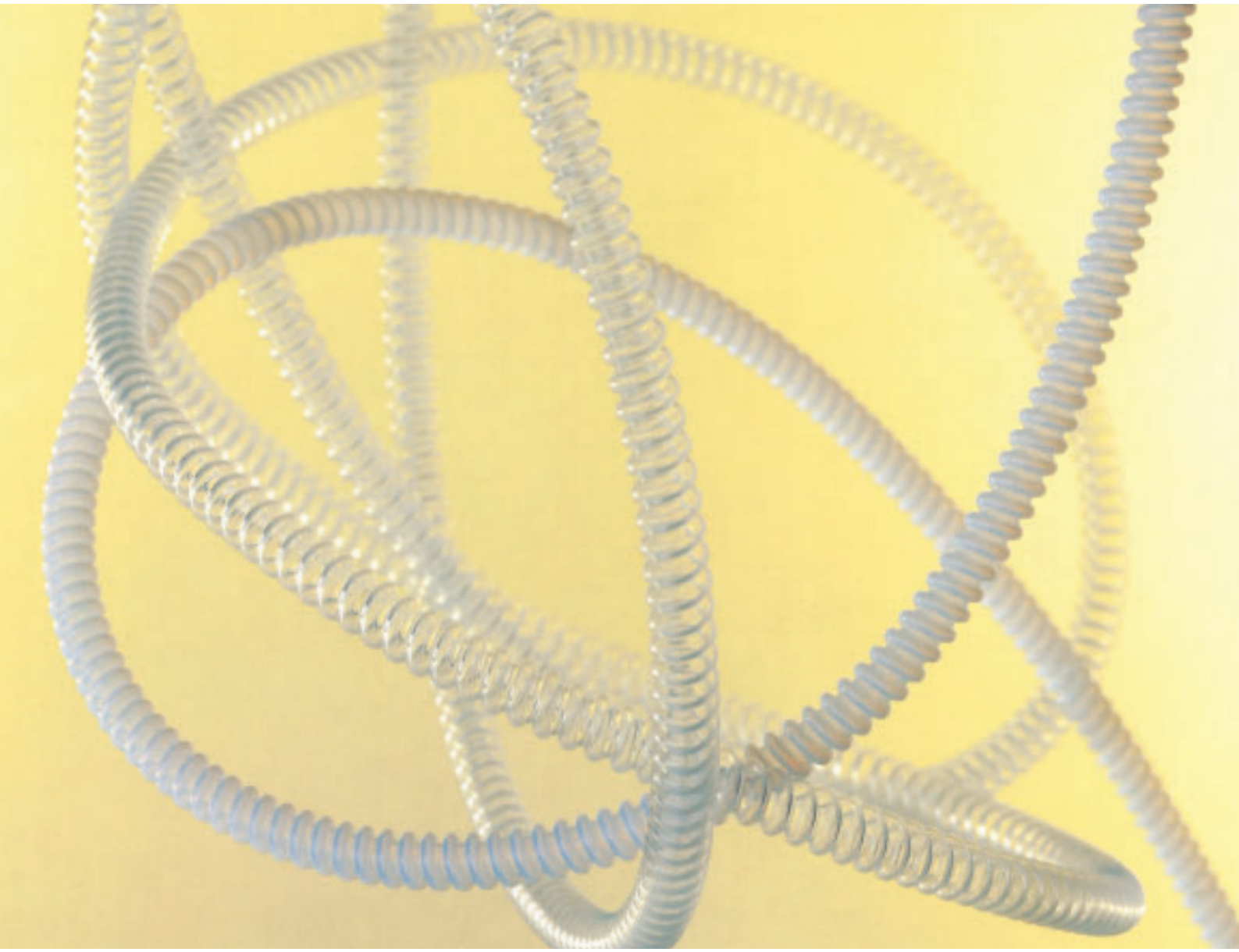
TOMBO BRAND

NAFLON® Tube

Fluoropolymer Products



NICHIAS Corporation

NAFLON TUBE

When compared with other types of plastics, fluoropolymer tubes have exceptional heat resistance, low frictional coefficients, and electrical insulation, chemical resistance, anti-adhesion, and weather resistance properties. Tombo brand fluoropolymer Products are pleased to bring to you the highest quality fluoropolymer tubes, created in clean environments using our unique forming technologies. These tubes may be used in cutting edge fields of technology such as semiconductor and liquid crystal electronics manufacturing, biotechnology, medical and food processing, and in the chemical industry, as well as in a wide variety of other fields such as petroleum chemistry and general engineering.

Features of Fluorine Plastic Tubes and Usage Examples

Chemical Resistance

Features:

Will not be deteriorated by even the strongest acids, alkalis, solvents, or most any corrosive fluids on the market (exceptions being molten alkaline metals, high temperature fluorine gas, etc.)

Applications:

- Waste fluid lines for highly corrosive materials
- Protective coatings for wiring

Usable Temperature Spans

Features:

These tubes are usable in a wide range of temperatures, from extremely low temperatures up to 260°C (in the case of PFA and PTFE).

Applications:

- Acidic/alkaline cleaning lines in plating plants
- Liquid nitrogen and liquid oxygen transport lines
- Steam transport lines
- Fuel transport lines for aircraft, automobiles, etc.

Anti-Adhesion Properties (Low Frictional Coefficients)

Features:

These tubes have high levels of anti-adhesion, so even the most viscous of fluids will hardly stick to them.

Applications:

- Transport lines for foam polyurethane fluid
- Paint transport lines
- Transport of powders with a tendency to clump
- Transport of glues and adhesives
- Coverings for pipes, rollers, etc.

Purity

Features:

Because these tubes use no fillers or plasticizers, there will be very little pollution of the carried fluid.

Applications:

- High purity chemical transport for semiconductor manufacture
- Transport of extremely pure water
- Manufacturing processes for beverages
- Manufacturing processes for medication and foodstuffs
- Medical-use tubes
- Clean air transport lines
- Fluid and gas analysis device tubing

Electrical insulation

Features:

One of the best insulators in terms of electrical characteristics, and stable over a wide range of temperatures and frequencies.

Applications:

- Tubes for electrical coatings
- Cooling tubes for electronics and electrical devices
- Insulation for wiring and heaters
- Insulating coating for wiring

Weather resistance

Features:

Exceptionally weather-resistant, these tubes will not degrade with age, and in addition are non-flammable.

Applications:

- Applications where exchanging worn tubes is not practical (aerospace applications, use in nuclear power plants, etc.)
- Usage near the ocean, where potential damage from salt and ultraviolet light is extreme.

Selection guidelines

Type	T/#9003 Naflon tube			T/#9003-PFA-HG Naflon PFA-HG tube	T/#9003-NE Naflon NE tube	T/#9003-CD Naflon PTFE Conducting tube	T/#9003-HG-W Naflon PFA-HG-W tube		T/#9003-PL Naflon Pliable tube		T/#9003-BT Naflon BT Tube T/#9003-FC Naflon FC Tube	T/#9003-SF Naflon SF tube
Material / Feature	PTFE	PFA	FEP	PFA	PFA	PTFE+filler	PFA		PTFE	PFA	PTFE	
Pliability	C	C	C	C	C	C	C		A	A	B	A
Little liquid accumulation	A	A	A	A	A	A	A		C	C	A	A
Ease of fluid visibility	C	B	A	B	B	C	B		C	B	C	A
Maximum operating temperature	A	A	B	A	A	A	B		A	A	A	C
Manufacture of long tubes	A	A	A	A	A	A	A		C	C	A	C
Vacuum Resistance	B	B	B	B	B	B	B		A	A	B	C
Purity	A	A	A	A	A	B	A		A	A	A	A
Permeation Resistance	B	B	B	A	A	B	A		B	B	B	B
Page	2~5			6	7	8	8		9		10	11

Performance Rating: A: Excellent , B: Good to Excellent , and C: Not recommended.

