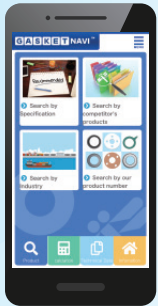
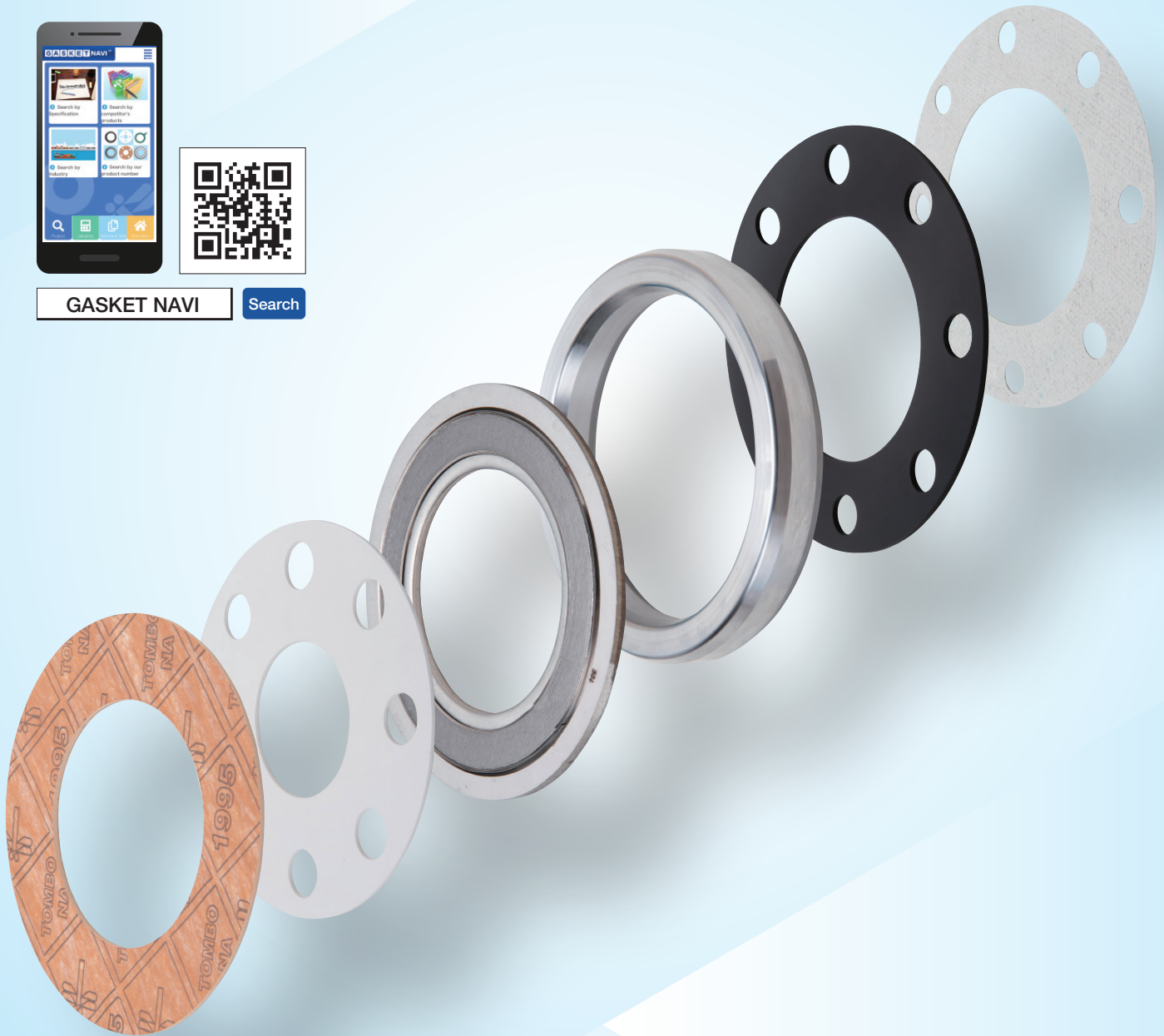


# GASKETS Products

**GASKETNAVI™**



**GASKETNAVI** Search





# TOMBO™ BRAND GASKETS

TOMBO BRAND GASKETS

---

NICHIAS gaskets support the development of various industries in Japan and overseas.

We provide new value of maintaining safety through products derived from the “Insulation and Protection” technology and services that solve problems from all angles.



# TOMBO™ BRAND GASKETS

TOMBO BRAND GASKETS

Gaskets play an important role in the prevention of fluid leakage from piping and equipment parts in all industrial fields such as the petroleum refining and chemical industry, ships, construction, electric power, and steel.

NICHIAS pursues customer satisfaction with the advanced technology of “Insulation and Protection” and provides peace of mind and trust.



You can choose from a wide range of line-up according to your requirements.

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

\* SGM, EZL, TRIGUARD are trademarks of W.L. Gore&Associates. Inc.

\* Names with TM are trademarks of NICHIAS Corporation.

1

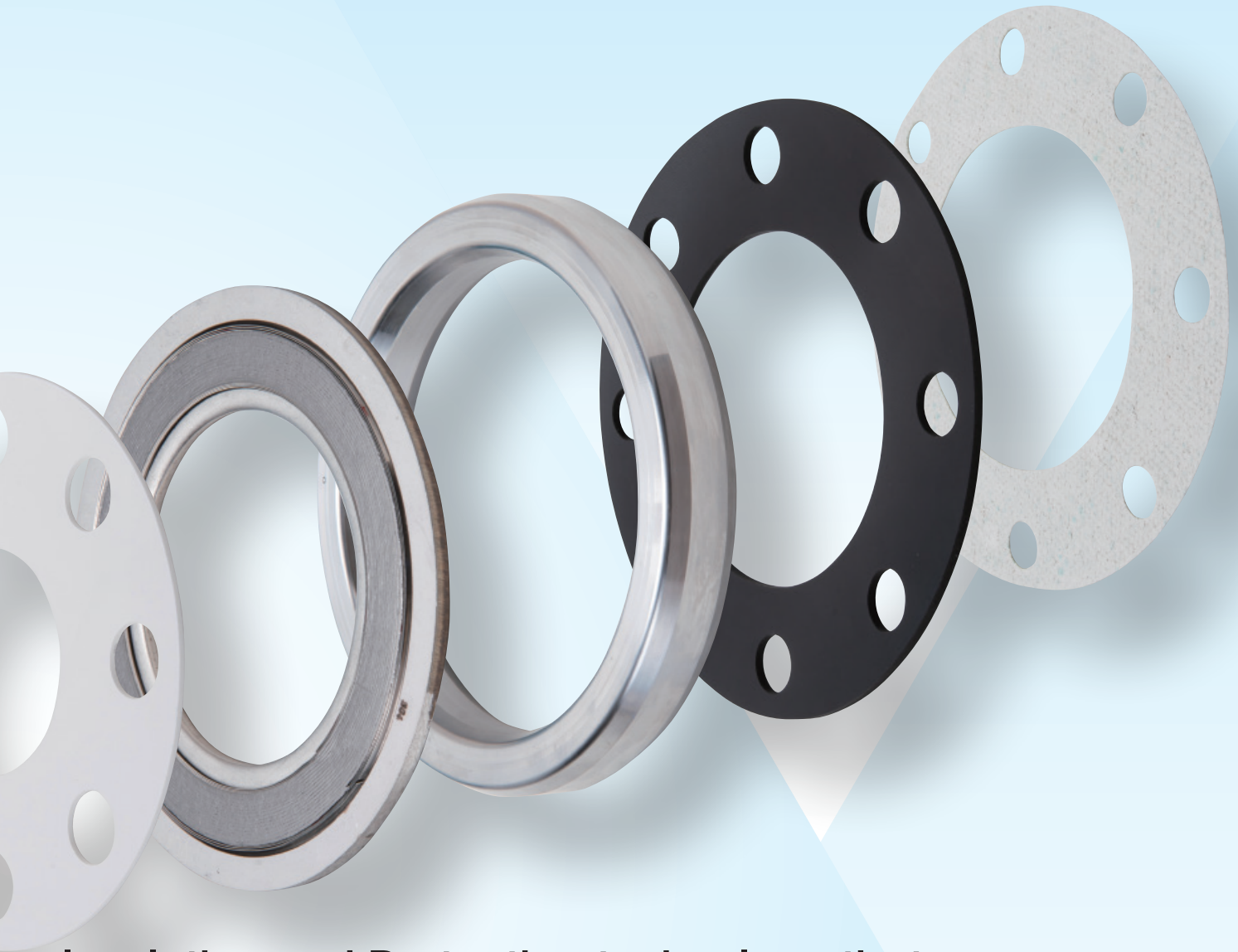
## Sheet gaskets

Jointing sheets

Fluoropolymer gaskets

Expanded graphite gaskets

P15-P36



Insulation and Protection technology that continues to deepen with development capabilities cultivated over many years and reliable quality

2

**Semi-metallic gaskets**

- VORTEX gaskets
- Kammprofile gaskets
- Metal jacketed gaskets
- Gaskets for heat exchangers

P37-P59

3

**Metallic gaskets**

- Ring joint gaskets
- Metallic gaskets
- Metal O seal

P60-P68

4

- Pastes
- Rubber gaskets
- Cloth gaskets
- Other sealing materials

P69-P78



# NICHIAS Gasket solution service

Based on the knowledge cultivated over 125 years of history, NICHIAS has prepared three solutions, “GASKET NAVI”, [GASKET工房] and “GASKET LAB” which utilize the latest technology and data.

With the aim of ensuring safe operation of all plants and improvements through preventive maintenance, we are based on the “Insulation and Protection”<sup>®</sup> technology.

We support the new value of maintaining safety with advanced technology.

## GASKET NAVI™

- A suitable gasket can be easily selected

## GASKET 工房™

- Explain how to pronounce 工房 as overseas persons don't know how to read it.
- Avoid delay of the construction period of plant maintenance.
- Urgent requests can be responded on the spot.

## GASKET Lab™

- Leakage prevention
- Skills of flange tightening work



## GASKET NAVI™

This is a technical support application that allows you to quickly select gaskets and calculate tightening torque on your PC, smartphone, or tablet. It contains various product information such as gasket characteristics, technical data, and handling precautions.

### Search by usage conditions

You can search and select the recommended gasket just by inputting the type, temperature, and pressure of the fluid.

### Search by industry

You can search for NICHIAS recommended products by industry.

### Tightening torque calculation

The minimum tightening torque required for tightening and the stress applied to the bolt at that time can be easily calculated.

**WEB site** ▶ <https://www.gasketnavi.com>

**Smartphone / tablet application version “Gasket NAVI”**

**click here to download**

For iPhone users



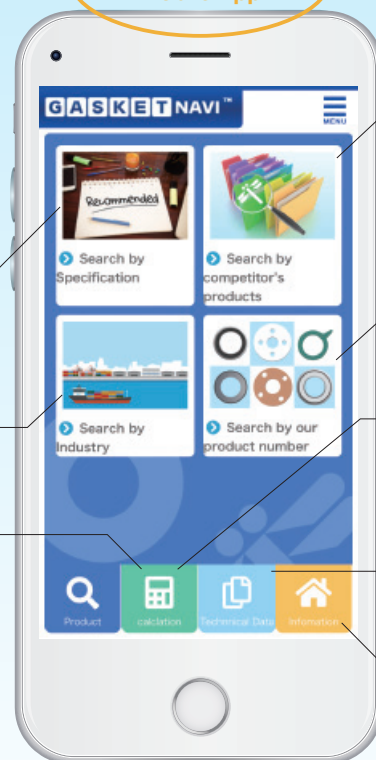
For Android users



GASKET NAVI



Available in web and mobile App



\* “GASKET NAVI” is a trademark of NICHIAS Corporation. \* The contents described are subject to change without notice.



**Solving on-site problems with three solutions**

**Search by competitor's products**

You can search for NICHIAS equivalents by entering the product number of another manufacturer.

**Search by product number**

You can browse product information such as service temperature / pressure and standard dimensions.

**Technical information**

If you register as a member, you can view technical data such as compression / recovery characteristics.

**Technical data**

You can browse the catalog, instruction manual, and NICHIAS technical data.

**FAQ**

We compiled commonly asked questions on gaskets and packings from our customers.

# GASKET 工房™

[GASKET工房] is a mobile service car that processes sheet gaskets. We will go to your plant premises and process and deliver gaskets on the spot. We will supply gaskets on the spot that are urgently needed due to unplanned construction work caused by plant maintenance or troubles.

\*This service is only available in Japan.



## GASKET Lab™

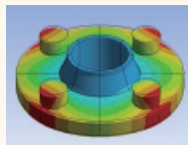
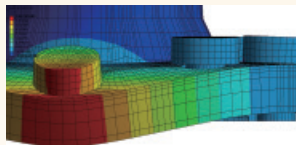
"Gasket Lab" is an engineering service that supports safe operation of plants based on preventive maintenance. We support preventive maintenance through a cycle of "evaluation technology," "verification technology," and "experiential learning."

**1 Evaluation technology** → **Know the cause of leakage by incorporating sealing technology and analysis technology.**

For customers who want to prevent leaks and want to know the state of deterioration due to usage. With the sealing technology cultivated through long experience and advanced analysis / analysis technology, we can identify the cause of leakage and contribute to preventive maintenance.

**2 Evaluation technology** → **Keep a safe sealing according to the usage location.**

For customers who want to improve leak-prone equipment and want a high degree of sealing. We propose the optimum operation of gaskets based on computer simulation technology and abundant experimental results.



CAE analysis (Computer Aided Engineering)

**3 Experiential technology** → **Providing useful education at construction sites.**

Learn the knowledge about gasket and flange tightening from the principle, and practice training to deepen your understanding.



## BT Master™



It is a system to monitor the tightened bolt axial force. It can be used to judge the skill of flange tightening work.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

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Sheet gaskets	Joining sheets	● CLINSIL™ Top	TOMBO™ No. 1120	18	
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		● CLINSIL™ White	TOMBO™ No. 1995-W	18	
		● CLINSIL™ Super	TOMBO™ No. 1993	19	
		● CLINSIL™ NF	TOMBO™ No. 1991-NF	19	
	Fluoropolymer gaskets	● CLINSIL™ Next	TOMBO™ No. 1155	22	
		● CLINSIL™ Clean	TOMBO™ No. 1133	23	
		● NAFLON™ special carbon filler filled PTFE cut gasket	TOMBO™ No. 9007-SC	23	
		● NAFLON™ PTFE low creep cut gasket	TOMBO™ No. 9007-LC	23	
		● NAFLON™ glass fiber filled PTFE cut gasket	TOMBO™ No. 9007-G20	24	
		● NAFLON™ PTFE cut gasket	TOMBO™ No. 9007	24	
		● NAFLON™ ST cut gasket	TOMBO™ No. 9007-ST	24	
		● SGM™ gasket	TOMBO™ No. 9096-SGM	24	
		● NAFLON™ GL cut gasket	TOMBO™ No. 9007-GL	25	
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		● TriGuard™ gasket	TOMBO™ No. 9096-TRI	27	
		● NAFLON™ PTFE envelope gasket	TOMBO™ No. 9010	28	
		● NICHIAS SOFT SEAL™	TOMBO™ No. 9096	32	
	Expanded graphite gaskets	● GRASEAL™ gasket	TOMBO™ No. 1200/1215-A/1210-A	34	
		● CMGC gasket	TOMBO™ No. 1880-GR	35	
		● GRASEAL™ Gasket Tape	TOMBO™ No. 1220/1221	35	
	Semi-metallic gaskets	VORTEX™ gaskets	● GRASEAL™ VORTEX™ gasket	TOMBO™ No. 1834R-GR series	39
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● NAFLON™ VORTEX™ gasket			TOMBO™ No. 9090-IOR series	41	



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<b>Rubber gaskets</b>	● Rubber cut gasket	TOMBO™ No. 1050/1051	<b>68</b>	
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# Selection method

## Gasket recommendation based on usage temperature and pressure

An example of selecting a gasket is set out below. Use it as a rough guide for selecting a gasket.



- This selection example indicates representative recommended gaskets for different fluid, temperature and pressure conditions. Not all of the usable gaskets are indicated here.
- **The fluid, temperature and pressure do not indicate the maximum conditions of use for each gasket.** Regarding the conditions of use of each gasket, refer to the service range in the main text of catalogue.
- For TOMBO No. 1850C (ring joint gasket), the 316 steel type is shown as a representative example. VORTEX gaskets are indicated using the TOMBO number that has inner and outer rings.
- In addition, there may be cases in which specified gaskets cannot be used depending on the conditions.

[Type of fluid] **Steam/hot water/water/salt water** (brine)

Room temperature	Working conditions															Recommended gasket		Other usable gaskets (TOMBO No.)		
	Temperature [°C]	Pressure [MPa]														TOMBO No.	page			
800°C																		1850C-G (316 stainless steel)	60	1838R-NM / 1891-NM
600°C																		1838R-NM	40	1850C-G / 1836R-GS, -GM, -GH
450°C																		1834R-GR	39	1836R-GS, -GM, -GH
400°C																		1880-GR	35	1834R-GR / 1215-A / 1210-A
350°C																		1834R-GR	39	1891-GR / 1850C-G
215°C																		1834R-NA	39	1834R-GR / 1891-GR / 1850C-G
175°C																		1834R-GR	39	1834R-NA / 1891-GR / 1850C-G
100°C																		1155	23	1133 / 1120
																		1155	23	1834R-GR / 1834R-NA / 1880-GR / 1133
																		1834R-GR	39	1891-GR / 1850C-G
																		1834R-NA	39	1834R-GR / 1891-GR / 1850C-G
																		1120	18	1834R-GR / 1834R-NA / 1880-GR
																		1155	23	1834R-GR / 1880-GR / 1133 / 1120
																		1995	18	1880-GR / 1155 / 1133 / 1120
																		1051-CR	68	1155 / 1133 / 1995 / 1880-GR

## Gaskets for negative pressure lines

Room temperature	Working conditions				Recommended gasket		Other usable gaskets (TOMBO No.)			
	Temperature [°C]	Pressure [torr]	5	0.1	0.01	Pressure [Pa]		TOMBO No.	page	
400°C							1.33	1850V	60	9200P-JAG
							13.3	1834R-GR	39	1850V
300°C							1.33	9090-IOR	41	1850V
							13.3	1834R-GR	39	9090-IOR / 850V
150°C							1.33	9090-IOR	41	1850V / 9200V-JTF / 1133
							13.3	1834R-GR	39	9090-IOR / 1850V / 9200V-JTF / 1133
100°C							666	1133	23	1834R-GR / 1120 / 1850V
							1.33	1050	68	2670 / 1834R-GR / 1133
							666	1995	18	1050 / 1215T / 1993

■ Unit of negative pressure / 1 torr = 1 mmHg = 133 Pa, 1Pa = 7.50×10<sup>-3</sup> torr = 7.50×10<sup>-3</sup> mmHg

■ Vacuum guideline / low vacuum: 100 Pa or higher, medium vacuum: 100 ~0.1 Pa, high vacuum: 0.1~10<sup>-5</sup> Pa, ultra-high vacuum: 10<sup>-5</sup> Pa or lower

[Type of fluid] **Petroleum hydrocarbons** (gasoline, naphtha, kerosene, heavy oil, LPG, etc.) / **Alcohol/ Animal and mineral oil**

Temperature [°C]	Pressure [MPa]	Working conditions																Recommended gasket		Other usable gaskets (TOMBO No.)			
		0.5	1.0	1.5	1.8	2.0	3.0	3.6	8.0	9.0	11	17	18	21	23	26	29	34	39		44	TOMBO No.	page
800°C																					1838R-NM	40	1850C-G / 1836R-GH / 1891-NM
600°C																					1850C-G (316 stainless steel)	60	
																					1838R-NM	40	1850C-G / 1836R-GS, -GM, -GH
450°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1836R-GS, -GM, -GH
400°C																					1215-A / 1210-A	34	1834R-GR / 1836R-GS, -GM, -GH
350°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1850C-G
																					1834R-NA	39	1834R-GR / 1891-GR / 1850C-G
260°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1850C-G
																					1834R-NA	39	1834R-GR
200°C																					1155	23	1120 / 1834R-GR / 1880-GR
																					1155	23	1133 / 1834R-GR / 1120
100°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1850C-G
																					1834R-NA	39	1834R-GR / 1850C-G
																					1155	23	1834R-GR / 1120 / 1880-GR
																					1995	18	1120 / 1834R-GR / 1880-GR
																					9007	24	1155 / 1133 / 1995

[Type of fluid] **Aromatic Hydrocarbons** (benzene, toluene, xylene, etc.) / **Organic solvent/ Thermal oils**

Temperature [°C]	Pressure [MPa]	Working conditions																Recommended gasket		Other usable gaskets (TOMBO No.)			
		0.5	1.0	1.5	3.0	3.6	9.0	11	17	18	21	23	26	29	34	39	44	TOMBO No.	page				
600°C																					1850C-G (316 stainless steel)	60	1838R-NM / 1891-NM
																					1838R-NM	40	1850C-G / 1838-GS, -GM, -GH
450°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1850C-G
400°C																					1880-GR	35	1834R-GR / 1215-A / 1210-A / 1850C-G
350°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1891-GR / 1850C-G
260°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1891-GR / 1850C-G
																					1834R-NA	39	1834R-GR / 1850C-G
200°C																					1155	23	1834R-GR / 1880-GR / 1215-A
																					1155	23	1133 / 9007-SC / 1880-GR
100°C																					1850C-G (316 stainless steel)	60	
																					1834R-GR	39	1891-GR / 1850C-G
																					1834R-NA	39	1834R-GR / 1891-GR / 1850C-G
																					1155	23	1834R-GR / 9007-LC / 9007-SC
																					9007	24	1155 / 1133 / 1120

[Type of fluid] **Weak acids** (acetic acid, carbonic acid, etc.)/ **weak alkalis** (ammonia, etc.)/ **Saline**

Working conditions		Recommended gasket		Other usable gaskets				
Temperature [°C]	Pressure [MPa]	TOMBO No.	page	(TOMBO No.)				
Room temperature	260°C	0.5	1834R-GR	1891-GR				
		1.0						
		1.5						
	200°C	1.8	1215-A / 1210-A	34	1834R-GR / 1891-GR			
		3.0						
		4.6						
	100°C	9.0	1133	23	1880-GR / 1215-A / 1210-A / 1120			
		11						
		0.5				9007-LC	23	1133 / 1834R-GR
		1.0						
		1.5						
		1.8						
3.0								
4.6								
Room temperature	260°C	9.0	1834R-GR	39				
		11						
		0.5			1133	23	1834R-GR / 1215-A / 1210-A	
		1.0						
		1.5						
		1.8						
3.0								
4.6								
Room temperature	200°C	9.0	1995	18				
		11						
		0.5			9007	24	1133 / 1880-GR / 1120	
		1.0						
		1.5						
		1.8						
3.0								
4.6								

[Type of fluid] **Strong acids** (sulfuric acid, hydrochloric acid, nitric acid, etc.)

Working conditions		Recommended gasket		Other usable gaskets				
Temperature [°C]	Pressure [MPa]	TOMBO No.	page	(TOMBO No.)				
Room temperature	260°C	0.5	9090-IOR <sup>Note 1</sup>	41				
		1.0						
		1.5						
	200°C	1.8	1133 <sup>Note 2</sup>	23	9090-IOR <sup>Note 1</sup>			
		3.0						
		4.6						
	100°C	9.0	9007-LC <sup>Note 3</sup>	23	1133 <sup>Note 2</sup> / 9090-IOR <sup>Note 1</sup>			
		11						
		0.5				9090-IOR <sup>Note 1</sup>	41	9090-IOR <sup>Note 1</sup>
		1.0						
		1.5						
		1.8						
3.0								
4.6								
Room temperature	260°C	9.0	1133 <sup>Note 2</sup>	23				
		11						
		0.5			9007-LC <sup>Note 3</sup>	23	1133 <sup>Note 2</sup> / 9090-IOR <sup>Note 1</sup>	
		1.0						
		1.5						
		1.8						
3.0								
4.6								
Room temperature	200°C	9.0	9007	24				
		11						
		0.5			1133 <sup>Note 2</sup> / 9090-IOR <sup>Note 1</sup>	1133 <sup>Note 2</sup> / 9090-IOR <sup>Note 1</sup>		
		1.0						
		1.5						
		1.8						
3.0								
4.6								

Note 1: Select a metal material that is resistant to fluid.

Note 2: Cannot be used for chromic acid.

Note 3: Cannot be used for chromic acid and hydrofluoric acid.

[Type of fluid] **Strong alkalis** (caustic soda, caustic potash)

Working conditions		Recommended gasket		Other usable gaskets				
Temperature [°C]	Pressure [MPa]	TOMBO No.	page	(TOMBO No.)				
Room temperature	260°C	0.5	1834R-GR	1891-GR				
		1.5						
		1.8						
	200°C	3.0	1215-A / 1210-A	34	1834R-GR / 1891-GR / 1880-GR			
		4.6						
		9.0						
	120°C	11	9007-SC	23	1834R-GR / 1880-GR / 1215-A / 1210-A			
		0.5				1133 <sup>Note 4</sup>	23	1834R-GR / 9007-SC / 1215-A / 1210-A
		1.0						
		1.5						
		1.8						
		3.0						
4.6								
100°C	9.0	1834R-GR	39	1834R-NA				
	11							
	0.5				1133	23	1834R-GR / 1834R-NA / 1215-A / 1210-A	
	1.0							
	1.5							
	1.8							
3.0								
4.6								
Room temperature	260°C	9.0	9007-SC	23				
		11						
		0.5			9007	24	1133 / 1834R-GR / 1120	
		1.0						
		1.5						
		1.8						
3.0								
4.6								
Room temperature	200°C	9.0	9007	24				
		11						
		0.5			1133 / 1834R-GR / 9007-SC	1133 / 1834R-GR / 9007-SC		
		1.0						
		1.5						
		1.8						
3.0								
4.6								

Note 4: Use at a concentration of 30% or less.

[Type of fluid] **Air**

Working conditions		Recommended gasket		Other usable gaskets				
Temperature [°C]	Pressure [MPa]	TOMBO No.	page	(TOMBO No.)				
Room temperature	600°C	0.3	1841-FI-G <sup>Note 5</sup>	54				
		0.5						
		1.0						
	300°C	1.5	1834R-GR	39	1841-FI-G <sup>Note 5</sup> / 1891-GR / 1850C-G			
		5.0						
		0.5				1155	23	1133 / 1834R-GR / 1880-GR / 1120
	1.0							
	1.5							
	260°C	5.0	1215-A / 1210-A	23	1880-GR			
		0.5				1995 <sup>Note 5</sup>	18	1155 / 1133 / 1834R-GR / 1050 series
		1.0						
	1.5							
100°C	5.0	9007	24	1155 / 1133 / 1834R-GR / 1995 <sup>Note 5</sup>				
	0.5							
	1.0							
	1.5							
	5.0							
	0.5							

Note 5: Use gasket paste

### [Type of fluid] Exhaust gas

Working conditions			Recommended gasket		Other usable gaskets
Temperature [°C]	Pressure [MPa]		TOMBO No.	page	(TOMBO No.)
700°C	0.01	1.0	1420-ST <sup>Note 6</sup>	72	1420-S <sup>Note 6</sup>
500°C			1420-TH <sup>Note 6</sup>	72	1420-ST <sup>Note 6</sup> / 1420-S <sup>Note 6</sup> / 1400-NA <sup>Note 6</sup>
300°C			1374 <sup>Note 6</sup>	72	1420-ST <sup>Note 6</sup> / 1420-TH <sup>Note 6</sup> / 1400-NA <sup>Note 6</sup>
260°C			1155	23	1133
200°C			1120	18	1155 / 1133 / 1834R-GR
100°C			1995	18	1155 / 1133 / 1834R-GR / 1120

Note 6: Use at locations where a certain amount of leakage is tolerated.

### [Type of fluid] Combustible gas/ Toxic gas/ Hydrogen gas/ Ammonia

Working conditions			Recommended gasket		Other usable gaskets
Temperature [°C]	Pressure [MPa]		TOMBO No.	page	(TOMBO No.)
600°C	0.5	1.0	1850C-G (316 stainless steel)	60	1838R-NM / 1891-NM
450°C	1.5	5.0	1850C-G (316 stainless steel)	60	1838R-NM / 1891-NM
350°C	6.0	9.0	1834R-GR	39	1850C-G
260°C	17	18	1850C-G (316 stainless steel)	60	
	21	23	1834R-GR	39	1891-GR / 1850C-G
	29	34	1834R-NA	39	1834R-GR / 1891-GR / 1850C-G
	39		1850C-G (316 stainless steel)	60	
			1834R-GR	39	1891-GR / 1850C-G
			9090-IOR	41	1834R-GR / 1891-GR / 1850C-G
			1834R-NA	39	1834R-GR / 9090-IOR / 1891-GR
200°C			1155	23	1133 / 1834R-GR / 9090-IOR
100°C			9007-LC	23	1133 / 1834R-GR / 9090-IOR
			9007	24	1155 / 1133 / 1834R-GR / 9007-LP

### [Type of fluid] Oxygen gas

Working conditions			Recommended gasket		Other usable gaskets
Temperature [°C]	Pressure [MPa]		TOMBO No.	page	(TOMBO No.)
260°C	1.0	2.0	1850C-G (316 stainless steel)	60	
	9.0	11	9090-IOR-OX	41	
	20	39	1133	23	9090-IOR-OX
100°C			1133	23	9007-LC / 9090-IOR-OX

### [Type of fluid] Low temperature fluid/ Liquefied gas/ LNG/ LN<sub>2</sub>/ LO<sub>2</sub>/ Ethylene

Working conditions			Recommended gasket		Other usable gaskets
Temperature [°C]	Pressure [MPa]		TOMBO No.	page	(TOMBO No.)
-200°C	1.0	2.0	1133	23	1120-LN / 1839R
-270°C			1834R-GR	39	
			1839R	41	

# Safety precautions

Please observe the following items in order to maintain the original functions of the gaskets in this catalog and use them safely.



## Common precautions for handling the products listed in this catalog

The physical characteristics, application selection, range of use, etc. described in this catalog are typical. In addition, the performance data is based on our test results and achievements in general applications. Since this product is used in various places and equipment and the actual usage conditions are also different, it is recommended to carry out a confirmation test under the actual conditions when using it. For individual applications, it is necessary to judge the selection after evaluating individual design and compatibility. Please contact us for special applications.

- Do not use for any purpose other than those listed in the catalog.
- Use products within the service temperature range specified in the catalog.
- When processing, use sharp cutting tools.
- Always follow the instructions in the instruction manual when installing equipment, etc.
- Do not reuse the gaskets.
- When replacing, carefully remove all of the old material before installing the new product.
- Store products indoor at ordinary temperature and humidity, and strictly avoid to get wet.
- Check the precautions for occupational health using the SDS.
- For disposal, follow local regulations.

## Precautions for handling GRASEAL™ Gasket

Since there is high risk of causing deformation and/or scratch damage on this product, pay enough attention to the following handling precautions.

If deformation and/or scratch damage is caused on the surface of the product, original performance may not be maintained.

- Do not place heavy items on the product.
- Do not hit GRASEAL™ product on a hard item.
- Do not step on the product nor bend the product.
- When a cutter knife, etc. is used to open a package, be careful not to damage the product.
- Do not pick up the product before completely opening the package.
- Wear the protection glove in order not to be hurt, when reinforcing metal sheet is exposed on the edge.

## Precautions for handling Manhole Gasket

- Wear the protection glove in order not to be hurt, when reinforcing metal sheet is exposed on the edge.

## Precautions for handling Jointing Sheet

- The surface sometimes becomes white, but this has no effect on performance.
- Recommended gasket paste TOMBO No.9105, 9106, or 9400. Please consult us when using any other paste.

## Precautions for handling fluoropolymer gaskets



### DANGER

- ⊘ Never allow the product to come into direct contact with body tissues or fluids.
- ⊘ Never administer (including by mistake) to humans.

- In cases when using or processing the product at above the maximum service temperature, fluorinated gas will be generated. The room must be adequately ventilated so as to prevent inhalation of gas.

# Sheet gaskets

NICHIAS has sheet gaskets such as jointing sheets, fluoropolymer gaskets, and expanded graphite (GRASEAL™) gaskets, which are used at relatively low temperatures and low pressures.

Sheet gaskets

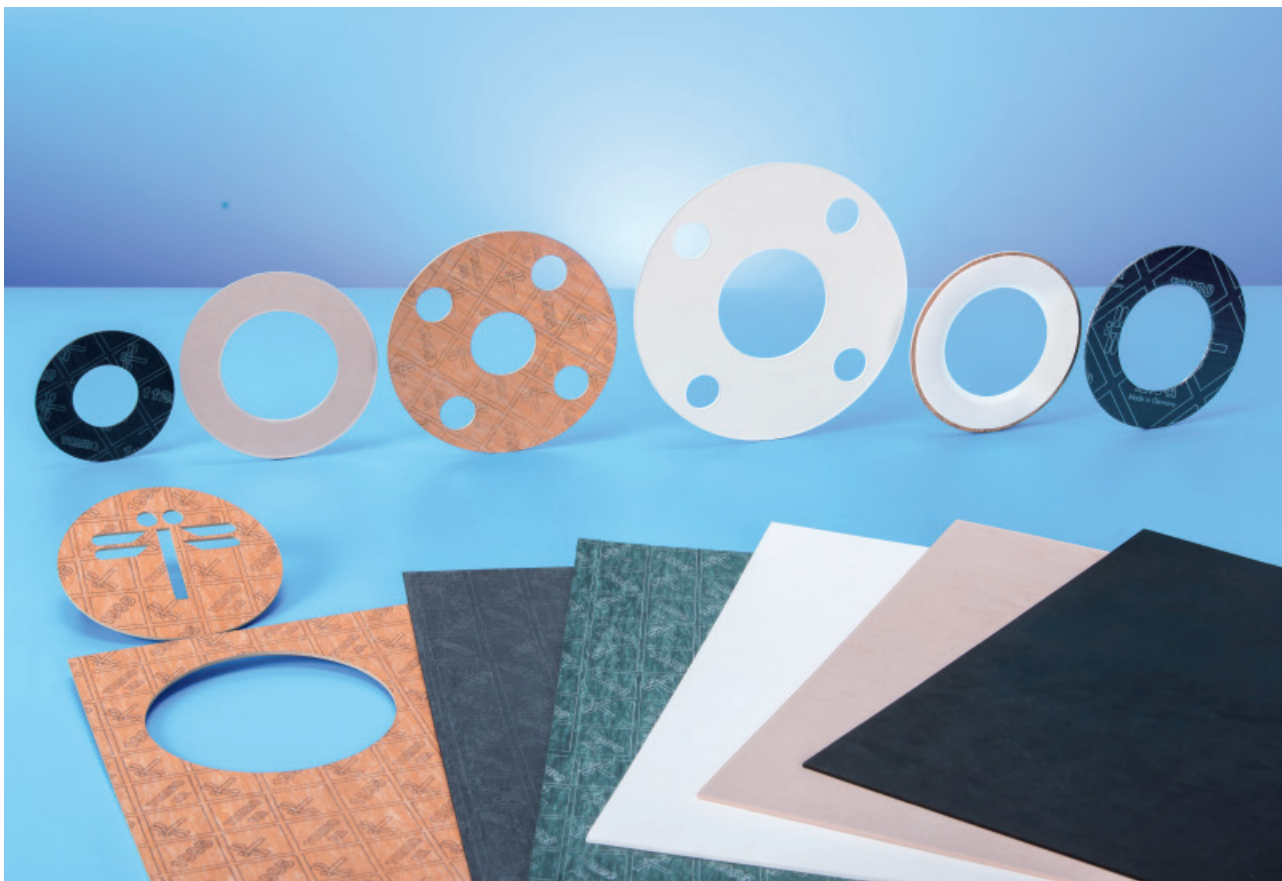
Semi-metallic gaskets

Metallic gaskets

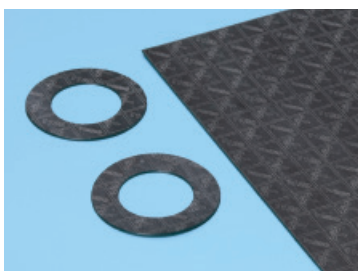
Rubber gaskets

Cloth gaskets

Pastes and other sealing materials



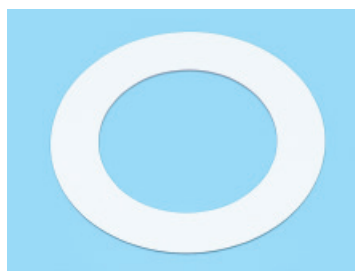
## Jointing sheets



A highly versatile gasket that can be processed into the required dimensions and shape with a sheet gasket that is made by mixing rubber, fiber, and filler kneaded together and then rolled using a roller.

