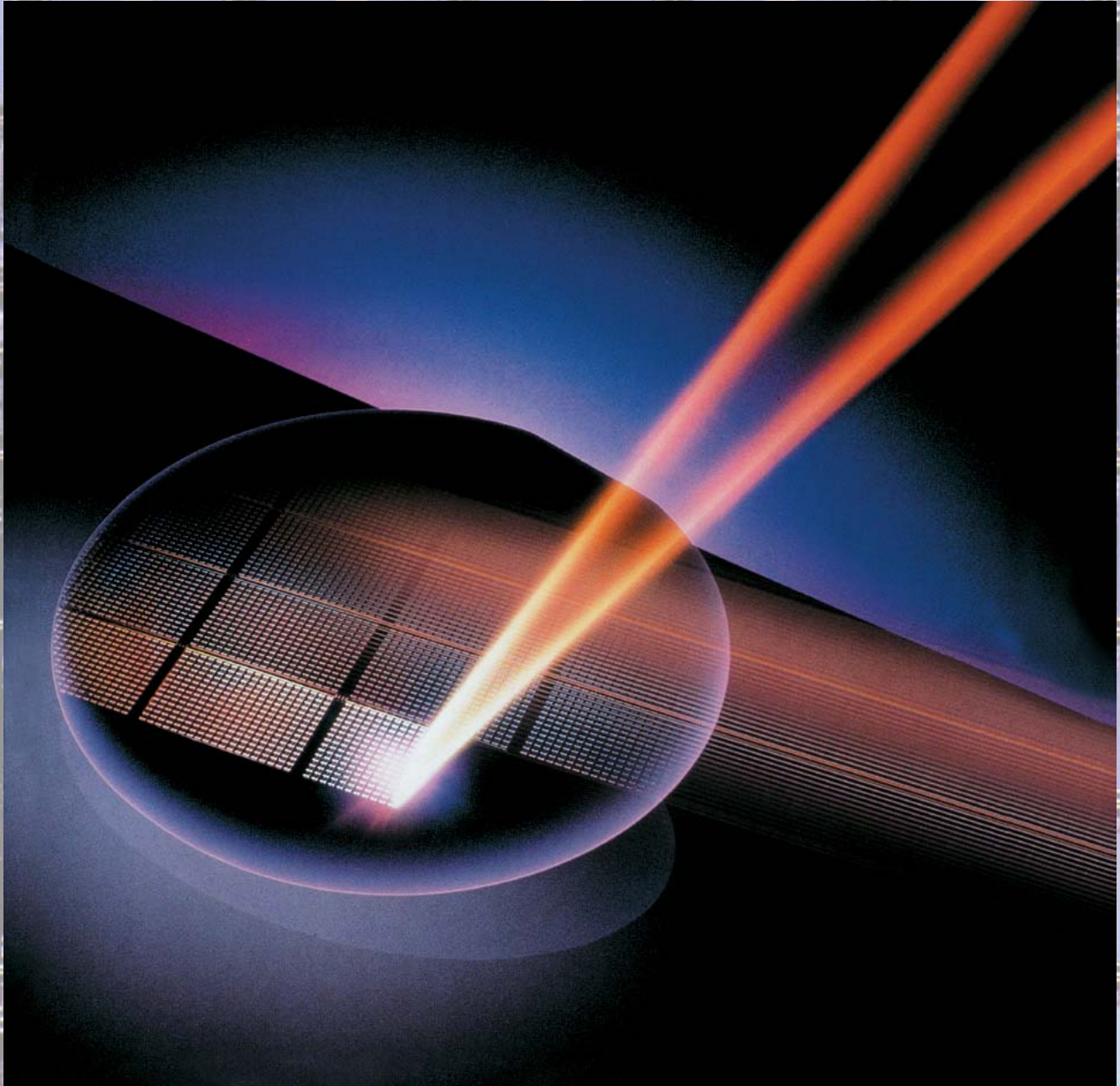


# **TOMBO™ BRAND**

**Semiconductor and FPD  
Related Products**



**NICHIAS**

# The NICHIAS product family, fulfilling advanced needs for semiconductor and FPD production

Materials used in clean rooms or in semiconductor/FPD manufacturing equipment must be highly clean and able to withstand diverse usage environments. Both contamination of materials and chemical contamination of the ambient atmosphere are factors that have an important impact on process.

NICHIAS offers a wide variety of fluoropolymer (NAFLON™) products with excellent chemical-resistance and high purity. NICHIAS also offers rubber products that can be used under more severe conditions and filter products that allow a clean environment, providing solutions to every problem.

## Examples of the application to semiconductor/FPD manufacturing process

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- Perfluoroelastomer PFW ..... 2
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## Explanatory notes for customers

The following signs and abbreviations are used in this catalogue.

☒ The product might fall into the category of goods to be controlled by Foreign Exchange and Foreign Trade Law. If it does fall into this category, export permission will be required in accordance with the law.

●PEEK™ PEEK™ is a trademark of Victorex, Inc. (United Kingdom).

### Fluoropolymer Engineering Plastic

PTFE	Poly-tetra-fluoro-ethylene (tetra fluoride)	PCTFE	Poly-chloro-trifluoro-ethylene
PFA	Perfluoro-alkoxyl-alkane	PEEK	Poly-ether-ether-ketone
FEP	Perfluoro-ethylene-propylene copolymer (tetra, hexa-fluoride)	PPS	Poly-phenylene-sulfide
PVDF	Poly-vinyliden-fluoride (difluoride)	PEI	Poly-ether-imide
ETFE	Ethylene-tetra-fluoro-ethylene	PES	Poly-ethyl-sulfone
		PI	Poryimide

\* TOMBO is a registered trademark or trademark of NICHIAS Corporation.

\* All brand names and product names are trademarks or registered trademarks of NICHIAS Corporation.

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## BLAZER™ NEXT

BLAZER™ NEXT (BNX) O-rings provide good sealing effect with its excellent heat resistance, for high temperature applications where other elastomer O-rings are difficult to use.

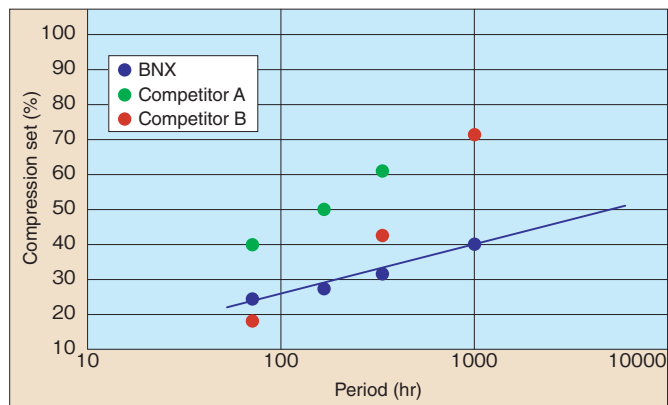
## Features

- Heat Resistance Guideline : 315°C
- Hardness (Durometer Type A): 76
- Small compression set at high temperatures, and long-term stable sealing performance is expected.

## Applications

- Seals for heat treatment equipment which requires heat resistance. (Annealing furnace, LPCVD system, etc.)
- Seals for CVD equipment (Plasma CVD, LPCVD system, etc.) which is subject to fluorine radicals environment.

## Test result of compression set



Test Condition

- Test specimen: O-ring (AS568-214,  $\phi$ 3.53× ID24.99mm)
- Temperature: 300°C
- Compression rate: 19% (RT), 25% (300°C)

## Chemical resistant elastomer

## BLAZER™ -A

Excellent in chemical resistance and has proven chemical resistance against polar solvents such as amine, organic acids, etc for which other types of fluoroelastomers cannot be used.

## Features

- Heat Resistance Guideline : 190°C
- Hardness (Durometer Type A): 75
- Excellent chemical resistance, and can be used for almost any chemical (with the exception of fluorine solvents)

## Applications

- Seals for cleaning equipment, coater/developers, wet etching equipment.



## Plasma resistant elastomer

## Perfluoroelastomer PFW

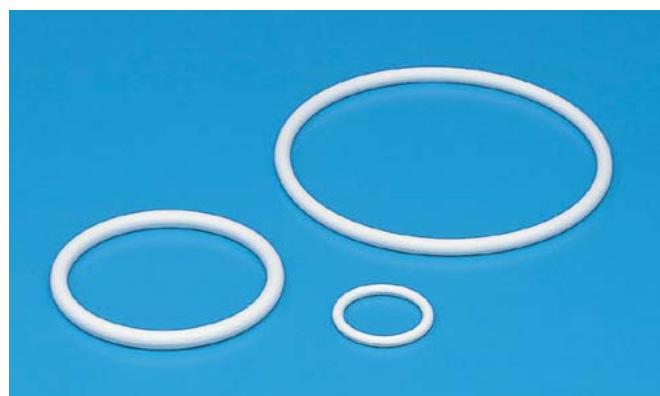
PFW is white perfluoroelastomer O-ring with excellent plasma resistance.