Abbreviations used in this catalogue

PTFE : Polytetrafluoroethylene
PFA : Tetrafluoroethylene・Perfluoroalkylvinylether copolymer
FEP : Tetrafluoroethylene・hexafluoropropylene copolymer
ETFE : Tetrafluoroethylene・ethylene copolymer

Naflon PTFE/PFA/FEP Tubes

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

Features

- Exceptional anti-adhesive properties prevent most dirtying and scaling.
- Almost no loss of electrical properties under high temperature, high humidity, and high frequency conditions, making these tubes excellent electrical insulators.
- Exceptional weather-resistant properties prevent degradation after use outside for extended periods of time.
- PFA and FEP tubes are extremely transparent.

Specifications

- Maximum usage temperature: 260°C (PTFE/PTA), 200°C (FEP)
- Maximum usage pressure: Refer to page 13, "Maximum Usage Pressure".

Standards

- Meets UL (Underwriters Laboratories) Standard #224
  - PTFE only

Types

- PTFE tubes can be made in a variety of colours.
- ETFE tubes are available upon request.
- PTFE specially shaped tube are available upon request.
  (Please refer to page 5.)

PTFE Tube Room-Temperature Destructive Pressure and Minimum Bend Radius

Inner Diameter × Outer Diameter	Room Temperature Destructive Pressure (MPa) {kgf/cm²G}	Minimum Bend Radius [mm]
2 × 3	5.5 {56}	7
3 × 4	3.6 {37}	10
4 × 6	5.5 {56}	13
6 × 8	3.6 {37}	25
8 ×10	2.7 {28}	48
10×12	2.2 {22}	75
16×19	2.1 {21}	115
1.59 × 3.17	10.8 {110}	4
3.17 × 6.35	11.0 {112}	8
4.35 × 6.36	5.1 {52}	15
6.35 × 9.52	5.5 {56}	20
7.52 × 9.52	2.9 {30}	45
9.52 × 12.7	3.6 {37}	50
10.7 × 12.7	2.1 {21}	80
15.83 × 19.05	2.2 {22}	115

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

PFA and FEP Tube Room-Temperature Destructive Pressure and Minimum Bend Radius

Inner Diameter × Outer Diameter	Room Temperature Destructive Pressure (MPa) {kgf/cm²G}	Minimum Bend Radius [mm]
2 × 4	9.8 {100}	15
4 × 6	6.9 {70}	20
6 × 8	4.4 {45}	40
8 ×10	3.4 {35}	65
10 × 12	2.9 {30}	110
20 × 23	2.3 {23}	260
3.17 × 6.35	12.4 {127}	15
4.35 × 6.35	5.6 {57}	20
6.35 × 9.52	6.2 {63}	30
7.52 × 9.52	3.6 {37}	60
9.52 × 12.7	4.3 {44}	60
10.7 × 12.7	2.7 {28}	130
15.88 × 19.05	2.7 {28}	160

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

T/#9003 Naflon PTFE Tubes

[Metric Size]

Nominal Dimensions	Inner Diameter (mm)		Wall Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
0.25 × 0.75	0.25	+0.20 −0.10	0.25	±0.10		
0.5 × 1.5	0.5		0.5			
0.8 × 1.8	0.8	+0.30	0.5			
1.0 × 2.0	1.0	−0.10	0.5			
1.0 × 3.0	1.0		1.0			
1.5 × 2.5	1.5	+0.40	0.5			
1.5 × 3.5	1.5	−0.20	1.0			
2.0 × 3.0	2.0		0.5			
2.0 × 4.0	2.0	+0.50	1.0			
2.5 × 3.5	2.5	−0.20	0.5			
2.5 × 4.5	2.5		1.0			
3.0 × 4.0	3.0		0.5			
3.0 × 5.0	3.0		1.0		10	
4.0 × 5.0	4.0		0.5		20	
4.0 × 6.0	4.0		1.0		30	
5.0 × 6.0	5.0		0.5	+0.13		+2%
5.0 × 7.0	5.0		1.0	−0.10		−0
6.0 × 7.0	6.0	+0.50	0.5			
6.0 × 8.0	6.0	−0.40	1.0			
7.0 × 8.0	7.0		0.5			
7.0 × 9.0	7.0		1.0			
8.0 × 9.0	8.0		0.5			
8.0 × 10.0	8.0		1.0			
9.0 × 10.0	9.0		0.5			
9.0 × 11.0	9.0		1.0			
10.0 × 11.0	10.0		0.5			
10.0 × 12.0	10.0		1.0			
11.0 × 12.0	11.0		0.5			
11.5 × 13.0	11.0	±0.50	1.0			
12.0 × 13.0	12.0		0.5		10	
12.0 × 14.0	12.0		1.0			
12.5 × 14.0	12.5		0.75			
13.0 × 15.0	13.0		1.0	+0.13 −0.01		
13.0 × 16.0	13.0	±0.50	1.5	±0.18		
14.0 × 16.0	14.0		1.0	+0.13 −0.10		
15.0 × 18.0	15.0		1.5	±0.18		
16.0 × 17.5	16.0		0.75	±0.13 ±0.10	10	
16.0 × 19.0	16.0		1.5	±0.18		
18.0 × 21.0	18.0	±0.60	1.5			
19.0 × 21.0	19.0		1.0	±0.13 ±0.10		
20.0 × 23.0	20.0		1.5	±0.18		
21.5 × 23.5	21.5		1.0	±0.13		
22.0 × 24.0	22.0		1.0	±0.10		
23.0 × 25.0	23.0		1.0			
23.0 × 27.0	23.0	±0.70	2.0	±0.28		
25.0 × 27.0	25.0		1.0	±0.13 ±0.10		+2%
25.0 × 28.0	25.0		1.5	±0.18		−0
25.0 × 29.0	25.0		2.0	±0.28		
26.0 × 29.0	26.0		1.5	±0.18		
27.5 × 29.5	27.5	±0.80	1.0	±0.13 ±0.10	1	
30.0 × 34.0	30.0		2.0	±0.28		
33.0 × 36.0	33.0	±1.00	1.5	±0.18	5	
35.0 × 39.0	35.0		2.0	±0.28		
38.0 × 42.0	38.0					
39.0 × 42.0	39.0		1.5	±0.18		
40.0 × 44.0	40.0	±1.50				
45.0 × 49.0	45.0					
46.0 × 50.0	46.0					
49.0 × 53.0	49.0		2.0	±0.28		
50.0 × 54.0	50.0					
64.0 × 68.0	64.0	±2.00				
76.0 × 80.0	76.0					

● Please enquire for information relating to delivery dates and availability.

[Inch size]

Nominal Dimensions	Inner Diameter (mm)		Wall Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
1.59 × 3.17	1.59	+0.50 −0.20	0.75			
3.17 × 6.35	3.17		1.59			
4.35 × 6.35	4.35	+0.50 −0.40	1.00		10	
6.35 × 9.52	6.35		1.59	+0.50	20	+2%
7.52 × 9.52	7.52		1.00	−0.40	30	−0
9.52 × 12.70	9.52		1.59		50	
10.70 × 12.70	10.70	±0.50	1.00			
15.83 × 19.05	15.83	±0.60	1.61			

● Please enquire for information relating to delivery dates and availability.