► P18-P21

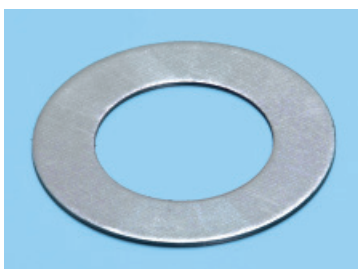
## Fluoropolymer gaskets



A sheet gasket based on fluoropolymer such as PTFE, which has excellent heat resistance and chemical resistance.

► P22-P33

## Expanded graphite gaskets





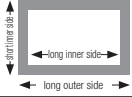




A cut gasket made from expanded graphite sheet which has excellent heat resistance and pressure resistance.

► P34-P36

# Sheet gaskets

**When ordering** When ordering, please specify the product number (TOMBO No.) and the following.

Shape	Item
Sheet	<ul style="list-style-type: none"> <li>● Thickness ● width ● length</li> </ul> For example) 1.5t × 1270 × 1270 For example) 1.5t × 1S
Cut gasket	Please specify the shape of the gasket. For complicated shapes, please specify in the drawing.

Shape	How to specify gasket dimensions	
 Ring gasket (Gasket for raised face)	Standard size	<b>Pressure class x nominal size x thickness</b> For example) 10K × 50A × 1.5T × RF、150LB × 2B × 1.5T × RF
	Non-standard size	<b>inner diameter X outer diameter X thickness</b> For example) 60φ × 100φ × 1.5T
 Full-face gasket (Gasket for flat face)	Standard size	<b>Pressure class x nominal size x thickness</b> For example) 10K × 50A × 1.5T × FF、150LB × 2B × 1.5T × FF
	Non-standard size	<b>Inner diameter x outer diameter x PCD X n-h X thickness</b> For example) 60φ × 130φ × PCD105 × 4n-12φ × 1.5T
 Frame-shaped	<b>Thickness x short inner side / long inner side x short outer side / long outer side</b> For example) 1.5T × 50/150 × 70/170	
 Oval	<b>Eclipse x Thickness x Short outer diameter x Long outer diameter x Width</b> For example) Oval × 1.5T × 100 × 130 × 10W	
 For heat exchangers	<b>Inner diameter x outer diameter x thickness x rib width-rib R x rib shape</b> For example) ○○φ × ○○φ × OT × ○○W-○○R × HEO	
 Blind (BF)	<b>Blind x outer diameter x thickness</b> For example) blind × 105φ × 1.5T	
 With handle	Standard size	<b>Handle x pressure x nominal size x thickness x rib shape</b> For example) Tab × ○○K × ○○A × OT × RF × OW × OL × OR
	Non-standard size	<b>Handle x inner diameter X outer diameter X thickness x rib shape</b> For example) Tab × ○○φ × ○○φ × OT × OW × OL × OR

### one-point

The ring gasket set inside the bolt has a high surface pressure, so it has good sealing performance, and the full-face gasket with bolt holes has the advantage of being easy to set and difficult to tighten on one side.

### Gasket thickness

The thinner the sheet gasket, the better the sealing performance and stress relaxation performance. The thicker the sheet gasket, the better the absorption of flange warping. Basically, we recommend 1.5mm for small and medium nominal size of 150A or less, and 3.0mm for medium and large nominal size of 200A or more.

fluid	nominal size	thickness
water oil type	150A (6B) and below	1.5mm
	200A (8B) and above	3.0mm
gas type	all size	1.5mm and below
steam / hot water line	all size	1.5mm



## Case study

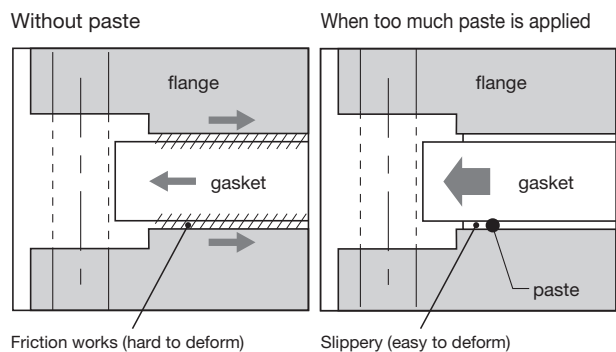
**Q. Why does the allowable seating stress decrease when paste is used for the jointing sheet?**

**A. This is because the paste reduces the frictional force with the flange and the jointing sheet is easily to deform.**

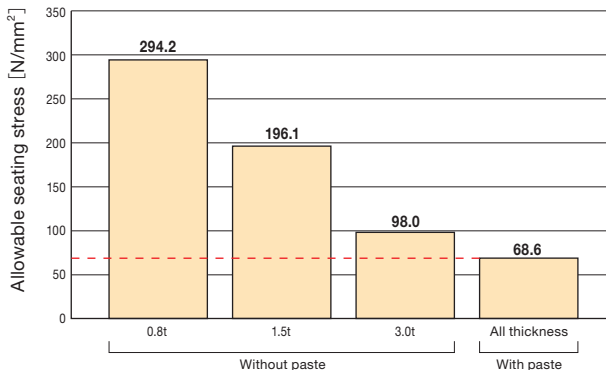
When the jointing sheet is tightened, the internal voids are compressed and the thickness becomes thinner, and at the same time, it tries to deform in the radial direction. Therefore, the deformation is usually suppressed by the frictional force with the flange, but if slippery material such as gasket paste intervenes, the frictional force between the jointing sheet and the flange becomes small and the deformation cannot be tolerated and destroyed.

Therefore, when paste is used, the allowable seating stress of the jointing sheet (Jointing sheet will be damaged if applied seating stress high than allowable value) is reduced.

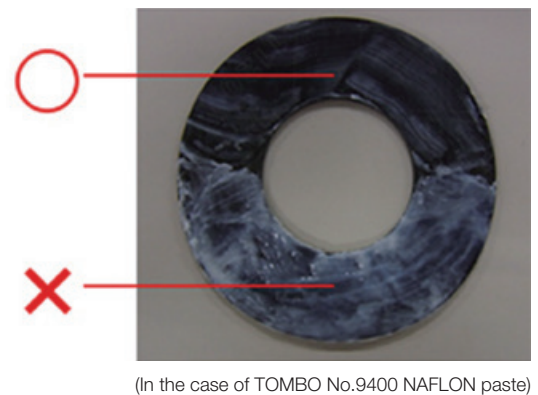
**Figure 1 With and without paste**  
Schematic diagram when the paste is applied too much



**Fig. 2 Allowable seating stress when applying paste (TOMBO No.1120)**



**Fig. 3 Estimated amount of paste applied**



As an example, Fig. 2 shows the allowable seating stress at room temperature with and without the paste of TOMBO No. 1120. If there is a paste, the allowable seating stress will be smaller. Therefore when using a paste, apply it thinly and evenly as shown by the “O” mark in Fig. 3. The “X” mark shown in Fig. 3 is too thick.

For other case studies, see “FAQ” of Gasket NAVI.



The jointing sheet cracked in the circumferential direction and was damaged. What could be the cause?

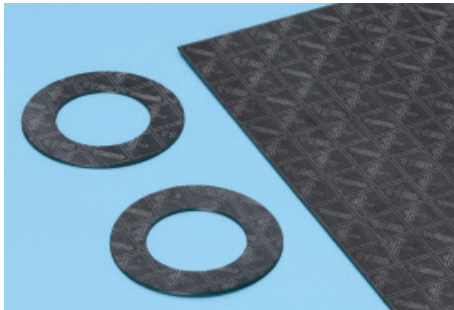


# Jointing sheets

A jointing sheet is a sheet gasket consisting of rubber, fibers and filler which are kneaded together and then rolled using a roller. It is formed to the necessary dimensions and shape and is used at joints of utility piping and equipment.

## TOMBO™ No. 1120

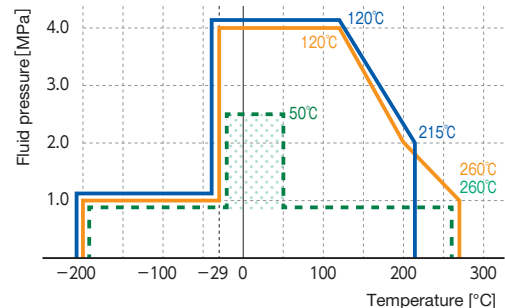
### CLINSIL™ Top



#### Service range

- Water type fluid
- Oil type fluid
- Gas type fluid<sup>Note 1</sup>

Note 1: For this area, please consider carefully in advance before use.



#### Features

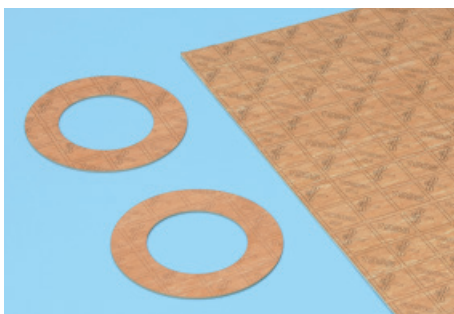
- Since it is mainly composed of expanded graphite, it has excellent heat resistance, steam resistance, and corrosion resistance.
- It is not easily scratched and has excellent flexibility.
- Used for relatively high temperature flanges, valves and equipment.

Main constituents: NBR, aramid fibers, expanded graphite

Line-up: TOMBO No.1120-LN For low temperature fluids such as LNG. Product with special treatment for TOMBO No.1120

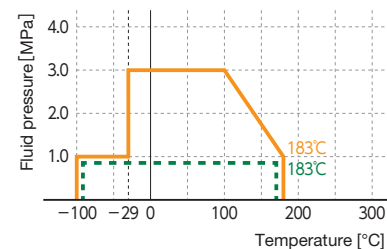
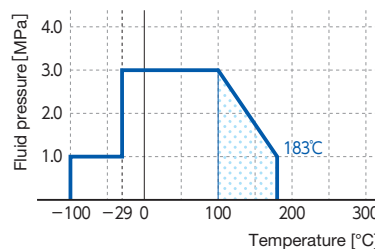
## TOMBO™ No. 1995

### CLINSIL™ Brown



#### Service range

- Water type fluid<sup>Note 2</sup>
- Oil type fluid
- Gas type fluid



Note 2: The guideline for the usage period when used as a piping gasket for steam seals of 100°C or higher is as follows. Area: 1-2 years

#### Features

- Standard grade jointing sheet
- Large size gasket is available. Can be manufactured without joints to a maximum of 3810mm x 3810mm (9S size)
- Can be used with relatively low temperature flanges, valves and equipment.

Main constituents: NBR, aramid fibers, inorganic fibers

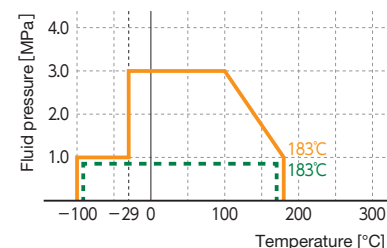
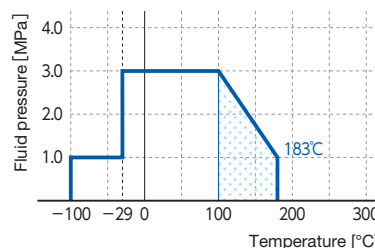
## TOMBO™ No. 1995-W

### CLINSIL™ White



#### Service range

- Water type fluid<sup>Note 3</sup>
- Oil type fluid
- Gas type fluid



Note 3: The guideline for the usage period when used as a piping gasket for steam seals of 100°C or higher is as follows. Area: 1-2 years

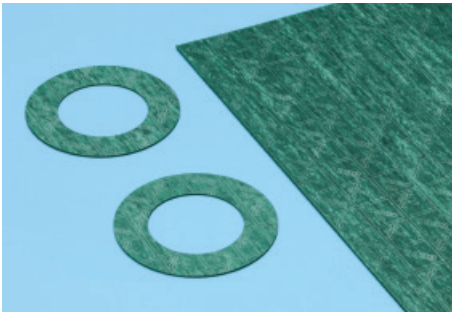
#### Features

- A white jointing sheet with the same performance as TOMBO No.1995.
- Suitable for places where you want to avoid black foreign matter entering the fluid.

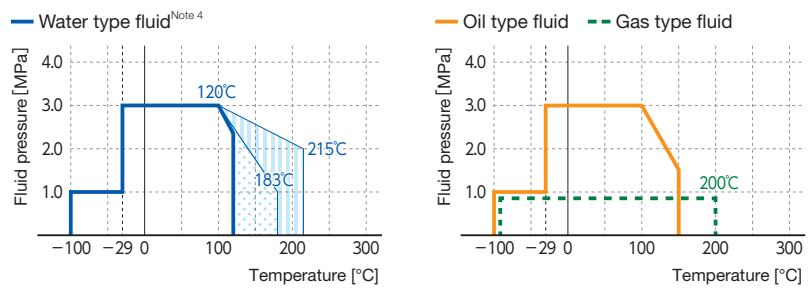
Main constituents: NBR, aramid fibers, inorganic fibers

**TOMBO™ No. 1993**

**CLINSIL™ Super**



**Service range**



Note 4: The guideline for the usage period when used as a piping gasket for steam seals of 100°C or higher is as follows. Area: 1-2 years

**Features**

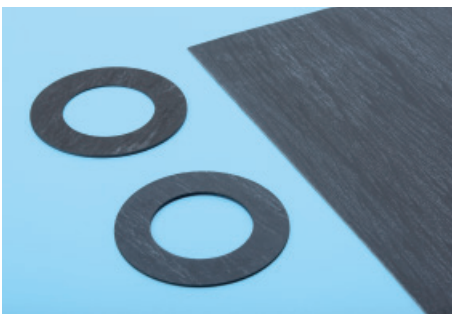
- It has excellent heat resistance, steam resistance and is suitable for steam lines.

⚠ Do not use TOMBO No. 1993 for gas-based fluids that cannot tolerate even the slightest leak. If you want to perform an airtight test with water / oil fluid, please use paste together. Alternatively, we recommend using TOMBO No.1133 and TOMBO No.1120.

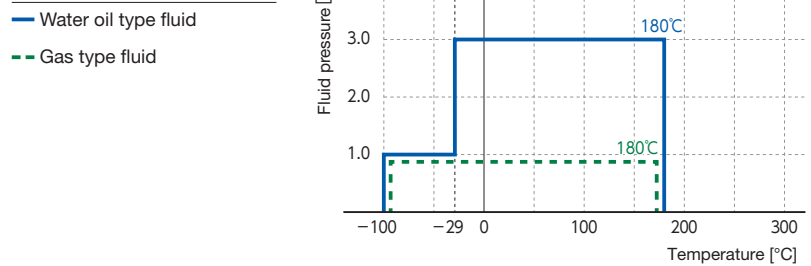
**Main constituents:** Specially blended rubber, aramid fibers, inorganic filler

**TOMBO™ No. 1991-NF**

**CLINSIL™ NF**



**Service range**



**Features**

- It has high resistance to alternative CFCs and is suitable for equipment that uses CFC substitutes (HCFC, HFC, etc.) such as refrigerator compressors.

**Main constituents:** NBR, aramid fibers, special inorganic filler

## Design criteria

TOMBO No.		1120	1995	1993	
Gasket factor m [-]	0.8 t		3.50		
	1.5 t		2.75		
	3.0 t		2.00		
Minimum design seating stress $\gamma$ [N/mm <sup>2</sup> ]	0.8 t		44.8		
	1.5 t		25.5		
	3.0 t		11.0		
Minimum seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water oil type fluid		14.7		
	gas type fluid		34.3 <sup>Note 1</sup>		
Allowable seating stress [N/mm <sup>2</sup> ]	without paste	0.8 t	294.2		
		1.5 t	196.1		
		3.0 t	98.0	147.1	
	with paste	0.8 t	68.6 <sup>Note 2</sup>		
		1.5 t			
		3.0 t			

Note 1: We do not recommend a thickness of 3.0t for gas-based fluids.

Note 2: 58.8N/mm<sup>2</sup> when used with anticorrosion paste.

## Standard dimensions

TOMBO No.		1120	1995	1995-W	1993	1991-NF
1S (1270 × 1270mm)	0.4 t	●	—	—	—	●
	0.5 t	●	—	●	●	●
	0.8 t	●	●	●	●	●
	1.0 t	●	●	●	●	●
	1.5 t	●	●	●	●	●
	2.0 t	●	●	●	●	—
3S (1270 × 3810mm)	0.4 t	●	—	—	—	●
	0.5 t	●	—	●	●	●
	0.8 t	●	●	●	●	●
	1.0 t	●	●	●	●	●
	1.5 t	●	●	●	●	●
	2.0 t	●	●	●	●	—
6S (2540 × 3810mm)	0.8t	●	●	—	—	—
	1.0 t	●	●	●	—	—
	1.5 t	●	●	●	—	—
	2.0 t	●	●	●	—	—
	3.0 t	●	●	●	—	—
9S (3810 × 3810mm)	0.8 t	—	—	—	—	—
	1.0 t	—	—	—	—	—
	1.5 t	—	●	—	—	—
	2.0 t	—	●	—	—	—
Weight (kg) per sheet of thickness 1.5t and 1S size (reference) [kg] (reference)		3.63	4.35	4.35	4.23	3.75

\* The above are standard dimensions. We can also manufacture some sheets that are not marked. For details, please contact us.

## Typical physical properties

TOMBO No.		1120	1995	1993	1991-NF	
Sample thickness [mm]		1.5	1.5	1.5	1.0	
Tensile strength [N/mm <sup>2</sup> ]		27.5	24.1	14.7	26.2	
Compressibility [%]	34.3N/mm <sup>2</sup>	9	7	7	6	
Recovery [%]		70	65	52	67	
Oil resistance	IRM903 oil 150°C×5h	thickness increase ratio [%]	2	3	24	1
		tensile strength reduction ratio [%]	11	23	33	-1
	IRM903 oil 40°C×48h	thickness increase ratio [%]	—	4	—	1
		tensile strength reduction ratio [%]	—	4	—	6
		compression ratio [%]	—	6	—	6
recovery [%]	—	64	—	73		
Resistance to fuel oil	ASTM Fuel B (JIS fuel oil B) R.T.×5h	thickness increase ratio [%]	2	4	18	3
		mass increase ratio [%]	1	6	17	5
Stress relaxation ratio [%] 100°C × 22h		25	28	20	15	
Density [g/cm <sup>3</sup> ]		1.53	1.84	1.71	1.62	

\* The above values are measured value. They are not standard values.

Measured by: NICHIAS

## ⚠️ Precautions concerning jointing sheets

### ■ Precautions concerning design and selection

#### ● Gasket contact surface finish

The recommended surface roughness when using a jointing sheet is as follows.

- For sealing liquid: 6.3µm Ra or below
- For sealing gas: 3.2µm Ra or below

#### ● Recommended thickness and shape of gasket

The recommended thickness and shape of jointing sheets are as follows.

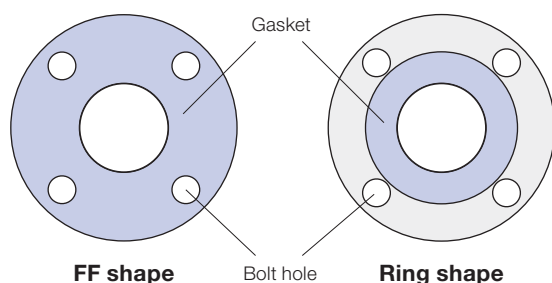
fluids	Nominal diameter	Thickness	Shape
water type and oil type	max 150A (6B)	1.5mm	—
	min 200A (8B)	3.0mm	—
Gas type	all sizes	max 1.5mm <sup>Note 2</sup>	ring shaped <sup>Note 3</sup>
Steam and hot water lines <sup>Note 1</sup>	all sizes	1.5mm	ring shaped <sup>Note 3</sup>

Note 1: Recommended when TOMBO No. 1995 is used in a steam or hot water line at 100°C or higher or when TOMBO No. 1993 is used in a steam or hot water line at 120°C. use a VORTEX gasket or a kammprofile gasket in a location where maintenance is difficult to carry out.

Note 2: It is recommended that a thin gasket to prevent permeation leakage.

Note 3: If the FF shape does not provide sufficient seating stress, it is recommended to use a ring shape with the gasket inside the bolt.

#### Gasket shape



### ■ Precautions for use

#### ● For gas-based fluids

A jointing sheet consists of fibers, filler and rubber which are kneaded together and then rolled. It has a structure with many voids inside. Since gas-based fluids are prone to permeation leakage, please note the following points when using.

- Apply gasket paste thinly and evenly to the seating surfaces and inner periphery.
- Apply sufficient seating stress.
- Before carrying out an air tightness test, install the gasket with paste and leave it for 2 to 3 hours to allow it to bond with the flange.
- Do not use a jointing sheet as a seal for a toxic gas line or a high vacuum line or combustion promoting gas (oxygen) that cannot tolerate even a small amount of leakage.

#### ● For Steam or hot water line

When using TOMBO No. 1995 for steam / hot water lines at 100°C or higher and TOMBO No. 1993 at 120°C or higher, the seating stress should be 29.4N/mm<sup>2</sup> or higher and be careful not to apply piping stress to the gasket.

#### ● Using a jointing sheet between stainless steel flanges

Compared to an asbestos jointing sheet, a non-asbestos jointing sheet contains only a small amount of soluble halogen. Therefore it can also be used with stainless steel flanges as well. There is no need to use anti-corrosion paste.

#### ● Additional tightening

- For TOMBO No. 1995 and TOMBO No. 1993, the gasket will harden over time after the temperature rises therefore retightening is not possible.

- Although TOMBO No.1120 can be retightened, retightening (hot bolting) is not possible when the temperature is high because the allowable seating stress decreases at high temperatures.

#### ● To prevent compressive breakage

To prevent compressive breakage of the jointing sheet, strictly observe the following items.

##### Do not overtighten

- Do not tighten the gasket more than the allowable seating stress.
- Tighten with a uniform force.  
(Please note that if the load is easily applied to a part of the gasket by one-sided tightening, compression breakage may occur even if the seating stress is less than the allowable tightening surface pressure.)
- In the case of small I.D. flange, a large tightening force may be applied to the gasket therefore be careful not to overtighten.W36

#### Precautions when using gasket paste

- Recommended gasket paste  
TOMBO No. 9105, 9106, 9400  
\*Please consult us when using any paste other than the above
- Unusable gasket paste  
Do not use the following pastes as they may cause compressive breakage below the allowable seating stress.  
Solvent-based liquid gasket (it may swell the gasket)  
Silicone oils and greases (promotes gasket slippage)

#### Tightening gasket at high temperature (hot bolting)

Hot bolting may cause compressive breakage even though below the allowable seating stress.

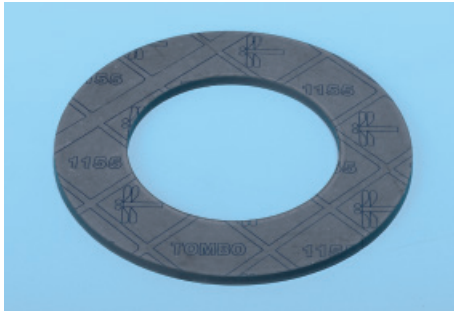
#### ● The surface may turn white but there is no problem with performance.

### Applicable standards

- JIS F 0602  
"Shipbuilding - Non-asbestos gasket to cargo piping system - Application standard"  
(HJ TOMBO No.1995, TOMBO No.1993, TOMBO No.1991-NF)
- JIS F 7102  
"Standard for Using Gaskets and Packing for Pipes in Marine Engines"  
(HJH TOMBO No.1995, HJT TOMBO No.1993)

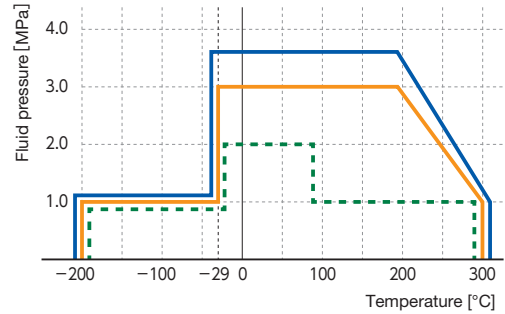
# Fluoropolymer gaskets

TOMBO™ No. 1155 | CLINSIL™ Next



### Service range

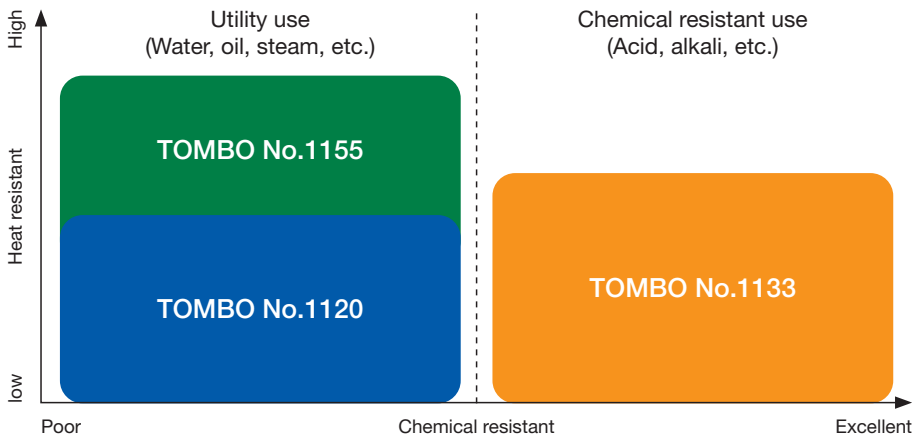
- Water type fluid
- Oil type fluid
- Gas type fluid



- Features**
- Can be used for utility applications such as high-temperature water, oil, steam, various organic solvents, low-temperature fluids, flammable gas, inert gas, and non-combustible gas. (Can also be used for some alkaline / acid fluids)
  - Creep at high temperature is small and can be used at high temperature. It can be used for a long time with little deterioration at high temperatures.

**Main constituents:** PTFE, silica, graphite

## Positioning of our sheet gasket



## 310°C thermal cycle seal test result

TOMBO No.1155 has high thermal resistance and exhibits sealing performance even at 300°C.

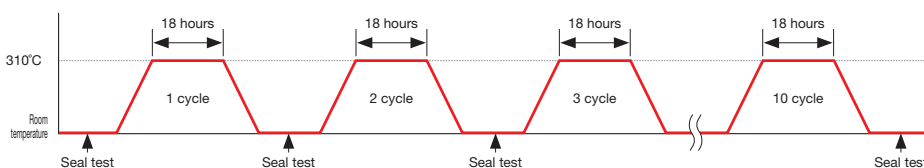
### Test condition

Sample dimension	JIS 10K 25A FR 3.0t	Number of test	n=3
Flange	JIS 10K 25A FR	Leak detection	Pressure drop
Seating stress	34.3N/mm <sup>2</sup>	Heating condition No. of heat cycles	310°C*1 × 18hours 10 cycle
Fluid	N <sub>2</sub> gas		
Internal pressure	0.98MPa		

### Test result

Number of cycles	Leakage*2
1	No
2	No
3	No
4	No
5	No
~10	No

Measured by: NICHIAS



\*1 This evaluation is measured at 310°C, which exceeds the maximum operating temperature as an accelerated deterioration test. We do not guarantee the use of 310°C.

\*2 Leakage-free standard: 0.12 ml/min

JIS B 2490-2008 "Test method for sealing behavior of gaskets for pipe flanges" The leak amount  $3.0 \times 10^{-4} \text{ Pa} \cdot \text{m}^3/\text{s}$  that can be detected by the soapy water foaming method described in Section 7 "Quantification of non-leakage" is converted to the leak amount at the sample size JIS 10K 25A.

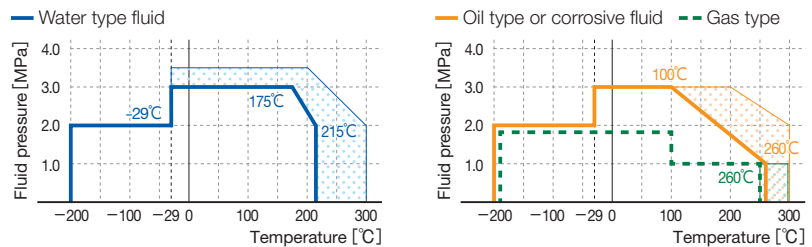
\*3 This is an actual measurement value, not a standard value.

A gasket based on fluoropolymer, which has excellent heat resistance and chemical resistance. Gaskets containing a filler such as alumina are less likely to creep when heated than gaskets containing only PTFE because the filler suppresses deformation.

**TOMBO™ No. 1133** | **CLINSIL™ Clean**



**Service range**



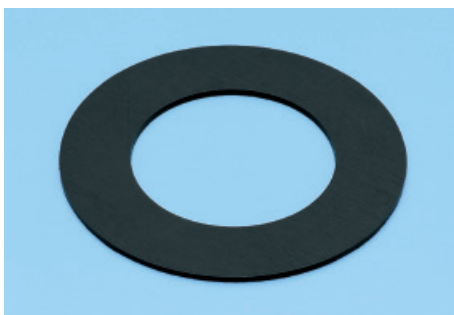
The area marked with \* is the range that can be used depending on the conditions. Please be sure to consult us in advance.

\* Since the amount of deformation due to creep increases as the thickness increases, we recommend a gasket thickness of 1.5mm for gas lines exceeding 200°C.

- Features**
- Can be used for a wide range of fluids such as acids/alkalis, petroleum / petrochemical products, organic solvents, hot oils, heating medium gases, and steam. (excluding some strong alkalis and strong acids)
  - It has the highest chemical resistance compared to other fluoropolymer gaskets. ● Can also be used where electrical insulation is required.

Main constituents: PTFE, alumina

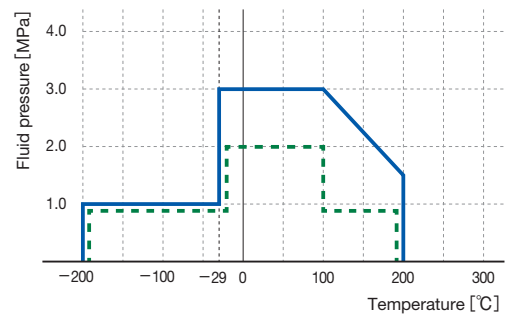
**TOMBO™ No. 9007-SC** | **NAFLON™ special carbon filler filled PTFE cut gasket**



**Service range**

- water, oil, corrosive fluids
- - - Gas type

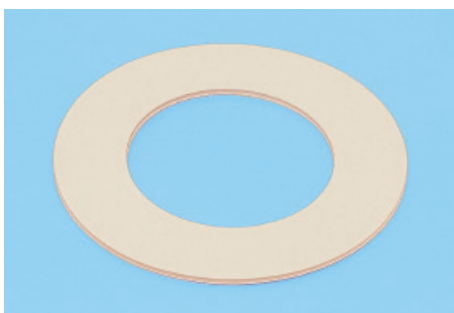
\* When using the welded product of TOMBO No.9007-SC for a gas-based fluid or when performing an airtightness test, please use together with paste.



- Features**
- Can be used mainly for strong alkaline fluids. (Cannot be used for oxidizing fluids such as nitric acid, concentrated sulfuric acid, and chromic acid)

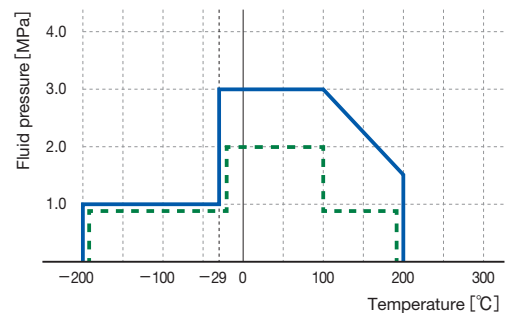
Main constituents: PTFE, carbon

**TOMBO™ No. 9007-LC** | **NAFLON™ PTFE low creep cut gasket**



**Service range**

- water, oil, corrosive fluids
- - - Gas type



- Features**
- Can be used mainly for strong acid fluids. (Cannot be used for hydrofluoric acid and strong alkali).
  - Can be used where electrical insulation is required.

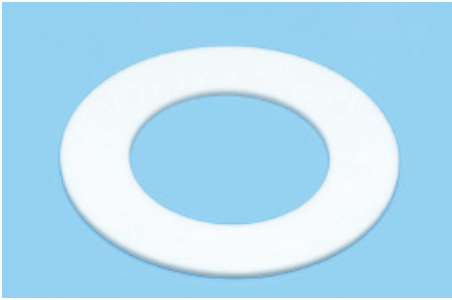
Main constituents: PTFE, silica

**Information**

Creep is the deformation that occurs to a material after exposed to a certain temperature and stress after a certain amount of time. Creep at room temperature is also called "cold flow".

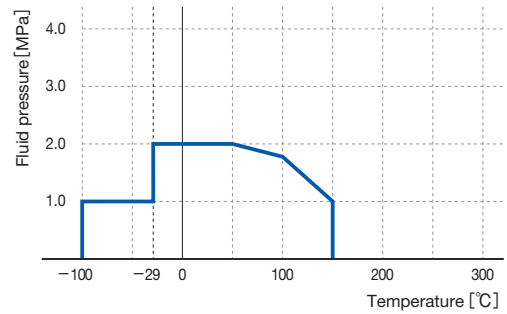
## TOMBO™ No.9007-G20

### NAFLON™ glass fiber filled PTFE cut gasket



#### Service range

— water,oil, gas, corrosive fluids



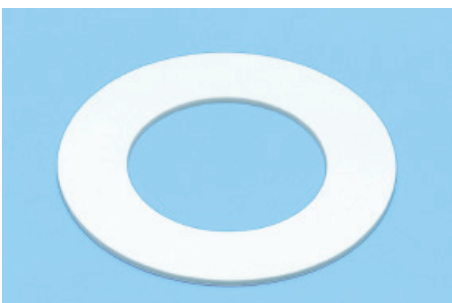
Features

- Standard filler filled PTFE gasket.
- Cannot be used for hydrofluoric acid and strong alkali.

Main constituents: PTFE, glass fiber

## TOMBO™ No.9007

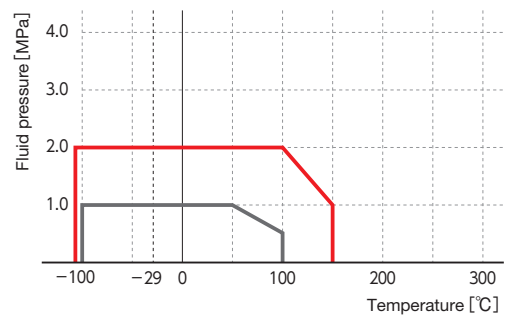
### NAFLON™ PTFE cut gasket



#### Service range

— TOMBO No.9007  
(water,oil, gas, corrosive fluids)

— TOMBO No.9007-ST  
(water,oil, gas, corrosive fluids)



※TOMBO No. 9007 is prone to creep, it should be used with a tongue and groove flange (T&G) as general rule.

Features

- Since it does not contain filler, it can be used for lines that contamination is not allowed.
- Can also be used where electrical insulation is required.

Main constituents: TOMBO No.9007: PTFE TOMBO No.9007-ST: Modified PTFE

## TOMBO™ No.9096-SGM

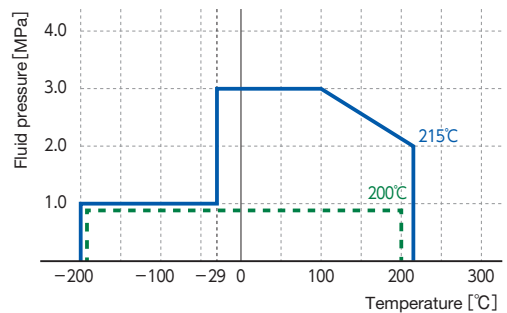
### SGM™ gasket



#### Service range

— water,oil, corrosive fluids

- - - gas type fluids



Features

- It is very flexible.
- Since it does not contain filler, it can be used for lines that contamination is not allowed.
- Can also be used where electrical insulation is required.