## Features

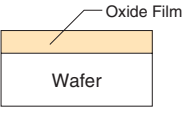

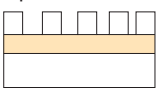

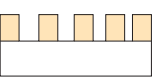
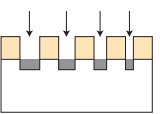
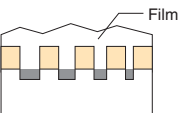
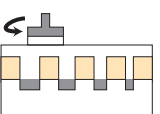
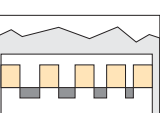
- Heat Resistance Guideline : 200°C
- Hardness (Durometer Type A): 70
- Less weight reduction when exposed to plasma, and excellent plasma resistance.

## Applications

- Seals for plasma etching equipment, plasma CVD equipment.



# O-Ring Selection Guide for Semiconductor Manufacturing Processes

Process	Device	Applications	Recommended Material	Material Features
<b>Oxidation/Diffusion</b>				
	Oxidation/ Diffusion furnace	Furnace casing seals	<b>BLAZER™ NEXT</b>	Exceptional heat resistance and reduced gas emissions
<b>Lithography</b>				
<b>● Resist Coating</b> 	Coater	Chemical bath line seals	<b>BLAZER™-A</b>	Exceptional solvent resistance and purity characteristics
<b>● Development</b> 	Developer	Chemical bath line seals	<b>BLAZER™-A</b>	Exceptional solvent resistance and purity characteristics
<b>Etching</b>				
<b>● Dry Etching</b> 	Plasma etching system	Inner chamber seals (Chamber lids, view ports, etc.)	<b>Perfluoro PFW</b>	Exceptional plasma resistance characteristics
<b>● Ashing</b> 	Plasma etching system	Inner chamber seals (Chamber lids, view ports, etc.)	<b>Perfluoro PFW</b>	Exceptional plasma resistance characteristics
<b>Ion Implantation</b>				
	Heat diffusion system Ion injection system	Inner chamber seals	<b>BLAZER™ NEXT</b>	Exceptional heat resistance and reduced gas emissions
<b>Thin Film Deposition</b>				
	Low pressure CVD systems Metal CVD systems Plasma CVD systems Sputtering systems	Inner chamber seals (Chamber lids, view ports, etc.) Exhaust seals	<b>BLAZER™ NEXT</b>	Exceptional heat resistance and reduced gas emissions
<b>Planarization</b>				
	CMP systems	Inner chamber seals Chemical bath line seals	<b>BLAZER™-A</b>	Exceptional solvent resistance and purity characteristics
<b>Cleaning</b>				
	Cleaning equipment	Chemical bath line seals Filter seals	<b>BLAZER™-A</b>	Exceptional solvent resistance and purity characteristics

## CRYSTAL H™/CRYSTAL H™ Super

CRYSTAL H™ is a constant temperature-controlled bath consisting of a high-purity transparent quartz tank with stamped heating elements on all side walls and the bottom of the tank. It ensures stable temperature control in any range from ambient up to max (200°C).

The service temperature is 200°C for CRYSTAL H™ and 300°C for CRYSTAL H™ Super. CRYSTAL H™ Super, which allows a rapid heat-up time, is especially suitable for phosphoric acid cleaning in nitride film removal processes.

The enclosure, made of PVDF (Poly-vinylidene-fluoride), affords resistance to chemicals and atmospheric conditions.



## Features

■ The quartz bath has heating elements on all side walls and the bottom of the tank, providing many advantages.

- Rapid heat-up time
- Accurate temperature control
- Uniform heat distribution
- Spacious interior
- Contamination free since the bath is heated from outside
- Safe operation

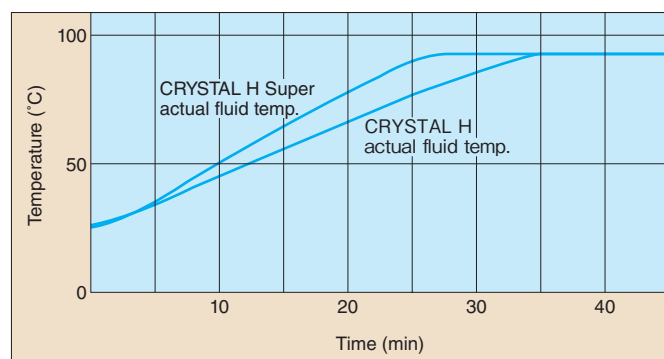
\*Note that at more than 150°C phosphoric acid will react with quartz (corrosion).

## Applications

- Temperature control of chemicals used for semiconductor cleaning equipment

## Heat-up Properties

## ■ Fluid: Water



- Fluid mass: 21 Liters
- Heating value: CRYSTAL H ...4280W (nominal) 3530W (in operation)  
CRYSTAL H Super ...5700W (nominal) 4700W (in operation)
- Room temp.: 23°C

\* The above values are actual measurement values, not specification values.

## Specifications

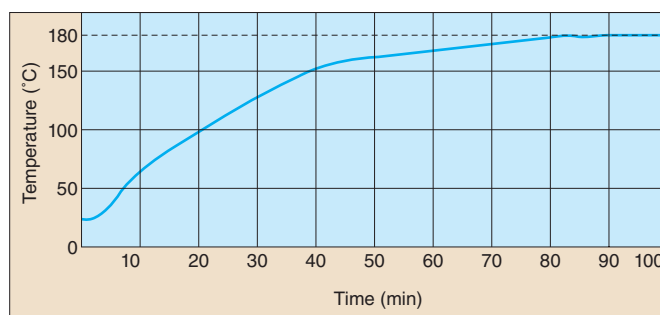
Item	Type	CRYSTAL H™ Super	CRYSTAL H™
Maximum temperature for continuous use (°C)		200	
Watt density of heater (w/cm <sup>2</sup> )		2.0	1.5
Maximum service temperature of heater (°C)		300	200
Enclosure material		PVDF, PVC, SUS	
Type of Tank		Overflow type, single type	

\* Products for 100V and 200V available

\* Please ask us about detailed specifications for individual design.

\* Please prepare the quartz tank used for this product by the customer.

## ■ Fluid: Phosphoric Acid



- Fluid mass: 20 Liters
- Heating value: CRYSTAL H ...5500W (nominal) 4600W (in operation)
- Room temp.: 25°C

\* The above values are actual measurement values, not specification values.

## In-Line Heater (Lamp type)

The In-Line Heater (Lamp type) is heating equipment for DI water or chemical water. It consists of a halogen lamp heater around the double quartz pipe through which fluid runs. Using a halogen lamp as a heat source allows excellent heat-up capabilities.

There are two types (A and B) depending on the direction of the port and the locations of the fluid inlet and outlet.



### Features

- As all components coming into contact with fluid are made of high-purity quartz, there is no contamination.
- Halogen lamp allows rapid heat-up and easy control.
- Heater can easily be replaced without draining fluid (easy maintenance)
- Heater can easily be fitted into a system, since it is small.

### Dimensions

Model type	Product dimensions (W×H×D)
Type A	240×196×530
Type B	240×200×515

### Specifications

Model type	Insertion of halogen lamp	Location of fluid inlet and outlet	Maximum service temperature (°C)	Electric capacity (v·kW)	Number of passes	Enclosure material	Pipe dimension (mm)	Applied volume of fluid (liter/min)	Maximum acceptable inner pressure MPa (kgf/cm <sup>2</sup> )
Type A	One side	One side	180	200·6	2	Self-extinguishing PP	φ20×φ14	5~40	0.5 (5)
Type B	One side	Both sides			1				

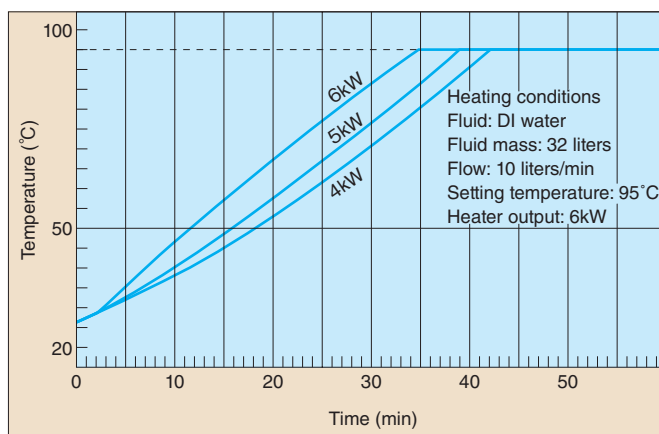
\* Heaters with 4 and 5 kW capacity are available in addition to 6 kW.

\* Alarm outputs: excessive heat sensor, leak sensor

\* Maximum service temperature depends on the type of fluid used.

### Heat-up Properties

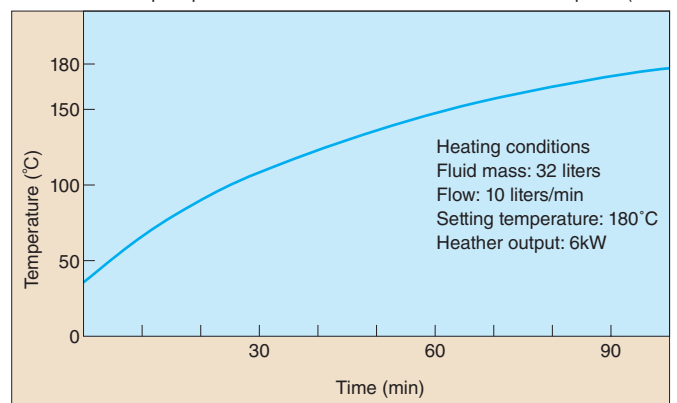
#### Heat-up Properties (DI water)



\* The above values are actual measurement values, not specification values.