T/#9003 Naflon PTFE Tubes for AWG Electrical Wiring

AWG (No.)	Inner Diameter × Wall Thickness	Inner Diameter (mm)		Thickness (mm)		Length (m)	
		Standard Value	Allowed Variance	Standard Value	Allowed Variance	Standard Value	Allowed Variance
30	0.31 × 0.28	0.31	+0.10 0	0.28	+0.10 −0.05	10 20 50	+2% −0
28	0.38 × 0.28	0.38					
26	0.46 × 0.28	0.46	+0.20 0		+0.15 −0.05		
24	0.57 × 0.28	0.57					
22	0.70 × 0.28	0.70					
20	0.87 × 0.33	0.87	+0.30 0	0.33	+0.20 −0.10		
19	0.97 × 0.33	0.97					
18	1.08 × 0.33	1.08					
17	1.20 × 0.33	1.20					
16	1.36 × 0.33	1.36					
15	1.51 × 0.33	1.51					

AWG (No.)	Inner Diameter × Thickness	Inner Diameter (mm)		Thickness (mm)		Length (m)	
		Standard Value	Allowed Variance	Standard Value	Allowed Variance	Standard Value	Allowed Variance
14	1.69 × 0.33	1.69	+0.30 0	0.33	+0.20 −0.10	10 20 50	+2% −0
13	1.93 × 0.33	1.93					
12	2.16 × 0.33	2.16					
11	2.41 × 0.33	2.41					
10	2.69 × 0.33	2.69					
9	3.00 × 0.38	3.00		0.38			
8	3.35 × 0.38	3.35					
7	3.76 × 0.38	3.76					
6	4.22 × 0.38	4.22					
5	4.72 × 0.38	4.72					

● Standard inventory items

T/#9003 AMS Conforming Naflon PTFE Tubes

Size (No.)	Conforming to AMS3653					Conforming to AMS3654					Conforming to AMS3655					Length (m)	
	Inner Diameter (mm)			Thickness (mm)		Inner Diameter (mm)			Thickness (mm)		Inner Diameter (mm)			Thickness (mm)		Standard Dimensions	Allowed Variance
	Minimum	Standard	Maximum	Standard Value	Allowed Variance	Minimum	Standard	Maximum	Standard Value	Allowed Variance	Minimum	Standard	Maximum	Standard Value	Allowed Variance		
30	0.25	0.30	0.38	0.23	±0.05	0.25	0.30	0.38	0.15	±0.05	0.25	0.30	0.38	0.23	±0.05	10 20 30	+2% −0
28	0.33	0.38	0.48	0.23	±0.05	0.33	0.38	0.46	0.15	±0.05	0.33	0.38	0.48	0.23	±0.05		
26	0.41	0.46	0.56	0.23	±0.05	0.41	0.46	0.53	0.15	±0.05	0.41	0.46	0.56	0.23	±0.05		
24	0.51	0.56	0.68	0.30	±0.08	0.51	0.56	0.60	0.20	±0.05	0.51	0.56	0.68	0.25	±0.08		
23	0.58	0.66	0.76	0.30	±0.08	—	—	—	—	—	0.58	0.66	0.76	0.25	±0.08		
22	0.64	0.71	0.81	0.30	±0.08	0.60	0.71	0.81	0.20	±0.05	0.64	0.71	0.81	0.25	±0.08		
21	0.74	0.81	0.91	0.30	±0.08	—	—	—	—	—	0.74	0.81	0.91	0.25	±0.08		
20	0.81	0.86	1.02	0.41	±0.08	0.81	0.86	0.96	0.20	±0.05	0.81	0.86	1.02	0.30	±0.08		
19	0.91	0.96	1.12	0.41	±0.08	0.91	0.96	1.07	0.20	±0.05	0.91	0.96	1.12	0.30	±0.08		
18	1.02	1.07	1.24	0.41	±0.08	1.02	1.07	1.17	0.20	±0.05	1.02	1.07	1.24	0.30	±0.08		
17	1.14	1.19	1.37	0.41	±0.08	1.14	1.19	1.32	0.20	±0.05	1.14	1.19	1.37	0.30	±0.08		
16	1.30	1.35	1.55	0.41	±0.08	1.30	1.35	1.47	0.20	±0.05	1.30	1.35	1.55	0.30	±0.08		
15	1.45	1.50	1.70	0.41	±0.08	1.45	1.50	1.65	0.20	±0.05	1.45	1.50	1.70	0.30	±0.08		
14	1.62	1.68	1.88	0.41	±0.08	1.62	1.68	1.83	0.20	±0.05	1.62	1.68	1.88	0.30	±0.08		
13	1.83	1.93	2.08	0.41	±0.08	1.83	1.93	2.06	0.20	±0.05	1.83	1.93	2.08	0.30	±0.08		
12	2.06	2.16	2.31	0.41	±0.08	2.06	2.16	2.31	0.20	±0.05	2.06	2.16	2.31	0.30	±0.08		
11	2.31	2.41	2.56	0.41	±0.08	2.31	2.41	2.56	0.20	±0.05	2.31	2.41	2.56	0.30	±0.08		
10	2.59	2.69	2.84	0.41	±0.08	2.59	2.69	2.84	0.20	±0.05	2.59	2.69	2.84	0.30	±0.08		
9	2.90	3.00	3.15	0.51	±0.10	2.90	3.00	3.15	0.20	±0.05	2.90	3.00	3.15	0.38	±0.08		
1/8	3.05	3.18	3.30	0.51	±0.10	—	—	—	—	—	—	—	—	—	—		
8	3.28	3.38	3.58	0.51	±0.10	3.28	3.38	3.53	0.20	±0.05	3.28	3.38	3.58	0.38	±0.08		
7	3.66	3.76	4.01	0.51	±0.10	3.66	3.76	3.94	0.20	±0.05	3.66	3.76	4.01	0.38	±0.08		
6	4.11	4.22	4.52	0.51	±0.10	4.11	4.22	4.42	0.25	±0.08	4.11	4.22	4.52	0.38	±0.08		
5	4.62	4.72	5.03	0.51	±0.10	4.62	4.72	4.95	0.25	±0.08	4.62	4.72	5.03	0.38	±0.08		
4	5.18	5.28	5.69	0.51	±0.10	5.18	5.28	5.54	0.25	±0.08	5.18	5.28	5.69	0.38	±0.08		
3	5.82	5.93	6.32	0.51	±0.10	5.82	5.93	6.20	0.25	±0.08	5.82	5.93	6.32	0.38	±0.08		
1/4	6.35	6.48	6.60	0.51	±0.10	—	—	—	—	—	—	—	—	—	—		
2	6.55	6.68	7.06	0.51	±0.10	6.55	6.68	6.93	0.25	±0.08	6.55	6.68	7.06	0.38	±0.08		
1	7.34	7.47	7.90	0.51	±0.10	7.34	7.47	7.75	0.25	±0.08	7.34	7.47	7.90	0.38	±0.08		
5/16	7.95	8.15	8.48	0.51	±0.10	—	—	—	—	—	—	—	—	—	—		
0	8.26	8.38	8.81	0.51	±0.10	8.26	8.38	8.69	0.30	±0.08	8.26	8.38	8.81	0.38	±0.08		

● Please enquire for information relating to delivery dates and availability.