Main constituents: ePTFE

When using TOMBO No.9096-SGM for gas-based fluids

- Ring shape (FR type) gasket is recommended. (Because the seating stress may be insufficient for the FF type)
- It is recommended to use TOMBO No.9400 (NAFLON paste) together to improve the sealing performance.

#### Information

Modified PTFE is a PTFE whose chemical structure has been partially changed.  
It has better creep resistance than general PTFE and can be used at higher temperatures.  
ePTFE is made porous by expanded, it has excellent flexibility and cushioning properties.



**Please use TOMBO No.9096-SGM only for general industrial use.**

It cannot be used in the manufacturing, processing and packaging processes of foods, pharmaceuticals, cosmetics and pharmaceutical equipment.



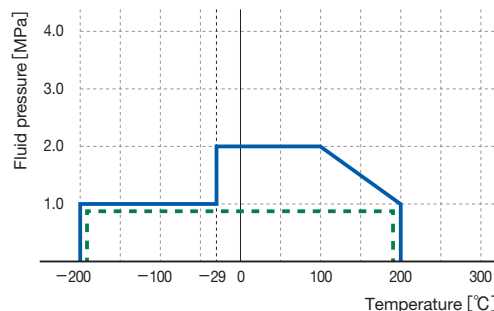
## TOMBO™ No.9007-GL

### NAFLON™ GL cut gasket



#### Service range

- water, oil, corrosive fluids
- - - Gas type fluids



- Due to its high flexibility, it is suitable for places where high seating stress cannot be applied such as glass lining pipes and plastic pipes.

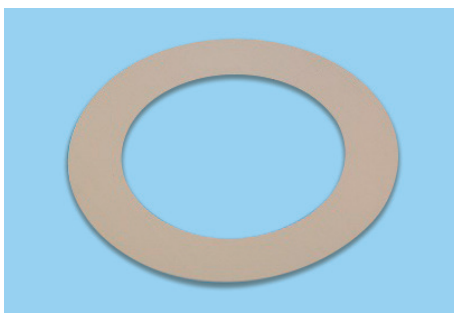
Main constituents: PTFE, silica filler

When using TOMBO No.9007-GL for gas-based fluids

- Ring shape (FR type) gasket is recommended. (Because the seating stress may be insufficient for the FF type)
- It is recommended to use TOMBO No.9400 (NAFLON paste) together to improve the sealing performance.

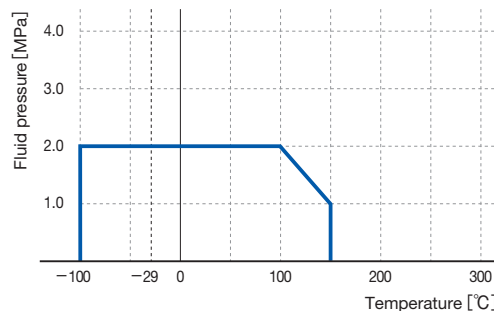
## TOMBO™ No.9007-ML

### NAFLON™ ML cut gasket



#### Service range

- water, oil, gas, corrosive fluids



- Gasket suitable for monomer line.
- In a radical polymerization environment, the monomer fluid permeates and stays in the gasket, suppresses the “popcorning phenomenon” that breaks due to volume expansion and exhibits stable sealing properties for a long period of time.

Main constituents: PTFE, special additives

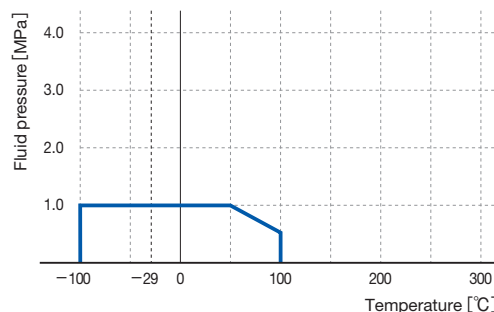
## TOMBO™ No.9007-LP

### NAFLON™ LP gasket



#### Service range

- water, oil, gas, corrosive fluids



- Since it has less penetration of chemicals and gases than PTFE, it is suitable for highly permeable halogen-based fluids.

Main constituents: PFA

## Design criteria

TOMBO No.		1133	1155	9007-SC	9007-LC	9007-G20	9007	9007-ST	9096-SGM	9007-GL	9007-ML	9007-LP
Gasket factor m [-]	1.0 t	3.50	—	—	3.50	3.50	3.50	—	2.50	—	—	—
	1.5 t	2.75	2.75	3.20	3.20	3.20	3.20	3.20	2.50	—	3.20	—
	2.0 t	2.75	2.75	3.00	3.00	3.00	3.00	3.00	2.50	—	—	3.00
	3.0 t	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	—
Min. design seating stress y [N/mm <sup>2</sup> ]	1.0 t	44.8	—	—	24.5	24.5	24.5	—	19.6	—	—	—
	1.5 t	25.5	25.5	22.5	22.5	22.5	22.5	22.5	19.6	—	22.5	—
	2.0 t	25.5	25.5	19.6	19.6	19.6	19.6	19.6	19.6	—	—	19.6
	3.0 t	11.0	11.0	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	—
Min. seating stress σ <sub>s</sub> [N/mm <sup>2</sup> ]	Water, oil type fluids	14.7	14.7	14.7	14.7	12.7	10.8	10.8	19.6	14.7	10.8	14.7
	Gas type fluids	34.3	34.3	29.4	24.5	24.5 <sup>Note 1</sup> 19.6 <sup>Note 2</sup>	19.6 <sup>Note 1</sup> 14.7 <sup>Note 2</sup>	19.6 <sup>Note 1</sup> 14.7 <sup>Note 2</sup>	39.2	14.7	19.6 <sup>Note 1</sup> 14.7 <sup>Note 2</sup>	19.6
Allowable seating stress	[N/mm <sup>2</sup> ]	150.0	150.0	58.8	49.0	49.0	39.2	39.2	117.6 <sup>Note 3</sup>	39.2	39.2	29.4

Note: 1 Minimum seating stress for a thickness of 1.0t or 1.5t.

Note: 2 Minimum seating stress for a thickness of 2.0t or 3.0t.

Note: 3 The allowable seating stress for a thickness of 2.0t or 3.0t is 78.4N/mm<sup>2</sup>.

## Standard dimensions

TOMBO No.		1133	1155	9007-SC	9007-LC	9007-G20	9007	9007-ST	9096-SGM	9007-GL	9007-ML	9007-LP
Maximum O.D [mm]	1.0 t	φ 610	—	—	φ 1200	φ 1200	φ 1200	—	φ 1380	—	—	—
	1.5 t	φ 1250	φ 1250	φ 1200				φ 1200			φ 1200	φ 1200
	2.0 t	φ 1250	φ 1250	φ 1200	φ 1200	φ 1200	φ 1200	φ 1200	φ 1380	φ 600	φ 930	φ 277
	3.0 t	φ 1430	φ 1250	φ 1200	φ 1430	φ 1200	φ 1200	φ 1200	φ 1380	φ 600	φ 930	—
Standard thickness	1.0 t	●	—	—	●	●	●	—	●	—	—	—
	1.5 t	●	●	●	●	●	●	●	●	—	●	—
	2.0 t	●	●	●	●	●	●	●	●	—	—	●
	3.0 t	●	●	●	●	●	●	●	●	●	●	—

\* The yellow part in the figure can be manufactured with a larger diameter than indicated by welding.

\* The green part in the figure can be manufactured with a larger diameter than the indicated by adhesive.

## Physical properties

TOMBO No.		1133	1155	9007-SC	9007-LC	9007-G20	9007	9007-ST	9096-SGM	9007-GL	9007-ML	9007-LP
Thickness	[mm]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3.0	1.5	2.0
Specific gravity	[-]	2.74	2.24	2.06	2.30	2.21	2.18	2.17	1.83	1.94	2.18	2.18
tensile strength	[N/mm <sup>2</sup> ]	18	11	24	18	21	34	35	141	22	22	28
Compressibility [%]	34.3MPa	5	6	4	5	8	9	14	18	18	13	9
Recovery [%]		47	46	67	55	53	60	69	39	69	62	78
Stress relaxation ratio [%]	100°C × 22h	27	23	56	50	67	73	57	43	62	59	65
	200°C × 22h	59	41	79	74	—	—	—	67	87	—	—

The above values are actual measurements, not standard values.

Measured by: NICHIAS

## ⚠ Precautions for fluoropolymer products

### Precautions concerning design and selection

#### ● Gasket contact surface finish

The recommended surface roughness according to JIS B 2220-2012 is as follows.

- For sealing liquid: 6.3μm Ra max
- For sealing gas: 3.2μm Ra max

### Conformity to food applications

Please contact us for the suitability of each product for food applications.

### Precautions for use

#### ● Unusable fluid

- Do not use the PTFE gasket for molten alkali metals, hot fluorine, trifluorinated chlorine and other fluids that attack the PTFE.

#### ● For monomer fluids

- When used for various monomer fluids, the fluid may penetrate inside the gasket and polymerize. TOMBO No.9007-ML is recommended for the monomer fluid.

#### ● For gas-type fluids

- When using it for gas sealing, use TOMBO No.9400 (NAFLON paste) together to improve the sealing performance.

TOMBO™ No. **9096-EZL** | EZL™ gasket

TOMBO™ No. **9096-TRI** | TriGuard™ gasket



TOMBO No.9096-EZL-S



TOMBO No.9096-TRI



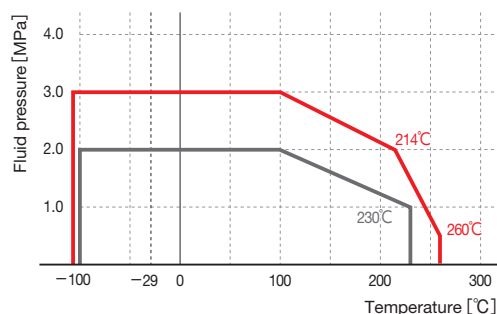
TOMBO No.9096-TRI-SP

Features

- A gasket using expanded PTFE with high compressibility is ideal for lining pipes and equipment that cannot apply high seating stress and flanges with large warping.
- The EZL gasket does not require gasket adjustment because the cushion material absorbs the distortion of the flange and the metal ring is used for the core thus installation work is easy even with a large diameter.
- Use a tri-guard gasket for JIS 10K and JPI class 150 standard flanges. EZL gaskets are suitable for other sizes.

Service range

- TOMBO No.9096-EZL (water,oil, gas types, corrosive fluids)
- TOMBO No.9096-TRI (water,oil, gas types, corrosive fluids)



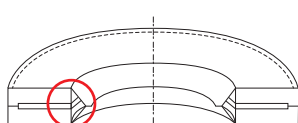
Since TOMBO No.9096-EZL has a high compressibility, it is recommended to perform retightening after initial tightening work or after applying a temperature cycle.  
\* Please contact us if you would like to use the product out of the recommended service range shown on the left.

**Use TOMBO No.9096-EZL, -TRI only for general industrial use.**  
It cannot be used in the manufacturing, processing and packaging processes of foods, pharmaceuticals, cosmetics and pharmaceutical equipment.

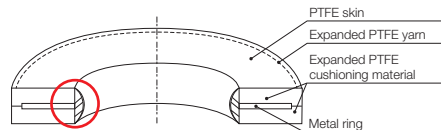
Structure

[TOMBO No. 9096-EZL]

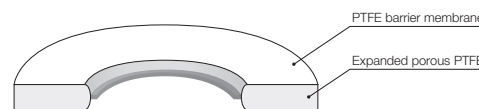
A metal ring is sandwiched between expanded PTFE cushioning materials with high compressibility. These are covered with PTFE and the outer peripheral part is sewn and integrated with expanded PTFE thread. There are S type and F type depending on the shape on the inner diameter side of the covering material. It is also available with metal hooks.



TOMBO No. 9096-EZL-S (S type)



TOMBO No. 9096-EZL-F (F type)



TOMBO No.9096-TRI

[TOMBO No. 9096-TRI]

A three-layer structure in which the surface layer of expanded porous PTFE is covered with an extremely thin special PTFE barrier membrane.

Design criteria

TOMBO No.9096-EZL	Shape	Gasket factor [m]	Min. design seating stress [y]
	S type	3.5	14.7N/mm <sup>2</sup>
F type	4.0	19.6N/mm <sup>2</sup>	

TOMBO No.9096-TRI	Gasket thickness [mm]	Gasket factor [m]	Min. design seating stress [y]
	1.5	2.4	10N/mm <sup>2</sup>
3.0			

Standard dimensions

TOMBO No.9096-EZL	Shape	Thickness [mm]	Nominal diameter	Maximum outer diameter [mm]
	S type	4.5, 8, 12	300A ~ 600A	1000
F type	650A ~ 1500A		3000	

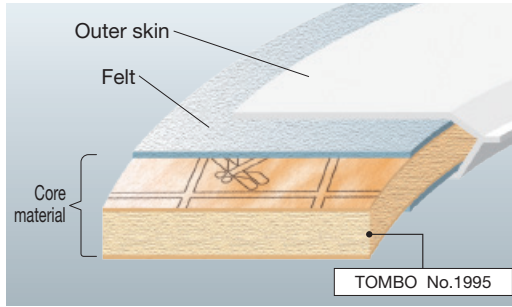
  

TOMBO No.9096-TRI	Standard	Nominal diameter	Thickness [mm]
	JIS10K	10~350A <sup>Note1</sup>	1.5, 3.0, 6.0
	JPI class150	1/2B ~ 12B	
	Dimensions for lining piping JIS 10K	15 ~ 300A	3.0, 6.0

Note 1: It depends on the thickness.

## NAFLON™ PTFE envelope gasket

A PTFE envelope gasket with a PTFE outer skin covered on a core material such as a jointing sheet.



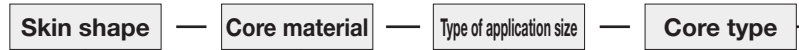
### When ordering

- Please specify the product number (TOMBO No.).
- Please note that the product thickness varies depending on the core material and core structure.

TOMBO No.9010-A-6

**TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **9010** — **A** — **5** — **S** — **D**



Skin Shape	Indication symbol
	<b>A standard type</b> <b>A</b>
	<b>B large diameter type</b> <b>B</b>
	<b>AS right angled type</b> <b>AS</b>
	<b>KA Outside sewing type</b> <b>KA</b>
	<b>KB Outer sewing type (large diameter)</b> <b>KB</b>
	<b>KS Outer sewing type (right angled type)</b> <b>KS</b>
	<b>RA Outside welded type</b> <b>RA</b>
	<b>RB Outside welded type (large diameter)</b> <b>RB</b>
	<b>RS Outside welded type (right angled type)</b> <b>RS</b>
	<b>Others</b> <b>Z</b>

Core material	Indication symbol
	TOMBO No. 1880-GR <b>2</b>
	TOMBO No. 1993 <b>3</b>
	TOMBO No. 1995-W <b>4</b>
	TOMBO No. 1995 <b>5</b>
	TOMBO No. 1995 <b>6</b>
	TOMBO No. 1120 <b>7</b>
	TOMBO No. 1120 <b>8</b>
	TOMBO No. 1120 <b>9</b>
	<b>Others</b> <b>Z</b>

\* A version of this product using rubber for the core is also available

■ Selection example

Application	TOMBO No.	Skin shape	Core structure	Applicable dimensions	Core structure
Standard specifications	9010-A-5-S	Basic shape	TOMBO No.1995	Standard dimensions	Single
For glass lining	9010-A-5-G-D	Basic shape	TOMBO No.1995	Glass lining standard size	2 pieces
Used at 150°C or higher	9010-A-2-Z	Basic shape	TOMBO No.1880-GR	Specified dimensions	Single
Outer diameter is $\Phi$ 1000mm or more	9010-B-5-Z	Large diameter compatible type	TOMBO No.1995	Specified dimensions	Single

**Information**

The felted jointing sheet (core material code: 6, 8) has a larger amount of compression than the jointing sheet alone (core material code: 5, 7), thus it is easier to conform the unevenness of the sealing surface. Suitable to use on lining flanges with uneven sealing surfaces.

Dimension type	Indication symbol
Standard dimension	<b>S</b>
NAFLON lining standard dimension <sup>Note 1</sup>	<b>F</b>
Glass lining standard dimension <sup>Note 2</sup>	<b>G</b>
Insulation gasket standard dimension	<b>E</b>
Customized dimension	<b>Z</b>

Note: (1) Please refer to the Dimension catalogue of Tombo Brand Gaskets for details.

(2) Applicable to the GL JPI flange from AGC Technology Solutions, Co., Ltd

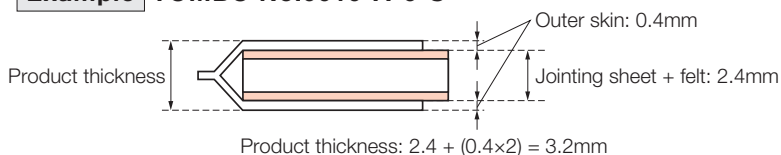
Core type	Indication symbol
	<b>Single</b> No symbol
	<b>With handle</b> <b>H</b>
	<b>Double</b> <b>D</b>
	<b>Corrugated metal insert</b> <b>C</b>
	<b>Flat metal insert</b> <b>P</b>
	<b>Others</b> <b>Z</b>

\* When core material 6 or 8 is used in the double, corrugated or plate core structure, attach the felt only to the top and bottom surfaces.

**Information**

The product thickness of NAFLON PTFE enveloped gasket is the combined thickness of the core and the outer skin.

**Example TOMBO No.9010-A-6-S**



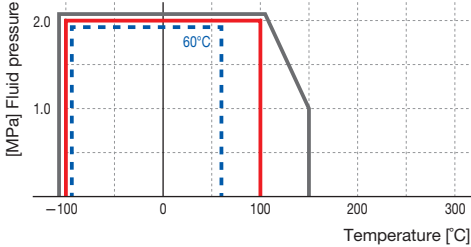
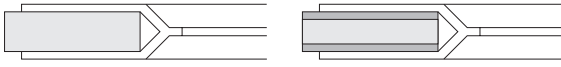
\* The standard outer skin thickness for the basic type (A type) is 0.4mm, and the standard outer skin thickness for the right-angled type (AS type) is 0.5mm.

\* The thickness of the core changes depending on the size. Please refer to the TOMBO brand gasket / Dimensions for the product thickness of standard dimensions.

# Fluoropolymer gaskets

## Service range

● For standard: Jointing sheet, jointing sheet with felt  
(Core material symbol: 3-8)



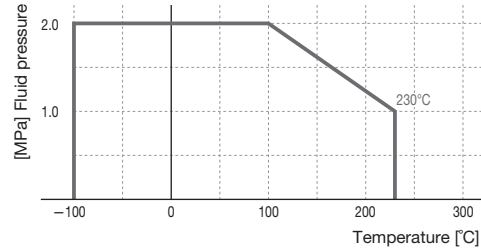
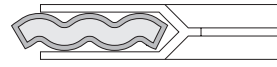
- Total core thickness : ~3.0mm<sup>Note 1</sup>
- Total core thickness : ~4.0mm
- - - Total core thickness : ~6.0mm

\*The total thickness of the core refers to the thickness not including the outer skin.

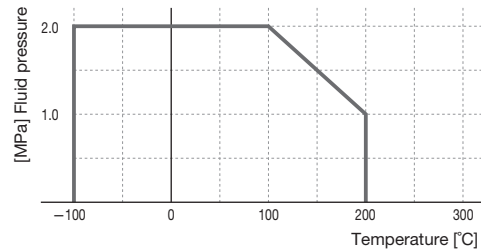
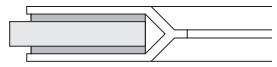
\*When the core structure is corrugated (symbol: C), the service pressure should be up to 1.0MPa.

Note 1: When the core material is "6,8", the usage range of the total core thickness: ~ 3.0mm is applied even if the core thickness is 4.2t.

● For high temperature use (core material symbol: 2)



● For high temperature use (core material symbol: 9)



## Design criteria

Shape symbol	A / AS / KA / KS / RA / RS Type		B / KB / RB Type	
	<b>Core material symbol</b>	3、4、5、7 (jointing sheet) 6、8 (jointing sheet with felt)	2 (TOMBO No.1880-GR) 9 (TOMBO No.1120+ SUS mesn)	3、4、5、7 (jointing sheet) 6、8 (jointing sheet with felt)
<b>Gasket factor m</b>	[—]	3.50	4.00	4.00
<b>Min. design seating stress <math>\sigma_y</math></b>	[N/mm <sup>2</sup> ]	14.7	19.6	19.6
<b>Min. seating stress <math>\sigma_3</math></b>	Water,oil type fluid	9.8	14.7	14.7
	Gas type fluid	14.7	19.6	19.6
<b>Allowable seating stress</b>	[N/mm <sup>2</sup> ]	29.4	24.5 (39.2) <sup>Note 1</sup>	24.5

Note 1: The values in parentheses are TOMBO No.1120 + stainless steel net type values.

## Standard dimensions

Shape	A / KA / RA Type	B / KB / RB Type	AS / KS / RS Type
<b>Minimum I.D</b>	[mm] $\phi 15$	$\phi 300$	$\phi 20$
<b>Maximum O.D</b>	[mm] $\phi 1000$ <sup>Note 1</sup>	arbitrary <sup>Note 1</sup>	$\phi 700$ <sup>Note 1</sup>

Note 1: Please contact us for the maximum outer diameter of the outer peripheral welding type.

## Precautions for NAFLON™ PTFE Envelope gasket

### ■ Precautions concerning design and selection

#### ● Gasket contact surface finish

The recommended surface roughness according to JIS B 2220-2012 is as follows.

- For sealing liquid : 6.3 $\mu$ m Ra max
- For sealing gas : 3.2 $\mu$ m Ra max

#### ● Tightening torque control

The gasket factor  $m$ , minimum design tightening pressure  $y$  and minimum tightening surface pressure  $\sigma_3$  of the NAFLON PTFE cushion gasket are designed assuming the above gasket contact surface finish.

If the gasket contact surface is uneven or distorted, it may require tightening beyond the design value.

Due to the structure of the NAFLON PTFE envelope gasket, the allowable seating stress is low. In such cases, perform sufficient tightening control.

#### ● Outer skin shape (inner periphery)

NAFLON PTFE cushion gasket outer skin shape A type (basic type) may cause liquid accumulation due to its structure. We recommend the outer skin shape AS type (right angled type) especially for places where there is a concern about liquid accumulation.

#### ● Outer skin shape (outer periphery)

NAFLON PTFE envelope gasket with types A, B and AS may deteriorate in the following situations:

- Operated under vacuum pressure
- Forcibly installed with insufficient distance between flange faces

If such situation is expected, we recommended using the type sewn on the outer periphery (KA, KB, KS) or welded (RA, RB, RS).

### ■ Precautions for use

Although PTFE envelope gaskets can be used in a wide range of applications but they can cause problems in the following cases. We recommend using fluoropolymer gaskets such as the TOMBO No. 1133 and TOMBO No. 9007 series whenever possible.

Case	Assumed phenomenon	Countermeasures
Used for highly permeable fluids. Nitric acid, ethylene oxide, Halogen (chlorine, bromine, etc.), molten sulfur, monochloroacetic acid.	During long term use, the fluid may permeate into the gasket through the PTFE outer skin, deteriorate the core material and causing the gasket to lose its function.	<ul style="list-style-type: none"> <li>● Replace the gasket as soon as possible.</li> <li>● Use a fluoropolymer gasket.</li> </ul>
Gasket with jointing sheet + felt as core material is used	<b>If the core material gets wet with liquid, the compression breakage strength will decrease.</b> If soapy water or rainwater during the airtightness test permeates and the felt softens and is pushed out, the gasket seating stress may drop and possibly lead to leakage.	<ul style="list-style-type: none"> <li>● Store the gasket in waterproof condition.</li> <li>● Take note that there is no ingress of rainwater after installing the gasket.</li> <li>● Ensure the tightening force is sufficient.</li> </ul>
Air bubbles were found between the PTFE outer skin and the core material when airtightness test was performed	The air contained in the core material and the air accumulated in the inner periphery are discharged.	<ul style="list-style-type: none"> <li>● After applying internal pressure load, wait a certain period of time before airtightness test is performed.</li> </ul> <p>* It is especially likely to occur with the jointing sheet + felt type.</p>
Core material is rubber	Excessive deformation or air trapped in the inner periphery may compress and damage the outer skin	<ul style="list-style-type: none"> <li>● Tighten below allowable seating stress</li> </ul>
Insufficient tightening	Since the range between the minimum recommended tightening value and the allowable tightening value is narrow, the gasket seating stress may be insufficient and leakage may occur even when tightening to the target torque. (Especially the large diameter type has a heat seal part, so the sealing performance is lower than the basic type and the right angle processing type.)	<ul style="list-style-type: none"> <li>● Use TOMBO No. 9400 (NAFLON paste)</li> </ul>
Use standard size gaskets for lining piping.	Liquid accumulation or leakage may occur due to different inner diameters.	<ul style="list-style-type: none"> <li>● Use NAFLON lining standard dimensions (applicable dimension symbol: F)</li> <li>● Use Glass lining standard dimensions (applicable dimension symbol: G)</li> <li>● Design appropriate gasket dimensions.</li> </ul>

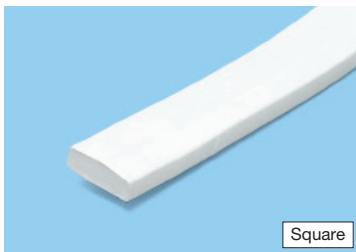
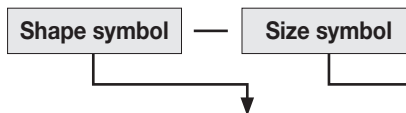
# Fluoropolymer gaskets

## TOMBO No. 9096 series NICHIAS SOFTSEAL™

This is a PTFE soft type gasket. It is extremely soft and the version with adhesive tape can be easily installed on sealing faces that are complicated shapes. It is suitable to be used as a piping sealant or as a gasket for tanks, casings, ducts, pressure vessels, reaction tanks, lining vessels, large diameter equipment and other applications.

■ **TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **9096** — **R** — **10**



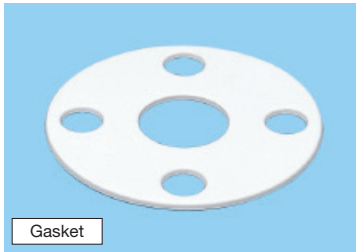
Shape	Shape symbol	Size			Size symbol
		Thickness [mm]	width [mm]	standard length/roll [m]	
Elliptical	No shape symbol	1.5	3.0	30	<b>3</b>
		3.0	6.0	15	<b>6</b>
		4.5	9.0	8	<b>9</b>
		6.0	12.0	5	<b>12</b>
Not available without adhesive tape					
Flat	BT (With adhesive tape)	1.0	20.0	15	<b>1020</b>
		1.0	30.0	15	<b>1030</b>
		1.0	50.0	15	<b>1050</b>
	B (Without adhesive tape)	1.0	100.0	15	<b>1100</b>
		2.0	20.0	5	<b>2020</b>
		2.0	30.0	5	<b>2030</b>
		2.0	50.0	5	<b>2050</b>
		3.0	20.0	5	<b>3020</b>
		3.0	30.0	5	<b>3030</b>
		3.0	50.0	5	<b>3050</b>
Square	KT (With adhesive tape)	5.0	14.0	10	<b>5014</b>
		K (Without adhesive tape)	7.0	20.0	5

Shape	Shape symbol	Size		Size symbol
		thickness [mm]	standard length/roll [m]	
Round	R	10.0	5	<b>10</b>
		without adhesive tape	12.0	5

Shape	Shape symbol	Size			Size symbol
		Outer diameter [mm]	Inner diameter [mm]	standard length/roll [m]	
Tube	TB	5.0	4.0	20	<b>54</b>
		7.0	6.0	20	<b>76</b>
		8.0	7.0	10	<b>87</b>
		10.0	8.0	10	<b>108</b>
		12.0	10.0	10	<b>1210</b>
		without adhesive tape	14.0	12.0	10



**TOMBO No. 9096**



Shape	Shape symbol	Size		Size symbol
		width [mm]	Thickness [mm]	
Sheet	<b>ST</b> (With adhesive tape)	1500 × 1500	1.0	<b>1.0</b>
			1.5	<b>1.5</b>
			2.0	<b>2.0</b>
			3.0	<b>3.0</b>
	<b>S</b> (Without adhesive tape)	1500 × 1500 1500 × 3000	4.0	<b>4.0</b>
			0.5	<b>0.5</b>
			1.0	<b>1.0</b>
			1.5	<b>1.5</b>
	1500 × 1500	2.0	<b>2.0</b>	
		3.0	<b>3.0</b>	
		4.0	<b>4.0</b>	
		5.0	<b>5.0</b>	
		6.5	<b>6.5</b>	
		10.0	<b>10.0</b>	

Shape	Shape symbol	Remarks
Cut gasket	<b>GT</b> (With adhesive tape)	Gaskets for JIS and JPI piping are cut from soft seal sheets.
	<b>G</b> (Without adhesive tape)	For other dimensions, please consult us.

**⊘ Please use TOMBO No.9096-S, -ST, -G, -GT only for general industrial use.**  
 It cannot be used in the manufacturing, processing and packaging processes of foods, pharmaceuticals, cosmetics and pharmaceutical equipment.

**Service range**

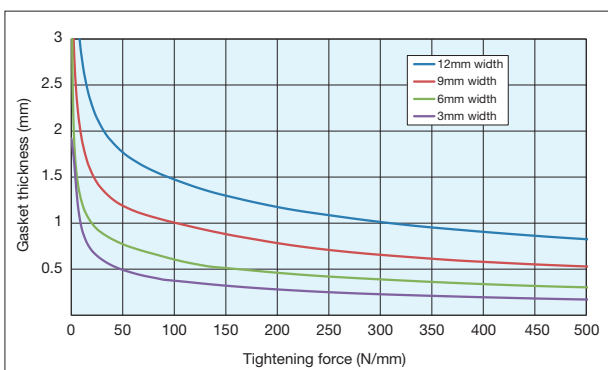
Shape	Elliptical	sheet
Temperature [°C]	-100-260	
Pressure [MPa]	Liquid	2
	Gas	2

**Design criteria**

Shape	Elliptical				sheet
	3mm	6mm	9mm	12mm	
Minimum seating stress[N/mm]	75	100	125	150	—
Minimum seating stress[N/mm <sup>2</sup> ]	—				15-20

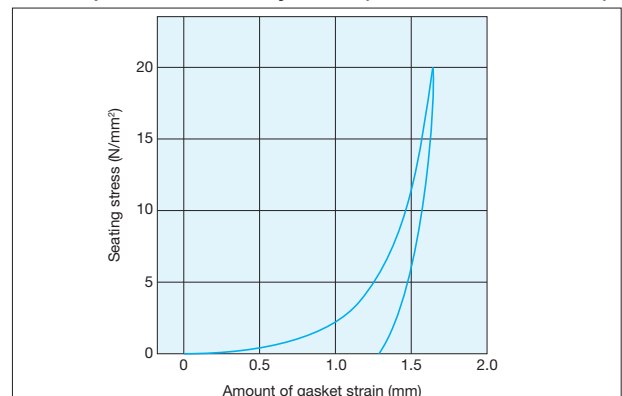
**Compression characteristics**

● Relationship between thickness and width with respect to tightening force (Elliptical)



\* The above values are measured value. They are not standard values. Measured by: NICHIAS

● Compression-recovery curve (sheet: thickness 2mm)



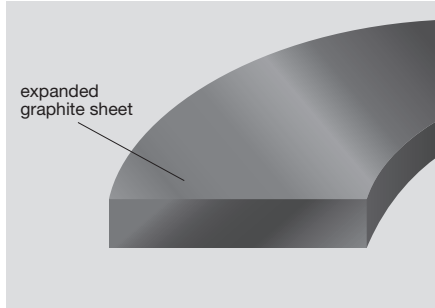
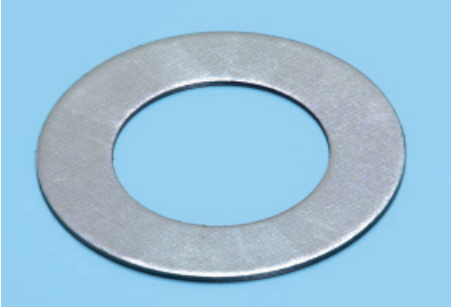
\* The above values are measured value. They are not standard values. Measured by: NICHIAS

- Sheet gaskets
- Semi-metallic gaskets
- Metallic gaskets
- Rubber gaskets
- Cloth gaskets
- Pastes and other sealing materials

# Expanded graphite gaskets

GRASEAL™ Gasket is a cut gasket made from expanded graphite sheet or an expanded graphite sheet containing a metal reinforcing plate.

## TOMBO No. 1200 | GRASEAL™ gasket

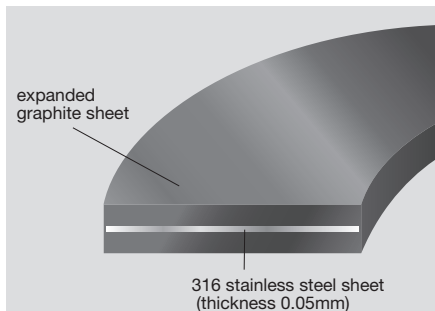
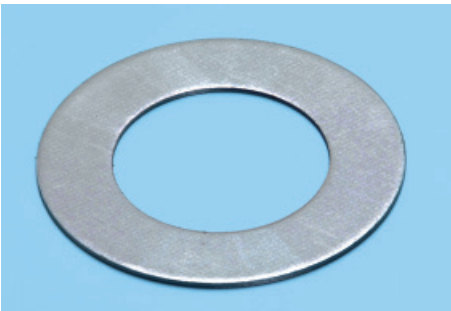


Features

- More economical than other GRASEAL gaskets.
- This gasket has lower strength and poor handling compared to a gasket containing a steel plate. For this reason, it is recommended for small diameter with nominal diameter 4 inches or less.

**Service temperature:** Oxidizing atmosphere -240~400°C Non-oxidizing atmosphere -240~800°C **Service pressure:** ~3.0MPa

## TOMBO No. 1215-A | GRASEAL™ gasket PM-A



Other lineup

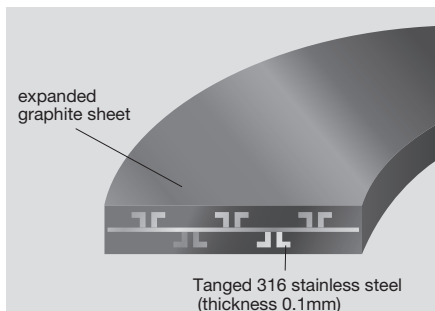
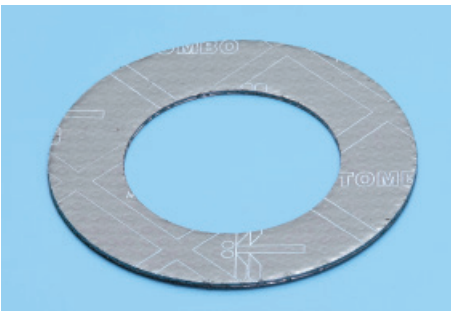
- **TOMBO No.1215-AT**  
1215-A with impermeable treatment.
- **TOMBO No.1215-B**  
The steel plate is thicker than 1215-A, and a large diameter with an outer diameter of 2800mm can be manufactured by welding.

Features

- It is easy to handle and can be processed into complicated shapes.
- Used for specially shaped flanges, valve bonnets, heat exchangers, etc.

**Service temperature:** Oxidizing atmosphere -240~400°C Non-oxidizing atmosphere -240~800°C **Service pressure:** ~5.2MPa

## TOMBO No. 1210-A | GRASEAL™ gasket MI-A

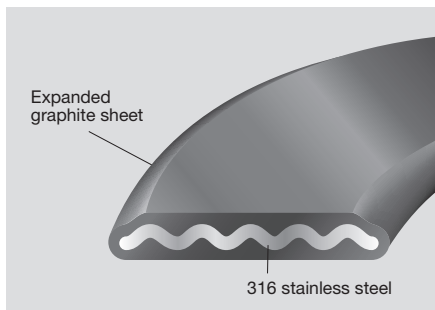
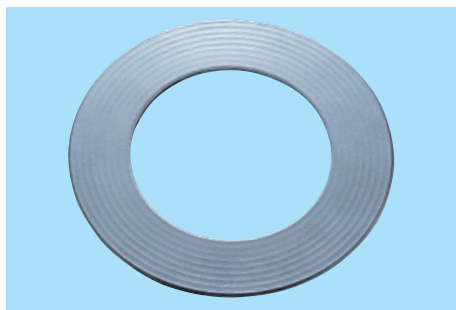


Features

- Higher strength than TOMBO No.1215-A.
- \* TOMBO No.1215-A is recommended when the strength is insufficient or there are restrictions on the specifications.

