	●	●	●
TD/TID	Modified PTFE	●	●	●	●	●	●
T/TIA	Nylon	●	●	-	●	-	●
TS/TISA	Soft nylon	●	●	-	●	-	●
TU/TIUB	Polyurethane	-	●	-	-	●	-
TPH	Polyolefin	-	●	-	●	-	-
TUS	Soft polyurethane	-	●	-	-	-	-
TUH	Hard polyurethane (High pressure)	-	●	-	-	-	-
TUZ	Wear Resistant Tubing	-	●	-	-	●	-
TPS	Soft polyolefin	-	●	-	-	-	-
TAS	Antistatic soft nylon	-	●	-	-	-	-
TAU	Antistatic polyurethane	-	●	-	-	-	-

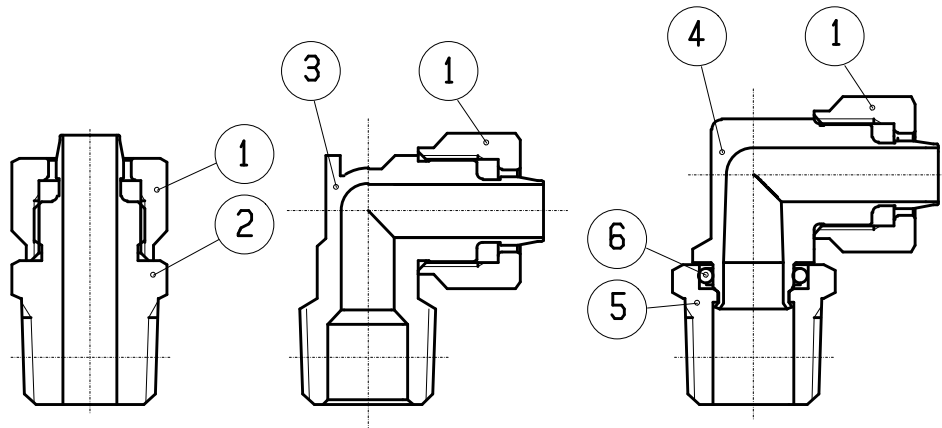
**Spare Parts**

Description	Tubing O.D.	Part No.	Material
Bulkhead nut	$\phi$ 1/8"	KFG201-P01	SUS316
	$\phi$ 5/32"	KFG203-P01	
	$\phi$ 4	KFG204-P01	
	$\phi$ 6	KFG206-P01	
	$\phi$ 1/4"	KFG207-P01	
	$\phi$ 8	KFG208-P01	
	$\phi$ 5/16"	KFG209-P01	
	$\phi$ 10	KFG210-P01	
	$\phi$ 3/8"	KFG211-P01	
	$\phi$ 12	KFG212-P01	
	$\phi$ 1/2"	KFG213-P01	
	$\phi$ 16	KFG216-P01	

**4. Troubleshooting**

KFG2 series insert fitting cannot be disassembled or repaired in order to quality maintenance. When failure such as "Non-removable tubing" occurs, please replace the whole product.

## 5. Construction



**Male connector**

**Male elbow**

**Swivel elbow**

No.	Description	Material	Remarks
(1)	Union nut	Stainless steel 316	Fluorine coating
(2)	Half union body	Stainless steel 316	
(3)	Elbow union body	Stainless steel 316	
(4)	Swivel elbow body	Stainless steel 316	
(5)	Stud	Stainless steel 316	Fluorine coating
(6)	O-ring	Special FKM	Fluorine coating

### Stainless steel

Metal exists in nature as ore (like oxide or sulfide). This means that oxide or sulfide is more stable than pure metal. Accordingly, metallic material chemically oxidizes (metallic constituent becomes ion and melts out). It corrodes in the natural environment.

Even though corrosion of metal easily occurs in an environment where oxidizing tendency is stronger, some kinds of metal have a characteristic for which corrosion never happens if the level of oxidizing goes higher than a specific point. In such case, it is called "metal in passive state".

Stainless steel has corrosion resistance because of a thin coat of passive state on its surface. However, there does not exist stainless steel with absolute corrosion resistance; therefore, many types of stainless steel have been developed for improved corrosion resistance performance.

## 6. Applicable Fluid List

Compatibility checklist for used materials and fluids

Chemical	Body	Seal
	SUS316	Special FKM
Acrylonitrile	◎	×
Acetamide	○	○
Acetaldehyde	◎	×
Acetone	◎	×
Aniline	○	◎
Amylene	◎	—
Sulphurous acid gas (Humid gas)	◎	—
Sodium bisulfite [50%]	◎	—
Allyl alcohol	◎	—
Benzoic acid	◎	—
Ammonia (Compressed gas)	◎	×
Isopropyl alcohol	○	◎
Isophorone	×	—
Ethyl alcohol	◎	○
Ethyl ether	○	×
Ethylene	◎	—
Ethylene glycol	○	◎
Ethylene diamine	◎	—
Ethylene dichloride	◎	—
Epichlorohydrine	◎	×
Methyl tertiary butyl ether	—	×
Allyl chloride	×	—
Ammonium chloride	◎	—
Calcium chloride	◎	—
Iron (II) chloride [5%]	×	—
Sodium chloride	○	—
Magnesium chloride	◎	—
Hydrochloric acid [5%]	×	—
Chlorine gas (Humid gas)	×	—
Carbitol	×	—
Hydrochloric acid [50%]	○	×
o-Xylene	△	△