T/#9003 Naflon PFA/PFA-HG/FEP Tubes

PFA Tubes [Metric size]

Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
2 × 3	3.0		0.5	±0.06		
2 × 4	4.0		1.0	±0.10	10	
3 × 4	4.0		0.5	±0.06	20	
3 × 5	5.0		1.0	±0.10	50	
4 × 5	5.0		0.5	±0.16	100	
4 × 6	6.0		1.0	±0.10	200	
5 × 6	6.0		0.5	±0.06		
5 × 7	7.0	+0.20 −0.10	1.0	±0.10		
6 × 7	7.0		0.5	±0.06		
6 × 8	8.0		1.0	±0.10		
7 × 8	8.0		0.5	±0.06		
7 × 9	9.0		1.0	±0.10	10	
8 × 9	9.0		0.5	±0.06	20	
8 × 10	10.0		1.0	±0.10	50	
9 × 10	10.0		0.5	±0.06	100	
9 × 11	11.0		1.0	±0.10		
9 × 12	12.0		1.5	±0.15		+1% −0
10 × 12	12.0		1.0	±0.10		
11 × 12	12.0		0.5	±0.06		
10 × 13	13.0		1.5	±0.15		
11 × 13	13.0		1.0	±0.10		
12 × 14	14.0		1.0	±0.10		
12 × 15	15.0		1.5	±0.15		
13 × 15	15.0		1.0	±0.10		
13 × 16	16.0		1.5	±0.15		
14 × 16	16.0		1.0	±0.10		
15 × 17	17.0		1.0	±0.10		
15 × 18	18.0	+0.30 −0.10	1.5	±0.15	10	
16 × 18	18.0		1.0	±0.10	20	
16 × 19	19.0		1.5	±0.15	50	
17 × 19	19.0		1.0	±0.10		
18 × 21	21.0		1.5	±0.15		
19 × 22	22.0		1.5	±0.15		
20 × 22	22.0		1.0	±0.10		
20 × 23	23.0		1.5	±0.15		
22 × 25	25.0		1.5	±0.15		
23 × 25	25.0		1.0	±0.10		

[Inch size]

Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
1.59 × 3.17	3.17		0.75	±0.10	10,20	
3.17 × 6.35	6.35		1.59	±0.15	50	
3.96 × 6.35	6.35	+0.20 −0.10	1.20	±0.12	100	
4.35 × 6.35	6.35		1.00	±0.10	200	
6.35 × 9.52	9.52		1.59	±0.15		
7.52 × 9.52	9.52		1.00	±0.10	10,20 50	+1% −0
9.52 × 12.70	12.70		1.59	±0.15	100	
10.70 × 12.70	12.70	+0.30 −0.10	1.00	±0.10		
15.88 × 19.05	19.05		1.59	±0.15	10,20	
22.00 × 25.40	25.40		1.59	±0.15	50	

● Please enquire for information relating to delivery dates and availability.

PFA-HG Tubes [Metric size]

Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
2 × 4	4.0		1.0		10,20 50	
4 × 6	6.0	+0.20 −0.10	1.0	±0.10	100 200	
6 × 8	8.0		1.0		10,20	+1% −0
8 × 10	10.0		1.0		50	
10 × 12	12.0		1.0		100	
14 × 16	16.0	+0.30 −0.10	1.0		10,20	
16 × 19	19.0		1.5	±0.15	50	
22 × 25	25.0		1.5			

[Inch size]

Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
3.96 × 6.35	6.35	+0.20 −0.10	1.20	±0.12	10 20 50 100	+1% −0
6.35 × 9.52	9.52		1.59	±0.15		
9.52 × 12.70	12.70	+0.30 −0.10			10,20 50	
15.88 × 19.05	19.05					
22.22 × 25.40	25.40					

FEP Tubes [Metric size]

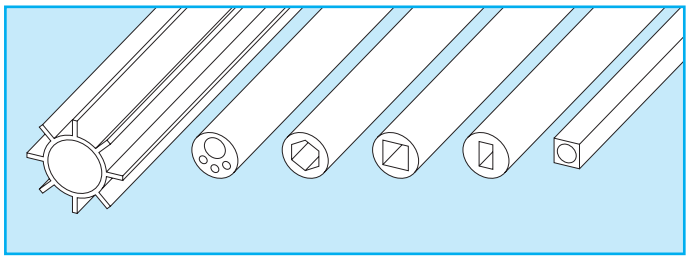
Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
2 × 4	4.0		1.0		10,20 50	
4 × 6	6.0	+0.20 −0.10	1.0	±0.10	100 200	
6 × 8	8.0		1.0		10,20	+1% −0
8 × 10	10.0		1.0		50	
9 × 12	12.0		1.5	±0.15	100	
10 × 12	12.0		1.0	±0.10		

[Inch size]

Nominal Dimensions	Outer Diameter (mm)		Thickness (mm)		Length (m)	
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance	Standard Dimensions	Allowed Variance
2.36 × 3.18	3.18		0.41	±0.06	10,20 50	
3.18 × 4.76	4.76	+0.20 −0.10	0.79	±0.10	100 200	+1% −0
4.57 × 6.35	6.35		0.89		10,20	
5.90 × 7.94	7.94		1.02		50	
6.99 × 9.53	9.53		1.27	±0.12	100	
9.56 × 12.70	12.70	+0.30 −0.10	1.57	±0.15		

● Please enquire for information relating to delivery dates and availability.

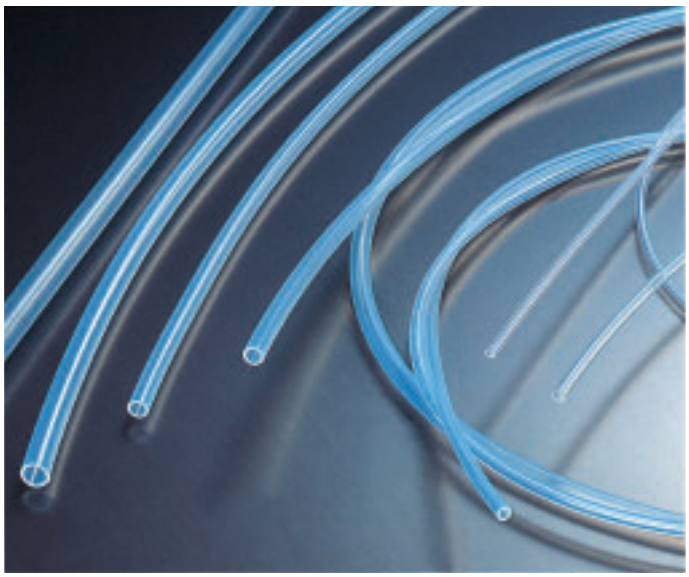
PTFE specially shaped Tubes



● Please contact us concerning the creation of other shapes.

Naflon PFA-HG Tubes

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



Features

In addition to the features of our standard PFA tubes:

- **Smoothness of the tube inner surface is increased to Rt = 0.2 μm. (Rt is approximately equal to Rmax, maximum height)**
  - Reduced incidence of retained particles or chemicals
  - Reduced time required for cleaning
  - Reduced chemical absorption due to a lessening of tube inner surface area
  - Improved transparency
  - Longer performance as an insulator
- **Uses a Super PFA material**
  - Reduction in eluted fluorine ions
  - Resistant to cracking under stress conditions such as exposure to SPM or fuming sulphuric acid

Specifications

- Maximum usage temperature: 260℃
- Maximum usage pressure: Same as Naflon PFA tubes
- Minimum bending radius: Same as Naflon PFA tubes

Standard Dimensions

- Please refer to the Naflon PFA-HG tube dimensions table on page 5.