#### Heat-up Test with Phosphoric Acid

Please note that phosphoric acid at more than 150°C will react with quartz (corrosion).



\* The above values are actual measurement values, not specification values.

## PFA Roto Molded Container K

PFA Roto Molded Containers are made from pure PFA with a rotational molding method. Screw caps are made from PTFE. Couplers, connectors, and so on can be fitted to the caps on request. They can be sealed with O-Rings.

### Features

- Seamless one piece structure provides good heat and pressure resistance.
- Low initial mold cost for special order, so suitable for small production of various models.

### Specifications

- Capacity  
Round bottles: 2 liters, 3 liters, 5 liters, 8 liters, 15 liters, 50 liters, 100 liters  
\* Regarding service temperature for each case, please consult.

### Applications

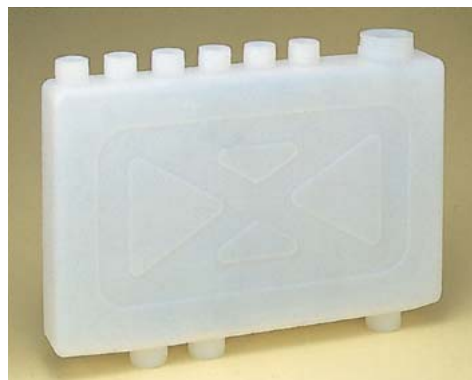
- Chemical dispense, storage and weighing tank of semiconductor manufacturing equipment

### Dimensions

- Maximum available dimensions:  $\phi 700 \times 700 \text{H}$
- Standard sizes

	H (mm)	O.D. (mm)	Pressure resistance MPa [kgf/cm <sup>2</sup> ]
2 liters	238	125	0.1 [1.0]
3 liters	239	155	
5 liters	282	186	
8 liters	275	237	
15 liters	435	245	0.19* [1.9]
50 liters	590	400	
100 liters	725	490	

\* The 50-liters and 100-liters containers are designed to be used with an outer casing.  
Please ask us about other capacities and shapes.



## NAFLON™ PFA Roto Molded Tank K

NAFLON™ PFA Roto Molded Tank is a tank for the supply, storage, and transportation of chemicals, with a single-piece PFA container on the external SUS can.

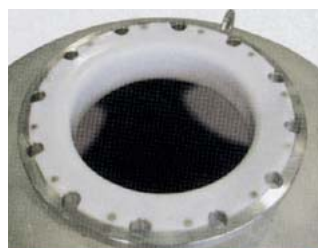
The parts in contact with the liquid are made from one-piece PFA-HG to provide a smooth surface. In addition, the lack of welded parts enables efficient washing.

### Applications

- Tank for chemical dispense, storage and transfer

### Specifications

- Standard capacities: 100 liters, 200 liters, 400 liters, 500 liters, 800 liters, 1000 liters
- Maximum service temperature: 50°C



# NAFLON™ PFA Chemicalware

NAFLON™ PFA Chemicalware is a blow-molded PFA container. It is suitable for use as a high purity chemical container since almost no impurities dissolve out into the liquid in use.

## Features

- Almost no impurities dissolve out into the liquid in use.
- Transparency allows easy confirmation of the volume of liquid.
- More shock-resistant than glass.

## Applications

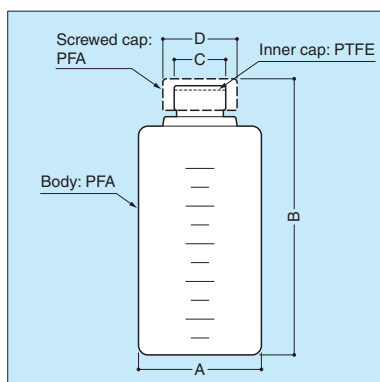
- Container for highly pure chemicals

\* Regarding service temperature for each case, please consult.



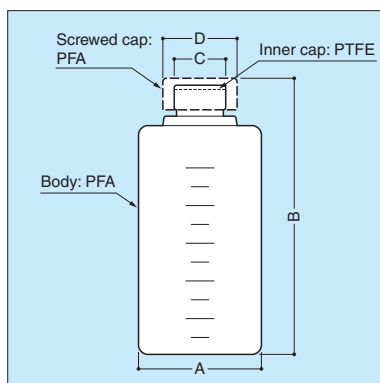
## Specifications

### PFA Narrow Mouth Bottles



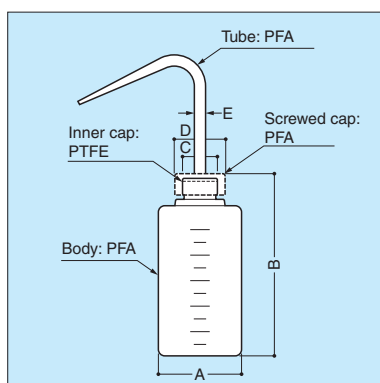
Model number	Capacity (mℓ)	A (mm)	B (mm)	C (mm)	D (mm)
N-20	20	28	62	φ12	φ25
50	50	48	67	φ17	φ32
100	100	48	105	φ17	φ32
250	250	61	132	φ17	φ32
500	500	74	165	φ17	φ32
1L	1000	95	203	φ25	φ41
2L	2000	129	245	φ37	φ56
3L	3000	146	265	φ37	φ56
5L	5000	172	330	φ37	φ56
10L	10000	230	360	φ37	φ56

### PFA Wide Mouth Bottles



Model number	Capacity (mℓ)	A (mm)	B (mm)	C (mm)	D (mm)
W-20	20	26.5	60	φ14.5	φ27.5
100	100	48	105	φ25	φ41
250	250	61	136	φ25	φ41
500	500	74	177	φ37	φ56
1L	1000	95	214	φ37	φ56

### PFA Wash Narrow Mouth Bottles



Model number	Capacity (mℓ)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
WN-100	100	48	105	φ17	φ32	φ6
250	250	61	132	φ17	φ32	φ6
500	500	74	165	φ17	φ32	φ6
1L	1000	95	203	φ25	φ41	φ6

\* PFA Wash Wide Mouth Bottles are also available (manufacturing number: WW-100, 250, 500, 1 liter)

● Please ask us about other sizes and chemicalware not listed on this catalogue.



## TOMBO™ No.9500-M, -H

# NAFLON™ PTFE Sink

There are two types of NAFLON™ PTFE Sink. "Molded Seamless PTFE Sink (TOMBO™ No.9500-M)" is a one-piece sink manufactured by isostatic molding. "Welded PTFE Sink (TOMBO™ No.9500-H)" is made by welding sheets in 7~25 mm thickness. Both can be designed with any flow gradient and drain opening. Welded type offers greater freedom in its design and size.



### Features

- Our unique welding technology (welding structure) and strict quality control ensure the high reliability of welded parts.

### Specifications

- Maximum service temperature: 80°C

### Applications

- Chemical storage
- Wafer processing tank

### Dimensions

- Maximum size available (Molded Seamless PTFE Sink):  
Square type: 700×500×500Hmm    Round type:  $\phi$ 700×500Hmm ( $\phi$ 500×700Hmm)
  - Thickness  
Molded Seamless PTFE Sink: 15~50mm    Welded PTFE Sink: 7~25mm
- \* Please ask us about the Welded PTFE Sink.

## TOMBO™ No.9023

# NAFLON™ Welded Products **K**

NAFLON™ Welded Products are products made of welded fluoropolymer (PTFE, PFA, PVDF) for many purposes. They can be fabricated in a variety of forms, ranging from pump and valve parts to manufacturing parts for semiconductor/FPD.

### Features

- Fabrication in a clean environment enables us to supply high quality products.
- Our unique welding technology enables the production of products for specific purposes.

### Applications

- Parts for semiconductor or FPD manufacturing equipment



## TOMBO™ No.9024

# PEEK™ Fabricated Products

PEEK™ fabricated products not only have excellent resistance to chemicals and heat, but also are made out of an extremely strong plastic, PEEK™. PEEK™ is the most suitable plastic for jigs, since the semiconductor production process requires metal-free materials. By putting together the welding, machining, injection molding, and depositing technologies we have developed over many years, we can now manufacture a variety of PEEK™ products.

### Features

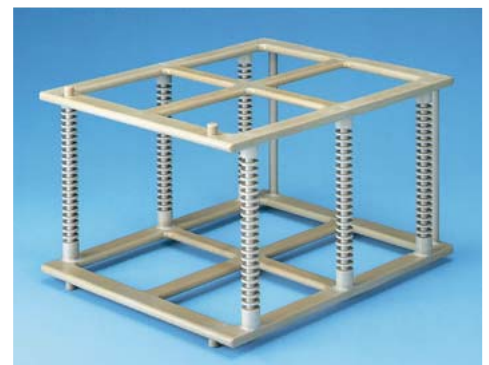
- Our original welding technology cultivated over many years ensures safe use of products.
- Our welding, machining, injection molding, and depositing technologies enable us to assist you with holistic product design.