Chemical	Body	Seal
	SUS316	Special FKM
p-Xylene	△	△
Citric acid	◎	—
Cumene	×	—
Glycerin	◎	◎
Cresol	◎	△
Chromic acid [10%]	◎	—
Chlorosulfonic acid	○	×
Chlorofluorocarbon (CFC) 11	—	×
Chlorofluorocarbon (CFC) 113	—	×
Chlorofluorocarbon (CFC) 12	○	×
Chlorofluorocarbon (CFC) 13B1	—	×
Chlorofluorocarbon (CFC) 14	—	◎
Chlorofluorocarbon (CFC) 22	○	×
Chlorobenzene	×	○
Chloroform (Trichloromethane)	○	○
Acetic acid	○	×
Amyl acetate	◎	×
Isopropyl acetate [20%]	◎	×
Ethyl acetate	×	×
Butyl acetate	×	×
Methyl acetate	◎	×
Calcium hypochlorite	◎	—
Sodium hypochlorite [5%]	◎	◎
Potassium cyanide [50%]	◎	—
Copper cyanide	◎	—
Diisobutyl ketone	◎	—
Diisobutylene	—	◎
Diethanolamine	◎	—
Diethylamine	×	×
Diethylene glycol	◎	—
Carbon tetrachloride	◎	◎
Cyclohexanol	×	—

[ ] denotes the concentration. Aqueous solutions without condensation are in a saturated state.

Note 1) The above data is based on a room temperature of 20°C. Note that you may obtain different figures, depending on temperature conditions.

Note 2) The above data shows compatibility guidelines based upon component parts. Therefore, it is no guarantee of product performance.

In addition, using fluids other than those specified in the catalog are not covered by the product's warranty.

### How to read the table

◎: Completely unaffected or largely unaffected.

○: May be slightly affected, but, dependent upon condition, can sufficiently withstand.

△: Advisable to use as little as possible.

×: Not applicable, as substantially affected.

—: No data is available.

Chemical	Body	Seal
	SUS316	Special FKM
Cyclohexanone	×	×
Cyclohexane	×	○
Dichloroethylene	—	△
Dichlorobenzene	—	△
Dichloromethane (Methylene chloride)	△	△
Ethylene bromide	×	—
Potassium bromide [30%]	◎	—
Potassium dichromate [25%]	◎	—
Oxalic acid	◎	—
Bromine gas	×	—
Tartaric acid	◎	—
Nitric acid [65%]	◎	◎
Ammonium nitrate	◎	—
Ammonium hydroxide	—	○
Calcium hydroxide	◎	—
Sodium hydroxide [50%]	◎	○
Barium hydroxide	◎	—
Solvent naphtha	◎	—
Carbonic acid (Humid gas and aqueous solution)	◎	—
Tetrachloroethylene	×	◎
Tetrahydrofuran	—	×
Dodecylbenzene	◎	—
Trichloroethane	△	—
Trichloroethylene	◎	○
Trichloroacetic acid	—	—
Toluene	◎	◎
Naphtha	○	○
Naphthenic acid	◎	—
Lactic acid	◎	—
Carbon bisulfide	○	◎
Picric acid	◎	—
Pyridine	×	×

Chemical	Body	Seal
	SUS316	Special FKM
Phenol	×	○
Butyl phthalate	×	—
Butyl alcohol	△	—
Hydrofluoric acid [50%]	◎	—
Furfural	×	×
n-Propyl alcohol	◎	—
Propylene glycol	◎	—
Bromochloroethane	—	×
n-Hexane	○	◎
n-Hexyl alcohol	◎	—
n-Heptane	◎	—
Benzene	×	×
n-Pentane	×	—
Boric acid	◎	—
Galic acid	◎	—
Formic aldehyde	◎	×
Methyl methacrylate	×	×
Methyl alcohol	◎	○
Methyl isobutyl ketone	×	×
Methyl ethyl ketone	×	×
Ethyleneglycol monomethyl ether	×	—
Monoethanolamine	◎	—
Morpholine	◎	—
Butyric acid	◎	—
Hydrogen sulfide (Humid gas and aqueous solution)	◎	×
Sulphuric acid [10%]	◎	◎
Ammonium sulfate	◎	×
Sodium bisulfate [10%]	◎	—
Iron (II) sulfate	○	—
Sodium sulfate	◎	—
Phosphoric acid [85%]	◎	—

[ ] denotes the concentration. Aqueous solutions without condensation are in a saturated state.

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Revision history
A - : Fluid N <sub>2</sub> , Turbine oil class1 (ISO VG32) add Applicable Tubing : TUZ add

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NOTE: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.  
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