Other Features

Metallic ion elution

Element	Amount eluted (μg)
K	<0.02
Na	<0.01
Ca	<0.01
Al	<0.02
Cr	<0.01
Ni	<0.01
Fe	<0.02
Cu	<0.01

Method of analysis:

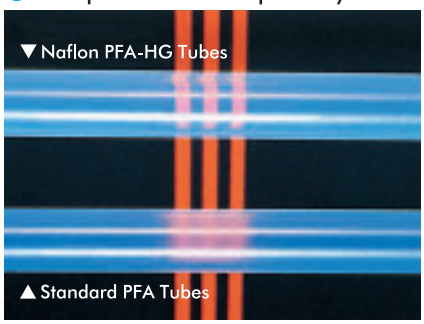
(1) A 1m section of the φ10×φ12 Naflon PFA-HG tube to be tested was cut, the cut portion cleaned, and then the tube was washed in water.

(2) Approximately 70 ml (length: 900 mm) of hydrofluoric acid was added, and the test material was allowed to sit at room temperature for Six days.

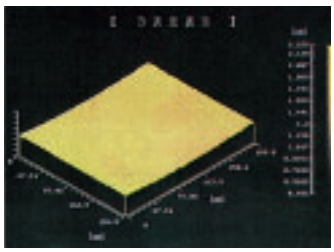
(3) At the conclusion of the test period, the elution liquid was allowed to evaporate. After nitric acid was added to the remaining liquid, the mixture was diluted with pure water, and frameless atomic absorption analysis was used to determine the amounts of each element contained in the elution liquid.

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

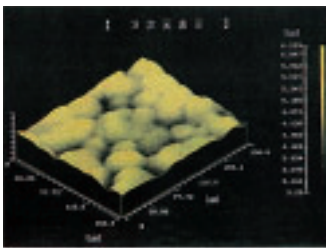
Comparison of transperancy



Comparison of inner wall surface image



Naflon PFA-HG Tubes



Standard PFA Tubes

Comparison of Inner Surface Roughness With PFA Tubes

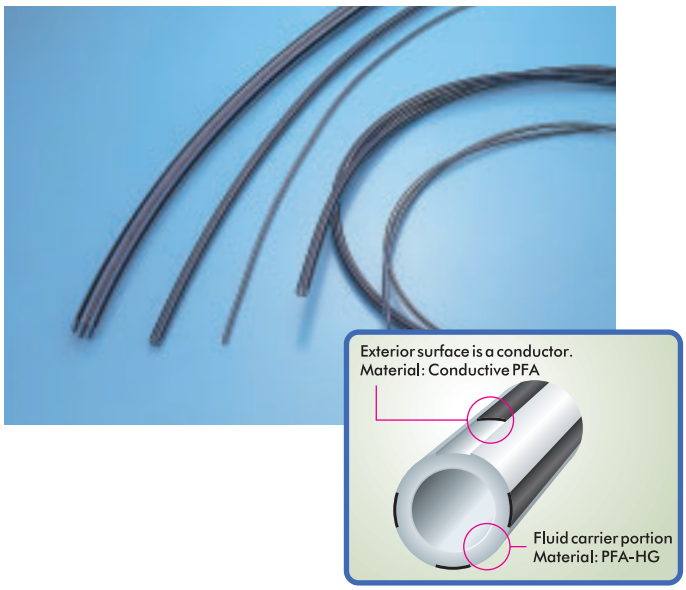
	Units	Naflon PFA-HG Tubes	Competitor A	Competitor B	New PFA Tubes
Surface Roughness (Rt)	(μm)	0.2	0.8	0.8	0.8

Notes:

- The values given above are intended as representative values, not standard values.
- Rt ≒ Rmax
- Products from Competitor A and B are standard PFA tubes.

Naflon PFA-NE Tubes

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



Features

- **The conducting PFA's shielding effect**
  - Prevents the release of sparks that could result in the starting of fires.
  - Prevents tube insulation damage that could result from electric release from an insulated atmosphere.
- **The fluid carrier portion being constructed from PFA-HG tubing**
  - Little elution of fluorine ions.
  - Little permeation or accumulation of chemicals.
  - The same chemical resistance, heat resistance, and strength as PFA.
- **Compared with PFA tubing coated with a shielding conductor as an anti-electrical measure**
  - No unsettling corrosion as with metallic wires and meshes.
  - Reduction in construction costs and variations in construction.

Applications

- Transport of high-purity chemicals and gases for semiconductor manufacturing devices that use highly flammable organic solvents, such as strippers, acetone, IPA, and thinners.
- Transport of high-purity chemicals and gases in the vicinity of electronic equipment that is sensitive to noise from static electricity.
- As a replacement for PFA tubing with shielding conductive coatings.

Specifications

Volumetric Resistance

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

- **Sample :** ϕ4.35 × ϕ6.35
- **Method of measurement :** As per JIS K 7194

Measurements / Specifications

Type	Nominal Dimensions: Inner Diameter × Outer Diameter	Nominal Dimensions: Wall Thickness	Conductive Portion (mm) Thickness × Width × Number	Length (m): Standard Dimentions	Room Temparature Destructive Pressure(MPa)	Minimum Bend Radius (mm)
Metric Size	2×3	0.50	0.03×0.6×4	10, 50, 100	5.4	15
	2×4	1.00	0.06×0.8×4		8.3	15
	3×4	0.50	0.03×0.8×4		3.9	25
	4×6	1.00	0.06×1.4×4		5.4	20
	6×8	1.00	0.06×1.8×4		3.9	40
	8×10	1.00	0.06×2.3×4		2.9	65
	10×12	1.00	0.06×2.6×8		2.5	110
	16×19	1.50	0.06×3.8×8		2.4	155
	22×25	1.50	0.06×4.9×8		1.8	320
Inch Size	2.17×3.17	0.50	0.03×0.6×4		5.3	15
	4.35×6.35	1.00	0.06×1.5×4		4.9	20
	6.35×9.52	1.59	0.06×2.4×4		5.4	30
	7.52×9.52	1.00	0.06×2.2×4		3.1	60
	9.52×12.70	1.59	0.06×2.6×8		4.1	60
	15.88×19.05	1.59	0.06×3.8×8		2.6	160
	22.22×25.40	1.59	0.06×4.9×8		1.9	330

- The values given above are intended as representative values, not standard values.
- **Destructive pressure at 25°C :** Using a 30 cm sample of tube, nitrogen gas was used to increase pressure at a maintained rate of 0.1 MPa/min.
- **Minimum bend radius :** Measured by performing the Nichias standardized minimum bend test (A S 5-6-0429)

Anti-Static Features

units: KV

Tube Type	Center of 1m Length Tube	Center of 15m Length Tube	Ends of 15m Length Tube
PFA-NE Tubing	0.5～0.7	0.5～0.7	0.5～0.7
PFA-HG Tubing	>2.0 (limit of measurement capability)	—	—

- **Sample :** ϕ4.35×ϕ6.35, length : 1m, 15m
- **Method of measurement :** One end was grounded, and cotton rubbed 50 times along a 20 cm span, either in the center or at the ends of the tube. Electric potential was then measured in the applicable area.
- According to the "Static Electricity Safety Guide" (published by the Technology Institution of Industrial Safety), in order to prevent explosions and fires, the electrostatic charge of non-conductors must be managed, with charged electric potential kept at 5KV or below for inflammable materials with a minimum ignition energy of 0.1–1 mJ (solvents such as toluene fall into this category).

Usage Notes

These tubes must always be grounded when used. Please use our conductive grounding band (sold separately) for grounding.

Grounding Band

- Please contact us with any enquiry about product usage and selection.