### Specifications

- Maximum service temperature: 240°C

### Applications

- Parts for semiconductor or FPD manufacturing equipment



## NAFLON™ Injection Molded Products

NAFLON™ Injection Molded Products are manufactured by injection molding fluoropolymers (PFA, ETFE, PVDF) and various super engineering plastics (PPS, PEEK, PEI, PES, PBI) with advanced technology and under severe quality control. These products can contribute to lowering the cost of products such as pump/valve parts, manufacturing parts for semiconductor/FPD, and electronics parts in mass production.

### Features

- Highly engineered quality products molded in clean rooms.
- Machining and welding after injection molding are available.

### Applications

- Parts for Pump, valve, flow meter and parts for semiconductor or FPD manufacturing equipment
- Parts for Office automation equipment

\* Regarding service temperature for each case, please consult.



## NAFLON™ Machined Products

NAFLON™ Machined Products consist of fluoropolymer (PTFE, PFA, PVDF, PCTFE etc). Materials can be machined into a variety of forms for specific purposes.

### Features

- Highly engineered quality products molded in clean rooms.
- Our unique welding technology enables production of products for specific purposes.

### Applications

- Pump, valve and parts for semiconductor or FPD manufacturing equipment

\* Regarding service temperature for each case, please consult.



FABRICATED PRODUCTS

## NAFLON™ Bubbler

NAFLON™ Bubbler is a bubble generator made with PTFE with no additives such as foaming agents. It generates bubbles of 40µm on average from randomly dispersed pores.

### Features

- Excellent resistance to chemicals since it is made with fluoropolymer.
- It generates bubbles with a major axis of 5~100µm (about 40µm on average).
- Maximum service temperature is 100°C.

### Applications

- For semiconductor or FPD manufacturing equipment

### Dimensions

Thickness (mm)	Short form (mm)	Round shape (mm)
15~30	Not more than 400×400	Not more than φ400

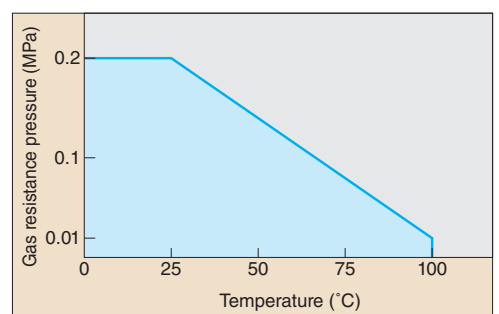
\* Effective area with pores.

### Shape of the bubbler: plate

\* Alcohol is used in the picture. Please note bubble size depends on the type of liquid.



### Range of use



# NAFLON™ Tube (PTFE/PFA/FEP)

NAFLON™ Tubes are pure fluoropolymer tubes, and contain no additives such as fillers or plasticizers. Each of the PTFE, PFA, and FEP tubes has exceptional chemical-resistant, heat-resistant, and weather-resistant features.

## Features

- Exceptional anti-adhesive properties prevent most dirtying and scaling.
- Almost no loss of electrical properties under high temperature, high humidity, and high frequency conditions, making these tubes excellent electrical insulators.
- Excellent Weather resistance.

## Applications

- For highly pure chemicals and pure water
- Protection of wiring

## Specifications

- Maximum usage temperature : 260°C (PTFE/PFA), 200°C (FEP)

\* Please refer to the below "Maximum Usage Pressure" for the maximum usage pressure.



## Type

- PTFE tubes can be made in a variety of colors.
- ETFE tubes are available upon request.

\* There may be slight difference of color tone for PTFE tubes depending on production lot. (There is no quality issue.)

\* Please ask us for fluoropolymer tubes other than PTFE, PFA or FEP.

## NAFLON™ Tube Room-Temperature Destructive Pressure and Minimum Bend Radius

### PFA/FEP Tube

Inner diameter (mm)	Outside diameter (mm)	Room-Temperature Destructive Pressure (Mpa)	Minimum Bend Radius (mm)
2	4	8.8	15
4	6	5.7	25
6	8	4.1	50
8	10	3.2	80
10	12	2.7	130
20	23	2.0	310
1.59	3.17	8.8	15
3.96	6.35	6.5	20
4.35	6.35	5.3	30
6.35	9.52	5.7	40
7.52	9.52	3.4	70
9.52	12.7	4.1	75
10.7	12.7	2.5	150
15.88	19.05	2.6	200
22.22	25.4	2.0	370

### PTFE Tube

Inner diameter (mm)	Outside diameter (mm)	Room-Temperature Destructive Pressure (Mpa)	Minimum Bend Radius (mm)
2	3	5.9	10
3	4	3.9	15
4	6	5.9	25
6	8	3.9	45
8	10	2.9	70
10	12	2.4	105
16	19	2.2	120
1.59	3.17	11.7	5
3.17	6.35	11.8	15
4.35	6.35	5.4	30
6.35	9.52	6.0	35
7.52	9.52	3.1	65
9.52	12.7	3.9	65
10.7	12.7	2.1	115
15.88	19.05	2.3	120

\* The above values are calculated based on actually measured values and partly calculated values, so not the specification values.

\* The minimum bend radius shows 1.2 times larger values than actually measured (calculated) values.

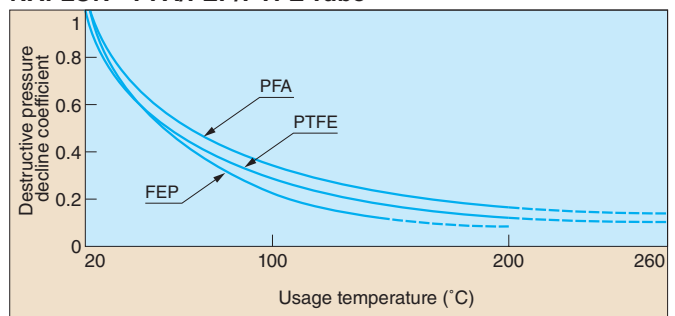
## Maximum Usage pressure

■ Please only use our tubes at pressures below P<sub>U.T</sub> as determined by the following formula:

$$P_{U.T} = S \times a \times P_{R.T}$$

- Tubes room temperature destructive pressure
- Destructive pressure decline coefficient  
\*The destructive pressure decline coefficient by material can be obtained from the table to the right.
- Safety factor (1/3~1/5)  
\*A safety factor of 1/3~1/5 is obtained according to the fluid type (gas or liquid), danger level and the existence of impact pressure levels.
- Maximum usage pressure at a given temperature.

NAFLON™ PFA/FEP/PTFE Tube



# TOMBO™ No.9003-PFA-HG

## NAFLON™ PFA-HG Tube

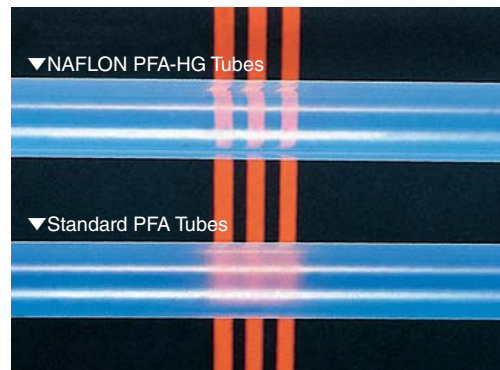
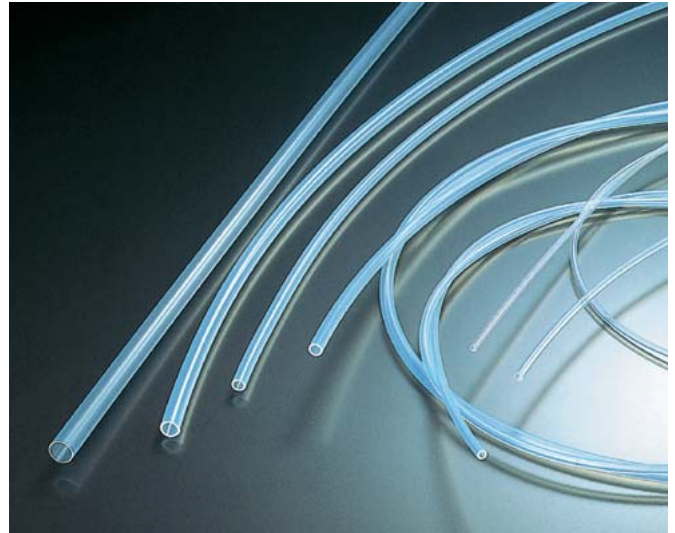
NAFLON™ PFA-HG Tubes is made from "Super PFA", a material with low levels of eluted fluorine ions. By allowing for control of the structure of PFA (miniaturization of spherulites), this tube allows for further smoothing of the inner tube surface. This tube is perfect for use in the manufacture of semiconductors and liquid crystal products, where ultra-clean environments are required.