**Service temperature:** Oxidizing atmosphere -240~400°C Non-oxidizing atmosphere -240~800°C **Service pressure:** ~5.2MPa

**TOMBO™ No. 1880-GR** | CMGC gasket

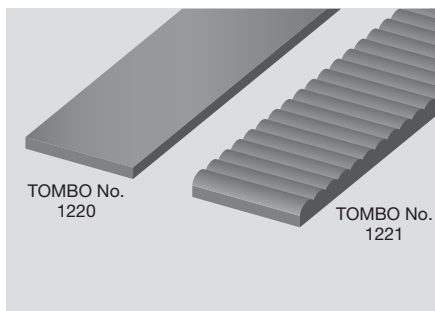


**Features**

- Gasket that is corrugated to concentrate the contact pressure, thus improving the sealing performance.
- Can also be processed into special shapes such as frame shape and full face.
- Used for specially shaped flanges, valve bonnets, heat exchangers, etc.

**Service temperature:** Oxidizing atmosphere -240~400°C Non-oxidizing atmosphere -240~800°C **Service pressure:** ~5.2MPa

**TOMBO™ No. 1220/1221** | GRASEAL™ Gasket Tape (Plane / Crinkle)



**Example of use**

- **TOMBO No.1220 Thickness 0.13mm**  
As a tape sealant for high temperature screw coupling. (maximum operating temperature is 300°C)
- **TOMBO No.1220 Thickness 0.25mm**  
For sealing large diameter flanges of 18 inches or more.
- **TOMBO No.1221**  
For flange seals of 16 inches or less.

**Features**

- Attached directly to the flange surface as a one-size-fits-all gasket.
- Attached to a hard gasket (TOMBO No.1850, 1841) as an auxiliary sealing material.

\* Do not apply this tape to a soft gasket such as jointing sheet.

**Service temperature:** Oxidizing atmosphere -240~400°C Non-oxidizing atmosphere -240~800°C **Service pressure:** ~3.0MPa

**Information**

**Oxidizing atmosphere:** A state in which gas contains large amount of oxygen, ozone, nitrogen dioxide or other oxidized gas. "Ambient atmosphere" refers to oxidizing atmosphere.

**Non-oxidizing atmosphere:** A state filled with noble gas, nitrogen, carbon dioxide, etc.

**Impermeable treatment:** Expanded graphite is a graphite that has been expanded between the crystalline layers. It has a porous structure so GRASEAL gasket is unable to completely prevent minute amounts of gas leakage. If high gas sealing performance is required, use a gasket with impermeable treatment to which sufficient seating stress can be applied.

The impermeable treatment lowers the heat resistance (maximum operating temperature: 260°C) but improves the gas sealability.

## Design criteria

TOMBO No.		1200	1215-A	1210-A	1880-GR
Gasket factor m	[-]	2.00	2.00	2.00	2.00
Minimum design seating stress $\gamma$	[N/mm <sup>2</sup> ]	26.0	29.4	29.4	26.0
Minimum seating stress $\sigma_3$	Water,oil type fluids	14.7	14.7	14.7	14.7
	Gas type fluids <sup>Note 1</sup>	49.0	49.0	49.0	39.2
Allowable seating stress [N/mm <sup>2</sup> ]	0.8 t	170.0	294.0	294.0	—
	1.6 t	106.0	167.0	167.0 <sup>Note 2</sup>	166.0
	3.2 t	79.0	98.0	98.0	166.0

Note 1: Please note that it may be difficult to apply the specified seating stress with standard size products.

Note 2: TOMBO No.1210-A indicates the allowable seating stress of 1.5t.

## Standard dimensions

TOMBO No.	1200	1215-A 1215-AT	1210-A	1880-GR
Nominal thickness [mm]	0.4, 0.8, 1.6, 3.2	0.8, 1.6, 3.0	1.5, 2.0, 3.0	1.6, 3.2
Reinforcement plate thickness [mm]	—	0.05	0.10	0.8
Manufacturable gasket diameter [mm]	$\phi$ 985	$\phi$ 1480 <sup>Note 1</sup>	$\phi$ 1480	$\phi$ 3300 <sup>Note 2</sup>
Minimum width [mm]	—	5	—	12.8

Note 1: Manufacturable dimensions with a nominal thickness of 0.8mm are  $\phi$ 985 or less.

Note 2: Please contact us for dimensions exceeding  $\phi$ 3300.

### [GRASEAL tape]

TOMBO No.	1220			1221	
Thickness [mm]	0.13	0.25	0.25	0.38	0.38
Width [mm]	12.7	12.7	25.4	12.7	25.4
Length [m]	7.6	7.6	15.2	7.2	14.2

## ⚠ Precautions for expanded graphite gasket

### Precautions regarding design and selection

#### ● Gasket contact surface finish

The recommended surface roughness according to JIS B 2220-2012 is as follows.

- For sealing liquid : 6.3 $\mu$ m Ra max
- For sealing gas : 3.2 $\mu$ m Ra max

#### ● For gas-type fluids

Since expanded graphite is a sheet with expanded layers, it has a structure with many voids inside.

Since gas-type fluids are prone to permeation leakage, please note the following points when using.

- Apply sufficient seating stress.
- Apply the paste and leave it for 2 to 3 hours until the gasket conforms with flange surface.
- Do not use for toxic gas or high vacuum seals that cannot tolerate even a small amount of leakage.
- If you want to improve the airtightness, please use the impermeable treatment product. (Maximum operating temperature 260°C)

Fluids for which a GRASEAL™ gasket is not suitable.

Classification	Name of fluid
Oxidizing acid	Nitric acid, concentrated sulfuric acid, hot sulfuric acid, chromic acid, mixed acid, etc.
Oxidizing salt	Nitrate, chloride, hypochlorite, etc
Halogen compound	Bromine, fluorine, iodine, chlorine, dioxide, etc.
Combustible gas	Oxygen (pure oxygen)

### Precautions for use

- Since the expanded graphite gasket is easily deformed and scratched, please be careful about the following points when handling it. If the surface of the gasket is deformed or has large scratches, it may not be possible to maintain its original performance.
  - Do not place heavy objects on top of the gasket
  - Do not strike the gasket with a hard object.
  - Do not step on the gasket or bend with your feet.
  - When using a cutter or etc. when opening from packing, please be careful not to damage the product.
  - Please take out the product after opening the package completely.
- When handling TOMBO No.1880-GR, 1215-A, 1210-A, please note that the internal reinforcement metal plate may cut your fingertips.
- When using TOMBO No.1880-GR, 1215-A, 1210-A, make sure that the stainless steel plate of the core is resistant to the fluid.

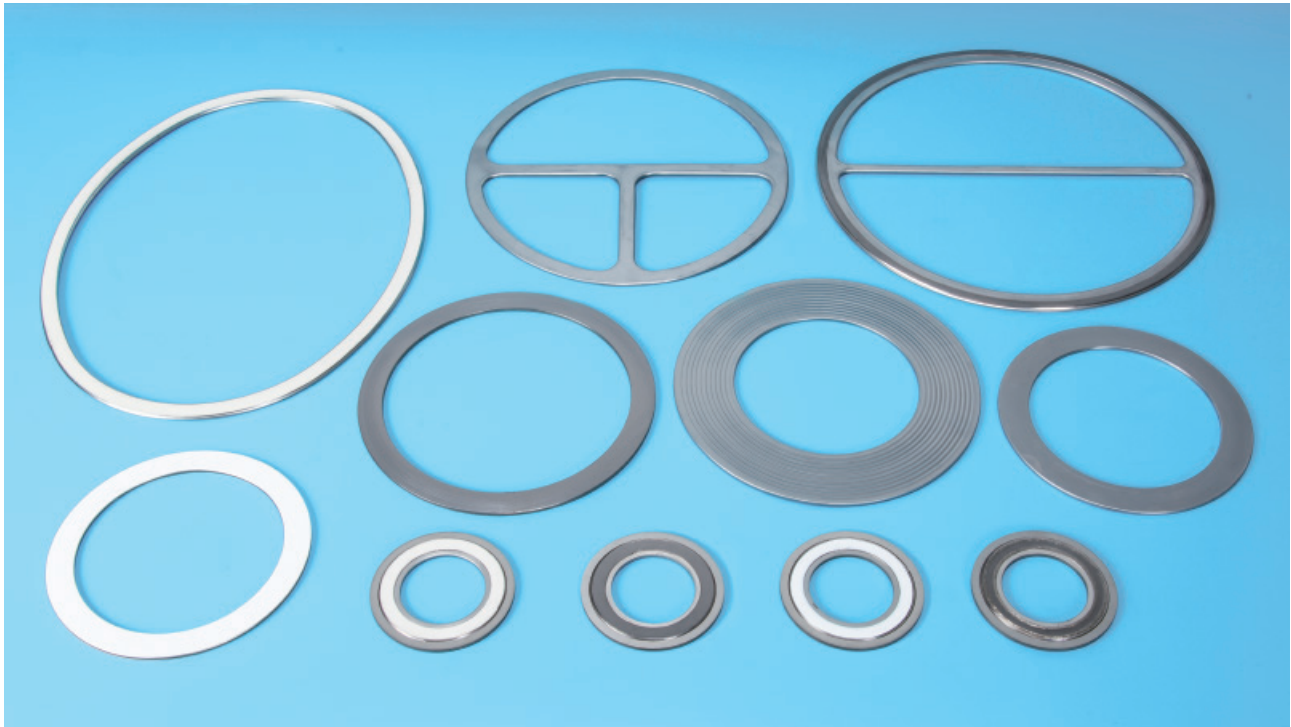
#### Applicable standards (TOMBO No.1200,1210,1215 series)

- JPI-7S-79 "Expanded Graphite Sheet Gasket for Piping"
- JIS F 7102 "Standard for Using Gaskets and Packing for Pipes in Marine Engines"

# Semi-metallic gaskets

Product 2

Semi-metallic gaskets are gaskets that combine metals such as stainless steel plates with non-metals such as expanded graphite, and are used at higher temperatures and pressures than sheet gaskets.



Sheet gaskets

Semi-metallic gaskets

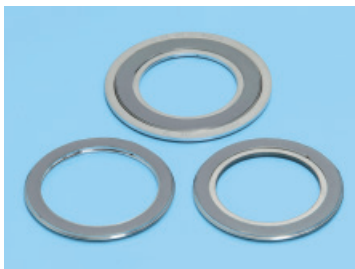
Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

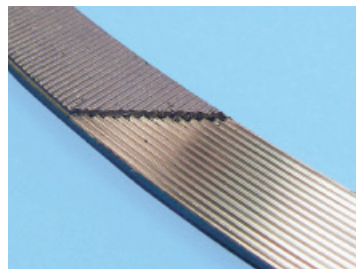
## VORTEX™ gaskets



A gasket in which V-shaped metal hoops and cushioning materials called fillers are alternately layered and wound in a spiral shape.

► P39-P49

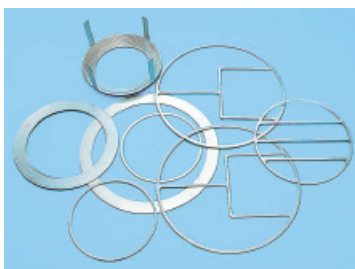
## Kammprofile gaskets



A gasket in which expanded graphite sheets and PTFE sheets are bonded to both sides of a metal ring with a groove shape.

► P50-P53

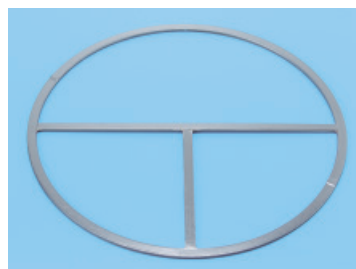
## Metal jacketed gaskets



A gasket in which an inorganic heat-resistant cushion material is covered with a thin metal plate.

► P54-P55

## Gaskets for heat exchangers



Semi-metallic gaskets can be manufactured in a shape suitable for heat exchangers. Please refer here for the shape number.

► P56-P57

**How to make an order**

● When ordering, please specify the product specifications (TOMBO No.) as below.

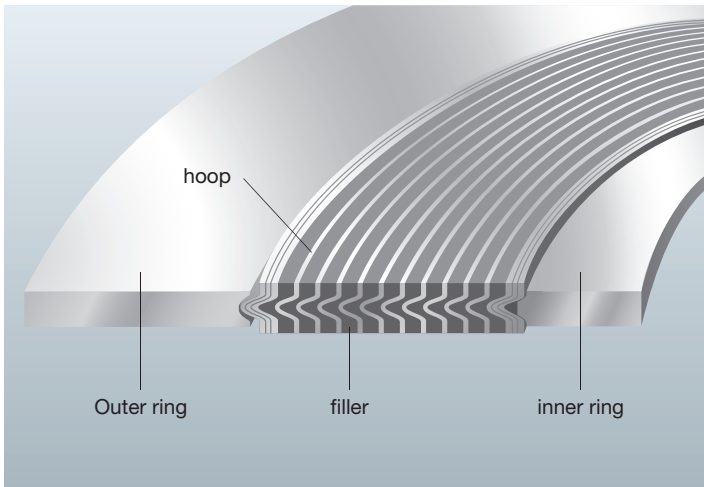
Type	Shape	How to specify gasket dimensions	
<b>VORTEX</b> Basic With inner ring With outer ring With inner and outer rings		Standard product	<b>Pressure class x nominal diameter x thickness</b> E.g. ) 300LB x 6B x 4.5
		Custom size	<b>Pressure class x inner ring inner diameter x body inner diameter x body outer diameter x outer ring outer diameter x thickness</b> * Please specify the pressure class even for dimensions other than standard products. E.g.) 300LB x 738 x 750 x 780 x 804 x 4.5
<b>VORTEX</b> With ribs		In addition to the gasket dimensions, specify the rib shape, type, material, core material, P dimension, rib R, etc. separately.	
<b>Kammprofile</b> Basic With outer rings		<b>Body inner diameter x body outer diameter x outer ring outer diameter x thickness</b> E.g.) 66.9 x 88.9 x 111.3 x 4T * For standard products, please specify the actual dimensions and also inform us of the pressure class and nominal diameter.	
<b>Kammprofile</b> With rib With hanger		<b>Body inner diameter x body outer diameter x outer ring outer diameter x thickness x rib width x rib shape x P dimension</b> E.g.) 1800 x 1840 x 1900 x 4T x 10W x HE5 x 123P x hanger * Please specify the dimensions of the hanger separately.	

■ **VORTEX™ gasket body outer diameter**

For VORTEX with outer rings and inner and outer rings, the position indicating the outer diameter of the main body differs depending on the applicable standard of the flange.

Flange applicable standard	Body outer diameter	
<ul style="list-style-type: none"> <li>• For JPI pipe flange</li> <li>• For ASME pipe flange</li> </ul>		<b>Convex part dimension</b> As shown in the figure on the left, it refers to the dimensions up to the convex part of the main body. Please note that it is different from the contact outer diameter with the flange
Other than the above standards <ul style="list-style-type: none"> <li>• For JIS pipe flange</li> <li>• Other dimensions</li> </ul>		<b>Shoulder part dimension</b> As shown in the figure on the left, it refers to the contact outer diameter with the flange.

It can be used at higher temperatures and pressures than sheet gaskets and because it fits well with flanges, it can be sealed with a lower tightening force than metal gaskets.



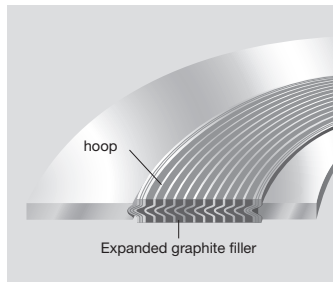
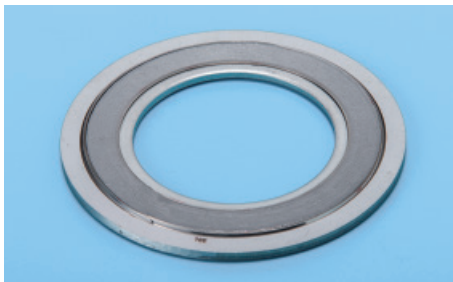
### How to make an order

- Specify the product number (TOMBO No.) and pressure class (working pressure).
- Select an appropriate shape according to the type of flange.
- For heat exchangers, specify the shape as well.

How to indicate TOMBO No.	<b>P43-P44</b>
Flange shape and proper gasket shape	<b>P47</b>
Gasket shape for heat exchanger	<b>P56</b>

## TOMBO™ No. 1834R-GR series

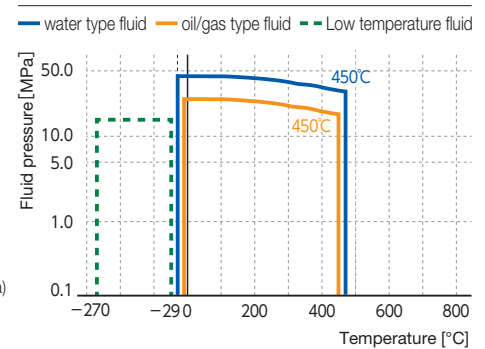
## GRASEAL™ VORTEX™ gasket



Maximum service temperature  
water type fluid: 450°C (650°C)  
oil/gas/corrosive fluid: 450°C (800°C)  
Minimum service temperature  
cryogenic fluid: -270°C

Maximum service pressure  
water type fluid: class 2500 (Approx. 43MPa)  
oil/gas/corrosive fluid: class 1500 (Approx. 26MPa)  
cryogenic fluid: 20MPa

### Service range



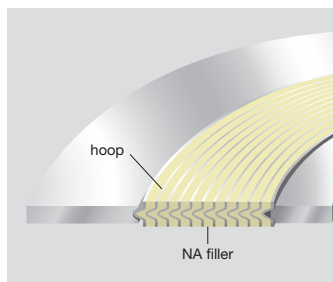
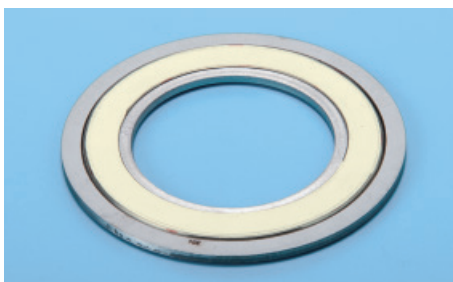
\* The numbers in parentheses are non-oxidizing fluids, which are the maximum service temperatures when used for confined flanges.

### Features

- Expanded graphite is used as the filler and it exhibits excellent sealing performance even under severe conditions such as high temperature and high pressure, extremely low temperature, and thermal cycle other than oxidizing fluids.
- It is most often used in various applications such as piping and equipment for power plants and petrochemical complexes.

## TOMBO™ No. 1834R-NA series

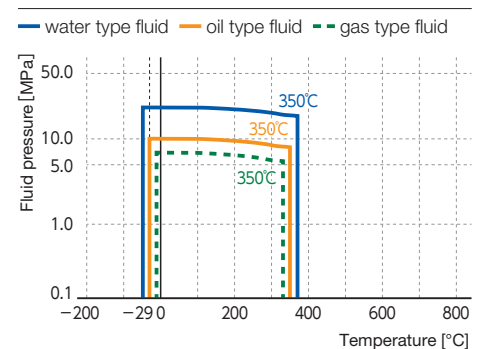
## NA VORTEX™ gasket



Maximum service temperature  
water/oil/gas type fluids: 350°C

Maximum service pressure  
water type fluid: class 1500 (Approx. 26MPa)  
oil type fluid: class 600 (Approx. 10MPa)  
gas type fluid: class 400 (Approx. 7MPa)

### Service range

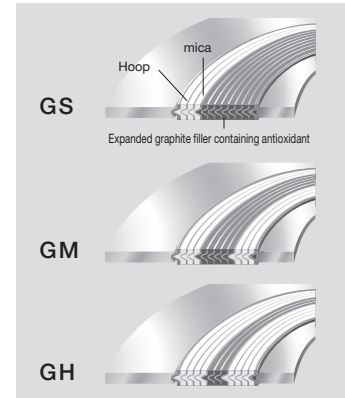
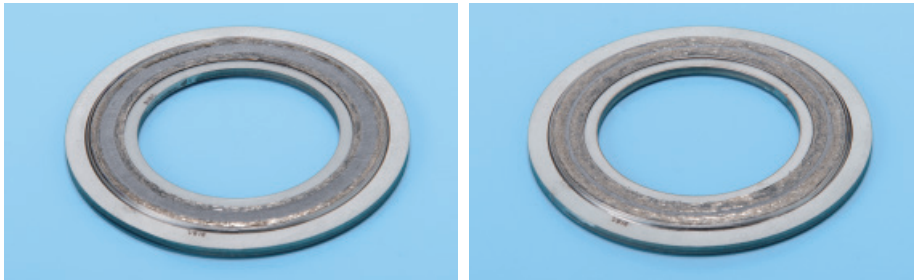


### Features

- NA paper (inorganic paper) is used for the filler, and it is economical because it can be used without an inner ring for piping of 24B or less.
- Used for plumbing and equipment for utilities such as steam, cooling water, and compressed air.

## TOMBO™ No. 1836R-GS/-GM/-GH series

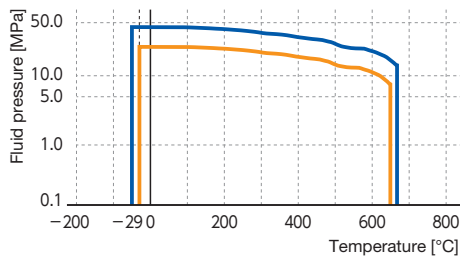
### VORTEX™ gasket-GS / -GM / -GH



#### Service range

— water type fluid — oil/gas type fluids

#### -GS series, -GM series

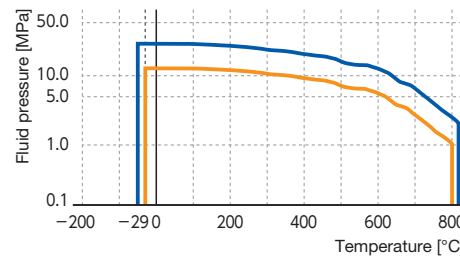


Maximum service temperature water type fluid: 650°C  
oil/gas type fluids: 650°C

Maximum service pressure water type fluid: class 2500 (Approx. 43MPa)  
oil/gas type fluids: class 1500 (Approx. 26MPa)

— water/oil type fluids — gas type fluid

#### -GH series



Maximum service temperature water/oil type fluids: 800°C  
gas type fluid: 800°C

Maximum service pressure water/oil type fluids: class 1500 (Approx. 26MPa)  
gas type fluid: class 600 (Approx. 10MPa)

\* This product is designed to reduce the loss of expanded graphite by oxidation, but if the internal fluid contains oxygen, the loss of expanded graphite may start when the temperature exceeds 450°C.

\* Do not use -GS series gasket at 450°C or higher if internal fluid contains oxygen.

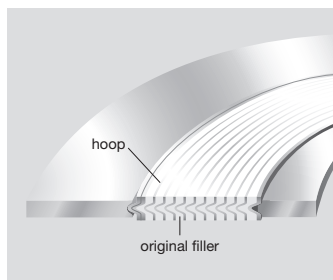
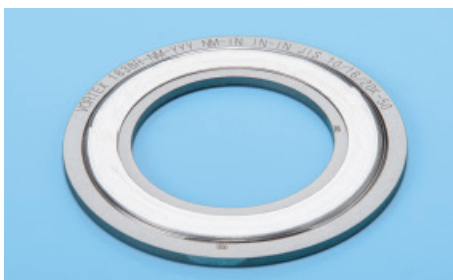
\* Do not use -GM, -GH series gasket at 450°C or higher if internal fluid contains air.

#### Features

- Since it uses special expanded graphite containing an antioxidant, it can be used under high temperature conditions of 450°C or higher.  
\* GR vortex is recommended below 450°C.
- You can select from three types, -GS, -GM, and -GH, depending on the usage conditions.
  - GS series: Suitable for high temperature conditions of 450°C or higher, which does not contain oxygen in the internal fluid.
  - GM series: Suitable for high temperature conditions of 450°C or higher and usage conditions with decoking.
  - GH series: Suitable for high temperature conditions of 650°C or higher and usage conditions with decoking.

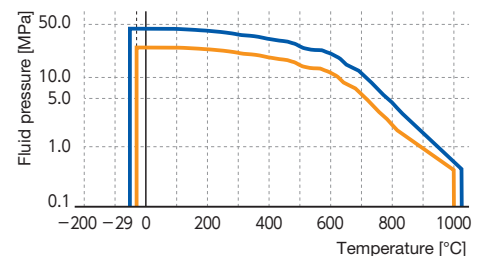
## TOMBO™ No. 1838R-NM series

### VORTEX™ gasket -NM



#### Service range

— water type fluid — oil/gas type fluids



Maximum service temperature water type fluid: 1000°C  
oil/gas type fluids: 1000°C

Maximum service pressure water type fluid: class 2500 (Approx. 43MPa)  
oil/gas type fluids: class 1500 (Approx. 26MPa)

#### Features

- An ultra-high temperature spiral gasket that can be used up to 1000°C using an original oxidation-resistant filler.
- Since the filler does not oxidize and disappear even at high temperatures, it is suitable for maintaining stable sealing properties for a long period of time.
- Can also be used with highly oxidizing molten salts.

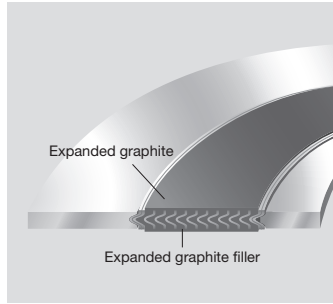
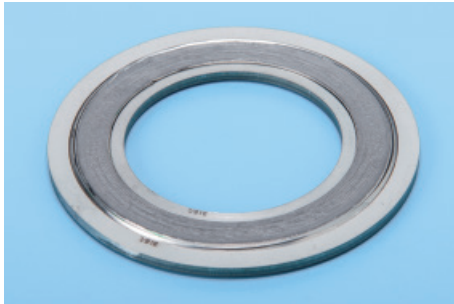
#### Information

Decoking is the process of burning and removing coke deposited on the inner walls of heating furnaces and equipment in ethylene plants. Since it is generally heated to a high temperature, the gasket is also required to have heat resistance.

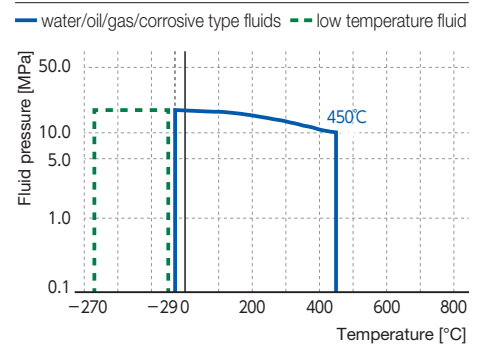


**TOMBO™ No. 1839R series**

**GRASEAL™ VORTEX™ gasket-L**



Service range



Maximum service temperature water/oil/gas/corrosive type fluids: 450°C  
 Minimum service temperature low temperature fluid: -270°C

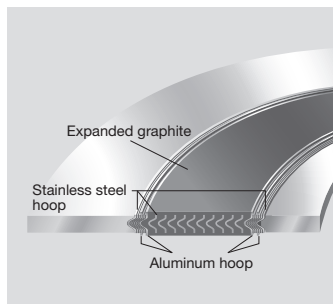
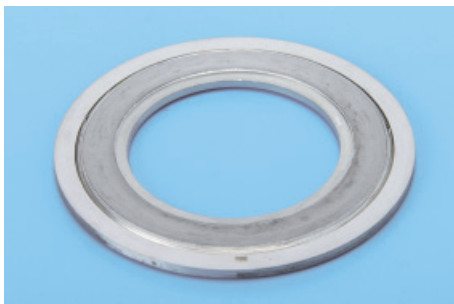
Maximum service pressure water/oil/gas/corrosive type fluids: class 900 (Approx. 16MPa)  
 low temperature fluid: class 900 (Approx. 16MPa)

Features

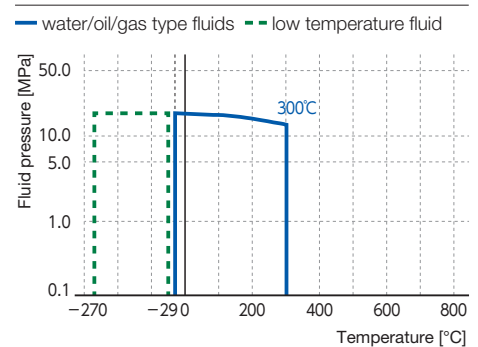
- A gasket that consists of large amount of filler on the sealing surface and enables sealing with a lower tightening force than a normal GRASEAL vortex gasket.
- For JPI standard flanges dimensions designed with a narrow seal width, please refer to TOMBO Brand Gasket (Dimensions).
- Can be used in cryogenic lines such as LNG, LN2, liquefied hydrogen, and liquefied air.

**TOMBO™ No. 1839RAL series**

**GRASEAL™ VORTEX™ gasket-AL**



Service range



Maximum service temperature water/oil/gas type fluids: 300°C  
 Minimum service temperature low temperature fluid: -270°C

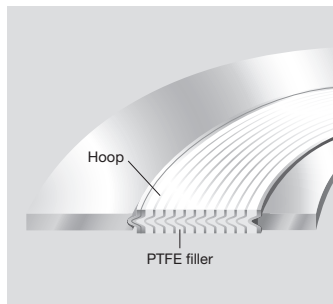
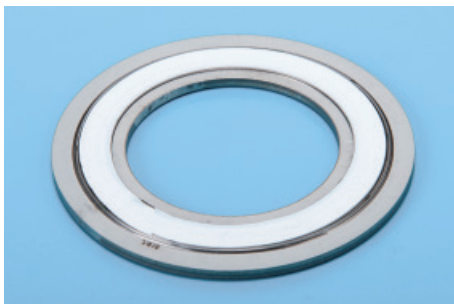
Maximum service pressure water/oil/gas type fluids: class 900 (Approx. 16MPa)  
 low temperature fluid: class 900 (Approx. 16MPa)

Features

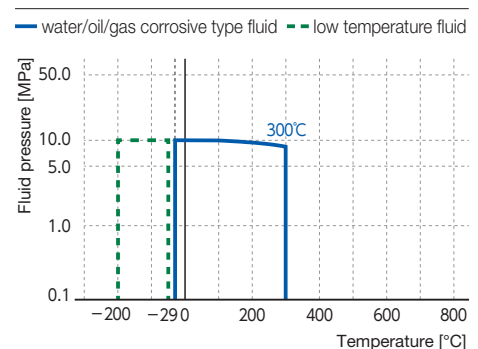
- GRASEAL VORTEX gasket for aluminum flange with a structure that does not easily damage the flange surface.
- Can also be used in cryogenic lines such as LNG, LN2, and liquefied air.

**TOMBO™ No. 9090-IOR series**

**NAFLON™ VORTEX™ gasket**



Service range



Maximum service temperature water/oil/gas corrosive type fluid: 300°C  
 Minimum service temperature low temperature fluid: -200°C

Maximum service pressure water/oil/gas corrosive type fluid: class 600 (Approx. 10MPa)  
 low temperature fluid: class 600 (Approx. 10MPa)

Features

- Using PTFE as the filler, it exhibits excellent sealing performance even in harsh conditions where corrosive fluids, pure oxygen gas, and airtightness are required.
- Used in piping and equipment such as petrochemical process lines and heat medium lines.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

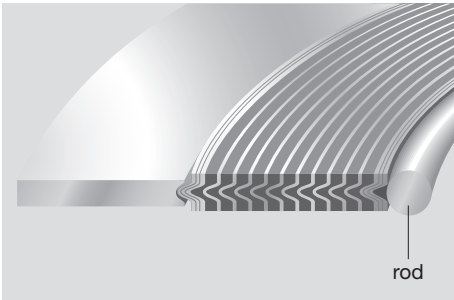
Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

## Line up

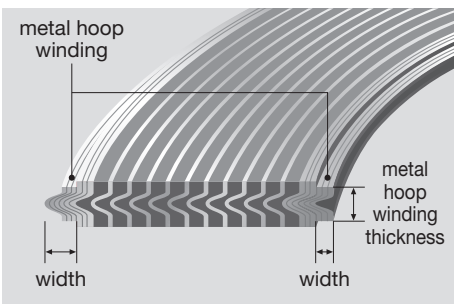
### With inner rod



It is a specification with a metal rod attached to the inner diameter side and is used in places where the required inner ring width is narrow.

- We recommend TOMBO No.1891 (Kammprofile gasket) because it is easy to buckle when the diameter is large.
- Only 4.5mm gasket thickness can be manufactured. (The rod diameter is  $\phi 3.2$ , the rod material is 304 stainless steel or 316 stainless steel)

### With wound metal hoop



It is a specification in which only the hoop is wound on the inner or outer diameter side, and it is used for male & female type and tongue & groove type flanges where the width is narrow and a normal outer ring cannot be manufactured.

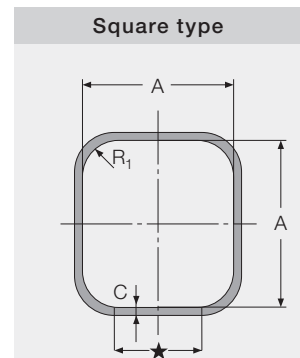
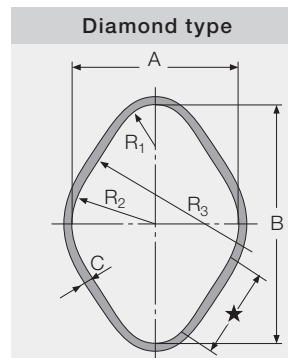
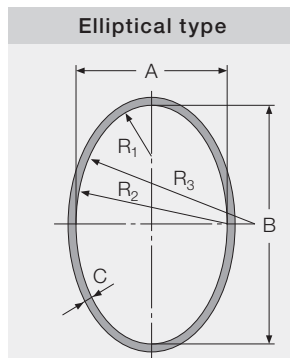
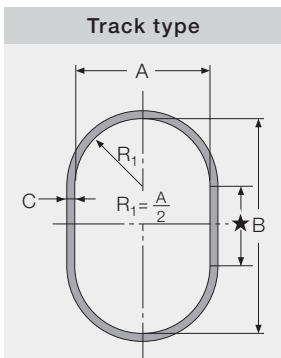
- It cannot be used for FF and RF flanges because the wound metal winding part does not have the strength of the inner ring and outer ring.
- 4.5mm and 6.5mm thickness can be manufactured. The thickness of the wound metal winding part is 3.2mm, and the maximum width of the metal winding is 3.0mm.

### Irregular shape



It is mainly used for boiler manholes, handholes, and other valve bonnets.

- Please specify the dimensions of A, B, C, R1, R2 and R3 shown in the figure below.
- It is difficult to manufacture a shape with a long straight part and a shape with an extremely small radius of curvature, so please contact us separately.



\* If  $R_3$  is a straight line with a diamond shape,  $R_3$  is not required.