TOMBO No.9003-CD

Naflon PTFE Conducting Tubes

Naflon PTFE conducting tubes are PTFE tubes with conductive properties (volumetric resistance: $\leq 10^8 \Omega \cdot cm$). These tubes are perfect for applications which require prevention of loss of insulation due to the creation of static electricity, such as the transport of chlorine, organic solvents, fuel, powders, and steam.

Features

- The same chemical-resistant, heat-resistant, and weather-resistant properties as PTFE tubes.
- Electrically conductive material makes this tube highly suited for applications where loss of insulation must be avoided.

Specifications

- Maximum usage temperature: 260°C
- Maximum usage pressure: Same as Naflon PTFE tubes
- Minimum bending radius: Same as Naflon PTFE tubes

Standard Dimensions

Nominal Dimensions	Inner Diameter (mm)		Wall thickness (mm)		Length (m)	
Inner Diameter × Wall thickness	Standard Value	Allowed Variance	Standard Value	Allowed Variance	Standard Value	Allowed Variance
0.5 × 0.5	0.5	+0.30 −0.10	0.5			
1.0 × 0.5	1.0					
1.0 × 1.0			1.0			
2.0 × 0.5	2.0	+0.50 −0.20	0.5			
2.0 × 1.0			1.0			
3.0 × 0.5	3.0		0.5			
3.0 × 1.0			1.0			
4.0 × 0.5	4.0		0.5			
4.0 × 1.0			1.0			
5.0 × 0.5	5.0		0.5	+0.13 −0.10		
5.0 × 1.0			1.0			
6.0 × 0.5	6.0		0.5			
6.0 × 1.0			1.0			
7.0 × 0.5	7.0	+0.50 −0.40	0.5			
7.0 × 1.0			1.0		5	
8.0 × 0.5	8.0		0.5		10	
8.0 × 1.0			1.0		20	+2% −0
8.5 × 1.0	8.5					
9.0 × 0.5	9.0		0.5			
9.0 × 1.0			1.0			
9.0 × 1.5			1.5	+0.18		
10.0 × 0.5	10.0		0.5			
10.0 × 1.0			1.0			
11.0 × 0.5	11.0	±0.50	0.5			
11.0 × 1.0			1.0	+0.13 −0.10		
12.0 × 0.5	12.0		0.5			
12.0 × 1.0			1.0			
12.5 × 1.0	12.5		0.5			
13.0 × 1.0	13.0		1.0			
13.0 × 1.5			1.5	±0.18		
14.0 × 1.0	14.0		1.0	+0.13 −0.10	1 5 10	
15.0 × 1.0	15.0					
16.0 × 0.75	16.0	±0.60	0.75			
16.0 × 1.0			1.0			
16.0 × 1.5			1.5	±0.18		
19.0 × 1.5	19.0					

- Please enquire for information relating to delivery dates and availability.

TOMBO No.9003-HG-W

Naflon PFA-HG-W Tubes

Naflon PFA-HG-W tubing consists of two layer of Fluoropolymer tubing which purpose is prevention of liquid permeation.
Inside layer is made from PFA-HG tube which is suitable for chemical resistance, elution of metal and elution of F-ion. On the other hand, outside layer is made from special fluoropolymer tubing which has little permeation performance.

Liquid permeation

Liquid	Concentration (%)	Liquid permeation amount (mg/m·hr)	
		PFA-HG-W Tube	PFA-HG Tube
hydrochloric acid	35	0.4×10^{-2} (36)	1.1×10^{-2} (100)
nitric acid	70	0.013×10^{-2} (1)	1.0×10^{-2} (100)
sulphuric acid	96	$<0.013\times10^{-2}$ (100)	$<0.013\times10^{-2}$ (100)
aqueous ammonia	30	40×10^{-2} (75)	54×10^{-2} (100)
hydrofluoric acid	50	4.6×10^{-2} (48)	9.6×10^{-2} (100)

- MeaMeasured condition. Tube size : Inner diameter φ10
ambient temperature : 0.3MPa
measured time : Ten days

Room temperature destructive pressure and minimum bend radius

Tube size	Room temperature destructive pressure (MPa)	Minimum bend radius (MPa)
3.96×6.35×7.35 (3.96×6.35)	6.9 (6.2)	20 (25)
9.52×12.7×13.7 (9.52×12.7)	4.9 (4.3)	120 (140)
15.88×19.05×20.05 (15.88×19.05)	2.9 (2.7)	250 (260)
22.22×25.40×26.40 (22.22×25.40)	2.0 (1.9)	400 (400)

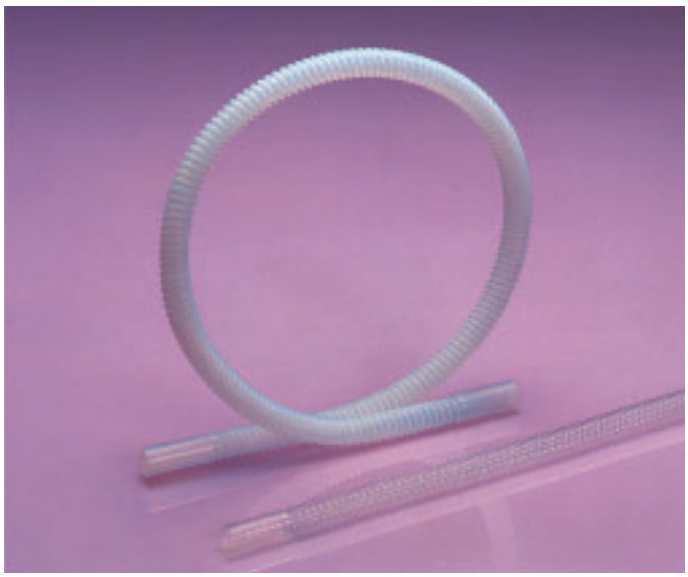
- Standard tube size is available above four sizes only.
( ) is measured value of PFA-HG tube

Tube size : 3.96×6.35×7.35
inside layer tube size — outside layer tube size

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

Naflon Pliable PTFE/PFA Tubes

Naflon pliable tubes are Naflon tubes with an added spiral groove. This allows exceptional flexibility, a small bend radius, a low frictional coefficient, and extremely good anti-adhesion properties. These tubes will cause little loss in fluid pressure, and little fluid adhesion to their inner walls.



Features

- An extremely low frictional coefficient reduces pressure losses.
- Extremely pliable.

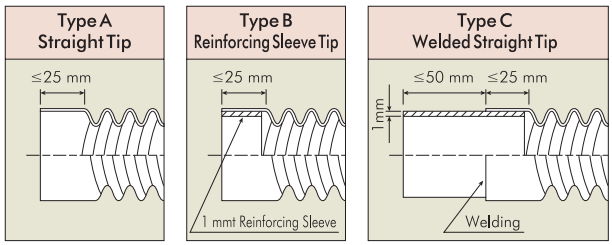
Specifications

- Maximum usage temperature: 200°C (PTFE/PTA)
- Maximum usage pressure: Refer to page 13, "Maximum Usage Pressure".

Types

There are two types of pliable tube products with measurements specified by inner (I) or outer (O) diameters according to the intended usage.

- Inner diameter-specified tubes (I)
  This type of tube is used when pipes, etc., will be used inside the tube for jointing. Joints can be created with glass, metals, and plastics. The pipe's outer diameter should be slightly larger than the tube's inner diameter. Should the fitting not be tight enough, a hose band may be used to tighten the joint.
- Outer diameter-specified tubes (O)
  These tubes should be used when connectors, etc. will be employed. Three end shapes are available, as shown below. Types B or C should be used for tube connectors made from fluorine-based plastics.