### Features

In addition to the features of our standard PFA Tubes:

■ **Smoothness of the tube inner surface is increased to  $Rt=0.2\mu\text{m}$ .. (Rt is approximately equal to Rmax, maximum height)**

- Reduced incidence of retained particles or chemicals
- Reduced time required for cleaning
- Reduced chemical permeation thanks to less inner surface area and higher crystallinity
- Improved transparency
- Longer performance as an insulator
- **Uses a Super PFA material**
- Reduction in eluted fluorine ions
- Resistant to cracking under stress conditions such as exposure to SPM or fuming sulphuric acid



\* Photo to compare transparency between NAFLON™ PFA-HG Tube and standard PFA Tube (Our products' comparison)

### Specifications

- Maximum usage temperature: 260°C
- Maximum usage pressure: Same as NAFLON™ PFA Tubes

\* Please refer to our catalogue, "NAFLON™ Tube" for maximum service pressure.

### Applications

- For highly pure chemicals and pure water

### Other Features

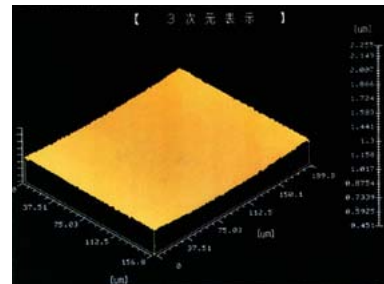
#### ■ Metallic elution

Element	Amount eluted ( $\mu\text{g}$ )
K	<0.02
Na	<0.01
Ca	<0.01
Al	<0.02
Cr	<0.01
Ni	<0.01
Fe	<0.02
Cu	<0.01

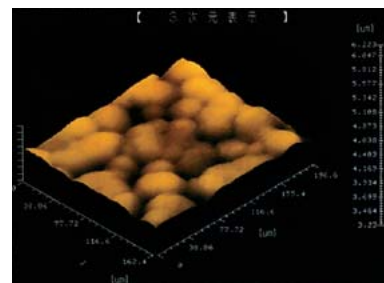
\* The values give above are intended as representative values, not standard values.

● Method of analysis:

- (1) A 1m section of the  $\phi 10 \times \phi 12$  NAFLON™ PFA-HG Tube to be tested was cut, the cut portion cleaned, and then the tube was washed in water.
- (2) Approximately 70 ml (length: 900mm) of hydrofluoric acid was added, and the test material was allowed in water.
- (3) At the conclusion of the test period, the elution liquid was allowed to evaporate. After nitric acid was added to the remaining liquid, the mixture was diluted with pure water, and frameless atomic absorption analysis was used to determine the amounts of each element contained in the elution liquid.



▲ Inner wall surface image of NAFLON PFA-HG Tube



▲ Inner wall surface image of general PFA Tube (Other manufacturer's)

#### ■ Comparison of Inner Surface Roughness With PFA Tubes

	Units	NAFLON™ PFA-HG Tubes	Competitor A	Competitor B	New PFA Tubes
Surface Roughness (Rt)	( $\mu\text{m}$ )	0.2	0.8	0.8	0.8

\* The values given above are intended as representative values, not standard values.

\*  $Rt \approx R_{\text{max}}$

\* Products from Competitor A and B are standard PFA Tubes.

## NAFLON™ PFA-SG Tube

NAFLON™ PFA-SG Tube not only has all the features of our PFA-HG Tube (smooth inner surface and stabilization of end group of molecules) but also ensures less permeation of chemicals and gases. It is anticipated that this tube will be able to reduce chemical contamination of ambient air and contamination by reverse permeation of highly permeable chemicals, and that it can also decrease permeable gasses in high temperature processes during semiconductor/FPD manufacturing.

### Features

- Less permeation of chemicals.  
Reduced permeation volume compared to PFA-HG (actual values) ...HCL, N<sub>2</sub> gas, O<sub>2</sub> gas: about 60%  
\* Permeation volume of PFA-HG is roughly 50% less than that of ordinary PFA tubes. (as far as HCL is concerned)
- Little elution of fluorine ions ...as little as PFA-HG Tube
- Little elution of metal ions ...as little as PFA-HG Tube
- Smooth inner surface ...as smooth as PFA-HG Tube
- Excellent resistance to stress such as chemicals, heat, and pressure. ...double the durability of PFA-HG Tube in terms of bending life.

### Applications

- For highly pure chemicals, pure water and highly permeable chemicals (hydrofluoric acid, hydrochloric acid, nitric acid, ozone, ammonia peroxide mixture, amine chemicals, fluorine surfactant, etc.)



### Specifications

- Maximum service temperature/pressure is the same as PFA-HG Tube.
- Destructive pressure at ambient temperature and minimum bending radius are the same as PFA-HG Tube.
- Maximum service temperature: 260°C

## NAFLON™ PFA-AS Tube

The NAFLON™ PFA-AS Tube is constructed with a PFA conducting stripe on both inner and outer surfaces of our PFA-HG Tube. This tube can prevent destruction of the tube insulation during the transport of organic solvents, fuels, refrigerant, powders, and vapors. In addition, transparency allows checking the liquid inside the tube.

### Features

- As resistant to chemicals, heat, and weather as PFA Tube.
- Anti-static function prevents destruction of tube insulation.
- Free from spark discharge that could lead to ignition.
- Transparency allows checking the liquid running inside.

### Specifications

- Maximum service temperature: 260°C (same as PFA Tube)

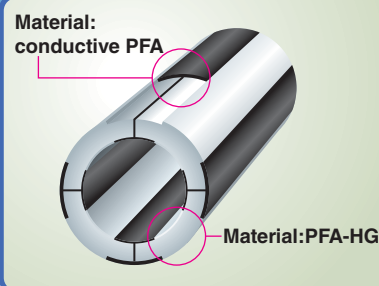
\* Please refer to "Maximum Usage pressure of NAFLON™ Tubes" on page 10 for Maximum usage pressure.

### Applications

- For refrigerant, flux, steam and organic solvent (stripping liquid, acetone, IPA, thinner, etc.)

### Properties

- Electric resistance value of conductive part (applied voltage 500V):  $5 \times 10^6 \Omega/m$



## NAFLON™ PFA-NE Tube

NAFLON™ PFA-NE Tubes are constructed with a PFA conducting stripe on surface of our PFA-HG tubing. Thanks to the conducting PFA portion's shielding effect, these tubes are excellent at preventing fires that could occur due to sparking between an atmosphere of transported flammable gases and the exterior surface of the tube.

### Features

- Prevents the release of sparks that could result in the starting of fires.
- Prevents tube insulation damage that could result from electric release from an insulated atmosphere.
- No unsettling corrosion as with metallic wires and meshes.

### Specifications

- Maximum service temperature: 260°C

\* Please refer to "Maximum Usage pressure of NAFLON™ Tubes" on page 10 for Maximum usage pressure.

### Applications

- For ignitable organic solvent (stripping liquid, acetone, IPA, thinner, etc.)
- For highly pure chemicals or gas transfer near precision electronics device which should avoid noise caused by static charge

### Properties

#### ■ Volumetric Resistance

Material	Volumetric Resistance (Ω·cm)
Conductive PFA	$5.3 \times 10^2$
PFA-HG	$>10^{18}$

\* Method of measurement: As per JIS K 7194

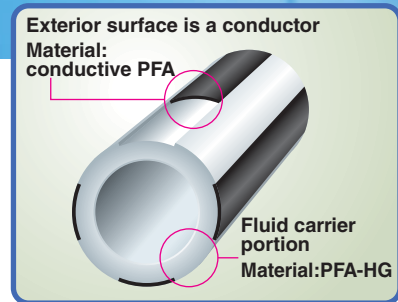
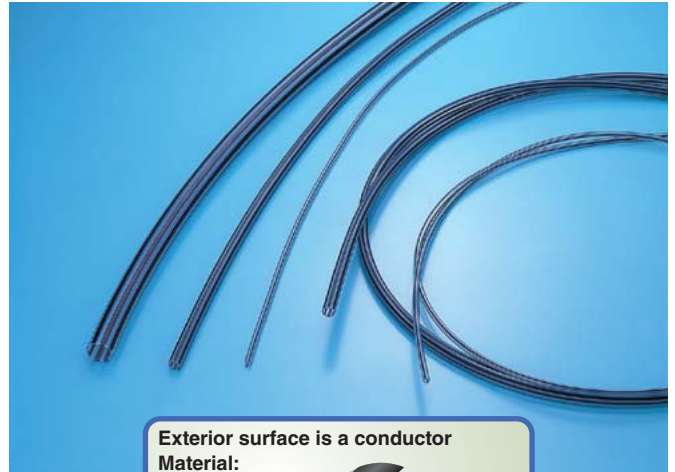
\* The values give above are intended as representative values, not standard values.

#### ■ Anti-Static Features

Tube Type	units:V		
	Center of 1m Length Tube	Center of 15m Length Tube	End of 15m Length Tube
PFA-NE Tubing	0.5~0.7	0.5~0.7	0.5~0.7
PFA-HG Tubing	$>2.00$ (limit of measurement capability)	—	—

\*Method of measurement: One end was grounded, and cotton rubbed 50 times along a 20cm span, either in the center or at the ends of the tube. Electric potential was then measured in the applicable area.

\*The values give above are intended as representative values, not standard values.



## NAFLON™ BT Tube

NAFLON™ BT Tubes are a PTFE tube with added flexibility and transparency. They bend easily and will not buckle, making them perfect for application where tubing in tight spaces is required.

### Features

- Bends easily, and will not buckle.
- More transparent than normal PTFE tubing.