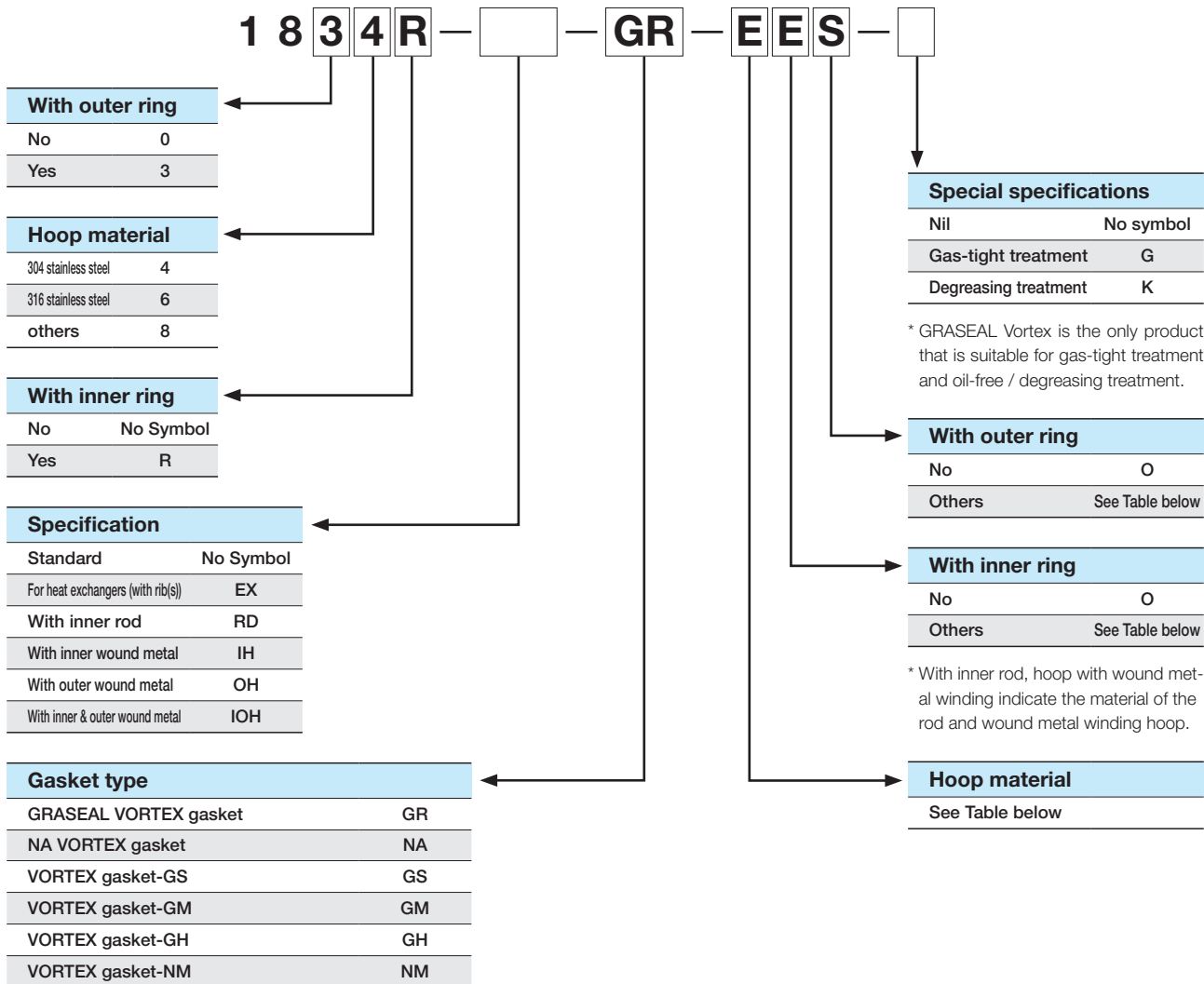
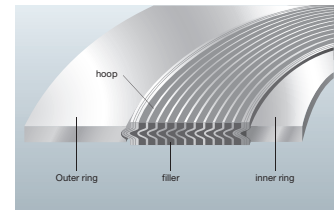
\* A dimension of track type and oval shape must be 40mm or more, diamond type and square shape must be 60mm or more.

\* Ratio A / B must be 2/3 or more.

\* As a guide, the length of the straight part (marked with ★ in the below figure) should be 100mm or less, as it will easily break apart.

### TOMBO No. indication method

- TOMBO No.1834R-GR** series | GRASEAL VORTEX gasket
- TOMBO No.1834R-NA** series | NA VORTEX gasket
- TOMBO No.1836R-GS/-GM/-GH** series | VORTEX gasket-GS/-GM/-GH
- TOMBO No.1838R-NM** series | VORTEX gasket-NM



#### Material indication symbols for hoops, inner rings, and outer rings

Carbon steel	S	310 stainless steel	V	Titanium	T
304 stainless steel	E	410 stainless steel	R	Alloy 600	Y
316 stainless steel	G	430 stainless steel	U	Alloy 400	M
304L stainless steel	L	309S + cb stainless steel	W	Nickel	N
316L stainless steel	H	316ELC stainless steel	X	Others	Z
321 stainless steel	J	347 stainless steel	K		

\* The above includes materials that can be used only for hoops and inner and outer rings. Please contact us for availability. Materials not listed may be available as individual specifications, so please contact us. In that case, use "Other: Z" and indicate the material name.

#### Recommended service temperature for hoop metal

304 stainless steel, 304L stainless steel	500°C max
316 stainless steel, 316L stainless steel	600°C max
347 stainless steel	750°C max
321 stainless steel	750°C max
Titanium	500°C max
Alloy 400	750°C max
Alloy 600	1000°C max

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

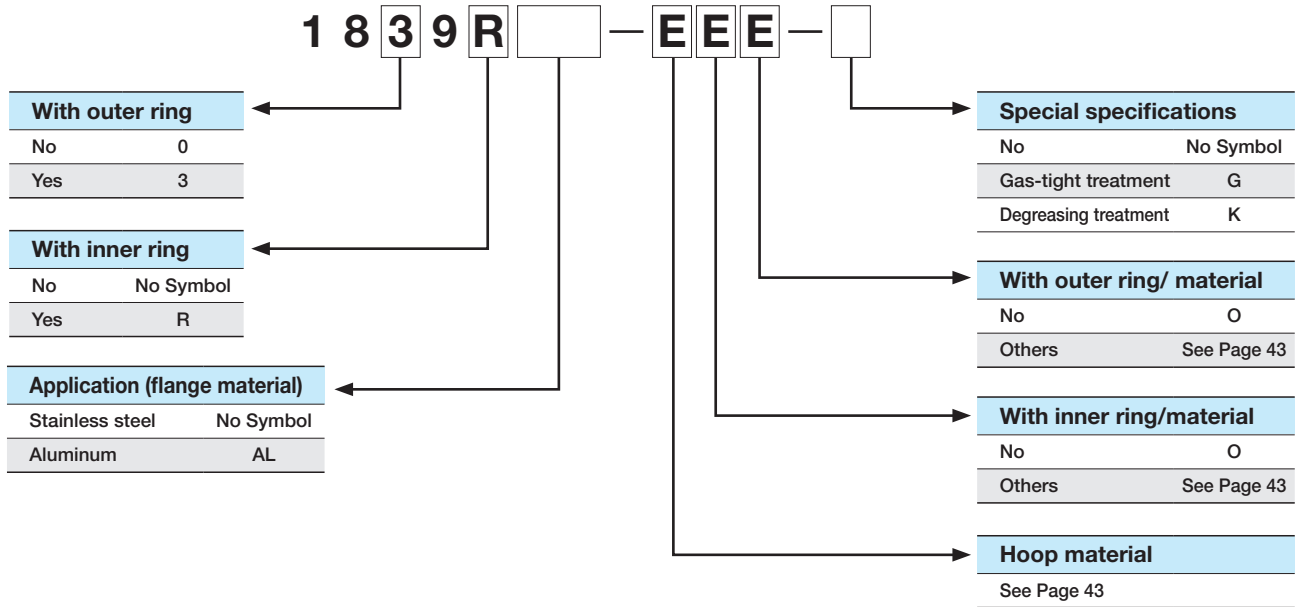
Rubber gaskets

Cloth gaskets

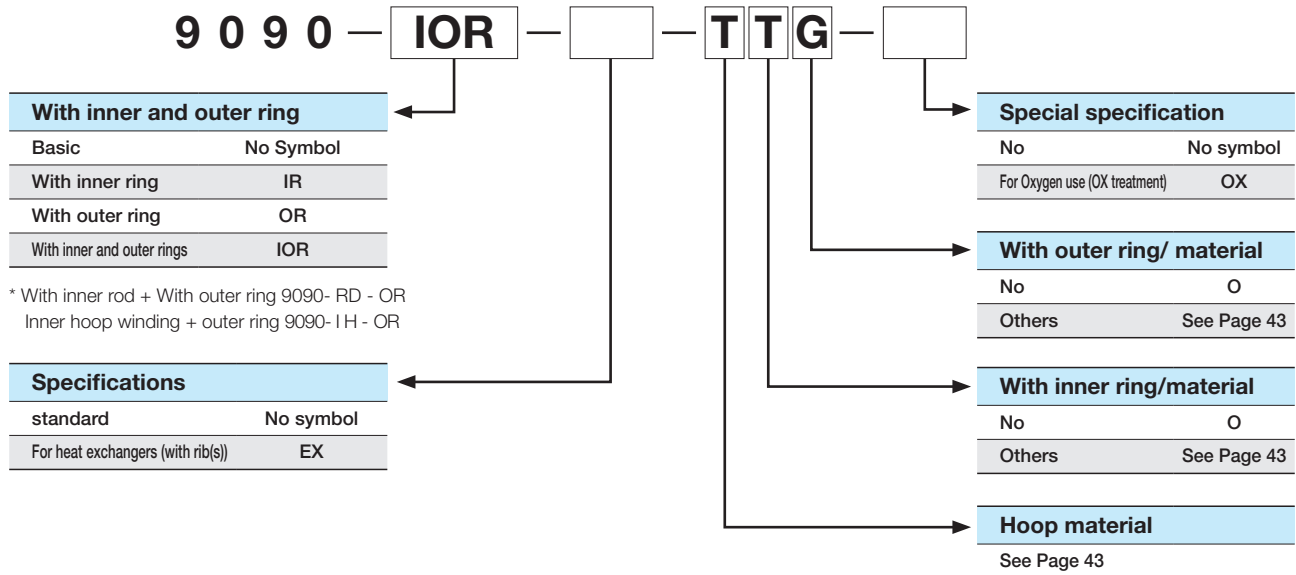
Pastes and other sealing materials

# VORTEX™ gaskets

- TOMBO No.1839R series | GRASEAL VORTEX gasket-L
- TOMBO No.1839RAL series | GRASEAL VORTEX gasket-AL



- TOMBO No.9090-IOR series | NAFLON VORTEX gasket



## Examples of TOMBO No. indication

	Shape	Specification	Type of product	Hoop material	inner ring material	outer ring material
1806-GR-GOO	Basic	—	GRASEAL VORTEX	316 stainless steel	none	none
1834-NA-EOS	With outer ring	—	NA VORTEX	304 stainless steel	none	carbon steel
9090-IOR-TTG	With inner and outer rings	—	NAFLON VORTEX	Titanium	Titanium	316 stainless steel
1838-IH-GR-ZZZ	With outer ring	With inner hoop wound metal winding	GRASEAL VORTEX	Others <sup>Note 1</sup>	Others <sup>Note 1</sup>	Others <sup>Note 1</sup>

Note 1: please specify material name for other materials.

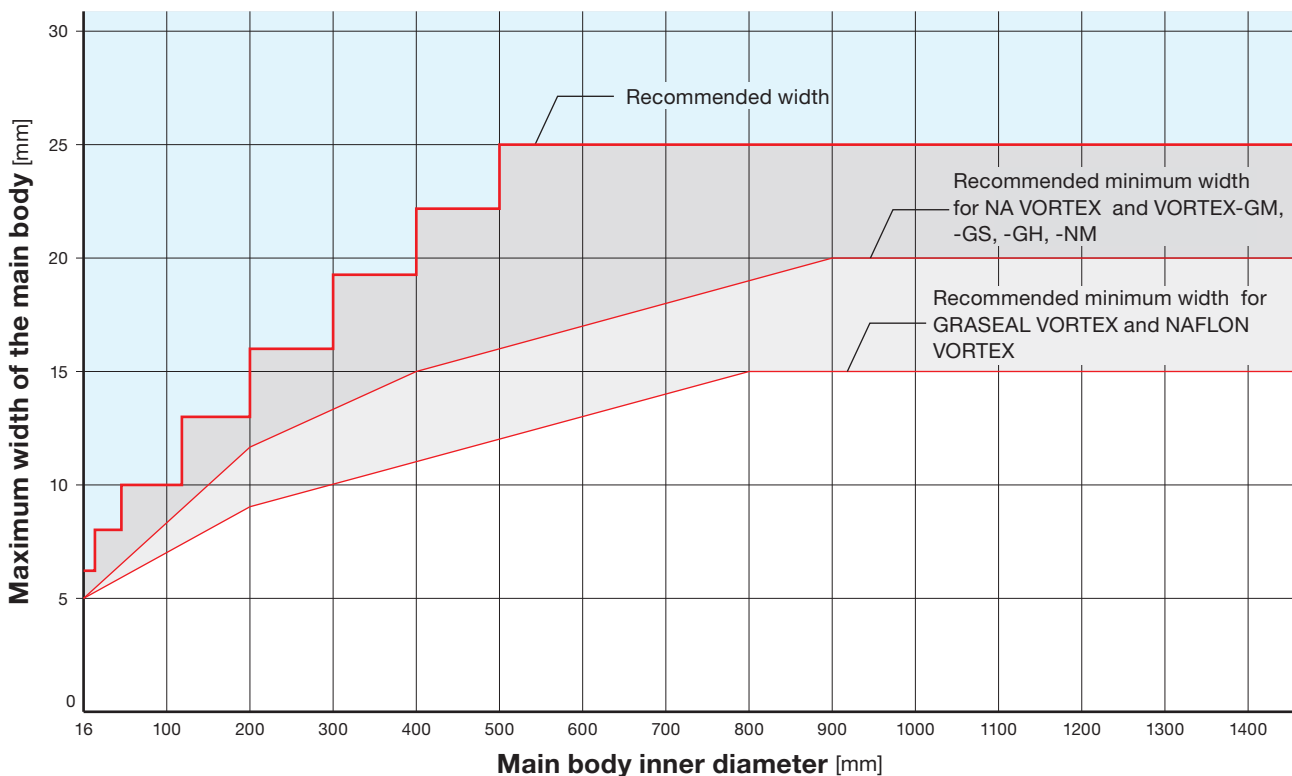
### Design criteria

TOMBO No. <sup>Note 1</sup>	1804-GR	1804-NA	9090	1806-GS -GM,-GH	1808-NM	1809 1809AL
Gasket factor $m$ [-]	3.00					3.00
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	68.9					58.8
Min seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	water, oil type fluids	29.4	34.3	29.4	34.3	34.3
	gas type fluid	39.2	78.4	39.2	78.4	78.4
Allowable seating stress [N/mm <sup>2</sup> ]	294.2					294.2

Note 1: Indicates the basic type of TOMBO No.

### Recommended width of gasket body (When gasket thickness is 4.5mm)

When setting the vortex dimensions individually, make sure that the gasket body width is at least the recommended minimum width shown in the figure below.



### Standard dimensions

Gasket thickness [mm] <sup>Note 1</sup>	inner and outer ring thickness [mm]		Recommended manufacturable body inner diameter <sup>Note 2</sup> [mm]	
	Carbon steel	Other than carbon steel	Min.	Max.
3.2	2.0	2.0	φ 16	φ 600
4.5 (standard)	3.2	3.0	φ 16	φ 3000
6.4	4.5	4.0	φ 1500	φ 3000

Note 1: Vortex Gasket-NM thickness lineup is only 4.5mm.

Note 2: We can also manufacture gaskets dimensions other than the above. However, this may result in deformation, warping, or breaking up of the gaskets. In addition, the delivery period may be longer than usual due to special specifications. Please consult us for details.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

## Available main body width and minimum inner and outer ring width

Main body I.D. Inner ring I.D. Outer ring I.D. [mm]	Available body width [mm]				Minimum width of inner ring [mm]	Minimum width of outer ring [mm]
	Main body thickness 3.2mm		Main body thickness 4.5mm	Main body thickness 6.4mm		
	(basic, with outer ring)	(with inner and outer ring)	(all shapes)	(all shapes)		
14 max	4.0 ~ 8	4.0 ~ 8	4.5 ~ 8	—	—	—
30 max	4.0 ~ 10	4.0 ~ 10	4.5 ~ 10	—	2.5	—
46 max	4.0 ~ 15	4.0 ~ 15	4.5 ~ 15	—	2.5	4.0
55 max	4.0 ~ 20	4.0 ~ 20	4.5 ~ 20	—	3.0	4.0
70 max	4.0 ~ 22	4.0 ~ 22	4.5 ~ 25	—	3.0	4.0
90 max	4.0 ~ 22	4.0 ~ 22	4.5 ~ 30	—	3.5	4.0
110 max	4.5 ~ 22	4.5 ~ 22	5.0 ~ 35	—	3.5	4.0
150 max	4.5 ~ 22	4.5 ~ 22	5.0 ~ 35	—	4.0	4.0
170 max	4.5 ~ 22	4.5 ~ 22	5.0 ~ 40	—	4.0	4.5
200 max	4.5 ~ 20	4.5 ~ 22 <sup>Note 1</sup>	5.0 ~ 40	—	4.0	4.5
300 max	4.5 ~ 20	4.5 ~ 22	5.0 ~ 40	5.0 ~ 40	4.5	4.5
400 max	4.5 ~ 18	4.5 ~ 22	5.0 ~ 40	5.0 ~ 40	5.0	5.0
500 max	5.0 ~ 18	5.0 ~ 27	5.5 ~ 40	5.5 ~ 40	5.5	5.5
600 max	5.5 ~ 15	5.5 ~ 27	6.0 ~ 35	6.0 ~ 35	6.0	6.0
700 max	6.5 ~ 15	6.5 ~ 29	6.5 ~ 35	6.5 ~ 35	7.0	7.0
800 max	6.5 ~ 15	6.5 ~ 10	7.0 ~ 35	7.0 ~ 35	8.0	8.0
900 max	6.5 ~ 15	6.5 ~ 10	7.5 ~ 35	7.5 ~ 35	9.0	9.0
1000 max	6.5 ~ 15	6.5 ~ 10	8.0 ~ 30	8.0 ~ 30	10.0	10.0
1100 max	8.5 ~ 15 <sup>Note 2</sup>	—	8.5 ~ 30	8.5 ~ 30	11.0	11.0
1200 max	9.0 ~ 15 <sup>Note 2</sup>	—	9.0 ~ 30	9.0 ~ 30	11.0	12.0
1300 max	10.0 ~ 15 <sup>Note 2</sup>	—	10.0 ~ 27	10.0 ~ 27	11.0	13.0
1400 max	11.0 ~ 15 <sup>Note 2</sup>	—	11.0 ~ 27	11.0 ~ 27	11.0	14.0
1500 max	12.0 ~ 15 <sup>Note 2</sup>	—	12.0 ~ 27	12.0 ~ 27	11.0	15.0
1600 max	—	—	(12.0) ~ 27	(12.0) ~ 30	15.0	16.0
1700 max	—	—	(12.0) ~ 25	(12.0) ~ 30	15.0	17.0
1800 max	—	—	(12.0) ~ 25	(12.0) ~ 30	15.0	18.0
1900 max	—	—	(12.0) ~ 25	(12.0) ~ 30	15.0	19.0
2000 max	—	—	(12.0) ~ 25	(12.0) ~ 30	20.0	20.0
2100 max	—	—	(12.0) ~ 22	(12.0) ~ 30	20.0	20.0
2200 max	—	—	(12.0) ~ 20	(12.0) ~ 30	20.0	20.0
2300 max	—	—	(12.0) ~ 20	(12.0) ~ 25	20.0	20.0
2400 max	—	—	(12.0) ~ 18	(12.0) ~ 25	20.0	20.0
2500 max	—	—	(12.0) ~ 18	(12.0) ~ 25	20.0	20.0
2600 max	—	—	(12.0) ~ 15	(12.0) ~ 22	20.0	20.0
2700 max	—	—	(12.0) ~ 15	(12.0) ~ 22	20.0	20.0
2800 max	—	—	(12.0) ~ 15	(12.0) ~ 22	20.0	20.0
2900 max	—	—	(12.0) ~ 15	(12.0) ~ 20	20.0	20.0
3000 max	—	—	(12.0) ~ 15	(12.0) ~ 20	20.0	20.0
3000 or more	—	—	(12.0) ~ 15	(12.0) ~ 20	20.0	20.0

\* Indicates the range that can be manufactured. Design the appropriate dimensions according to the usage conditions.

\* If the above dimensional range is exceeded, deformation, warpage, and breaking may easily occur and delivery may take longer than usual as a special specification, so please contact us for details.

\* The above dimensions may not be available depending on the type of filler and the material of the hoop.

\* As a general rule, the thickness of TOMBO No. 1808-NM, 1809, 1809AL and special shape vortex is only 4.5mm.

\* The maximum available size of TOMBO No.1809 is up to  $\phi$  1200 and TOMBO No.1809AL is up to  $\phi$  600. Please contact us for larger dimensions.

Note 1: The maximum width is 20mm when the filler type is "NA filler".

Note 2: Please contact us if you have an outer ring.

## Design guidelines for gasket standard clearance and appropriate groove depth

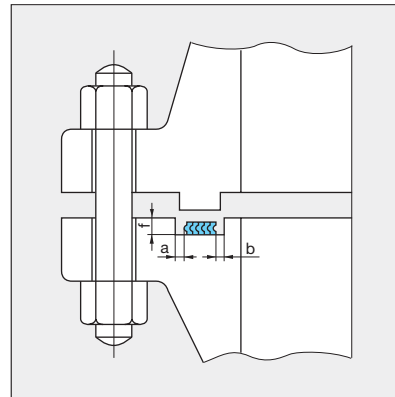
### (Tongue and groove(T&G)or male and female(M&F)type flange)

#### ● Gasket clearance

Gasket main body [mm]	Standard clearance [mm]	
	(a)	(b)
250 or lower	0.5	0.5
251 ~ 630	0.7	0.7
631 ~ 1600	1.0	1.0
1601 min	1.5	1.5

#### ● Groove depth

Gasket thickness [mm]	Appropriate groove depth (f) [mm]
3.2	3.5 min
4.5	5.0 min
6.4	7.0 min



When used in tongue and groove flange

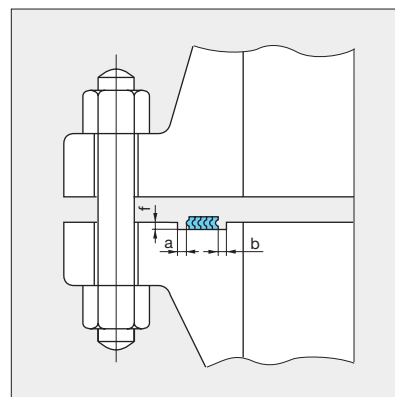
### (Face and groove(F&G)type flange)

#### ● Gasket clearance

The clearance (b) differs according to the gasket seating stress.  
Please consult us for details.

#### ● Groove depth

Gasket thickness [mm]	Appropriate groove depth (f) [mm]
3.2	2.4 (+0.1, -0)
4.5	3.2 (+0.1, -0)
6.4	-



When used in face and groove flange

## Type of flange face and appropriate gasket shape

Type of flange face	Flat face (FF)	Raised face (RF)	Male and female (M&F)	Tongue and groove (T&G)
Appropriate shape	With inner and outer ring	With inner and outer ring	With inner ring	Basic type

\* If all of the following conditions are met, it can be used without an inner ring.

- Size: Nominal diameter Ø24B or less or 600A or less
- Pressure rating: Class 600 or less or 40K or less
- NA vortex gasket

## ⚠️ Precautions for VORTEX gasket

### ■ Precautions regarding design and selection

#### ● Gasket contact surface finish

The recommended surface roughness according to JIS B2220-2012 is as follows.

- For sealing liquid : 6.3μm Ra max
- For sealing gas : 3.2μm Ra max

Not suitable for flanges with V-groove on the gasket seat surface.

#### ● Bolt material

VORTEX gaskets require greater tightening force than sheet gaskets. Therefore, it is recommended to use high-strength bolts such as SNB7 or higher as the bolt material.

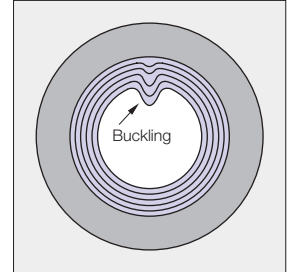
#### ● Plating of inner and outer rings

When the material of the inner ring and outer ring is carbon steel, the surface is plated to prevent rust during storage. Therefore, please note the following points.

- The heat resistant temperature of plating is 200°C.
- If you need to be careful about the small amount of elution of plating components, please use stainless steel.

#### ● Shape of VORTEX

By preventing the inner ring from deforming to the inner diameter side of the gasket body during tightening, it has the functions of preventing buckling of the gasket body, maintaining a high tightening force and preventing damage (breaking) of the gasket. Be sure to attach the inner ring when installing on a flange that is not restricted on the inner diameter side, or in the following cases.



- When the filler material is other than NA
- When the filler material is NA, the pressure rating is class 900 or more, or the nominal diameter of the flange is 650A (26B) or more.

#### ● For large diameter gaskets

When using a large-diameter gasket under high pressure conditions, the gasket may be deformed by the end force or the flange may be deformed. Please contact us in advance.

### ● Recommended gaskets for various fluids

Fluids	Precautions	Recommended gaskets
Combustible gas	Do not use GRASEAL VORTEX or NA VORTEX gasket. Oxidative loss of organic components in GRASEAL and NA filler may occur.	<ul style="list-style-type: none"> <li>• NAFLON VORTEX for oxygen (TOMBO No. 9090-OX series)</li> </ul>
Strong oxidizing fluid (Oxidizing acid, oxidizing salt, halogen compound)	Do not use GRASEAL VORTEX gaskets. There is a possibility of GRASEAL being oxidized.	<ul style="list-style-type: none"> <li>• NAFLON VORTEX</li> </ul>
High temperature fluid	Select materials for the hoop and inner ring that can withstand the conditions of use.	<ul style="list-style-type: none"> <li>• Vortex Gasket-GS, -GM, -GH</li> <li>• Vortex Gasket-NM</li> </ul>
Corrosive fluid	Do not use NA VORTEX gasket because the fluid corrodes the filler	<ul style="list-style-type: none"> <li>• Do not use NA Vortex as it will damage the filler.</li> </ul>

#### ● When used for the full face flange (FF)

If the flange is thin and low strength, tightening may distort the flange. If this happens, the flange surface and the outer ring may come into contact with each other, and the seating stress required for sealing may not be obtained. Therefore, the FF flange must have sufficient strength (thickness).

#### ● Use with low pressure flanges (JIS 5K or lower flange, vacuum flange, etc.)

Vortex gaskets require greater tightening force than sheet gaskets. Low pressure flanges are not recommended as they often do not provide sufficient bolt or flange strength to tighten the gasket.

#### ● Use with aluminum flanges

Use the TOMBO No.1809AL series for aluminum flanges. Use of any other vortex gasket may damage the flange.



● **When used for slip-on welding flanges**

When using for slip-on welding flanges, the gasket dimensions are different from those of butt welded flanges, so please check the types of A, B, and C before ordering.

Flange type	Shape	Figure
Slip-on welding type Plate flange (SOP)	—	
Slip-on welding type Hub flange (SOH)	A	
	B	
	C	
Socket welding type Flange (SW)	—	
Butt welding type Flange (WN)	—	
Lap joint flange (LJ flange)	—	
Thread flange (TR)	—	
Integrated flange (IT)	—	
Blind flange (BL)	—	

■ **Precautions for use**

● **Before installation**

- Before installing the gasket, clean the flange surface and check that there are no foreign objects or scratches.
- Handle the gasket with care. In particular, large-diameter gaskets are easily damaged (disassembled), so arrange appropriate persons to handle them carefully.
- Place the gasket in an appropriate position so that it does not shift to one side of the flange.
- As a general rule, it is not necessary to apply gasket paste but if there is a particular request, it is recommended to use TOMBO No. 9400 (NAFLON paste) together under the conditions of 260°C or lower.
- The gasket cannot be reused.

● **When using the basic vortex**

The basic vortex (including irregular shapes) may be deformed by a slight external force, so handle with care. In addition, even if some deformation occurs, it may be possible to use it by inserting it into the flange groove as it is, so please contact us.

**Applicable standard**

- JIS F 0602  
“Shipbuilding-Non-asbestos gaskets to cargo piping system”  
(HUC TOMBO No.1834-NA, HUD TOMBO No.1834R-NA, KUD TOMBO No.1834R-GR, FUC TOMBO No.9090-IOR)
- JIS F 7102  
“Standard for using gaskets and packing for pipes in marine engines”  
(HUC TOMBO No.1834-NA, HUD TOMBO No.1834R-NA, KUD TOMBO No.1834R-GR)
- JPI-7S-41  
“Spiral wound gaskets for piping”  
(TOMBO No.1804-GR series, TOMBO No.9090 series)
- ASME B16.20  
“METALLIC GASKETS FOR PIPE FLANGES”
- API 601 (II)  
METALLIC GASKETS FOR RAISED FACE PIPE FLANGES AND FLANGED CONNECTIONS (DOUBLE JACKETED CORRUGATED AND SPIRAL-WOUND)
- BS 3381  
METALLIC SPIRAL-WOUND GASKETS FOR USE WITH FLANGES TO BS 1560, PARTS 1 AND 2
- ISO 7483  
DIMENSIONS OF GASKETS FOR USE WITH FLANGES TO ISO 7005

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

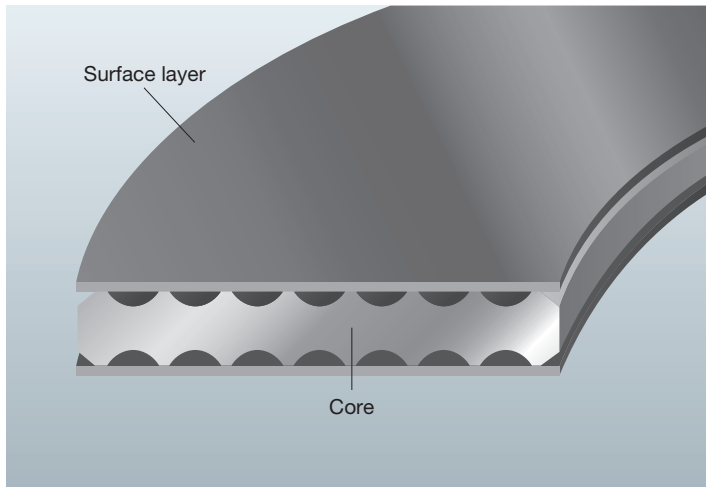
Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

# Kammprofile gaskets

It has the same sealing performance as a vortex gasket and can be used only with the main body. Since it can be designed even with a narrow gasket width, it is suitable for equipment such as heat exchangers and pressure vessels.



## When ordering

- Please specify the product number (TOMBO No.).
- Select an appropriate shape according to the type of flange.
- For heat exchangers, please specify the shape of the gasket.

Flange seat and proper gasket shape	<b>P53</b>
The gasket shape for the heat exchanger	<b>P56</b>

**■ TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **1891**

**GR**

**E**

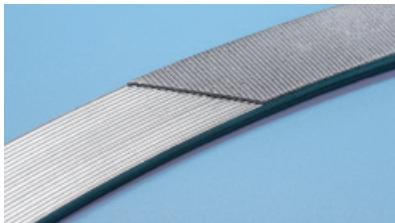
**E**

Surface layer

Core material

Outer ring material

Surface layer	indication symbol
Expanded graphite	GR



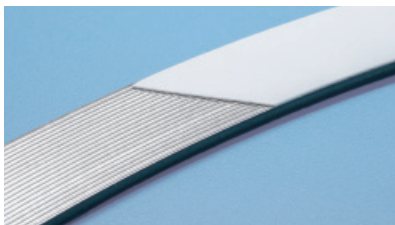
Core material	indication symbol
304 stainless steel	E
316L stainless steel	H
321 stainless steel	J
Alloy	Y
Material other than the above	Z

Outer ring material	indication symbol
304 stainless steel	E
430 stainless steel	U
none	O
material other than above	Z

\* For ribs and hangers, please specify the dimensions.

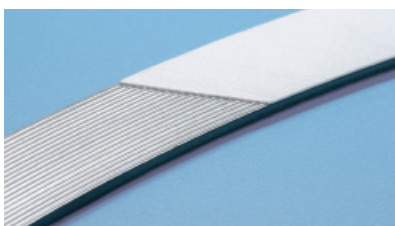
PTFE

TF

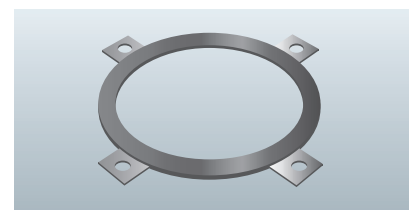


NM sheet

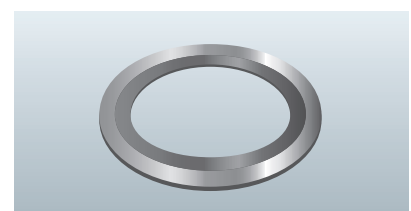
NM



**With hangers**



**With outer ring**

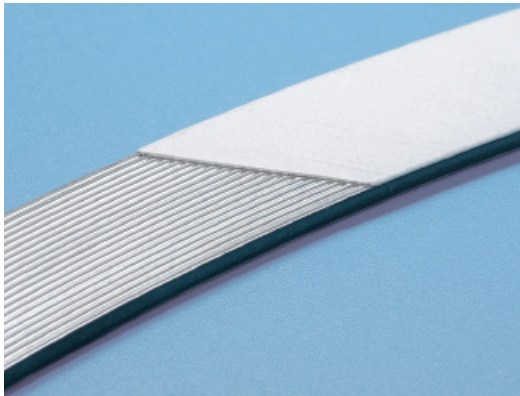


\* If the flange shape is raised face (RF) or a flat face (FF), use a hanger or an outer ring for centering.

\* This is a picture with a part of the surface material is removed.

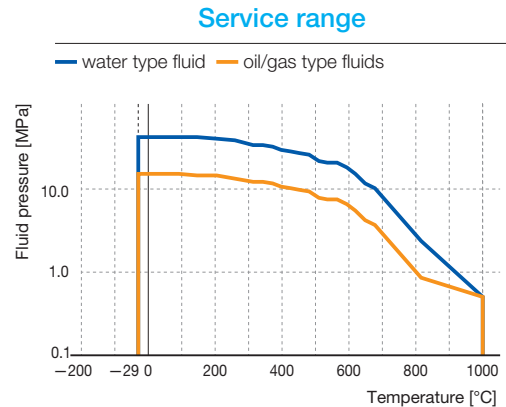
# TOMBO™ No. 1891-NM

## High temperature kammprofile gasket that can be used at 1000°C



Maximum service temperature  
water/oil/gas fluids: 1000°C

Maximum service pressure  
water type fluid:  
class 2500 (about 43MPa)  
oil/gas fluids:  
class 900 (about 16MPa)



### Features

- **Can be used under high temperature and oxidation conditions**

A gasket that uses the NM sheet as the surface layer material for high temperature that is originally developed, and can be used in the high temperature up to 1000°C. There is almost no oxidation loss of the sheet even if it exceeds 400°C, and stable sealing performance is maintained for a long period of time.

- **Excellent workability**

There is no worry that it will come apart even with a large diameter exceeding  $\phi 1000$ , and it is excellent in handleability.

### 1000°C heat resistance test

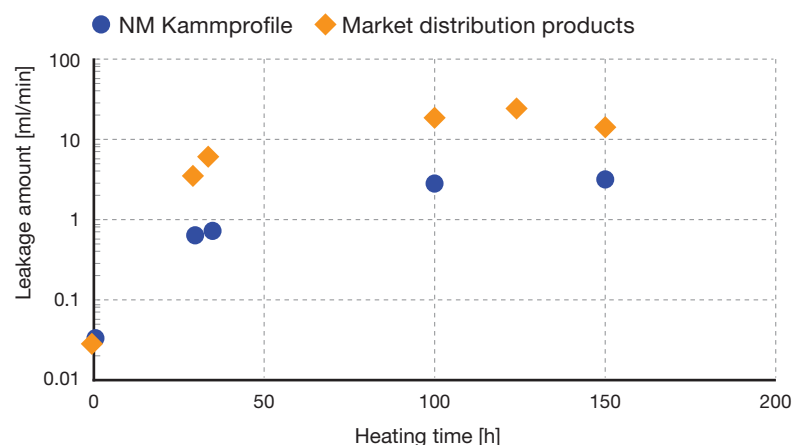
#### Test method

The gasket sandwiched between the simulated flanges is loaded with heat of 1000°C for a predetermined time, then cooled to room temperature, and a seal test is performed.