Naflon Pliable PTFE/PFA Tube Dimensions and Properties

Inner diameter-specified tubes (I)

Nominal Diameter	Tip Inner Diameter (mm)	Spiral Outer Diameter (mm)	Room Temperature Destructive Pressure (MPa) {kgf/cm²G}	Minimum Bend Radius (mm)	Maximum Manufacturable Length (m)
6 A	6	7	0.5 {5}	10	3
8 A	8	9	0.5 {5}	10	3
10 A	10	11	0.5 {5}	10	3
12 A	12	13	0.5 {5}	10	3
1/4B	6.4	7	0.5 {5}	10	3
3/8B	9.5	10	0.5 {5}	10	3
1/2B	12.7	13	0.5 {5}	10	3

Outer diameter-specified tubes (O)

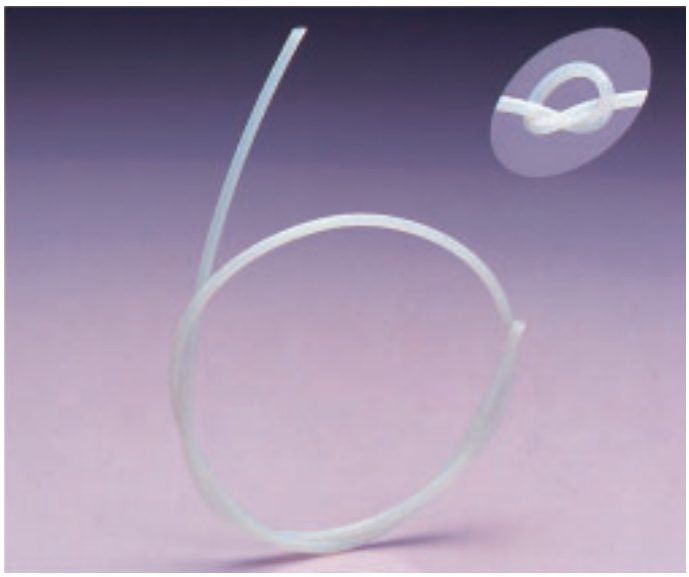
Nominal Diameter	Tip Outer Diameter (mm)	Spiral Outer Diameter (mm)	Room Temperature Destructive Pressure (MPa) {kgf/cm²G}	Minimum Bend Radius (mm)	Maximum Manufacturable Length (m)
6 A	6	6	0.5 {5}	10	3
8 A	8	8	0.5 {5}	10	3
10 A	10	10	0.5 {5}	10	3
12 A	12	12	0.5 {5}	10	3
1/4B	6.4	7	0.5 {5}	10	3
3/8B	9.5	10	0.5 {5}	10	3
1/2B	12.7	13	0.5 {5}	10	3

- The values given above are intended as representative values, not standard values.
- Please enquire for information relating to delivery dates and availability.

Naflon BT/FC Tubes

Naflon BT tubes are a PTFE tube with added flexibility and transparency. They bend easily and will not buckle, making them perfect for applications where tubing in tight spaces is required. Naflon FC tubes are extremely cost effective, and are well suited to applications where exacting dimensional measurements are not required .

- Naflon BT and Naflon FC tubes consist of same materials, and have the same transparency and flexibility features.



Features

- Bends easily, and will not buckle.
- Extremely transparent

Specifications

- Maximum usage temperature: 260°C
- Maximum usage pressure: Refer to page 13, [Maximum Usage Pressure].

Naflon BT/FC Tube Room-Temperature Destructive Pressure and Minimum Bend Radius

Inner Diameter × Outer Diameter	Room Temperature Destructive Pressure (MPa) {kgf/cm²G}	Minimum Bend Radius [mm]
2 × 4	11.0 {112}	7
3 × 6	11.0 {112}	10
5 × 8	6.7 { 68 }	15
7 ×10	4.7 { 48 }	22
9 ×12	3.7 { 38 }	42
1.59 × 3.17	10.8 {110}	6
3.17 × 6.35	11.0 {112}	10
6.35 × 9.52	5.5 { 56 }	22
9.52 × 12.7	3.6 { 37 }	42

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

Standard Dimensions

Nominal Dimensions	Inner Diameter (mm)		Outer Diameter (mm)		Wall thickness (mm)			Length (m)		
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance FC	Standard Dimensions	Allowed Variance BT	Standard Dimensions	Allowed Variance FC	Allowed Variance BT	Standard Dimensions	Allowed Variance FC	Allowed Variance BT
2.00 × 4.00	2.00	+0.50 −0.20	4.00	±0.10	1.00	+0.13 −0.10	±0.10	10 20 30	+2% −0%	+5% −0%
3.00 × 6.00	3.00	+0.20 −0.40	6.00	±0.10	1.50		±0.15			
5.00 × 8.00	5.00		8.00							
7.00 × 10.00	7.00		10.00							
9.00 × 12.00	9.00		12.00	±0.15						
1.59 × 3.17	1.59	+0.50 −0.20	3.17	±0.10	0.79		±0.10			
3.17 × 6.35	3.17	+0.50 −0.40	6.35	±0.10	1.59		±0.15			
6.35 × 9.52	6.35		9.52							
9.52 × 12.70	9.52		12.70	±0.15						

- Please enquire for information relating to delivery dates and availability.
- BT tube dimensions are based on its outer diameter, and FC tube dimensions are based on its inner diameter.

Naflon SF Tubes

Naflon SF tubes are exceptionally weather-resistant and chemical-resistant fluoro thermo plastic tubes created from a copolymer of tetrafluoroethylene, hexafluoropropylene, and vinylidene fluorides. These tubes are softer than PFA, PTFE, and other fluorine plastic tubes, and are therefore more suited to tubing in tight spaces. These tubes contain no additives such as fillers or plasticizers, and therefore release little gas and elution.

- Please note that as some organic solvents and other materials may cause expansion, there are limitations as to what materials may be used with these tubes. However, they may be used in many applications where high degrees of transparency and flexibility are required.

Features

- Resistant to both acids and alkalis.
- Soft and flexible.
- Extremely transparent.

Specifications

- Maximum usage temperature : 50°C
- Maximum usage pressure: Refer to page 13, “Maximum Usage Pressure”.

Recommended usage pressure

Nominal Dimensions	Recommended usage pressure (MPa)	
Inner Diameter × Outer Diameter	Room Temparature	50℃
6 × 8	0.4	0.3
8 × 10	0.4	0.3
10 × 12	0.3	0.2

- Recommended Usage Temperature and Pressure Room temperature

Measurements / Specifications

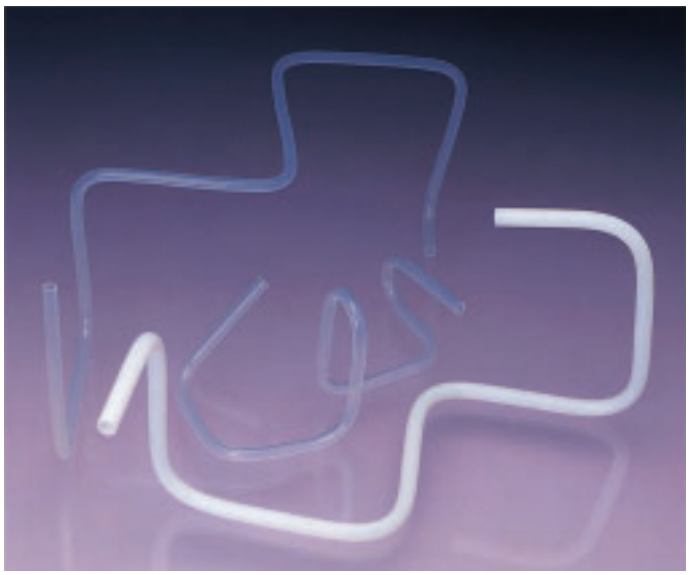
Nominal Dimensions	Outer Diameter (mm)		Wall thickness	Length (m)		Minimum Bend Radius (mm)
Inner Diameter × Outer Diameter	Standard Dimensions	Allowed Variance		Standard Dimensions	Allowed Variance	
6 × 8	8.0	±0.15	1.0	10	+2% −0	60
8 × 10	10.0					90
10 × 12	12.0					120

- Please enquire for information relating to delivery dates and availability.