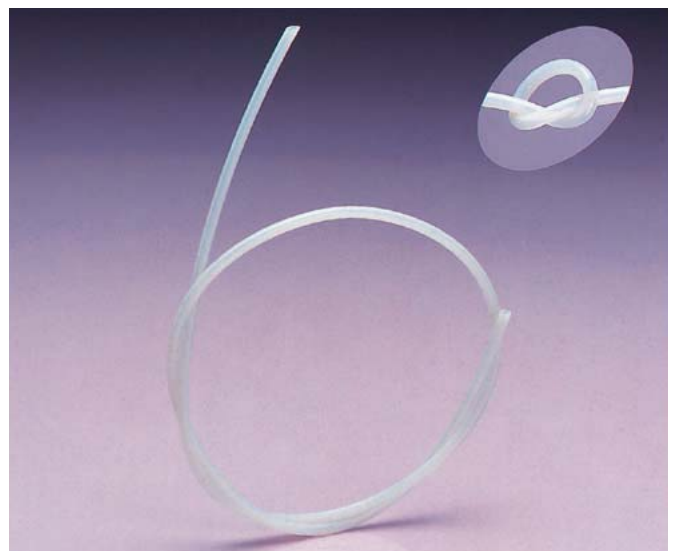
### Specifications

- Maximum service temperature: 260°C

\* Please refer to "Maximum Usage pressure of NAFLON™ Tubes" on page 10 for Maximum usage pressure.

### Applications

- For highly pure chemicals and pure water
- For tubing arrangement in a narrow space



## NAFLON™ DPL Tube

In addition to the features of our NAFLON™ PFA Tube, NAFLON™ PFA-DPL Tube has wavy grooves. It provides excellent flexibility, a small bending radius, low friction, and non-adhesivity. It also allows minimum loss of fluid from pressure and minimum attachment of fluid on the inner walls.

### Features

- Excellent flexibility
- Little contamination of liquid in use

### Applications

- For highly pure chemicals and pure water
- For tubing arrangement in a narrow space

\* Please ask us for movable tubing arrangement.

### Specifications

- Maximum service temperature: 150°C

\* Please refer to our catalogue, "NAFLON™ Tube" for Maximum usage pressure.



### Standard sizes/properties

Nominal diameter (1B)	Ends (straight part)			Wavy part		Destructive pressure at ambient temp. (MPa)	Minimum bending radius (mm)	Maximum length available (m)
	Inside diameter (mm)	Outside diameter (mm)	Length (mm)	Outside diameter (mm)	Pitch (mm)			
1/4	6.0	6.9	19	9.7	3.60	2.0	1.6	3.6
3/8	9.2	10.3	25	13.1	3.75	1.4	2.4	3.6
1/2	12.1	13.5	25	17.1	5.00	1.3	3.2	3.6
5/8	15.5	17.0	25	21.1	5.55	1.1	4.0	3.6
3/4	18.7	20.3	38	24.6	6.80	1.0	4.8	3.6
1	24.8	26.7	50	33.2	8.00	1.0	6.4	1.8

\* The dimensions given above are standard values.

\* The above values are actual measurement values, not specification values.

\* Length of the straight part can be customized upon request.

\* Inner pressure makes the pitch of the wavy part longer. Thus the minimum bending radius gets larger, slightly affecting flexibility.

## NAFLON™ RPL Tube

In addition to the features of our NAFLON™ PTFE Tube, NAFLON™ RPL Tube has a spiral-shaped groove. This provides excellent flexibility, a small bending radius, low friction, and non-adhesivity. It also allows minimum loss of fluid from pressure and minimum attachment of fluid on the inner walls.

### Features

- Excellent flexibility

### Applications

- For highly pure chemicals and pure water
- For tubing arrangement in a narrow space

\* Please ask us for movable tubing arrangement.

### Specifications

- Maximum service temperature: 200°C

\* Please refer to our catalogue, "NAFLON™ Tube" for Maximum usage pressure.



### Standard sizes/properties

#### Standard inside diameter tube (I)

Nomina diameter	Inside diameter of ends (mm)	Outside diameter of spiral part (mm)	Destructive pressure at ambient temp (MPa)	Minimum bending radius (mm)	Maximum length available (m)
6A	6	8.5	1.8	6.0	3.0
8A	8	10.5	1.4	7.0	3.0
10A	10	13.0	1.0	10.0	3.0
12A	12	16.0	0.9	15.0	3.0
15A	16	17.5	0.8	25.0	3.0
1/4B	6.4	8.5	1.8	6.0	3.0
3/8B	9.5	13.0	1.0	10.0	3.0
1/2B	12.7	16.0	0.9	15.0	3.0

\* Please refer to our catalogue, "NAFLON™ Tube" for the shape of the ends.

\* The above dimensions are standard values. Please contact us separately about lengths greater than 3m.

\* The above values are actual measurement values, not specification values.

#### Standard outside diameter tube (O)

Nomina diameter	Inside diameter of ends (mm)	Outside diameter of spiral part (mm)	Destructive pressure at ambient temp (MPa)	Minimum bending radius (mm)	Maximum length available (m)
6A	6	8.5	1.8	6.0	3.0
8A	8	9.5	1.6	7.0	3.0
10A	10	12.0	1.3	9.0	3.0
12A	12	14.5	1.0	10.0	3.0
1/4B	6.4	8.5	1.8	6.0	3.0
3/8B	9.5	12.0	1.3	9.0	3.0
1/2B	12.7	14.5	1.0	10.0	3.0

\* Please refer to our catalogue, "NAFLON™ Tube" for the shape of the ends.

\* The above dimensions are standard values. Please contact us separately about lengths greater than 3m.

\* The above values are actual measurement values, not specification values.

## NAFLON™ Bent Tube

NAFLON™ Bent Tubes are created with a special bending manufacturing process. This prevents leakage problems that can occur from the use of joints, and also helps to greatly reduce loss of pressure.

### Features

- Far less loss of pressure as compared to the use of joints.
- No leakage problems.
- Reduces space required for piping.
- Usable at high temperature up to 150°C.

### Specifications

- Maximum service temperature: 150°C

### Applications

- For highly pure chemicals of semiconductor manufacturing equipment, etc.

### Minimum Bend Radius and Measurement Variance

Inner Diameter × Outer Diameter (mm)	Minimum Bend Radius (mm)	R variance (mm)	Bend Area Flatness (%)	Bent Area Thickness (mm)	Angel (°)
4.35×6.35	10R	±2	≥85	≥0.8	±5
7.52×9.52	15R	±3	≥85	≥0.8	±5
9.52×12.7	20R	±4	≥85	≥1.3	±5
15.88×19.05	30R	±6	≥85	≥1.3	±5

\* The values give above are intended as representative values, not standard values.



## NAFLON™ Tube Connector

NAFLON™ Tube Connector is composed of connector body, union nut and a ferrule, and all are made with pure fluoropolymer. It has high sealing performance under heat cycles.

### Features

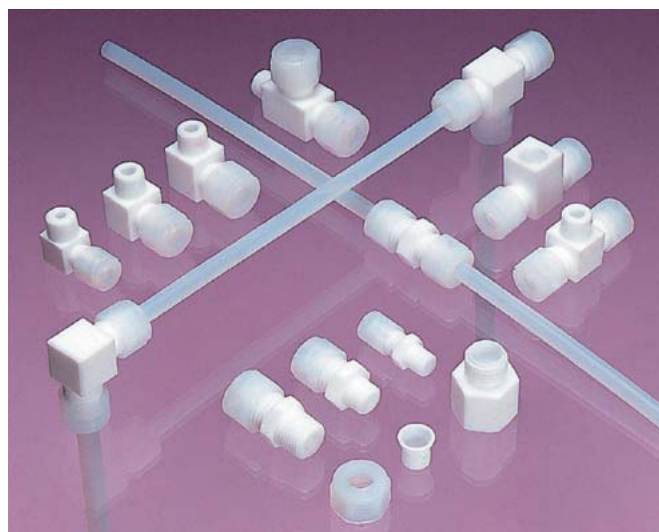
- High sealing performance can be maintained even under heat cycles.

### Specifications

- Maximum service temperature: 150°C

### Applications

- Connection of PTFE or PFA Tubes





## Fluoropolymer Lining **K**

Fluoropolymer Lining is manufactured with our accumulated experience in processing fluoropolymer and new technologies. Compared to other common plastics, fluoropolymer has excellent resistance to chemicals and heat. Also, it does not contaminate the fluid since no additives such as plasticizer or heat stabilizer are used for molding. This outstanding product can be used in a wide range of fields from semiconductor-related industries to petroleum chemistry, iron manufacturing, food industries, or nuclear power generation.

### Applications

- For highly pure chemicals and ultra pure water of semiconductor manufacturing equipment, etc.
- PFA-HG

Made of NEW-PFA material that has smooth surface and low level of fluorine ion elution, used in semiconductor applications. Thanks to its smooth surface, cleaning time can be effectively shortened. Also, since gas permeation level of PFA-HG is about half of that of PFA, it can effectively reduce environmental stress crack (specially at the nozzle and welded part), deterioration of adhesion force and pollution of highly pure chemicals caused by reverse permeation.