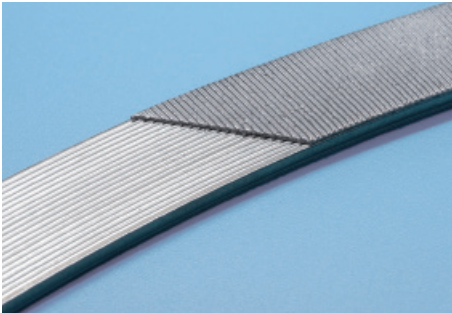
Test temperature	1000°C
gasket dimension	ASME class 300 2B
Seating stress	78.4 n/mm <sup>2</sup>
Internal pressure	before heating: 2.1 MPa after heating: 0.2 MPa
Test fluid	nitrogen gas
Evaluation method	pressure drop

\* Measured by: NICHIAS

#### Test result



## TOMBO™ No. 1891-GR



Maximum service temperature

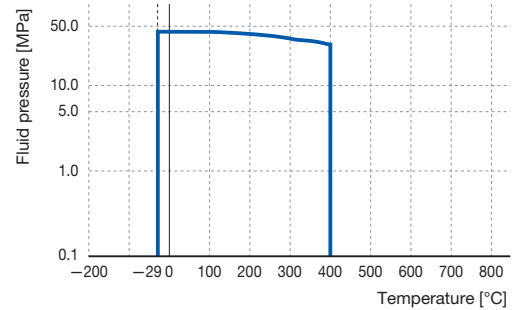
water/oil/gas type fluids: 400°C

Maximum service pressure

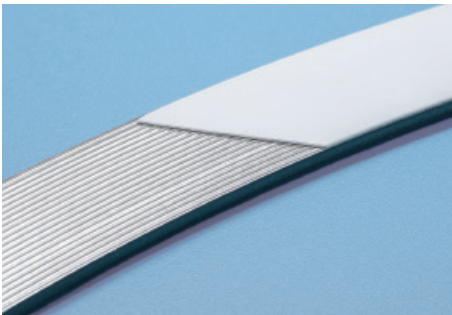
water/oil/gas type fluids: Class 2500 (about 43MPa)

### Service range

— water/oil/gas corrosive type fluids



## TOMBO™ No. 1891-TF



Maximum service temperature

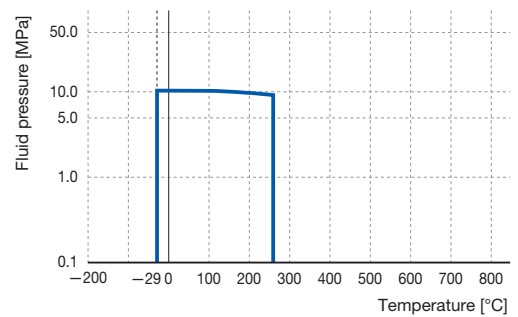
water/oil/gas type fluids: 260°C

Maximum service pressure

water/oil/gas type fluids: Class 600 (about 10MPa)

### Service range

— water/oil/gas/corrosive type fluids



## Design criteria

TOMBO No.		1891-GR	1891-TF	1891-NM
Gasket factor m	[-]	2.25 <sup>Note 1</sup>		3.00
Min. design seating stress y	[N/mm <sup>2</sup> ]	15.2 <sup>Note 1</sup>		44.8 <sup>Note 1</sup>
Min. seating stress $\sigma_3$	water/oil type fluids	29.4		34.3
	gas type fluid	39.2		78.4
Allowable seating stress	[N/mm <sup>2</sup> ]	450		450

Note 1: The applicable range is the standard flange and the design flange of the existing equipment. For new flange design, design criteria for spiral wound gaskets is as follows. ( $m = 3.00$ ,  $y = 68.9$  [N/mm<sup>2</sup>]).

## Standard dimension

Gasket thickness [mm]		2.3	4.0	5.0
Manufacturable range	Inner diameter	10 ~ 690.0	20.1 ~ 3980.0	
	Outer diameter	20 ~ 700.0	30.1 ~ 4000.0	
Core width	Standard width	—	10, 13, 15, 20	
	Manufacturable width	10~20	outer diameter $\phi$ 30.1 ~ $\phi$ 50.0 : 5~15 outer diameter $\phi$ 50.1 ~ $\phi$ 100.0 : 8~20 outer diameter $\phi$ 100.1 ~ $\phi$ 4000.0 : 10~30	
Standard Core material		304 stainless steel, 316L stainless steel		
Standard hanger material		304 stainless steel		
Construction <sup>Note 1</sup>		Basic type, with hanger type, with ribs type and with outer ring type		

Note 1: Kammprofile gaskets cannot be manufactured with "bolt holes for flat face" or "irregular shapes (track type, oval shape, etc.)."

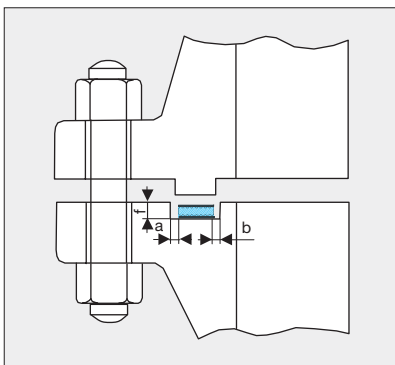
## Design guidelines for standard gasket clearance and appropriate groove depth

### Groove and gasket clearance

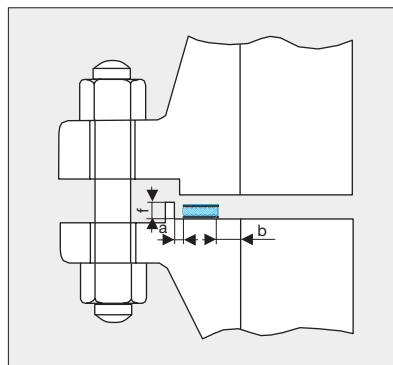
Gasket body [mm]	Standard clearance [mm]	
	(a)	(b)
250 or lower	0.5	0.5 or higher
251 ~ 630	0.7	0.7 or higher
631 ~ 2000	1.0	1.0 or higher
2001 ~ 3000	1.3	1.3 or higher
3001 or higher	1.5	1.5 or higher

### Groove depth (For a gasket thickness of 4mm)

Flange type	Appropriate groove depth (f) [mm]
Tongue and groove type (T&G)	5.0 or higher
Male and female type (M&F)	5.0 or higher



When used in tongue and groove (T&G) flange



When used in male and female (M&F) flange

## Type of flange face and appropriate gasket shape

Type of flange face	Flat face (FF)	Raised face (RF)	Male and female (M&F)	Tongue and groove (T&G)
Appropriate shape	With hanger <sup>Note 1</sup>	With hanger <sup>Note 1</sup>	Basic	Basic

Note 1: For piping standard gaskets (class 150 / class 300), an outer ring is attached.

### ⚠ Precautions for use

#### Gasket contact surface finish

The recommended surface roughness according to JIS B2220-2012 is as follows.

- For sealing liquid : 6.3 $\mu$ m Ra max
- For sealing gas : 3.2 $\mu$ m Ra max

● Since the Kamprofile gasket has expanded graphite, PTFE and NM sheet attached to the surface layer, the surface of the gasket is easily scratched, and if scratches are made until the metal is visible, it may cause leakage. Please be careful.

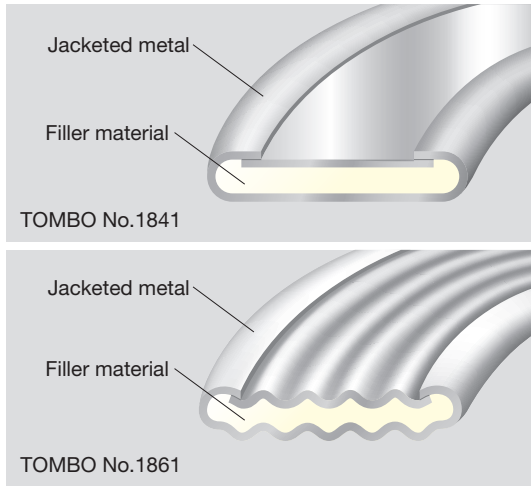
● As a general rule, Kamprofile gaskets with expanded graphite cannot be used for the fluids shown in the table on the right.

Fluids for which a Kamprofile gasket (clad with expanded graphite) is not suitable.

Classification	Name of fluid
Oxidizing acid	Nitric acid, concentrated acid, hot sulfuric acid, chromic acid, mixed acid, etc.
Oxidizing salt	Nitrate, chloride, hypochlorite, etc.
Halogen compound	Bromine, fluorine, iodine, chlorine dioxide, etc.
Combustible gas	Oxygen (pure oxygen)

# Metal jacketed gaskets

A gasket in which a heat-resistant cushion material is jacketed with a thin metal plate. It is manufactured in various shapes and covering methods depending on the application and location to be use. It is used for high temperature joint flanges, manholes, etc. for heat exchangers, pressure vessels, tower tanks, equipment, valves, etc.



## When ordering




- Please specify the product number (TOMBO No.).
- For heat exchangers, please specify the shape of the gasket.

The gasket shape for the heat exchanger **P56**

**■ TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **1841** — **FI** — **S** — **GR**

Shape — Filler material — Metal jacketed material — Facing material

Shape	indication symbol	Filler material	indication symbol	Metal jacketed material	indication symbol	Facing material	indication symbol
Flat	1841	Millboard	No symbpl	carbon steel	S	None	No symbpl
		Millboard for high temperature	FI	304 stainless steel	E	Expanded graphite	GR
		Expanded graphite	GR	316 stainless steel	G		
				310S stainless steel	V		
				Aluminum	A		
				copper	C		
				Alloy 400	M		
				other than the above	Z		

\* Please contact us for materials other than the above.

A type in which expanded graphite tape is attached to the sealing surface. (Maximum operating temperature: 400°C)

## Maximum service temperature

Filler material	temperate [°C]	Jacketed material	temperate [°C]
Millboard	530	carbon steel	535
Millboard for high temperature	1300	304 stainless steel	800
Expanded graphite	400	316 stainless steel	800
		copper	400
		Aluminum	400
		310S stainless steel	1150
		Alloy 400	800

\* Please check the heat resistance of both filler material and the jacketed material metal when using.

## Design criteria

TOMBO No.	1841-S	1841-E 1841-G others	1841-C	1841-A	1861-S	1861-E 1861-G others	1861-C	1861-A
Jacketed material	carbon steel	304 stainless steel 316 stainless steel others	copper	Aluminum	carbon steel	304 stainless steel 316 stainless steel others	copper	Aluminum
Gasket factor $m$ [-]	3.75	3.75	3.50	3.25	3.00	3.50	3.25	2.50
Min. design seating stress $\gamma$ [N/mm <sup>2</sup> ]	52.4	62.1	44.8	38.0	31.0	44.8	38.0	20.0
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	water/oil type fluid	39.2	49.0	34.3	29.4	—	—	—
	Gas type fluid	101.4	120.4	76.2	58.8	—	—	—

## Standard dimension

Jacketed material	coebon steel	304 stainless steel	316 stainless steel	310S stainless steel	Aluminum	copper
material symbol	S	E	G	V	A	C
standard dimension [mm]	1480	1180	1180	1180	980	1180

\* Indicates the largest diameter of gasket that can be made using a single metal sheet.  
If a larger gasket is necessary, we will make it by welding two or more metal sheets together.

## ⚠ Precautions for metal jacketed gasket

### Precautions concerning design and selection

#### ● Gasket contact surface finish

The recommended surface roughness according to JIS B2220-2012 is as follows.

- For sealing liquid : 3.2 $\mu$ mRa max
- For sealing gas : 1.6 $\mu$ mRa max

#### ● For temperature is 400°C or less

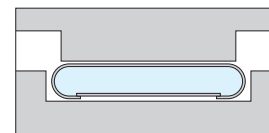
Since the sealing surface of the metal jacket gasket is metal, we recommend TOMBO No.1891 (Kammprofile gasket), which has good compatibility with the flange and provides stable sealing performance at temperatures below 400°C.

#### ● For standard flanges

Metal jacket gaskets are not recommended for standard flanges as it is difficult to obtain sufficient tightening force. If it is necessary to use metal jacketed gasket, we recommend that you use a hanger instead of a self-centering type.

### Precautions for use

- When used for gas-based fluids, use with GRASEAL (expanded graphite) tape or gasket paste (NEVERSEEZ Nickel Special Grade: Operating temperature: -183-1316°C, etc.).
- When using for a grooved flange, the folded side of the gasket shall be installed facing inside the groove.



### Reference standard

- ASME B16.20  
[Metallic Gaskets for Pipe Flanges]

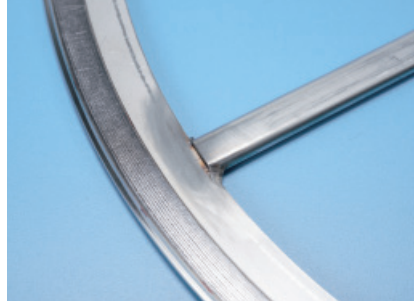
# Gasket for heat exchangers

Nichias semi-metal gaskets can be manufactured for various heat exchangers.

## VORTEX™ gasket



Metal hollow tube



Metal jacketed  
Inner ring - branch welding type



Metal jacket  
Inner ring - integrated

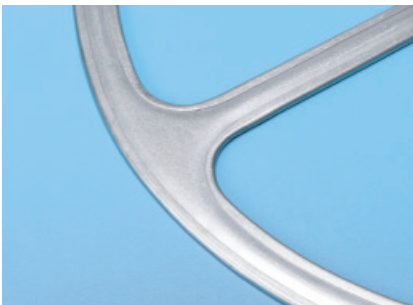
<b>Type of main body</b>	NA Vortex Gasket, GRASEAL Vortex Gasket, NAFLON Vortex Gasket		
<b>Type of ribs</b> (For thickness 4.5 mm)	Metal hollow tube	material	stainless steel 321
		Dimension	4.8 (Tube diameter) x 0.5 (thickness)
	TOMBO No.1841 (Metal jacketed gasket)	Metal jacketed	The standard is same material with the hoop or inner ring.
		Standard shape	10 (width) x 4.7 (thickness)

## Kammprofile gasket



It can be manufactured in any shape suitable for heat exchangers. There is no need for an inner ring or outer ring for reinforcement and there is no worry of disintegration even with a large diameter.

## Metal jacketed gasket

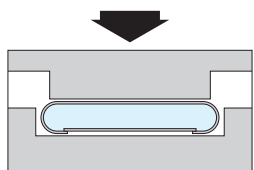


It can be manufactured in any shape suitable for heat exchangers. Install the gasket where the folded surface is in contact with the bottom of the flange groove.



# Shapes of gaskets for heat exchangers

When ordering a gasket for a heat exchanger, please specify the shape with the symbol below or the drawing.

<b>{HE1}</b>	<b>{HE2}</b>	<b>{HE3}</b>	<b>{HE4}</b>	<b>{HE5}</b>
<b>{HE6}</b>	<b>{HE7}</b>	<b>{HE8}</b>	<b>{HE9}</b>	<b>{HE10}</b>
<b>{HE11}</b>	<b>{HE12}</b>	<b>{HE13}</b>	<b>{HE14}</b>	<b>{HE15}</b>
<b>{HE16}</b>	<b>{HE17}</b>	<b>{HE18}</b>	<b>{HE19}</b>	<b>{HE20}</b>
<b>{HE21}</b>	<b>{HE22}</b>	<b>{HE23}</b>	<b>{HE24}</b>	<b>{HE25}</b>
<b>{HE26}</b>	<b>{HE27}</b>	<b>{HE28}</b>	<p>● For metal jacket gaskets The folded surface is facing down</p> 	

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

## Points to use properly for semi-metal gaskets

	VORTEX gasket	Kammprofile gasket	Metal jacketed gasket
Conformability with flange	◎	◎	△
Heat resistance	◎	○	◎
Large diameter workability	△	◎	○
Non-sticking to the flange	○	△	◎
Necessity of outer ring for centering	Necessary	can be used with hanger	can be used with hanger

### Conformability with flange

VORTEX gaskets and Kammprofile gaskets, which have a non-metallic surface, can fill the irregularities of the flange when tightened, and have better sealing properties than metal jacket gaskets.

### Heat resistance

VORTEX gaskets and metal jacket gaskets come in a variety that can withstand high temperatures.

VORTEX gaskets are recommended for high temperature conditions. A metal jacketed gasket can also be used for the heat exchanger but retightening is required because the seating stress tends to decrease due to heating.

### Large diameter workability

Kammprofile gaskets and metal jacketed gaskets have excellent workability with large diameters because they do not fall apart.

### Non-sticking to the flange

The surface layer of the Kammprofile gasket may stick to the flange surface.

Therefore, VORTEX gaskets are recommended for piping where flange space cannot be widened

### Necessity of outer ring for centering

If the flange shape is a flat face or raised face, centering is required. It requires an outer ring, but the Kammprofile gasket and metal jacketed gasket can be centered on a hanger.

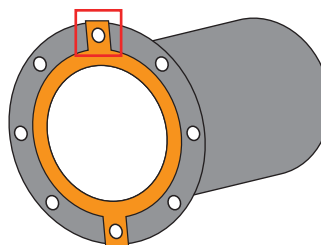
#### What is the “breakage” of vortex gaskets?

A phenomenon in which the hoop and filler fall apart.



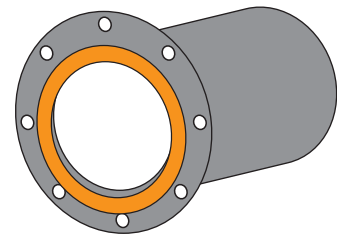
#### What is centering?

Align the gasket with the center of the pipe.



#### ▲There is a hanger

By aligning with the bolt holes, the gasket can be centered.

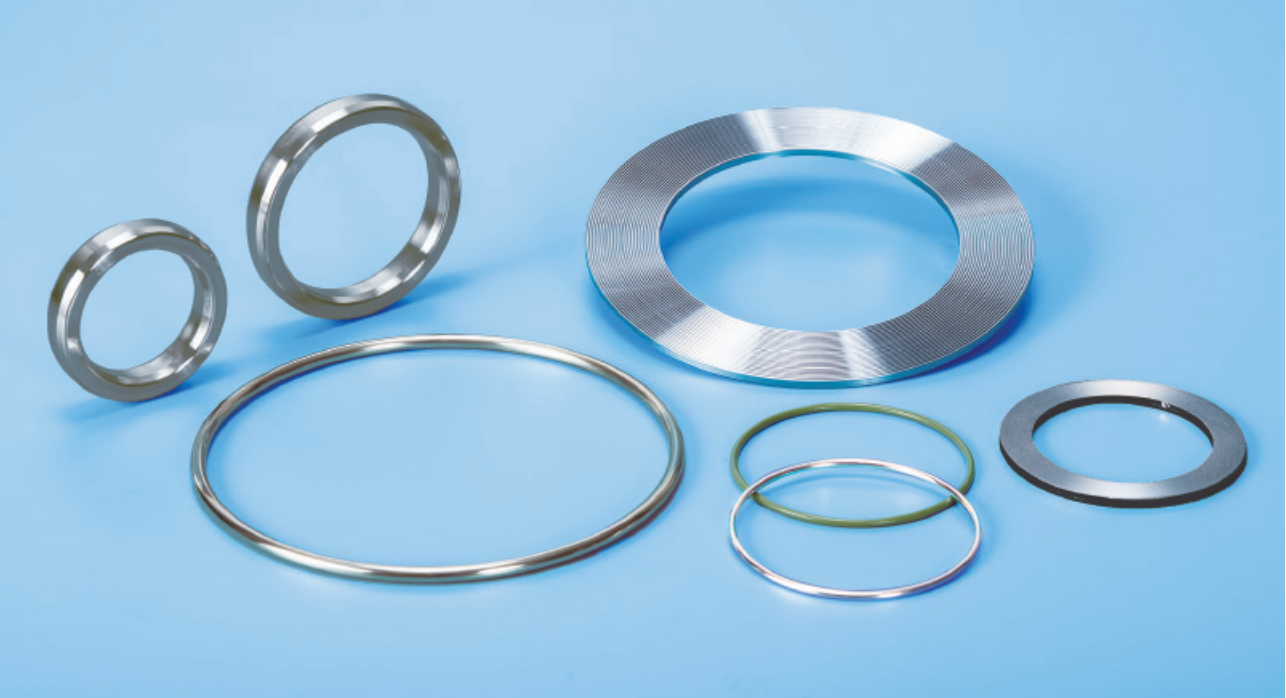


#### ▲No hanger

The gasket is off center

# Metallic gaskets

A gasket made by processing various metal materials into the required shape and dimensions according to the conditions. It is used at high temperature and high pressure conditions and high sealing performance are required.



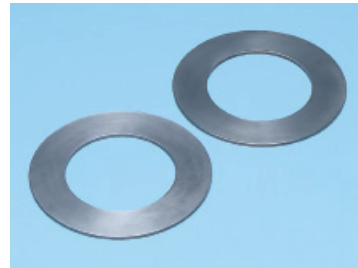
## Ring joint gaskets



Ring joint gasket used for flanges specified in JPI-7S-15, ASME B16.5, etc.

► P60-P61

## Metallic gaskets



A flat gasket manufactured by cutting and lathe processing from flat plates, round bars, forged metals, etc.

► P62-P64

## Metal O seals™



A hollow metal O ring

► P65-P67

# Ring joint gaskets

A gasket made by processing various metal materials into the required shape and dimensions according to the conditions. It is used at high temperature and high pressure conditions.

## TOMBO™ No. 1850C | Octagonal ring joint gasket



**Application:** Pipe flanges, valves, pressure vessels, heat exchangers, etc. under high temperature and high pressure which are difficult to seal with plain metal gaskets.

**Service range:** Depends on the material

A gasket made by processing forged metal into an octagonal cross section.

### Features

- The sealing surface of ring joint gasket and the flange groove come into surface contact to exhibit sealing performance.
- It can be reused by performing the grinding work<sup>1</sup>.

Note 1: Work to finish a smoother surface by rubbing metal surfaces together.

## TOMBO™ No. 1850V | Oval ring joint gasket



**Application:** Pipe flanges, valves, pressure vessels, heat exchangers, etc. that emphasize conformability.

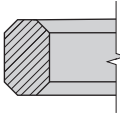
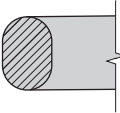
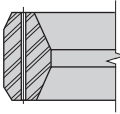
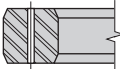
**Service range:** Depends on the material

A gasket made by processing forged metal into an oval cross section.

### Features

- Compared to an octagonal type, the sealing surface of this gasket contacts the flange along the line, thus it is easily to fit into flange groove but the ring cannot be reused.

## Line-up

Shape	Product name	Indication symbol	Features
	<b>Octagonal ring joint gasket</b>	<b>C</b>	Ring joint gasket used for flanges specified in JPI-7S-15, ASME B16.5, etc.
	<b>Oval ring joint gasket</b>	<b>V</b>	
	<b>RX type ring joint gasket</b>	<b>RX</b>	A special octagonal ring joint used for the 6B flange specified in API spe 6A.
	<b>BX type ring joint gasket</b>	<b>BX</b>	A special octagonal ring joint used for the 6BX flange specified in API spe 6A.

■ **TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **1850**

<b>C</b>		<b>D</b>	
<b>Shape</b>		<b>Material</b>	
Shape	Indication symbol	Material <sup>Note 1</sup>	Indication symbol
Octagonal	<b>C</b>	Pure iron	<b>D</b>
Oval	<b>V</b>	Dead soft steel	<b>S</b>
RX	<b>RX</b>	5Cr-0.5Mo steel	<b>F</b>
BX	<b>BX</b>	13Cr steel	<b>R</b>
		304 stainless steel	<b>E</b>
		304L stainless steel	<b>L</b>
		316 stainless steel	<b>G</b>
		316L stainless steel	<b>H</b>
		321 stainless steel	<b>J</b>
		347 stainless steel	<b>K</b>
		Alloy 400	<b>M</b>
		Nickel	<b>N</b>
		Titanium	<b>T</b>
		Materials other than the above	<b>Z</b>

Note 1: Other metal materials are also manufactured as specified. It is recommended that the gasket be made of a Brinell hardness (HB) that is 30 to 40 degrees softer than the flange material.

## ■ Metallic material and service temperature

Material	Material symbol	Max. service temperature [°C]	Max. hardness
			HB
Pure iron (Soft iron)	D	538	90
Dead soft steel (Low-carbon-steel)	S	538	120
5Cr-0.5Mo steel	F	649	130
13Cr steel	R	704	170
304 stainless steel	E	816	160
304 L stainless steel	L	816	150
316 stainless steel	G	816	160
316 L stainless steel	H	816	150
321 stainless steel	J	816	160
347 stainless steel	K	816	160
Alloy 400	M	800	(130)
Nickel	N	760	(120)
Titanium	T	800	(140)

\* The material is based on JPI-7S-23 "Ring-Joint Gaskets and Grooves for Petroleum Industry".

\* ( ) Is a reference value.

\* Please contact us for the availability of materials that are not listed.

## ■ Gasket contact surface finish

The recommended surface roughness is as follows.

- For sealing liquid : 1.6 $\mu$ mRa max
- For sealing gas : 1.6 $\mu$ mRa max

## ■ Ring joint gaskets

TOMBO™ No.	1850C-D, 1850V-D	1850C-S, 1850V-S	1850C-F, 1850V-F	1850C-E, 1850C-G 1850V-E, 1850V-G, others
Material	Pure iron	Mild steel	F5	Stainless steel
Gasket coefficient m [-]	5.50		6.00	6.50
Min. design seating stress $\gamma$ [N/mm <sup>2</sup> ]	124.2		150.3	179.3

### Applicable standard

■ JPI-7S-23

"Ring-Joint Gaskets and Grooves for Petroleum Industry". (TOMBO No.1850C, 1850V)

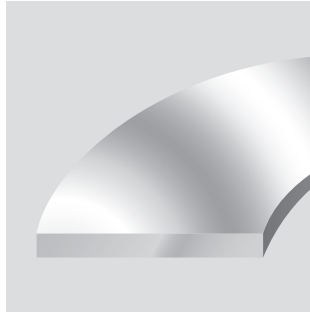
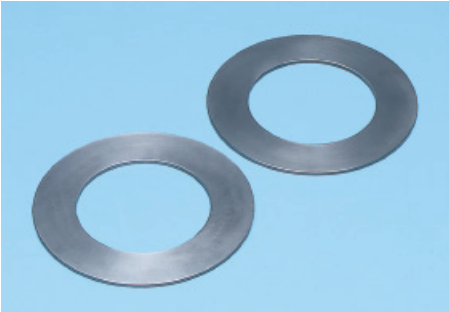
■ ASME B16.20

[Metallic Gaskets for Pipe Flanges] (TOMBO No.1850C, 1850V, 1850RX, 1850BX)

■ API spec 6A

[Specification for Wellhead and Christmas Tree Equipment] (TOMBO No.1850C, 1850V, 1850RX, 1850BX)

## TOMBO™ No. 1850P Plain metallic gasket



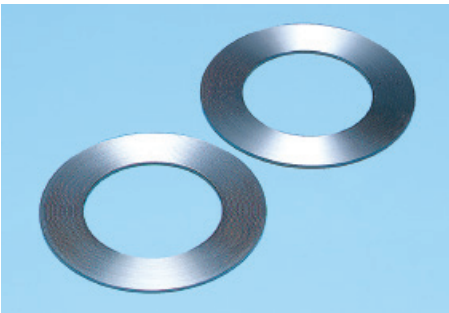
**Application:** Pipe flanges, valves, pressure vessels, heat exchangers, etc. under high temperature and high pressure conditions where the flange cannot be processed into the specified shape.

**Service use:** Depends on the material

**Construction:** A flat gasket manufactured by lathe processing by cutting out from flat plates, round bars, forged metals, etc.

- Features**
- Plain type gasket made by flat processing metal.
  - High seating stress is required to ensure good sealing with the flange

## TOMBO™ No. 1890 Serrated metallic gasket



**Application:** For pipe flanges, valves, pressure vessels, heat exchangers, etc. that required to obtain better sealing performance with the same tightening force as plain gaskets.

**Service range:** Depends on the material

**Construction:** A flat metal gasket with triangular grooves processed concentrically and a gasket with a sawtooth cross section.

- Features**
- Compared to flat metal gaskets, its shape provides higher sealing performance.
  - This gasket can withstand high seating stress, however the flange surface sometimes could be damaged.

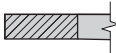

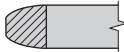



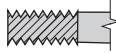
### ■ TOMBO No. indication When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. 1850		P	—	S	—	F			
TOMBO No. 1890			—	S	—				
Type of product		Shape		Materials		Special treatment			
Type of product	Indication symbol	Shape	Indication symbol	Materials <sup>Note 1</sup>	Indication symbol	Materials	Indication symbol	Special treatment	Indication symbol
Other than serrated type	1850	Plane	P	Pure iron	D	321 stainless steel	J	Polishing	F
Serrated type	1890	Delta	D	Dead soft steel	S	347 stainless steel	K	None	No indication symbol
		Lens shaped	L	5Cr-0.5Mo steel	F	Alloy 400	M		
		Others	No indication symbol	13Cr steel	R	Nickel	N		
		Other than TOMBO 1890		304 stainless steel	E	Titanium	T		
				304L stainless steel	L	Aluminum	A		
				316 stainless steel	G	Copper	C		
				316L stainless steel	H	Materials other than the above	Z		

\* In order to improve conformability, it can be applied only to TOMBO No.1850P-S by polishing the sealing surface with concentric circles.

Note 1: Other metal materials are also manufactured as specified. It is recommended that the gasket be made of a Brinell hardness (HB) that is 30 to 40 degrees softer than the flange material.

## Line-up

Shape	Product name	Indication symbol	Features
	Plain metallic gasket	P	Flat metallic gasket with a square cross section
	Delta metallic gasket	D	Self-sealing gasket with triangular cross section (Delta ring)
	Lens shaped metallic gasket	L	High pressure metal self-sealing gasket (lens ring) that has a cross-sectional shape with the lens shaped cross section and makes line contact with the flange.
	Double cone shaped metallic gasket	No symbol	High pressure metal self-sealing gasket with double conical cross section
	Bridgeman shaped metallic gasket	No symbol	Metal self-seal gasket for high pressure with wedge-shaped cross section (pressure seal, seal ring)
	Round metallic gasket	No symbol	Metallic gasket with a round cross section
	Serrated metallic gasket	No symbol	Metallic gasket with a sawtooth cross section

\* Please contact us for shapes other than the above.

## Plain type metallic gaskets

TOMBO™ No.	1850P-S	1850P-E, P-G, others	1850P-C	1850P-A
Material	Carbon steel	304 stainless steel, 316 stainless steel, others	Copper	Aluminum
Gasket coefficient m [-]	5.50	6.50	4.75	4.00
Min. design seating stress $\gamma$ [N/mm <sup>2</sup> ]	124.2	179.3	89.6	60.7
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water-type and oil-type fluids	98.1	117.7	58.8
	Gas-type fluids	235.4	343.2	98.1

## Serrated metallic gaskets

TOMBO™ No.	1890-S	1890-E, 1890-G, others	1890-C	1890-A
Material	Carbon steel	304 stainless steel, 316 stainless steel, others	Copper	Aluminum
Gasket coefficient m [-]	3.75	4.25	3.50	3.25
Min. design seating stress $\gamma$ [N/mm <sup>2</sup> ]	52.4	69.6	44.8	38.0

## ■ Type of metal and service temperature

Material	Material symbol	Max. Service temperature [°C]	Hardness <sup>註1</sup>	
			HB	HV
Soft iron	D	538	90	—
Low-carbon-steel	S	538	120	140
5Cr-0.5Mo steel	F	649	130	—
13Cr steel	R	704	170	190
304 stainless steel	E	816	160	180
304 L stainless steel	L	816	150	170
316 stainless steel	G	816	160	180
316 L stainless steel	H	816	150	170
321 stainless steel	J	816	160	180
347 stainless steel	K	816	160	180
Alloy400	M	800	(130)	150
Nickel	N	760	(120)	140
Titanium	T	800	(140)	180
Aluminum	A	300	—	40
Copper	C	400	—	80

Note 1: Hardness HB is based on JPI-7S-23 "Ring-Joint Gaskets and Grooves for Petroleum Industry" when forged material is used as a material.  
HV is the standard hardness when using steel plate.

\* ( ) Is a reference value.

\* Please contact us for the availability of materials that are not listed.

## ■ Production range

Production range of TOMBO NO.1850P-D and TOMBO NO.1850P-S-F

TOMBO No.	Gasket thickness
1850P-D	1.6mm and above
1850P-S-F	1.6mm and below

\* Other than the above dimensions (nominal size, width), we may be able to manufacture, so please contact us.

## ■ Gasket contact surface finish

The recommended surface roughness is as follows.

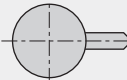

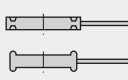
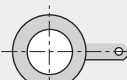
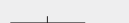
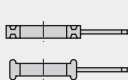
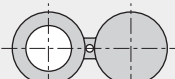

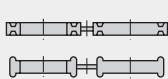
- For sealing liquid: 1.6 $\mu$ mRa max
- For sealing gas: 1.6 $\mu$ mRa max

## ■ Precautions for use

It is recommended to use together with gasket paste for sealing gas, vacuum and volatile fluids (Neverseerz Nickel Special Grade: Operating Temperature -183 ~1316°C)

## Blinds, spacers, spectacle blinds

We also manufacture spectacle blinds that are integrated with blinds and spacers that are used together with various gaskets to block pipes and to shut off pressure during sealing and pressure resistance tests. Some are integrated with the ring joint gasket. Please specify the material, dimensions, etc.

	shape	RF type	RTJ type
TOMBO No.1850-BL blind			
TOMBO No.1850-SP spacer			
TOMBO No.1850-SB spectacle blind			

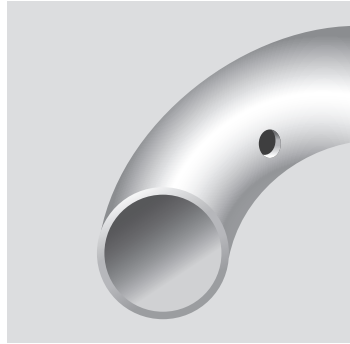


# Metal O seals

TOMBO™ No. **9200P**  
Standard Metal O seal™



TOMBO™ No. **9200V**  
Vent hole type Metal O seal™



- Structure:**
- A gasket in which a metal thin tube is formed into an O-ring shape, the end face is welded, and the surface is ultra-smooth finished.
  - TOMBO No.9200V has two or more small holes on the inside (for internal pressure) or outside (for external pressure) of the ring, and fluid enters the ring, exhibits self-sealing performance.
  - Since it is used by putting it in a groove and closing it, a high-pressure seal can be made with a small tightening force.
- Usage:** Equipment fittings, processing machines, compression equipment, and various engines that require a compact design.
- TOMBO No.9200P... Fluid from vacuum to about 7.0MPa.
  - TOMBO No.9200V... High pressure seal of 7.0MPa or more.

**Service range:** Depends on the material

- Features**
- Stable and high sealing performance can be obtained over a wide range from high temperature to low temperature and high pressure to vacuum.
  - PTFE coating or silver plating specifications are recommended for gases, vacuum and highly volatile fluids.

**TOMBO No. indication** When ordering, please specify the product specifications (TOMBO No.) as below.

TOMBO No. **9200 P — J AG**

Shape — Tube material — Surface treatment material

Shape	indication symbol	Tube material	indication symbol	Surface treatment material	indication symbol
standard type	<b>P</b>	321 stainless steel	<b>J</b>	None	<b>No symbol</b>
vent hole type	<b>V</b>	Alloy 600	<b>Y</b>	Silver plating	<b>AG</b>
				PTFE coating	<b>TF</b>

[Reference: old material symbol]

321 stainless steel	<b>321</b>
Alloy 600	<b>In</b>
Silver plating	<b>Ag</b>
PTFE coating	<b>TFE</b>

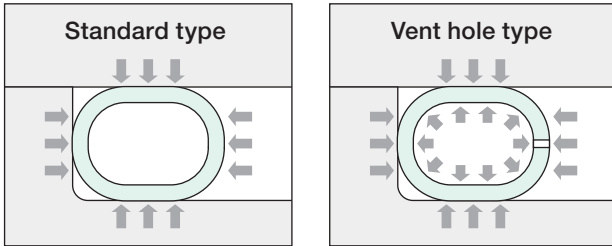
## Service range

Tube material <sup>Note 1</sup>	Surface treatment <sup>Note 2</sup>	Service temperature range [°C]	Service pressure
321 stainless steel	None	-250~500	High water pressure: 400MPa High pressure gas: 300MPa Vacuum: 10 <sup>-4</sup> Pa
	Silver plating		
	PTFE coating	-250~250	
Alloy 600	None	-250~700	Vacuum: 10 <sup>-4</sup> Pa
	Silver plating		
	PTFE coating	-250~250	

Note 1: Metal O seals can only be manufactured from 321 stainless steel and Alloy 600.