TOMBO No.9055-PFA / PTFE

Naflon Bent Tubes

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



Features

- Far less loss of pressure as compared to the use of joints.
- No leakage problems.
- Reduces space required for piping.

Specifications

- Maximum usage temperature: 150°C

Minimum Bend Radius and Measurement Variance

Inner Diameter × Outer Diameter	Minimum Bend Radius	R variance	Bent Area Flatness	Bent Area Thickness	Angle
6.35 × 4.35	10 R	±2	≥85%	≥0.8 mm	±5°
9.52 × 7.52	15 R	±3	≥85%	≥0.8 mm	±5°
12.7 × 9.52	20 R	±4	≥85%	≥1.3 mm	±5°
19.05 × 15.83	30 R	±6	≥85%	≥1.3 mm	±5°

- As the values given above are intended as reference values, please enquire for details.

TOMBO No.9055

Special Manufacturing Naflon tubes

We can also manufacture specially shaped tubes for a variety of applications. We have a variety of coiled tubes for use in heat exchangers, and we can also create complex shapes using covered steel tubes for heaters.

Specifications

- Summarized heat transference coefficient (reference value)

φ2.4×3.2
heating / 230～350W/m²・K{200～300Kcal/m²・hr°C}
cooling / 170～350W/m²・K{150～300Kcal/m²・hr°C}

φ10 × 12
heating / 150～170W/m²・K{130～150Kcal/m²・hr°C}
cooling / 130～160W/m²・K{110～140Kcal/m²・hr°C}

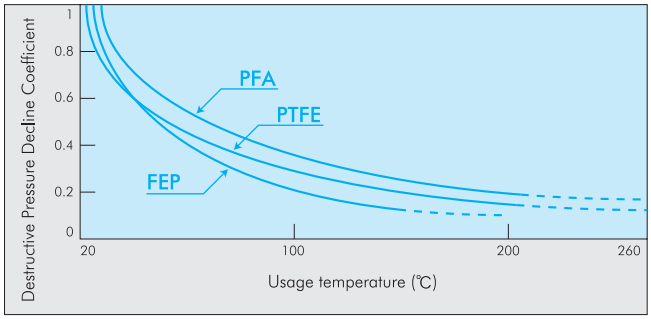
- Standard types Shell / Tube heat exchangers are available upon request.

Maximum Usage Pressure

Please only use our tubes at pressures below PU.T as determined by the following formula:

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

- $P_{R.T}$: Tube room temperature destructive pressure
- a: Destructive pressure decline coefficient
  - The destructive pressure decline coefficient by material can be obtained from the table to the right.
- S: Safety factor (1/3–1/5)
  - A safety factor of 1/3–1/5 is obtained according to the fluid type (gas or liquid), danger level and the existence of impact pressure levels.
- $P_{U.T}$: Maximum usage pressure at a given temperature.



Tube Size and Flow

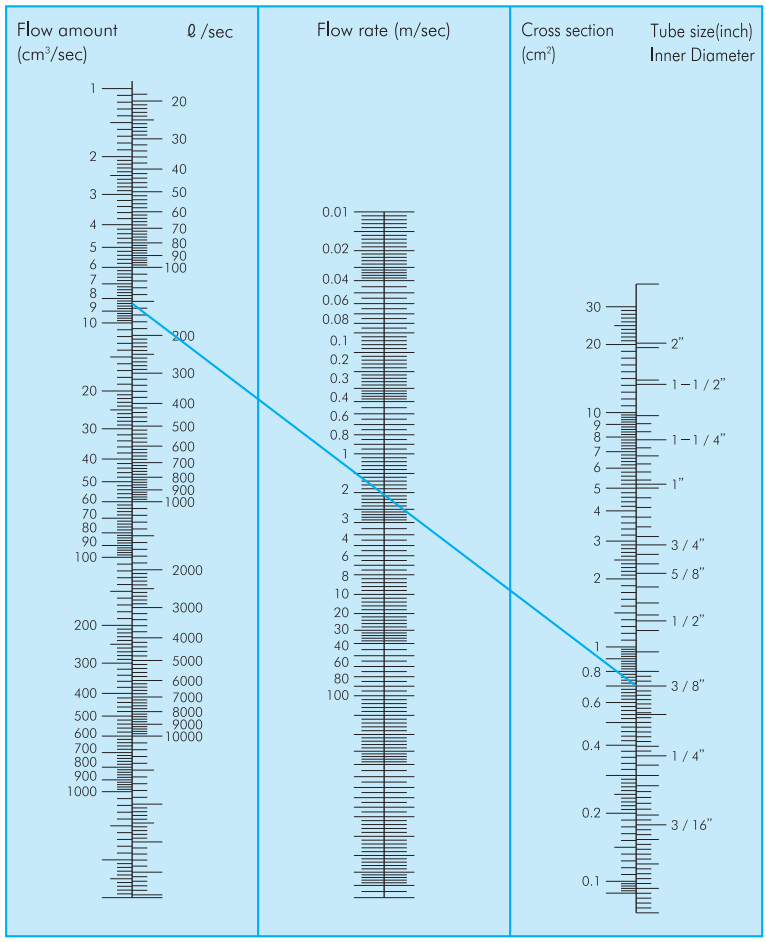
The relationship between tube inner diameter and fluid flow amount and rate is shown in the following equation:

$$\pi \left(\frac{\text{Tube inner diameter}}{2} \right)^2 [\text{cm}^2] = \frac{\text{Flow amount (cm}^3\text{/sec)}}{\text{Flow rate (cm/sec)}}$$

Presenting this relationship in a graph creates a nomograph, allowing one to see the flow permitted by a given tube size.

How to find the tube size required to allow a flow amount of 150 cm³ of pure water per second, at a flow rate of 2m.

In the leftmost column of the graph, find the point which indicates an outflow of 150 cm³/sec, and then in the center column find the point which indicates a flow rate of 2 m/sec. Extend a line which connects these two points to the rightmost column, and read the required tube size from where the line crosses that graph. For the flow described above, for example, the required tube has an interior diameter of 3/8".



⚠ CAUTION

These products are made of fluoropolymers. In order to ensure the original functions and properties are maintained, and to ensure safety in use, please observe the following precautions.

1. Tombo NAFLON tube should never be used for any purpose other than prescribed application.
2. Tombo NAFLON tube should never be recommended when both temperature and pressure are at the maximum listed at this catalogue.
3. Tombo NAFLON tube are not designed or manufactured for use in implantation in the human body fluids or tissues.
4. Vapour and fumes liberated during hot processing should be exhausted completely from the work area.
5. Waste disposal
   - Ensure conformity with all applicable disposal regulations.
   - Do not incinerate or dispose of in fire. Fluorine plastics will give off toxic gas.

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