- PFA

This is a product with a PFA lining. PFA is the best fluoropolymer and can be used for many purposes since it can be fusion molded like general thermoplastics while having properties equivalent to or better than PTFE. PFA is more resistant to chemicals and heat than PTFE.

Moreover, PFA is twice as mechanically durable as PTFE at a 250°C tensile yielding point. The continuous service temperature is 260°C. In addition, PFA is extremely pure. It does not include or dissolve out any impurities.

- PTFE

PTFE is widely known for its excellent resistance to heat and chemicals, but it is not easily molded. Thus, we offer bellows and hoses as standardized products fabricated from tubes.



▲Ball Check Valve **K**



▲Ball Valve **K**



▲Diaphragm valve **K**



▲Bellows connector **K**

### Available Products

Products		Material of lining Product	PFA-HG	PFA	PTFE
Straight pipe			*	15A~300A	—
Fitting			*	15A~300A	—
Valve	Diaphragm valve		—	15A~150A	—
	Ball valve		*	15A~100A	—
	Ball check valve		*	20A~100A	—
Vessel	Sheet (loose)		○	○	—
	Sheet (adhesion)		○	○	○
	Coating		—	○	—
Vessel accessories			○	○	—
Bellows/hoses			*	○	○

Please contact us regarding the products shown with an \*.



▲PFA chemical supply type (designed for semiconductor)

## ETFE Roto Lining

Our ETFE Roto Lining is firmly attached to the metal surface by a rotational molding method. Seamless lining on a base material in a complicated form is possible. This lining cannot be used with high purity chemicals.

### Features

- We can handle more complicated forms, which are not possible with sheet lining.
- We can ensure uniform thickness of the film, even with thick film.
- ETFE can be firmly attached to the base material without primer.
- We can ensure seamlessness by etching the ETFE powder to the base material.

### Specifications

- Maximum service temperature: 100°C

\* Please consult us for chemical-resistance, available size and others.

### Applications

- For storage of chemicals and waste fluid of semiconductor manufacturing equipment, etc.



### What is ETFE?

ETFE is a thermoplastic of the copolymer of Polytetrafluoroethylene (C<sub>2</sub>F<sub>4</sub>) and ethylene (C<sub>2</sub>H<sub>4</sub>). It has properties similar to other fluoropolymers, such as resistance to chemicals and heat, non-stickiness, and resistance to weather. Compared to other fluoropolymers, it has low fusion viscosity and can be firmly attached to metal without primer. It is most suitable for a rotational molding method.

## NAFLON™ Coating K

NAFLON™ Coating is an etching fluoropolymer used to make the surface of a metal non-sticky and corrosion-resistant. We will select from and process a wide range of fluoropolymer materials depending on their purpose and intended use.

### Dimension

Type of plastic		*Thickness of coating film (μm)	Upper temperature limit	Applicability for Pinhole-free film
PFA	Normal	10~100	260°C	possible
	Thick film	200~700	260°C	applicable
PTFE	Normal	10~50	260°C	not applicable
FEP	Normal	10~100	200°C	possible
	Thick film	200~700	200°C	applicable
Modified type	Low temperature	5~100	150~200°C	not applicable
	High temperature	5~100	200~260°C	not applicable
ETFE	Normal	20~100	150°C	possible
	Thick film	200~1000	150°C	applicable
PVDF	Normal	20~100	135°C	possible
	Thick film	200~800	135°C	applicable
	Laminated	1000~1500	135°C	applicable

\* Coating film is a coated item, so the thickness ranges ± 30% compared to the indicated value. We can finish coating with MIN (-) for specific thickness of film upon request.



### Applications

- Corrosion-resistant coating of semiconductor manufacturing equipment, etc.

## TOMBO™ No.4500-CR

# ENETHERMO™ CR

ENETHERMO™ CR helps improve the operational environment of plants for semiconductor related equipment, food, and precision equipment where cleanliness is a priority.

### Features

- Low dust characteristics enable usage in a clean room. (class 1000)
- Detachable
- Excellent insulation efficiency
- Can be designed to fit in equipment.

### Applications

- Semiconductor manufacturing equipment
- Heat retention and insulation of radiating equipment
- Valves
- Prevents burns from radiating equipment

### Specifications

- Fluoropolymer coating glass cloth with low dust characteristics is used.
- Maximum service temperature: 200°C

\* Never use this product under conditions which could exceed the maximum temperature indicated in this catalogue.



▲Clean room



▲Used for injection molding machine

## TOMBO™ No.4500-PH

# ENETHERMO™ PH

ENETHERMO™ is a detachable jacket heater for pipe heating and insulation in a clean room.

We can offer installation of heaters, control panel settings, second wiring, etc. upon your request.

### Features

- Detachable
- Low dust characteristics
- Maximum service temperature: 200°C (A heater for higher temperatures is also available)
- Low out gases (It is confirmed no Siloxane is generated)

### Applications

- Heating devices and pipes related to semiconductor/liquid crystal fabrication equipment:
  - Ensures discharging lines of CVD, dry etching equipment are not deposited.
  - Ensures charging lines of CVD, dry etching equipment are not liquidized.
  - Heats pipes of dry pumps, exhaust gas treatment equipment.
- Heating pipes related to food processing equipment



## TOMBO™ No.8805-SC

# SOLVENT CLEAN™

Organic solvents emitted to the atmosphere have negative impacts on the human body and the global environment. Previously, large volumes of gases containing low concentrations of volatile organic compounds (VOC) were emitted to the atmosphere because of the difficulty in processing them. Now, SOLVENT CLEAN™ concentrates these VOC-containing gases and reduces their volume. The combination of SOLVENT CLEAN™ and existing processing equipment (combustion method, collection method, etc.) enables the efficient processing of VOC which used to be emitted to the atmosphere.

\* VOC=VOLATILE ORGANIC COMPOUND

### Features

- Simple structure of whirling type rotor allows easy maintenance.
- Organic solvents can continuously be concentrated.
- Suitable for processing gases of low concentration and large volume, keeping the running cost low.
- Use of hydrophobic zeolite as the absorbent ensures non-combustibility.
- Applicable to the processing of a wide variety of organic solvents.
- Allows about 3~15 times concentration.

### Application

- Concentration of organic solvent of low concentration emitted during semiconductor manufacturing and LCD manufacturing.



## TOMBO™ No.8803-ZCH2

# HONEYCLE™ -ZCH2

HONEYCLE™-ZCH2 is a honeycomb ozone removal filter developed to remove high concentrations of ozone. As high performance catalyst is incorporated inside the paper, even high concentrations of ozone can be decomposed.

\* High concentration ozone: 200ppm, or less. Contact us directly for products dealing with even higher concentrations.

### Features

- As the catalyst is fully penetrated into the paper walls, it is possible to decompose ozone at high concentrations.
- Less deterioration and longer service life than activated carbon because it is a reactive catalyst type with high decomposing efficiency.
- A variety of cell type and filter dimension is service available.

\* Service life and performance are subject to design specification.

### Application

- Equipment generating high concentration ozone
- Semiconductor products, ozone washing products, ozone sterilizing products, corona discharge treatments



# HONEYCOMB WASHER™

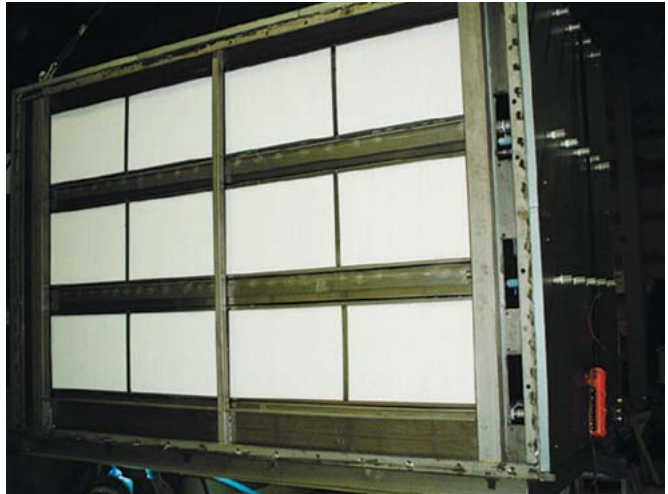
Clean as ever environments are required for the most advanced semiconductor industries. The HONEYCOMB WASHER™ made by NICHIAS is a system which removes water soluble gases (Nox, Sox, and NH<sub>3</sub>) existing in outside air or a clean room. The HONEYCOMB WASHER™ is an ideal system which removes chemicals with excellent performance, lower pressure loss, compact space and lower power consumption, in comparison with a conventional water spray system.