Note 2: The surface treatment thickness is 0.03 to 0.05 mm. Surface treatment should be applied to gas, vacuum and volatile fluid seals.

## Line-up



For high pressure of 7.0MPa and above, we recommend the vent hole type.

## Tightening criteria

For the actual tightening load, apply the sum of the load (Wx) for the end force due to the fluid pressure and the load (Wy) calculated from the compression load (Y) as the minimum tightening load. We recommend to apply safety factor to this value.

Tube cross section diameter [mm]	Wall thickness [mm]	Compression load [N/mm]
φ 0.8	0.15	69
φ 1.6	0.25	118
	0.36	284
φ 2.4	0.25	59
	0.46	235
φ 3.2	0.25	49
	0.35	88
	0.5	177
φ 4.8	0.5	69
	0.8	333
φ 6.4	0.8	177

■ Total minimum tightening load  
 $W = Wx + Wy$   
 $= \frac{\pi}{4} G^2 P + \pi G Y$

W: Total bolt load [N]  
 G: Gasket O.D [mm]  
 P: Pressure [MPa]  
 Y: Compression load [N/mm]

\* Compressive load indicates the load required to close the flange.

## Standard dimension

Tube cross section diameter [mm]	Wall thickness [mm]	Range of outer diameter [mm]	
		recommended service range	Manufacturable dimensions
φ 0.8	0.15	6 ~ 25	6 ~ 30
φ 1.6	0.25	—	12 ~ 200
	0.36	15 ~ 50	11 ~ 200
φ 2.4	0.25	—	40 ~ 500
	0.46	40 ~ 200	20 ~ 500
φ 3.2	0.25	—	60 ~ 1270
	0.35 <sup>Note 1</sup>	—	60 ~ 1270
	0.5	65 ~ 700	40 ~ 1270
φ 4.8	0.5 <sup>Note 1</sup>	—	150 ~ 1500
	0.8	500 ~ 1200	150 ~ 1500
φ 6.4	0.8	1000 ~ 1500	250 ~ 1500 <sup>Note 2</sup>

■ Minimum value of corner R in the case of a square gasket

For standard wall thickness (▨ area)  
 Radius of I.D side ≥ 6 times the O.D of the tube

For wall thickness that is less than standard wall thickness  
 Radius of I.D side ≥ 8 times the O.D of the tube

Note 1: The tube material that can be manufactured is only 321 stainless steel.

Note 2: Please contact us if it exceeds 1500mm.

Please contact us if outer diameter exceeds 1500mm.

\* ▨ Indicates standard wall thickness. For gas seals, use standard wall thickness.

\* ▨ The minimum outer diameter of the vent hole type is φ 10mm.

\* ▨ The maximum outer diameter of PTFE coating is φ 630mm, and the maximum outer diameter of silver plating is φ 1300mm. Please contact us for more information.

## Groove dimensions

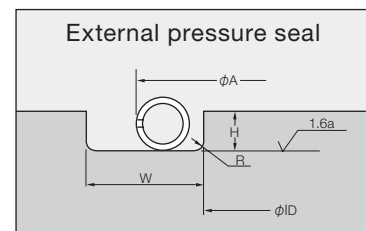
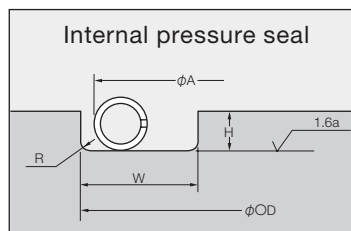
### Without surface treatment

Tube cross section diameter [mm]	For internal pressure seal Groove O.D [mm]	For external pressure seal Groove I.D [mm]	Groove radius (R) [mm]	Groove width (W) [mm]		Groove depth (H) [mm]
				Maximum	Recommended / Minimum	
φ 0.8	A +0.35 +0.25	(A-1.6) -0.25 -0.35	0.2	1.2 min	1.1	0.60±0.05
φ 1.6	A +0.40 +0.30	(A-3.2) -0.30 -0.40	0.3	2.4 min	2.0	1.15±0.05
φ 2.4	A +0.40 +0.30	(A-4.8) -0.30 -0.40	0.5	3.6 min	2.9	1.75±0.05
φ 3.2	A +0.50 +0.35	(A-6.4) -0.35 -0.50	0.8	4.8 min	3.7	2.55±0.05
φ 4.8	A +0.50 +0.35	(A-9.6) -0.35 -0.50	0.8	7.2 min	5.6	3.75±0.05
φ 6.4	A +0.55 +0.40	(A-12.8) -0.40 -0.55	0.8	9.6 min	7.5	5.00±0.05

### With coating / plating

Tube cross section diameter [mm]	For internal pressure seal Groove O.D [mm]	For external pressure seal Groove I.D [mm]	Groove radius (R) [mm]	Groove width (W) [mm]		Groove depth (H) [mm]
				Maximum	Recommended / Minimum	
φ 0.8	(A+0.1) +0.35 +0.25	(A-1.7) -0.25 -0.35	0.2	1.3 min	1.2	0.70±0.05
φ 1.6	(A+0.1) +0.40 +0.30	(A-3.3) -0.30 -0.40	0.3	2.5 min	2.1	1.25±0.05
φ 2.4	(A+0.1) +0.40 +0.30	(A-4.9) -0.30 -0.40	0.5	3.7 min	3.0	1.85±0.05
φ 3.2	(A+0.1) +0.50 +0.35	(A-6.5) -0.35 -0.50	0.8	4.9 min	3.8	2.65±0.05
φ 4.8	(A+0.1) +0.50 +0.35	(A-9.7) -0.35 -0.50	0.8	7.3 min	5.7	3.85±0.05
φ 6.4	(A+0.1) +0.55 +0.40	(A-12.9) -0.40 -0.55	0.8	9.7 min	7.6	5.10±0.05

A = O.D of gasket



## Gasket contact surface finish

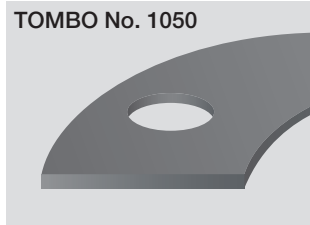
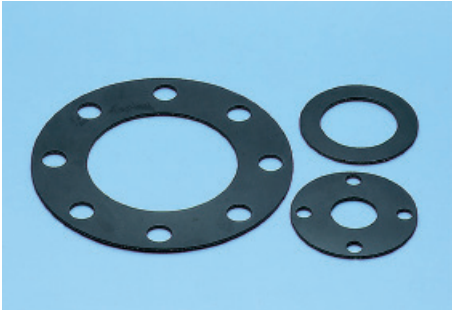
The recommended surface roughness is as follows.

- Fo gas seal or vacuum: 0.8µmRa max
- Other cases: 1.6µmRa max

# Rubber gaskets

Since it is made of elastic rubber as a base material, it has a feature that it fits well with the flange even at a low seating stress.

## TOMBO™ No. 1050/1051 | Rubber cut gaskets



A gasket is formed by cutting a rubber sheet into gasket shape



A gasket is made by cutting rubber sheet reinforced with polyester cloth into gasket shape.

Features

- A gasket that can be sealed with low seating stress due to the elasticity, resilience, and conformability of rubber.

\* Since TOMBO No. 1051 is reinforced with a polyester layer, the bulging from the flange is small. However, this gasket is not suitable for gas seal because leakage due to permeation is liable to occur.

**Service temperature range:** Depends on the rubber material

**Maximum service pressure:** Maximum working pressure 1.0MPa

### Standard dimensions

thickness [mm]	width [mm]	max O.D. [mm]
1.0	1000	φ1000
1.5		
2.0		
3.0		
5.0		
10.0		

\* The minimum thickness of 1051-NR gasket is 1.5mm

### Design criteria

TOMBO No.		1050	1050	1051
		(HS Note 1 less than 75)	(HS Note 1 75 or more)	
Gasket factor $m$	[-]	0.50	1.00	1.25
Min. design seating stress $y$	[N/mm <sup>2</sup> ]	0.0	1.4	2.8
Min. seating stress $\sigma_3$	water oil type fluids	1.5	2.0	2.9
	gas type fluid	2.0	2.9	—
Allowable seating stress	[N/mm <sup>2</sup> ]	14.7	14.7	14.7

Note 1: Hardness of rubber (by Type A durometer)

### Gasket contact surface finish

The recommended surface roughness is as follows.

- For sealing liquid : 12.5μmRa max
- For sealing gas : 12.5μmRa max

### Standard materials

Material	NICHIAS material code	service temperature range [°C]	TOMBO No.	
			1050	1051
Nitrile rubber (oil resistant)	NBR	-30 ~ 120	●	●
Chloroprene (weather resistant)	CR	-30 ~ 120	●	●
Ethylene-propylene rubber (weather and vapor resistant)	EP	-40 ~ 150	●	—
Butyl rubber (weather resistant, acid resistant, and vapor resistant)	IIR	-30 ~ 150	●	—
Silicone rubber (weather resistant and cold resistant)	SI	-50 ~ 200	●	—
Fluorine rubber (heat resistant)	FA	-15 ~ 200	●	—
Fluoro rubber (corrosion resistant)	FS	0 ~ 200	●	—
Natural rubber	NR	-20 ~ 100	●	●

**TOMBO™ No. 2670/2675** | Rubber O-ring / BLAZER™ O-ring



A rubber O-ring made by molding various elastic rubber.

- Features**
- It has excellent compatibility and can seal from vacuum to high pressure of about 25MPa even with a small tightening load.
  - Can be used as a gasket by putting it in a groove other than the shaft seal (packing).

**Service temperature range:** Depends on the rubber material

**Maximum service pressure:** 25MPa \*Considering the clearance and backup ring, it can be used even at 25MPa or more.

### Standard dimensions

- JIS B2401 “O-rings”
- AS 568B “Aerospace size standards for O rings”
- JIS B8365 “Dimension of Clamped type Vacuum Couplings”

### Service temperature and basic physical properties

ASTM abbreviation (type of rubber)	FFKM			Special FKM		FKM		Q	EPDM	CR	NBR	
Material name	BLAZER Next	BLAZER A	BLAZER S2	BLAZER FC	BLAZER FE	Fluoro rubber FB	Fluoro rubber FA	Silicone rubber	Ethylene propylene rubber	Chloroprene rubber	Nitrile rubber	
NICHIAS material symbol	BNX	A	S2	FC	FE	FB	FA	SI	EP	CR	NBR	
Features	Heat resistant	Chemical resistant	Steam resistant	Plasma resistant	Plasma resistant	Acid and steam resistant	Heat resistant	Heat resistant	Weather and water resistant	Weather and oil resistant	Mineral oil resistant	
JIS class	—	—	—	—	—	—	FKM-70	VMQ-70	EPDM-70	—	NBR-70-1	
color	black	black	black	black	black	black	black	reddish brown	black	black	black	
Service temperature range [°C]	0~335	0~210	0~320	0~200	0~200	0~200	-15~200	-50~200	-40~150	-30~120	-30~120	
Normal physical properties	Type A Durometer Hardness	76	75	80	60	60	70	69	70	70	67	68
	Tensile strength [MPa]	11.1	13.1	15.3	18.8	11.4	15.7	15.3	6.3	15.3	12.8	16.4
	Elongation [%]	140	150	198	210	230	460	300	260	280	260	300
	Tensile stress [100% elongation]	8.3	6.4	15.6	3.9	3.5	2.8	3.3	—	—	4.2	3.0
Compression set characteristics	Temperature x time [°C] x [hrs]	300x72	150x72	300x72	100x72	100x72	175x24	200x72	175x72	100x72	100x72	120x72
	Compression set [%]	26	20	45	9	9	20	22	27	8	29	13
Aging resistance	Temperature x time [°C] x [hrs]	—	—	—	—	—	230x24	230x24	230x72	100x72	100x72	120x72
	Type A Durometer Hardness change	—	—	—	—	—	0	+1	-6	+1	+9	+4
	Rate of change in tensile strength [%]	—	—	—	—	—	-13.0	-5	-8	+9	+8	-3
	Rate of change in elongation [%]	—	—	—	—	—	-6.0	0	-23	+4	-23	-29

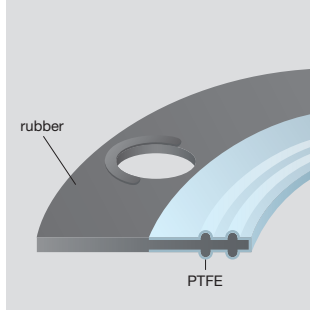
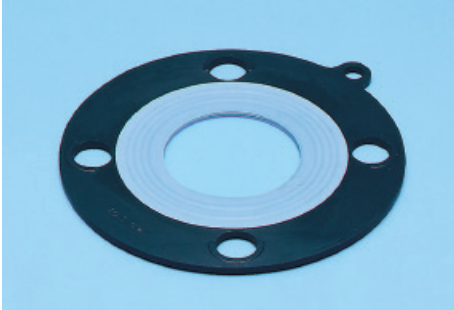
\* The above values are actual measurements, not standard values.

Measured by: NICHIAS

\* The Table above indicates the general physical properties of rubber O rings. For more details, please refer to “Rubber O rings” catalog.

\* In addition to the above, there are butyl rubber (IIR) and hydrogenated nitrile rubber (ZR).

## TOMBO™ No.9013/9013-D | EBILON™ gasket



Gasket with a rubber core integrated with a pressurized and heat-formed PTFE film.

- Features**
- This gasket combines the elasticity of rubber with the corrosion resistance of PTFE, resulting in excellent sealing performance.
  - It is ideal for PVC pipes, glass lined pipes and other applications where a large tightening force cannot be applied.

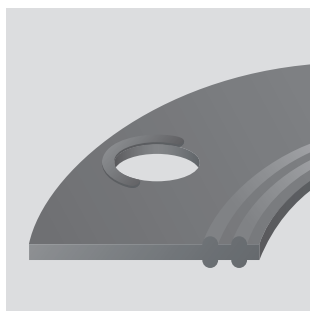
**Service temperature range:** -40 to 150°C

**Maximum service pressure:** 1.0MPa

**Flange shape:** Full face

**Line-up:** TOMBO No.9013 EPDM coated with PTFE TOMBO No.9013-D Special EPDM for electrolytic cell coated with PTFE

## TOMBO™ No.9013-EP/-DEP | EBILON™ gasket



- Features**
- Stable sealing performance can be obtained with a lower surface pressure than the rubber cut gasket.

\* This gasket is recommended for mild usage conditions and low requirement for chemical resistance.

**Service temperature range:** -40 to 150°C

**Maximum service pressure:** 1.0MPa

**Flange shape:** Full face

**Line-up:** TOMBO No.9013 EPDM coated with PTFE TOMBO No.9013-D Special EPDM for electrolytic cell coated with PTFE

### Standard dimensions

- Plastic flange (equivalent to JIS 10K) 15A to 300A
- ANSI class 150 1/2 ~ 12B

### Product thickness

The thickness of the rib part is 5mm, and the thickness other than the rib is 3mm.



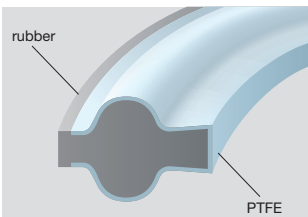
### Gasket contact surface finish

The recommended surface roughness is as follows.

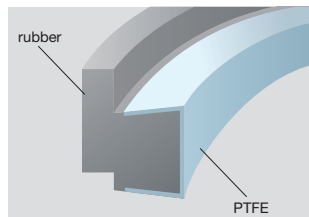
- For sealing liquid : 12.5µmRa max
- For sealing gas : 12.5µmRa max

\* When used for steel flanges, the roughness of the gasket seat is 6.3 µmRa.

**TOMBO™ No. 9014-B / BW**  
SANICLEAN™ gasket for ferrules



**TOMBO™ No. 9014-A**  
SANICLEAN™ gaskets for screw coupling



A type of combination sanitary gasket in which the surface is made of elastic rubber and covered with PTFE film that has excellent chemical resistance, heat resistance and contamination free.

Features

- Conforms to FDA (US Food and Drug Administration)<sup>1</sup> and USP (US Pharmacopeia)<sup>2</sup>.
- No surface deterioration due to hot water, acid, or base used during cleaning work (sanitation).
- Since there is little liquid adhesion and penetration, it can be expected to shorten the sanitization process during the flavor change<sup>3</sup>.

Note 1: §177.1550 Perfluorocarbon Resins §177.2600 Rubber articles intended for repeat use

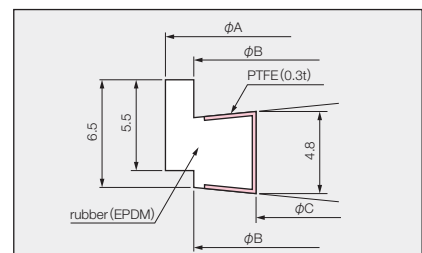
Note 2: <87> Biological Reactivity Tests, In Vitro <88> Biological Reactivity Tests, In Vivo (Class VI)

Note 3: Flavor change: Changing the production item on a production line that shares several types of beverages, such as a product filling line.

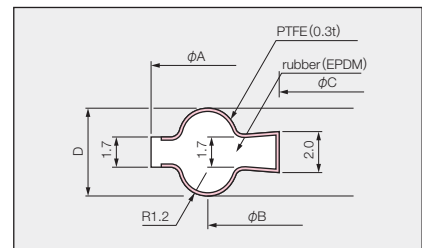
Max service temperature: -40 ~ 150°C Max. service pressure: 1.0MPa

**Standard dimension**

Nominal dimension	TOMBO No.						
	9014-A (for screw coupling) [mm]			9014-B / BW (for ferrule) [mm]			
	φA	φB	φC	φA	φB	φC	D
8A	—	—	—	34.0	27.5	10.5	5.0
10A	—	—	—	34.0	27.5	14.0	
15A	—	—	—	34.0	27.5	17.5	
1B	32.5	29.2	23.0	49.5 (49.0)	43.5	23.1	5.3
1 1/2 B	46.0	42.7	35.6	49.5 (49.2)	43.5	35.8	
2B	59.5	56.2	47.8	63.0 (62.5)	56.5	48.0	
2 1/2 B	73.0	69.9	59.5	76.5	70.5	59.7	
3B	86.5	82.6	72.1	90.0	83.5	72.3	
3 1/2 B	—	—	—	105.0	97.0	85.2	
4B	112.5	108.3	97.6	118.0	110.0	97.8	



TOMBO No.9014-A (For screw coupling)



TOMBO No.9014-B / BW (For ferrule)

\* For sizes with different standard dimensions for B type and BW type the numbers in parentheses indicate the standard dimensions for BW type. Also, 3 1/2 B is only B type.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

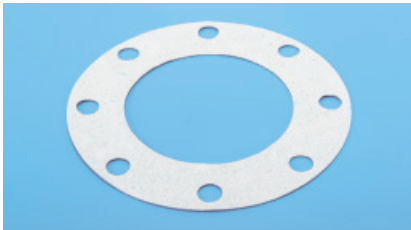
Pastes and other sealing materials

# Cloth gaskets

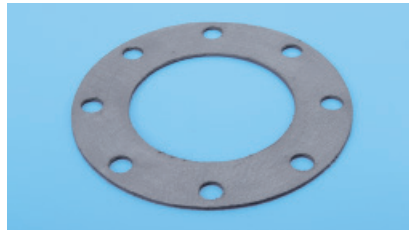
A sealing material made by processing a woven fabric coated with a rubber compound to a specified shape and thickness. Depending on the shape, there are processing methods such as cutting with a die and sewing. Since it is possible to process large diameters and the amount of compression under low load is large, it is used for sealing high temperature ducts that cannot take high tightening surface pressure.

Due to the characteristics of gasket, it is not suitable for tight seal applications. Please use it in a place where some leakages can be tolerated.

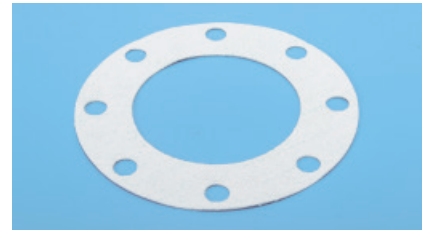
**TOMBO™ No. 1420-ST**  
Super Manhole™ gasket-ST



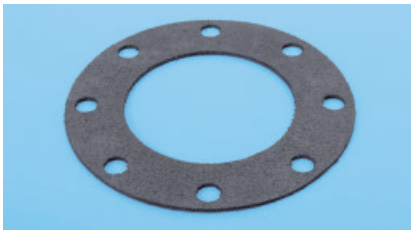
**TOMBO™ No. 1420-S**  
Super Manhole™ gasket-S



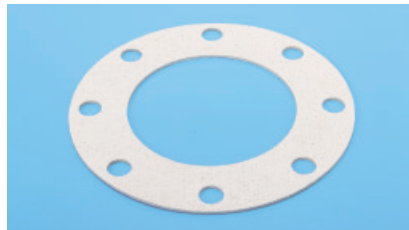
**TOMBO™ No. 1420-TH**  
Super Manhole™ gasket-TH



**TOMBO™ No. 1400-NA**  
Super Manhole™ gasket-NA



**TOMBO™ No. 1374**  
Manhole gasket



TOMBO No.		1420-ST	1420-S	1420-TH	1400-NA	1374
Cloth structure	Weft	AES fiber + SUS wire	AES fiber + SUS wire	AES fiber + SUS wire	Glass fiber + SUS wire	Glass fiber
	Warp	AES fiber + SUS wire	SUS wire	AES fiber + SUS wire	SUS wire	Glass fiber
Max. service temperature	□	800	800	600	600	400
Color tone		Yellowish white (partly green)	Gray	Yellowish white (partly green)	Black	Cream
Smoke emission (organic matter)		25% max	20% max	20% max	15% max	25% max

Heat resistance		400 °C	600 °C	800 °C	Point of selection
Stiffness	Strong [hardness]	—	1400-NA (Deflection amount: 1mm)	1420-S (0mm)	Since products with strong stiffness do not easily bend even with a large diameter, they are excellent in handling when installing with a gasket upright or when inserting into a flange that does not open between faces. Please select especially when handling is important.
		1374 (18mm)	—	—	
	Weak [softness]	—	1420-TH (47mm)	1420-ST (42mm)	

Value inside ( ) holds one end of a test piece with a size of 20mm x 200mm and bends due to its own weight.

Measured by: NICHIAS

**Application**

Manholes for exhaust gas, hot air, hand holes, autoclaves, large diameter flanges.  
Diesel engine exhaust pipe, flue manhole, boiler combustion

**Line-up**

**TOMBO No.1374-G**

TOMBO No.1374 with anti-seizure treatment (graphite treatment). Black.

**TOMBO No.1420-THG**

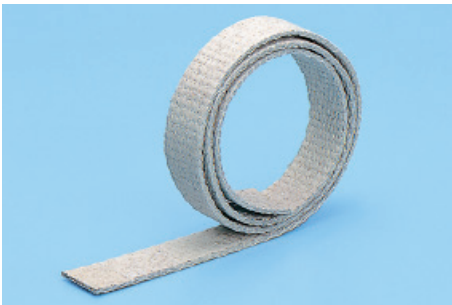
TOMBO No.1420-TH with anti-seizure treatment (graphite treatment). Black.

**TOMBO No.9094 NAFLON Manhole Gasket**

A manhole gasket that uses PTFE dispersion as the filler material, and is used for ducts that require chemical resistance and solvent resistance, and for corrosive gases such as acidic exhaust gas. Heat resistant temperature is 300 °C. The color is white.



**TOMBO™ No. 1364** | NA gasket tape



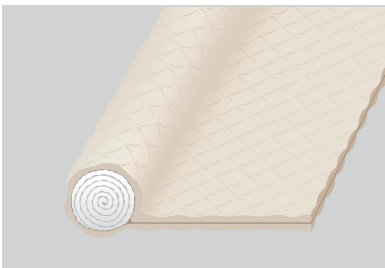
This gasket tape consists of woven glass cloth coated with natural rubber and folded to form a laminated tape.

**Service temperature:** 400°C

**Color tone:** gray

**Application:** Low pressure vapor, Manholes for exhaust gas, hot air, hand holes, autoclaves, large diameter flanges

**TOMBO™ No. 1368**  
NA tadpole gasket tape



A gasket tape consists of a core of woven glass cloth coated with rubber compound and coiled and its outer skin is formed as shown in left figure.

**TOMBO™ No. 1378**  
NA Tadpole gasket



TOMBO No. 1368 formed into ring and sewn into the shape of a gasket

**Service temperature:** 400°C

**Color tone:** gray

**Application:** Doors such as furnaces, heaters and dryers, and manholes such as dampers, exhaust gas, hot air and dust.

**Line-up:** TOMBO No. 1368-G Anti-seizure treatment for TOMBO No.1368 (Graphite treatment). Black.

**Standard dimension**

TOMBO No.	1420-ST	1420-S	1420-TH 1420-THG	1400-NA	1374 1374-G	9094	1364	1368 1368-G	1378
Nominal thickness [mm]	2.0	—	●	—	—	—	—	—	—
	2.5	●	—	—	—	—	—	—	—
	3.0	—	●	—	—	—	—	—	—
	3.2	—	—	—	●	●	●	●	●
	4.0	—	—	●	—	—	—	—	—
	4.8	—	—	—	●	●	●	—	—
	5.0	●	●	—	—	—	—	—	—
	6.0	—	●	●	—	—	—	—	—
	6.4	—	—	—	●	●	●	—	—
	7.5	●	—	—	—	—	—	—	—
	8.0	—	●	●	●	●	—	—	—
	9.6	—	—	—	●	●	—	—	—
	10.0	●	●	●	—	—	—	—	—
12.5	●	—	—	—	—	—	—	—	
Dimensions	Please specify						[width mm] 13, 20, 25, 30, 40, 50 [length m] 30	[height mm] 6.4, 7.9, 9.5, 11.1, 12.7, 15.9, 19.1, 22.2, 25.4	Please specify

**⚠ Precautions when using cloth gaskets**

Since an organic binder is used, organic gas is generated during the initial heating. Ventilate during initial heating  
Gasket with metal wires may be injured by the metal wires protruding from the end face.  
Please handle it with care.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

A sealing aid for gaskets. By applying a thin layer on the contact surface with the flange, it is effective in improving the sealing property and preventing seizure.

## TOMBO™ No.9105 | AQUA-TIGHT™ Paste



- Features:** A gasket paste suitable for water-based fluids, which is a mixture of a special oil-soluble binder and fine powder of mica.
- Application:** Water-based fluids such as water, steam, hot water, seawater, acids, alkalis, and salt solutions.
- Color:** cream color
- Service temperature range:** -200°C ~ 200°C
- Application amount:** Approximately 200g/m<sup>2</sup> (12.5m<sup>2</sup>/can)
- Capacity:** 2.5 kg polyethylene container

## TOMBO™ No.9106 | OIL-TIGHT™ Paste



- Features:** Gasket paste suitable for oil-based fluids, which is a mixture of fine powder of mica in a water-soluble binder with excellent oil resistance and solvent resistance.
- Applications:** Petroleum oil, oil gas, solvent, solvent steam, animal and vegetable oil, hydrocarbon fluid, exhaust gas, etc.
- Color phase:** cream color
- Operating temperature range:** -200°C to 900°C
- Application amount:** Approximately 300g/m<sup>2</sup> (8.3m<sup>2</sup>/can)
- Capacity:** 2.5 kg polyethylene container

## TOMBO™ No.9400 | NAFLON™ Paste



- Features:** Room temperature inert gasket paste in which colloidal fine particles of fluororesin are dispersed in water. A versatile gasket paste that has excellent chemical resistance and can be used for acidic fluids and corrosive fluids. \* NAFLON paste is the most suitable for PTFE gaskets.
- Application:** Various water-based fluids, various oil-based fluids, acidic fluids, corrosive fluids, vacuum seals.
- Color:** White
- Operating temperature range:** ~ 260°C
- Application amount:** Approximately 50g/m<sup>2</sup> (2m<sup>2</sup>/tube)
- Capacity:** 65cc (about 100g) containing tube, 700cc (about 1kg) containing polyethylene container

## TOMBO™ No.9401 | Fluorine grease



- Features:** Grease made by adding a fine powder polymer substance that is chemically inert and has high heat resistance to fluororesin oil.
- Application:** Oxygen, corrosive fluid, vacuum seal.
- Color:** Milky white
- Operating temperature range:** ~ 150°C
- Application amount:** Approximately 50g/m<sup>2</sup> (1m<sup>2</sup>/tube)
- Capacity:** 50g tube

## ■ Applicable paste

Indicates the standard paste to use. It may not be usable depending on conditions such as temperature and fluid.

Gasket		Fluid		Suitable paste (TOMBO No.)	
Product name	TOMBO No.	gas	liquid <sup>Note 1</sup>		
Jointing sheet <sup>Note 2</sup>	1995、1120、1993	○	△	9105、9106、9400	
Fluoropolymer gasket	1133、9007-LC、9007-SC	○	△	9400	
VORTEX gasket (GRASEAL, NAFLON, high temperature combination)	GRASEAL	1834R-GR series	x <sup>Note 3</sup>	x <sup>Note 3</sup>	—
	NA	1834R-NA series	△	△	—
	NAFLON	9090 series	△	△	—
	high temperature combination	1836R-GM、-GS、-GH series	x <sup>Note 3</sup>	x <sup>Note 3</sup>	—
Metal jacketed gasket	1841、1841-FI	○	△	NeverSeez	
Kammprofile gasket	1891-GR	x <sup>Note 3</sup>	x <sup>Note 3</sup>	—	
Ring joint gasket	1850C、1850V	x <sup>Note 4</sup>	x <sup>Note 4</sup>	—	
Flat metallic gasket	1850-P	○	△	NeverSeez	

- : Recommended to use
- △: Optional (can be used)
- x: Cannot be used

Note 1: When carry out air tightness test in liquid fluid condition, please follow the gas condition.

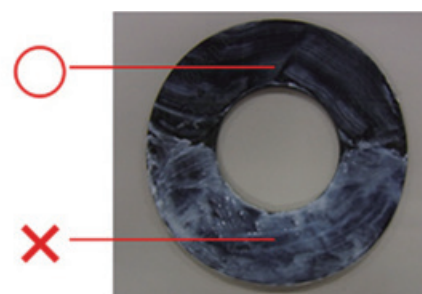
Note 2: When solvent based paste is used in jointing sheet, the jointing sheet may undergone compressive breakage at below allowable seating stress. In addition, the use of silicone based paste, it may cause the slipping of the gasket during tightening and thus compressive breakage easily occurs. Please consult us about this usage.

Note 3: If a gasket using expanded graphite is used and a paste containing metal such as NeverSeez is used under high temperature conditions, the expanded graphite may be oxidized and disappear due to the catalytic action of the paste components. Therefore, it cannot be used.

Note 4: Since the ring joint gasket is sealed by rubbing together, the paste may become foreign matter and the sealing performance may deteriorate if it is used continuously. Therefore, it cannot be used.

## ⚠ Precautions for using gasket paste

- Gasket paste cannot be used alone. Be sure to apply it to the gasket before use.
- Use a brush, waste cloth, etc. to spread the gasket paste thinly as shown by “○” in the figure on the right. Applying a large amount such as “x” may lead to the destruction of the gasket. (Refer to P17 case study)
- When using for the purpose of improving the gas sealability of the jointing sheet, apply gasket paste to the end face on the inner diameter side to prevent gas permeation leakage.
- Set the gasket on the flange before the gasket paste has completely dried.
- Stir the canned gasket paste well before use.
- After use, close the lid tightly and store in a cool and dark place.
- A slight fine particles of paste may elute. Do not use for fluids that do not like even trace amounts of elution, such as for food applications.

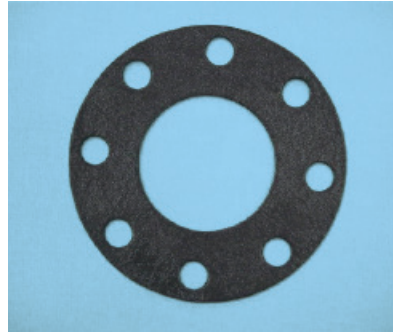
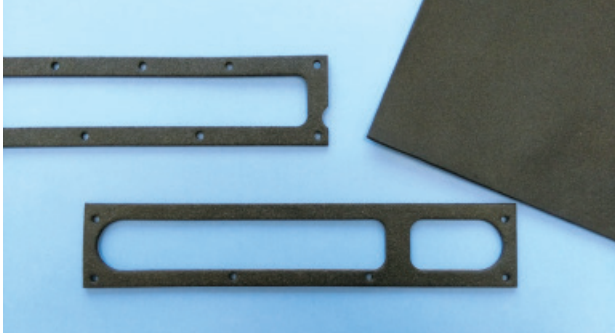


**Approximate paste application amount**

(TOMBO No.9400  
For NAFLON paste)

TOMBO™ No.4140/4140-NK

SOFLEX™ / SOFLEX™-NK processed product



- Soflex is a black foam sheet made by mixing fluoropolymer and various inorganic fillers and molding it into a sponge structure.
- Since the compression rate is very large, it fits well to the flange even with a low tightening force, and high sealing performance can be obtained.
- Excellent chemical resistance due to the use of fluoropolymer.

## Line-up

TOMBO No.4140-NK Soflex-NK. (coated with adhesive for temporary fixing)

Since the adhesive is dot-shaped, it is easy to peel off the release paper and it has excellent workability.

## Applications

- Sealing material for gas water heaters
- Sealing material for petroleum combustion equipment
- Other heat insulating materials

## Standard dimension

Nominal thickness	Dimension [mm]
1.0t	1000×570
2.0t	
3.0t	

\* Any shape can be produced by punching.

## Basic physical properties

Item	Measured value
Density [g/cm <sup>3</sup> ]	0.40
Tensile strength [MPa]	vertical 1.1 horizontal 0.3
Compression rate [%]	load 0.05N/mm <sup>2</sup>
	load 0.10N/mm <sup>2</sup>
Thermal conductivity [W/m·K]	200°C
Max service temperature [°C]	260

\* Physical property values are actual measurement values of our standard products, not standard values.

Measured by: NICHIAS

**TOMBO™ No. 9082 / 9082-BL | NAFLON™ Seal Tape**



**Applications:** Water, steam, oil, chemicals, solvents, etc. Seals for bolts and nuts.  
 \* Do not use for flammable gas or toxic gas.

**Operating temperature range:** -200 to 260°C  
 \* Please use as a guide as it varies depending on the usage conditions.

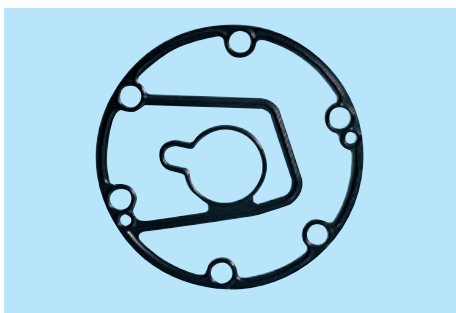
**Standard dimensions:** Thickness 0.1mm, width 13mm, length 5m/15m  
 It is wound on a plastic reel and put in a decorative paper case as a set of 10 rolls.

- Features**
- A product made by extruding unsintered PTFE with an extruder and rolling it into a tape.
  - Because of its high flexibility, it is easy to seal complicated shapes, it does not contaminate fluids, it is easy to put on and take off and it has excellent workability.
- \* When using for threaded joints, be sure to use for tapered screws.

**Line-up**

TOMBO No.	Standard density/cm <sup>3</sup>	Reel color	Features
9082	1.2	green	Standard type (tight sealing)
9082-BL	0.95	blue	Low density type (easier to cut and install than 9082)

**TOMBO™ No. 1600 | METAKOTE™**



**Applications:** Hydraulic equipment, pneumatic equipment, automobile related equipment, compressor gaskets for refrigerators, sealing washers.

**Maximum service temperature:** 180 °C

- Features**
- Gasket with a thin rubber coating on both sides or one side of a thin metal plate and the surface treated with graphite.
  - Good thickness and dimensional accuracy, no leakage.
  - Since stress relaxation is small, retightening is not required.

Sheet gaskets

Semi-metallic gaskets

Metallic gaskets

Rubber gaskets

Cloth gaskets

Pastes and other sealing materials

## Technical data ① Gasket tightening standards and tightening methods

### ■ Gasket tightening criteria

It is very important to tighten gaskets safely using an appropriate force and tightening method.

The “ $W_{m1}$ ” and “ $W_{m2}$ ” which are stipulated in “JIS B8265 (construction of pressure vessel -- General principles)” are generally used as a rough guide for the required tightening force to seal the internal fluid.

However, depending on the type of fluid and usage conditions, these “ $W_{m1}$ ” and “ $W_{m2}$ ” calculated can be insufficient, therefore NICHIAS has set an additional value “ $W_{m3}$ ”.

When tightening the gasket, it is necessary to apply force that is at least the largest values among “ $W_{m1}$ ”, “ $W_{m2}$ ”, and “ $W_{m3}$ ”.

### ■ Concept in tightening calculation

#### - Effective diameter and effective width of a gasket -

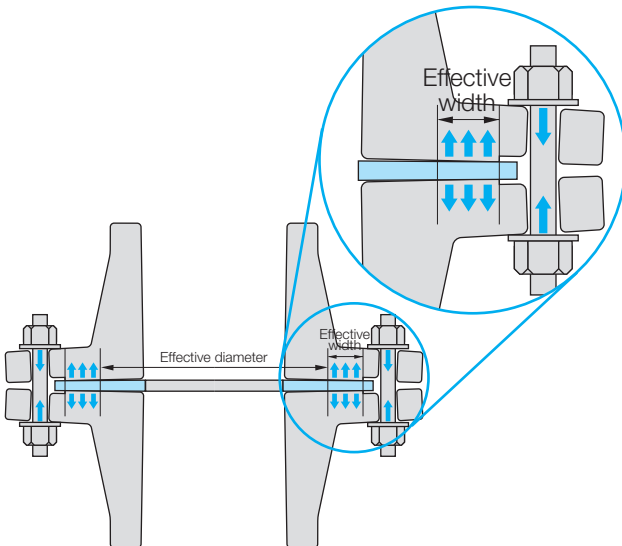
The flange has a convex shape (flange rotation) as shown in diagram due to tightening of the bolts and internal pressure. This is taken into account in the determination of the effective diameter and effective width of the gasket.

#### ● Effective gasket width

The width where a gasket actually sealed

#### ● Effective gasket diameter

The diameter where an internal fluid transmitted.



### ■ To determine the effective gasket width and effective gasket diameter

- First, consider the basic width ( $b_0$ ) of the gasket.

The basic width of the gasket depends on the shape of the gasket seat. However, it is generally half the gasket contact width.

$$b_0 = \text{gasket contact width} / 2$$

- Effective gasket width ( $b$ )

Using the basic width of the gasket as a guide, calculate by the following formula.

$$\text{In the case of } b_0 \leq 6.35 \quad b = b_0$$

$$\text{In the case of } b_0 > 6.35 \quad b = 2.52 \sqrt{b_0}$$

- Effective gasket diameter ( $G$ )

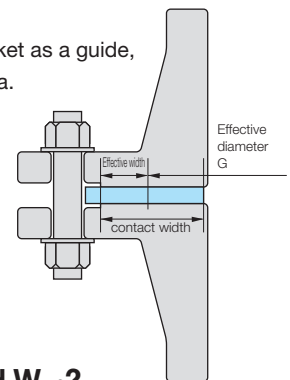
Using the basic width of the gasket as a guide, calculate by the following formula.

$$\text{In the case of } b_0 \leq 6.35$$

$G =$  Average diameter of gasket contact surface

$$\text{In the case of } b_0 > 6.35$$

$G =$  O.D of gasket contact surface  $- 2b$



### ■ What are $W_{m1}$ , $W_{m2}$ and $W_{m3}$ ?

- $W_{m1}$  is the necessary minimum tightening force [N] to prevent the flange from opening under pressure. It is calculated by the following formula.

$$W_{m1} = H + H_p$$

H: Force which tends to open the flange due to internal pressure. This force is called end force (internal pressure reaction).

$$H = \frac{\pi}{4} G^2 P$$

$H_p$ : Force required to seal the internal fluid pressure P

$$H_p = 2\pi b G m P$$

$H_p$  is  $m$  (gasket factor) times the internal pressure P with respect to the effective area of the gasket. Normally, the value is usually doubled in order to provide a safety margin.

$$W_{m1} = H + H_p = \frac{\pi G P}{4} (G + 8bm)$$

- $W_{m2}$  is the required bolt load [N] when tightening the gasket. It is calculated by the following formula.

$$W_{m2} = \pi b G y$$

- Since  $W_{m1}$  and  $W_{m2}$  are calculated regardless of the type of fluid (gas, liquid), the tightening force may be insufficient with these values. The minimum bolt load [N] set by NICHIAS to compensate for this is  $W_{m3}$ , which is calculated by the following formula.

$$W_{m3} = \sigma_3 A_g$$

P = Internal pressure [MPa]

b = Effective gasket width [mm]

G = Effective gasket diameter [mm]

m = Gasket factor [-] (Ratio of minimum effective tightening pressure without leakage and internal pressure)

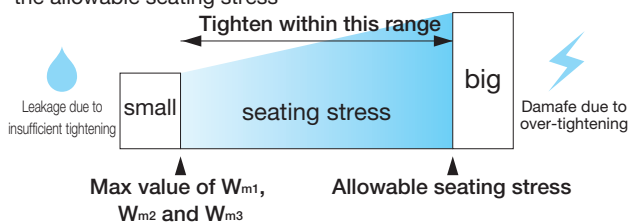
y = Minimum design seating stress [N/mm<sup>2</sup>]

$\sigma_3$  = Minimum seating stress [N/mm<sup>2</sup>]

$A_g$  = Gasket contact area [mm<sup>2</sup>]

## Gasket seating stress

The tightening force of the gasket should be the value calculated from the largest of “ $W_{m1}$ ,  $W_{m2}$ ,  $W_{m3}$ ”. However, in order to prevent compression breakage, it must be less than the allowable seating stress



## Calculation of tightening torque

The tightening torque of the bolts is calculated from the maximum value [ $W_{max}$ ] of  $W_{m1}$ ,  $W_{m2}$  and  $W_{m3}$ .

$$T = \frac{1}{1000} K \frac{W_{min}}{n} D$$

T = Bolt tightening torque [N·m]  
 K = Torque coefficient [—] (normally 0.20)  
 n = Number of bolts [—]  
 D = Bolt diameter [mm]

## JIS B 2251-2008

### Bolt tightening for pressure boundary flanged joint assembly

“Diagonal tightening” is widely adopted as the bolt tightening method in which bolts in diagonal positions are tightened in order. In 2008, JIS B 2251 established tightening method for jointing sheet and flange joint for spiral wound gasket. The method is described in below.

#### <Introduction>

Install gasket correctly centered on the gasket seat to ensure it is not tightened unevenly. Use a torque wrench to control the tightening torque.

#### <Temporary tightening>

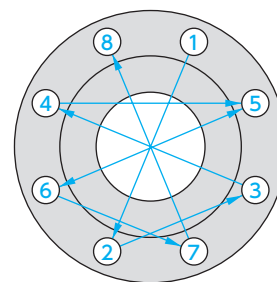
If the number of bolts on the flange is 8 or less, temporarily tighten them according to the following procedure. If the number of bolts is 12 or more, select the bolts to be temporarily tightened according to Table 1 and tighten them in the same way.

- (1) As shown in Fig. 1, tighten the diagonal bolts in order.
- (2) Increase the tightening torque step by step (for example, 10% → 20% → 60% → 100% of the target tightening torque) and tighten evenly.
- (3) Measure the gaps between the flange surfaces diagonally at four points with a caliper, etc., and check if they are tightened on one side.

\* For VORTEX gaskets, at the end of temporary tightening, tighten all bolts in clockwise direction at 50% of the target tightening torque (to prevent one-sided tightening).

\* Target tightening torque setting  
 8 or less bolts: 100% of the specified tightening torque  
 12 or more bolts: 110% of the specified tightening torque

Fig. 1 Diagonal tightening procedure



#### bolt selection criteria

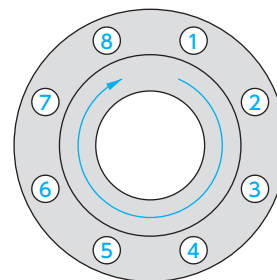
Number of flange bolts	selection criterion
12 or more, less than 24	4 bolts equally spaced at 90°
More than 24	Two sets of four bolts 90 degrees apart and evenly spaced, and four bolts 45 degrees apart from the set of bolts (8 in total)

#### <Final tightening>

- (1) If the number of flange bolts is 4, tighten diagonally with a tightening torque of 100% of the target tightening torque.
- (2) If the number of flange bolts is 8 or more, tighten them in clockwise based on the Table below.

Nominal flange diameter	Number of turns
~ 250A	4 turns
250A以上	6 turns

Fig. 2 clockwise tightening procedure



#### <Tightening>

If retightening is required, wait at least 4 hours after the end of final tightening, and then tighten 1 to 2 times using the same procedure for final tightening.

## Technical data ② Flange type

### ■ JIS flange and JPI flange

Flange commonly used in Japan includes JIS flange and JPI flange.

JIS flanges are specified in JIS B 2220 “Steel pipe flanges”, JIS B2239 “Cast iron pipe flanges”, etc., and JPI flanges are made by the Japan Petroleum Institute (JPI) and the American Society of Mechanical Engineers (ASME). It is stipulated in the JPI standard created so that the flange standard can be used in Japan.

JIS flanges are used in many industries such as building equipment piping, and JPI flanges are widely used in the petroleum refining industry and are also the mainstream in overseas.

JIS flanges and JPI flanges differ in pressure class classification, flange seat dimensions, bolt specifications and the gasket dimensions also differ, therefore please specify the standard when ordering.

### ● Differences in specifications between JIS flanges and JPI flanges

Flange nominal diameter		Gasket contact area (mm <sup>2</sup> )		Bolt specifications <sup>Note 1</sup> (Number x size)	
A	B	JIS 10K	JPI class 150	JIS 10K	JPI class 150
15	1/2	1663	576	4×12	4×1/2
20	3/4	1847	830	4×12	4×1/2
25	1	2564	1119	4×16	4×1/2
50	2	4316	3740	4×16	4×5/8
80	3	6107	6306	8×16	4×5/8
100	4	7521	8840	8×16	8×5/8
150	6	13395	14178	8×20	8×3/4
200	8	16588	19200	12×20	8×3/4
250	10	25192	22950	12×22	12×3/4
300	12	25434	30540	16×22	12×3/4
350	14	32742	33175	16×22	12×1
400	16	45180	42680	16×24	16×1

Note 1: JIS flange uses Metric bolt, JPI flange uses UNC bolt.

### ■ Flange shape

JIS B 2220 “Steel Pipe Flange” classifies by the shape of the flange as shown in the table below.

The A and B types of slip-on welded hub flanges (SOH) have larger inner diameters than the C type and butt welded flanges of SOH.

Therefore, when using VORTEX gaskets for SOH A-type and B-type flanges with nominal pressures of 20K and 30K, the dimensions of the gaskets will be different, so be sure to specify the type when ordering.

In addition, SOH A-type and B-type flanges are prone to compression failure, so be careful of tightening control when using NAFLON PTFE enveloped gaskets.

### ● Flange type

Flange type	Shape	Figure
Slip-on welding type Plate flange (SOP)	—	
Slip-on welded hub flange (SOH)	A	
	B	
	C	
Socket welded flange (SW)	—	
Butt welded flange (WN)	—	
Lap Joint flange (LJ)	—	
Threaded flange (TR)	—	
Integrated flange (IT)	—	
Blind flange (BL)	—	



### ■ Type of gasket seat

Types of gasket seats include raised face, full seats, male and female seats, tongue seats and group seats and ring joint seats.

A ring-shaped gasket (F.R. : Flat Ring) is used for the raised face seat (R.F. : Raised Face) with the gasket seat finished in a convex circular shape, and rubber is used for the flat face seat (F.F. : Flat Face) with the entire flange flat face finished. For rubber gaskets, full-face gaskets are used, and for sheet-based gaskets and coated gaskets, ring-shaped gaskets are used.

It is possible to use a full-face gasket for the raised face flange, but if a full-face gasket is used for the flat face flange, or if a spiral-wound gasket is used, please be cautious of insufficient tightening force or poor installation may occur. It is also possible to use a ring gasket for the flat face flange, but in this case, the values of the minimum tightening torque and the allowable tightening torque are different from the values of the technical data, so calculate from the gasket tightening area.

In addition to this, there is also a type of gasket that has a ring-shaped gasket with hangers for easy insertion into the flange.

### ■ Precautions when using a lap joint flange

The loose flange (lap joint) is a type of flange in which a stub end with a brim is inserted into the end and the brimless side of the stub end is butt welded to the pipe end.

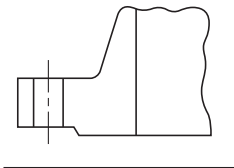
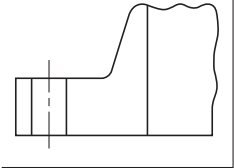
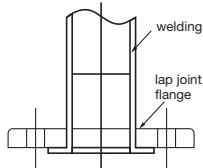
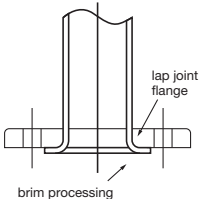
The loose flange is widely used because the flange and the pipe are not fixed and can rotate freely, so it is easy to install, and because the flange material can be changed to the pipe, it is also economical.

However, since there is a clearance between the flange and the outer diameter of the pipe, the center of the gasket shifts and contacts one side, and the gasket surface pressure tends to be uneven. Especially for flanges with flare processing, the angle of of the flange and the R processing of the inner diameter differ depending on the flange manufacturer, and the contact width between the gasket and the flange may become significantly smaller.

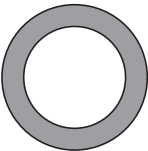
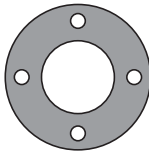
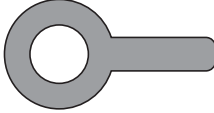
For this reason, we generally recommend sheet gaskets for lap joint flanges, but this is not the case if the flange manufacturer specifies a gasket.

In addition, compression failure is likely to occur, so appropriate torque management is required.

### ● Types of flange seats and loose flanges

Raised face (R.F.)	Flat face (F.F.)	Stub end	Brim processing
			

### ● Gasket shape

Flat ring gasket (F.R.)	Full-face gasket (F.F.)	With hangers
		

## Technical data ③ General gasket selection guidelines

### (1) Carbon steel flange (Raised face / flat face)

- General-purpose jointing sheets (TOMBO No.1995) are common and have a proven usage record for applications below 100°C.
- For steam / hot water applications of 100°C or higher, use heat-resistant jointing sheets, fluoropolymer gaskets, and VORTEX gaskets according to the conditions.

### (2) Carbon steel flange (flare processing)

- Since misalignment and one-sided contact are likely to occur, sheet gaskets are generally selected.
- However, the flare processing flange manufacturer may specify the gasket based on testings and actual performance verification. In this case, use the gasket.
- Since the NAFLON PTFE envelope gasket is easily compressed and broken, when using it for a stub end flange, follow the instructions of the flange manufacturer and perform appropriate tightening management.

### (3) Stainless steel flange

- For electrical insulation applications, use the most suitable electrical insulation gaskets and bolts according to the temperature and pressure conditions.

### (4) Resin-coated steel pipe flange

- General-purpose jointing sheets (TOMBO No.1995) are common and have a proven usage record for applications below 100°C.
- For parts where cleanliness is required, select various fluoropolymer gaskets in consideration of performance and economy. Tighten the NAFLON PTFE envelope gasket with the allowable tightening torque or less.
- VORTEX gaskets cannot be used as they may damage the resin.

### (5) Plastic flange

- EBILON gaskets with ribs and NAFLON PTFE envelope gaskets are recommended because it is often not possible to apply high seating stress.
- PTFE-coated products are recommended for areas with high chloride ion concentration and temperature.

### (6) Exhaust pipe, flue flange

- Select a manhole gasket that meets the temperature conditions.
- Other gaskets are not recommended as they often do not meet the required seating stress.

# List of standard dimensions of gasket

## Jointing sheets

TOMBO No.		1120	1995	1995-W	1993	1991-NF
1 S (1270×1270mm)	0.4 t	●	—	—	—	●
	0.5 t	●	—	●	●	●
	0.8 t	●	●	●	●	●
	1.0 t	●	●	●	●	●
	1.5 t	●	●	●	●	●
	2.0 t	●	●	●	●	—
	3.0 t	●	●	●	●	—
3 S (1270×3810mm)	0.4 t	●	—	—	—	●
	0.5 t	●	—	●	●	●
	0.8 t	●	●	●	●	●
	1.0 t	●	●	●	●	●
	1.5 t	●	●	●	●	●
	2.0 t	●	●	●	●	—
	3.0 t	●	●	●	●	—
6 S (2540×3810mm)	0.8t	●	●	—	—	—
	1.0 t	●	●	●	—	—
	1.5 t	●	●	●	—	—
	2.0 t	●	●	●	—	—
	3.0 t	●	●	●	—	—
9 S (3810×3810mm)	0.8 t	—	—	—	—	—
	1.0 t	—	—	—	—	—
	1.5 t	—	●	—	—	—
	2.0 t	—	●	—	—	—
	3.0 t	—	●	—	—	—
Thickness 1.5t 1S size Weight per sheet		3.63	4.35	4.35	4.23	3.75

\* Standard dimensions are shown as above. \* It may be possible to manufacture even the dimensions are not stated in above Table. Please contact us for the availability.

## Fluoropolymer gaskets

TOMBO No.		1133	1155	9007-SC	9007-LC	9007-G20	9007	9007-ST	9096-SGM	9007-GL	9007-ML	9007-LP
Maximum outer diameter [mm]	1.0 t	φ610	—	—	φ1200	φ1200	φ1200	—	φ1380	—	—	—
	1.5 t	φ1250	φ1250	φ1200				φ1200			φ1200	φ1200
	2.0 t	φ1250	φ1250	φ1200	φ1430	φ1200	φ1200	φ1200	φ1380	φ600	φ930	φ277
	3.0 t	φ1430	φ1250	φ1200	φ1430	φ1200	φ1200	φ1200	φ1380	φ600	φ930	—
Standard thickness	1.0 t	●	—	—	●	●	●	—	●	—	—	—
	1.5 t	●	●	●	●	●	●	●	●	—	●	—
	2.0 t	●	●	●	●	●	●	●	●	—	—	●
	3.0 t	●	●	●	●	●	●	●	●	●	●	—

Dimensions indicated in yellow can be made larger by welding.

Dimensions indicated in green can be made larger by welding.

## NAFLON™ PTFE envelope gaskets

Skin shape	A/KA/RA type	B/KB/RB type	AS/KS/RS type
Maximum inner diameter [mm]	φ 15	φ 300	φ 20
Maximum outer diameter [mm]	φ 1000 <sup>Note 1</sup>	arbitrary <sup>Note 1</sup>	φ 700 <sup>Note 1</sup>

Note 1: please contact us for maximum outer diameter of welded product.

## GRASEAL™ gaskets

TOMBO No.	1200	1215-A 1215-AT	1210-A	1880-GR
Nominal thickness [mm]	0.4, 0.8, 1.6, 3.2	0.8, 1.6, 3.0	1.5, 2.0, 3.0	1.6, 3.2
Reinforcing plate thickness [mm]	—	0.05	0.10	0.8
Maximum outer diameter [mm]	φ985	φ1480 <sup>Note 1</sup>	φ1480	φ3300 <sup>Note 2</sup>
Minimum width [mm]	—	5	—	12.8

Note 1: Gasket with nominal thickness of 0.8mm can be manufactured to a maximum diameter of 985mm.

Note 2: Please consult us for dimensions more than 3300mm.

# List of standard dimensions of gasket

## VORTEX™ gaskets

Gasket thickness [mm] <sup>Note 1</sup>	Inner and outer ring thickness [mm]		Recommended I.D. <sup>Note 2</sup> [mm]	
	carbon steel	Other than carbon steel	Min.	Max.
3.2	2.0	2.0	φ 16	φ 600
4.5 (standard)	3.2	3.0	φ 16	φ 3000
6.4	4.5	4.0	φ 1500	φ 3000

Note 1: When using as a gasket for pipe flanges, the gasket thickness should be 4.5mm as general rule. VORTEX Gasket-NM thickness line-up is only 4.5mm.  
 Note 2: We can manufacture products with dimensions other than those listed, but please contact us as it may be deformed, warped, or breakage, or it may take longer than usual as a special specification.  
 Also, please note that the inner ring cannot be attached if the inner diameter of the main body is the smallest, or it may take longer than usual as a special specification.

## Kammprofile gaskets

Gasket thickness [mm]		2.3	4.0	5.0
Manufacturable range	Inner diameter	10 ~ 690.0	20.1 ~ 3980.0	
	outer diameter	20 ~ 700.0	30.1 ~ 4000.0	
Body width	Standard	—		
	Manufacturable range	10 ~ 20	outer diameter φ 30.1 ~ φ 50.0 : 5 ~ 15 outer diameter φ 50.1 ~ φ 100.0 : 8 ~ 20 outer diameter φ 100.1 ~ φ 4000.0 : 10 ~ 30	
Standard metal main body material		304 stainless steel, 316L stainless steel		
Standard hanger material		304 stainless steel		
Construction <sup>Note 1</sup>		basic, with hangers type, with ribs type and with outer ring type		

Note 1: Kammprofile gaskets cannot be manufactured with "bolt holes for flat faces" or "irregular shapes (track-shaped, oval, etc)"

## Metal jacketed gaskets


Metal jacketed material	carbon steel	304 stainless steel	316 stainless steel	310S stainless steel	Aluminum	Copper
Material symbol	S	E	G	V	A	C
Standard dimension [mm]	1480	1180	1180	1180	980	1180


\*Indicates the maximum diameter that can be manufactured with a single metal plate. For diameter larger than this, we will weld it with two or more metal plates together.


## Metal O Seals

Tube cross section diameter [mm]	Wal thickness [mm]	O.D dimension [mm]	
		Recommended service range	Manufacturable dimensions
φ 0.8	0.15	6 ~ 25	6 ~ 30
φ 1.6	0.25	—	12 ~ 200
	0.36	15 ~ 50	11 ~ 200
φ 2.4	0.25	—	40 ~ 500
	0.46	40 ~ 200	20 ~ 500
φ 3.2	0.25	—	60 ~ 1270
	0.35 <sup>注1</sup>	—	60 ~ 1270
	0.5	65 ~ 700	40 ~ 1270
φ 4.8	0.5 <sup>注1</sup>	—	150 ~ 1500
	0.8	500 ~ 1200	150 ~ 1500
φ 6.4	0.8	1000 ~ 1500	250 ~ 1500 <sup>注2</sup>


Note 1: The only tube material that can be manufactured is 321 steel.  
 Note 2: Please contact us if diameter exceeds 1500mm.

\*  Indicates the standard wall thickness. For gas seals, please use standard wall thickness.

\*  The minimum O.D. of a vent hole type is 10mm.

\*  The maximum outer diameter of PTFE coating is φ 630, Please contact us for more information. and the maximum outer diameter of silver plating is φ 1300.

**Minimum value of corner R in the case of a square gasket**

**For standard wall thickness** ( area)  
 radius of I.D side ≥ 6 times the O.D of the tube

**For thickness less than standard wall thickness**  
 radius of I.D side ≥ 8 times the O.D of the tube

## Rubber cut gaskets

thickness [mm]	width [mm]	Maximum O.D [mm]
1.0	1000	φ 1000
1.5		
2.0		
3.0		
5.0		
10.0		

\* The minimum thickness of 1051-NR gasket is 15mm

## EBILON™ gaskets

- Plastic flange (JIS 10K equivalent) 15A-300A
- ANSI class 150 1/2 ~ 12B

## Rubber O rings

- JIS B 2401 "O-ring"
- AS 568B "Aerospace size standards for O -ring"
- JIS B 8365 "Dimensions of clamped-type vacuum couplings"

# Gasket design criteria list

## Jointing sheets

TOMBO No.		1120	1995	1993
Gasket factor $m$ [—]	0.8 t	3.50		
	1.5 t	2.75		
	3.0 t	2.00		
Minimum design seating stress $y$ [N/mm <sup>2</sup> ]	0.8 t	44.8		
	1.5 t	25.5		
	3.0 t	11.0		
Minimum seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water,oil type fluid	14.7		
	gas type fluid	34.3 <sup>Note 1</sup>		
Allowable seating stress [N/mm <sup>2</sup> ]	without paste	0.8 t	294.2	
		1.5 t	196.1	
		3.0 t	98.0	147.1
	with paste	0.8 t	68.6 <sup>Note 2</sup>	
		1.5 t		
		3.0 t		

Note 1: We do not recommend a thickness of 3.0t for gas-based fluids.

Note 2: 58.8N/mm<sup>2</sup> when used with anticorrosion paste.

## Fluoropolymer gaskets

TOMBO No.	1133	1155	9007-SC	9007-LC	9007-G20	9007	9007-ST	9096-SGM	9007-GL	9007-ML	9007-LP	
Gasket factor $m$ [—]	1.0 t	3.50	—	—	3.50	3.50	3.50	—	2.50	—	—	—
	1.5 t	2.75	2.75	3.20	3.20	3.20	3.20	3.20	2.50	—	3.20	—
	2.0 t	2.75	2.75	3.00	3.00	3.00	3.00	3.00	2.50	—	—	3.00
	3.0 t	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	—
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	1.0 t	44.8	—	—	24.5	24.5	24.5	—	19.6	—	—	—
	1.5 t	25.5	25.5	22.5	22.5	22.5	22.5	22.5	19.6	—	22.5	—
	2.0 t	25.5	25.5	19.6	19.6	19.6	19.6	19.6	19.6	—	—	19.6
	3.0 t	11.0	11.0	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	—
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water,oil type fluids	14.7	14.7	14.7	14.7	12.7	10.8	10.8	19.6	14.7	10.8	14.7
	Gas type fluids	34.3	34.3	29.4	24.5	24.5 <sup>Note 1</sup>	19.6 <sup>Note 1</sup>	19.6 <sup>Note 1</sup>	39.2	14.7	19.6 <sup>Note 1</sup>	19.6 <sup>Note 2</sup>
Allowable seating stress [N/mm <sup>2</sup> ]	150.0	150.0	58.8	49.0	49.0	39.2	39.2	117.6 <sup>Note 3</sup>	39.2	39.2	29.4	

Note: 1 Minimum seating stress for a thickness of 1.0t or 1.5t.

Note: 2 Minimum seating stress for a thickness of 2.0t or 3.0t.

Note: 3 The allowable seating stress for a thickness of 2.0t or 3.0t is 78.4N/mm<sup>2</sup>.

## NAFLON™ PTFE envelope gaskets

Shape symbol	A / AS / KA / KS / RA / RS Type	B / KB / RB Type
Core material symbol	3、4、5、7 (jointing sheet)	2 (TOMBO No.1880-GR)
	6、8 (jointing sheet with felt)	9 (TOMBO No.1120+SUS mesn)
Gasket factor $m$ [—]	3.50	4.00
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	14.7	19.6
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water,oil type fluid	14.7
	Gas type fluid	19.6
Allowable seating stress [N/mm <sup>2</sup> ]	29.4	24.5 (39.2) <sup>Note 1</sup>

Note 1: The values in parentheses are TOMBO No.1120 + stainless steel net type values.

## GRASEAL™ gaskets

TOMBO No.	1200	1215-A	1210-A	1880-GR
Gasket factor $m$ [—]	2.00	2.00	2.00	2.00
Minimum design seating stress $y$ [N/mm <sup>2</sup> ]	26.0	29.4	29.4	26.0
Minimum seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water,oil type fluids	14.7	14.7	14.7
	Gas type fluids <sup>Note 1</sup>	49.0	49.0	39.2
Allowable seating stress [N/mm <sup>2</sup> ]	0.8 t	170.0	294.0	—
	1.6 t	106.0	167.0	167.0 <sup>Note 2</sup>
	3.2 t	79.0	98.0	98.0

Note 1: Please note that it may be difficult to apply the specified seating stress with standard size products.

Note 2: TOMBO No.1210-A indicates the allowable seating stress of 1.5t.

# Gasket design criteria list

## Kammprofile gaskets

TOMBO No.	1891-GR	1891-TF	1891-NM
Gasket factor $m$ [-]	2.25 <sup>Note 1</sup>		3.00
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	15.2 <sup>Note 1</sup>		44.8 <sup>Note 1</sup>
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	water oil type fluids	29.4	34.3
	gas type fluid	39.2	78.4
Allowable seating stress [N/mm <sup>2</sup> ]	450		450

Note 1: The applicable range is the standard flange and the design flange of the existing equipment. For new flange design, design criteria for spiral wound gaskets is as follows. ( $m = 3.00$ ,  $y = 68.9$  [N/mm<sup>2</sup>]).

## VORTEX™ gaskets

TOMBO No. <sup>Note 1</sup>	1804-GR	1804-NA	9090	1806-GS -GM,-GH	1808-NM	1809 1809AL
Gasket factor $m$ [-]	3.00					3.00
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	68.9					58.8
Min seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	water, oil type fluids	29.4	34.3	29.4	34.3	—
	gas type fluid	39.2	78.4	39.2	78.4	class 150 29.4 class 300 39.2 class 600 49.0
Allowable seating stress [N/mm <sup>2</sup> ]	294.2					294.2

Note 1: Indicates the basic type of TOMBO No.

## Metal jacketed gaskets

TOMBO No.	1841-S	1841-E 1841-G others	1841-C	1841-A	1861-S	1861-E 1861-G others	1861-C	1861-A
Jacketed material	carbon steel	304 stainless steel 316 stainless steel others	copper	Aluminum	carbon steel	304 stainless steel 316 stainless steel others	copper	Aluminum
Gasket factor $m$ [-]	3.75	3.75	3.50	3.25	3.00	3.50	3.25	2.50
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	52.4	62.1	44.8	38.0	31.0	44.8	38.0	20.0
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	water/oil type fluid	39.2	49.0	34.3	29.4	—	—	—
	Gas type fluid	101.4	120.4	76.2	58.8	—	—	—

## Plain type metallic gaskets

TOMBO™ No.	1850-P-S	1850-P-E, P-G, others	1850-P-C	1850-P-A
Material [-]	Carbon steel	304 stainless steel, 316 stainless steel, others	Copper	Aluminum
Gasket coefficient $m$ [-]	5.50	6.50	4.75	4.00
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	124.2	179.3	89.6	60.7
Min. seating stress $\sigma_3$ [N/mm <sup>2</sup> ]	Water-type and oil-type fluids	98.1	117.7	58.8
	Gas-type fluids	235.4	343.2	98.1

## Serrated metallic gaskets

TOMBO™ No.	1890-S	1890-E, 1890-G, others	1890-C	1890-A
Material [-]	Carbon steel	304 stainless steel, 316 stainless steel, others	Copper	Aluminum
Gasket coefficient $m$ [-]	3.75	4.25	3.50	3.25
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	52.4	69.6	44.8	38.0

## Ring joint gaskets

TOMBO™ No.	1850-C-D, 1850-V-D	1850-C-S, 1850-V-S	1850-C-F, 1850-V-F	1850-C-E, 1850-C-G 1850-V-E, 1850-V-G, others
Material [-]	Pure iron	Mild steel	F5	Stainless steel
Gasket coefficient $m$ [-]	5.50		6.00	6.50
Min. design seating stress $y$ [N/mm <sup>2</sup> ]	124.2		150.3	179.3

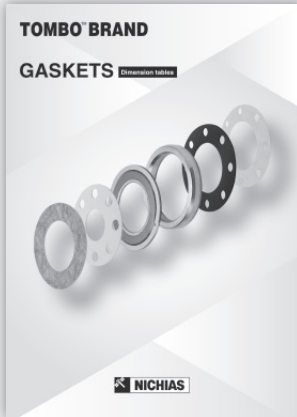
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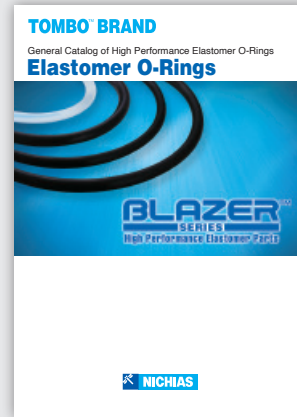
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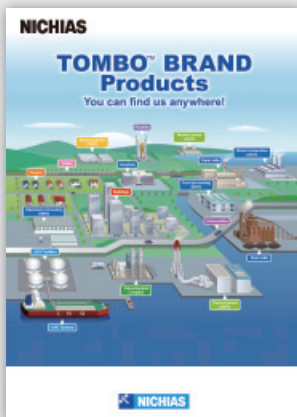
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## Head Office

6-1, Hatchobori 1-chome, Chuo-ku, Tokyo 104-8555, Japan  
**International Marketing and Sales Group**  
 Phone: 81-3-4413-1132 Fax: 81-3-3552-6108  
 Web Site: <https://www.nichias.co.jp/>

## Overseas Sales Companies

### Indonesia

#### PT. NICHIAS SUNIJAYA

Sequis Tower Level 19 Suite 1&2,  
 Jl. Jend Sudirman Kav. 71, Jakarta 12190, Indonesia  
 Phone: +62-21- 2277-6101 Fax: +62-21- 2793-8033

### Malaysia

#### NICHIAS SOUTHEAST ASIA SDN. BHD.

Suite A1102, 11th Floor, West Wing, Wisma Consplant 2,  
 No. 7, Jalan SS 16/1, 47500 Subang Jaya, Selangor Darul Ehsan, Malaysia.  
 Phone: +60-3-5636-4067 Fax: +60-3-5636-4078

### Singapore

#### NICHIAS SINGAPORE PTE. LTD.

25 International Business Park, #01-15/17 German Centre,  
 Singapore 609916  
 Phone: +65-6571-0830/0838 Fax: +65-6265-7681

### Vietnam

#### NICHIAS VIETNAM CO., LTD

Room 709, Elite Business Center, 7th Floor Diamond Flower Building,  
 48 Le Van Luong Street, Nhan Chinh Ward, Thanh Xuan District,  
 Hanoi, Vietnam  
 Phone: + 84-24-6664-3136 Fax: + 84-24-6666-8168

### Thailand

#### NICHIAS (THAILAND) CO., LTD.

85 Moo 1, Wellgrow Industrial Estate T. Homsin, A. Bangpakong  
 Chachoengsao 24180, Thailand  
 Phone: +66-38-570-600 Fax: +66-38-570-601

#### THAI NICHIAS INTERNATIONAL CO., LTD.

Unit 1107, 11th Floor, AIA Capital Center  
 89 Ratchadaphisek Road, Dindaeng, Dindaeng, Bangkok 10400 Thailand  
 Phone: +66-2-001-2060 Fax: +66-2-001-2062

### China

#### NICHIAS (SHANGHAI) TRADING CO., LTD.

霓佳斯（上海）贸易有限公司  
 Room 1701, THE PLACE, Tower A, No. 100 Zun Yi Road,  
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 中国上海市长宁区遵义路100号虹桥南丰城A栋1701室 邮编200051  
 Phone: +86-21-6236-1783 Fax: +86-21-6236-1781

#### NICHIAS (SHANGHAI) TRADING CO., LTD. Guangzhou Branch

霓佳斯（上海）贸易有限公司 广州分公司  
 17F-G, Gold Sun Building, No.109 Tiyu West Road, Guangzhou,  
 Guang Dong Province, 510620, P.R.China  
 中国广东省广州市天河区体育西路109号高盛大厦17楼G室 邮编 510620  
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霓佳斯（上海）汽车零部件贸易有限公司  
 Room 1702, THE PLACE, Tower A, No. 100 Zun Yi Road,  
 Changning District, Shanghai, P.R.China Postcode 200051  
 中国上海市长宁区遵义路100号虹桥南丰城A栋1702室 邮编200051  
 Phone: +86-21-6236-2668 Fax: +86-21-6236-2667

## Overseas Construction Companies

### Malaysia

#### NICHIAS SOUTHEAST ASIA SDN. BHD.

Suite A1102, 11th Floor, West Wing, Wisma Consplant 2,  
 No. 7, Jalan SS 16/1, 47500 Subang Jaya, Selangor Darul Ehsan, Malaysia.  
 Phone: +60-3-5636-4067 Fax: +60-3-5636-4078

### Thailand

#### THAI-NICHIAS ENGINEERING CO., LTD.

45 Huaypong-Nongbon Road, Huaypong, Muang Rayong,  
 Rayong Province 21150, Thailand  
 Phone: +66-38-682-242 Fax: +66-38-691-156

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