## Features

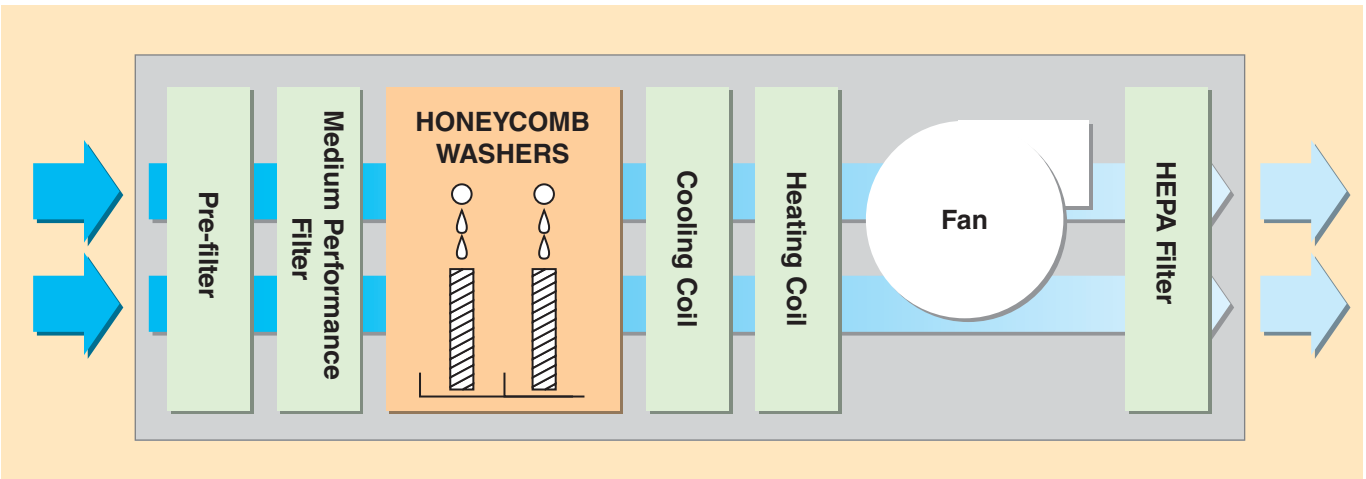
- **High chemical removal performance**  
By employing our unique porous ceramic, the HONEYCOMB WASHER™ holds water to the inner part of wall and maintains a high chemical removal performance.
- **Low pressure drop**  
The honeycomb construction of highly water adsorptive performance eliminates water dropping, does not require an eliminator and minimizes pressure drop of the whole system.
- **Low energy consumption**  
In comparison with conventional air washer, the HONEYCOMB WASHER™ reduces circulated water by 80% and reduces circulation pump power. energy consumption effect: consumed power is 50% down.
- **Compact space**  
The width of system can be reduced to more than 50% of a conventional air washer.

## Applications

- **Installed on the outdoor unit of air conditioners in a semiconductor manufacturing factory.**  
Removal of water soluble gases from outside air / humidification of air taken into a clean room.
- **Installed on the outdoor unit of air conditioners in a FPD manufacturing factory.**  
Removal of water soluble gases from outside air / humidification of air taken into a clean room.



## Basic Process Flow



TOMBO™ No.8803

**CHEMICAL GUARD™**

CHEMICAL GUARD™ is a low concentration gas removal chemical filter for Clean room, Semiconductor & FPD production tools.

CHEMICAL GUARD™ is designed for removing a wide range of basic gas, acid gas and organic gas.

**Model**

Product Name	Target Gas
TOMBO™ No.8803-HC	Basic Gas
TOMBO™ No.8803-HA	Acid Gas
TOMBO™ No.8803-HT	Organic Gas

**Features**

- **Honeycomb structure that has a larger surface area allows superior removal efficiency.**  
A great adsorption capacity achieves longer service life.
- **Low out gassing and dust**  
Consisting of the raw materials which have low out gassing and less dusts achieves high cleanliness.
- **Dimensional advantage**  
High removal efficiency and long life time makes thin filter design.
- **Laminar airflow**  
The honeycomb structure supplies laminar airflow and contributes to the long service life.
- **Design flexibility**  
Design dimension, service life, removal efficiency ratio etc flexibly for requirement.

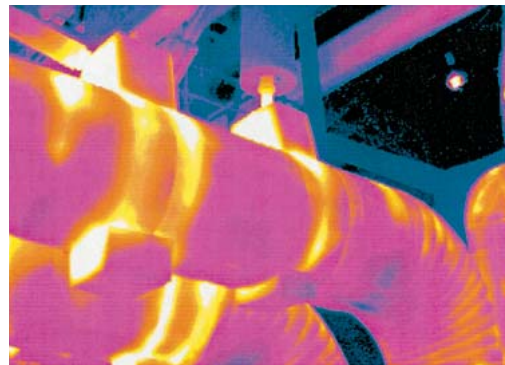
**Applications**

- Remove low concentration gas from the clean room or manufacturing tool for Semiconductor and FPD.

# Analysis Technologies

## Thermal diagnostics

Thermographic imaging provides a quantitative understanding of the distribution of the amount of emitted heat and calculates the level of degradation. The pattern of the image also enables estimating the shape of the open space of an insulator.



## Gas analysis

Air in a clean room or in the manufacturing equipment is taken as sample, and metal components, inorganic components, and organic components are analyzed. Contamination levels in the manufacturing environment can be read and the functioning of chemical filters can be confirmed.

### Inorganic component



Sampling Kit



Ion Chromatograph

### Organic component



Sampling Kit



Gas Chromatograph Mass Spectrometer

## Main analytical equipment

- X-ray Diffraction (XRD)
- X-ray Fluorescence Analysis (XRF)
- Inductively Coupled Plasma - Atomic Emission Spectrometer (ICP-AES)
- Thermo Gravimetric/Differential Thermal Analysis (TG/DTA)
- Differential Scanning Colorimetry (DSC)
- Fourier Transform Infrared Spectrophotometer (FT-IR)
- High Performance Liquid Chromatography (HPLC)

## ⚠ Cautions for handling products

- \* Please use products within the permissible temperature range specified in the catalogue.
- \* Please refer to MSDS (material safety data sheet) when using products.
- \* Please dispose of products in accordance with applicable laws for waste disposal in each country.
- \* When selecting or using our products, please refer to the details or cautions indicated in the relevant catalogue in the following list.

Item	Product name	Relevant catalogue (others)	
		Details	Cautions
O-Rings	BLAZER™ NEXT	"O-Ring"	"O-Ring"
	BLAZER™-A	"O-Ring"	"O-Ring"
	Perfluoroelastomer PFW	"O-Ring"	"O-Ring"
Heating Devices	CRYSTAL H™/CRYSTAL H™ Super	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	In-Line Heater (Lamp type)	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Containers	PFA Roto Molded Container	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ PFA Roto Molded Tank	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ PFA Chemicalware	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Fabricated Products	NAFLON™ PTFE Sink	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Molded Products	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	PEEK™ Fabricated Products	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Injection Molded Products	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Machined Products	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Bubbler	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Tube/ Tube Fabricated Products	NAFLON™ Tube (PTFE/PFA/FEP)	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ PFA-HG Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ PFA-SG Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ PFA-AS Tube	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ PFA-NE Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ BT Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ DPL Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ RPL Tube	"NAFLON™ Tube"	"NAFLON™ Tube"
	NAFLON™ Bent Tube	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Tube Connector	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Linings	Fluoropolymer Lining	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	ETFE Roto Lining	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	NAFLON™ Coating	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Insulators/Heaters	ENETHERMO™ CR	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
	ENETHERMO™ PH	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page
Honeycomb Filters	SOLVENT CLEAN™	"SOLVENT CLEAN™"	Refer to the "Instructions for use" of the product
	HONEYCLE™-ZCH2	—	Refer to the "Instructions for use" of the product
	HONEYCOMB WASHER™	"HONEYCOMB WASHER™"	"HONEYCOMB WASHER™"
	CHEMICAL GUARD	"Semiconductor and FPD related products"	Refer to "warnings and cautions" on the next page



## Prohibitions

1. Never allow the product to touch body tissues or body fluid.
2. Never be administered (including by mistake) to human.

## WARNING

Please observe the following cautions in order to maintain the intrinsic functions of the products and also to ensure that these products are used safely.

1. Do not use a product for any purpose other than the ones described in the catalog and specification, etc.
2. Use products within the service temperature range specified in the catalogue.
3. In case when processing the product at above the maximum service temperature, fluorinated cracked gas will be generated. The room must be adequately ventilated so as not to inhale the gas.
4. Do not bring the product close to naked fire nor weld. It may cause damage on the product and it may cause leakage.
5. Refer to the safety data sheet (SDS) when using the product.
6. For disposal, follow local regulations.

## Handling precautions

Please note the following points in order to maintain the original functions of the product.

1. Technical data given in this catalogue (to show the performance of the product) are all actual values measured in experiments or representative values; they are not guaranteed values. Please carefully consider in advance the suitability of the product for your intended purpose.
2. Especially careful consideration is required for the use of acid, alkali, and other poisonous fluids. Please contact our technical staff for advice.
3. Because of the nature of the materials, repeated loading, highly concentrated loading, and bending loading could affect the durability of the product. Always check the usage environment in advance.
4. Fluoropolymer is self-lubricating by nature, but does become worn after some time. Periodical replacement is recommended for the parts where much wear is observed.
5. Due to the nature of fluoropolymer, curing and change in size could occur or fluid could penetrate the fluoropolymer depending on the usage environment, which may not comply with the general specifications. Always check the usage environment in advance.

If you are unsure about any other issues, please contact our sales or technical staff for advice.

## Other cautions

Using this product as part of a heat exchanger and exporting it may infringe security export controls. Please contact us for advice.

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- 4) Performance verification under actual operating conditions is recommended even for the application shown in this catalog.
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