

**Products for
Hydrogen Applications**

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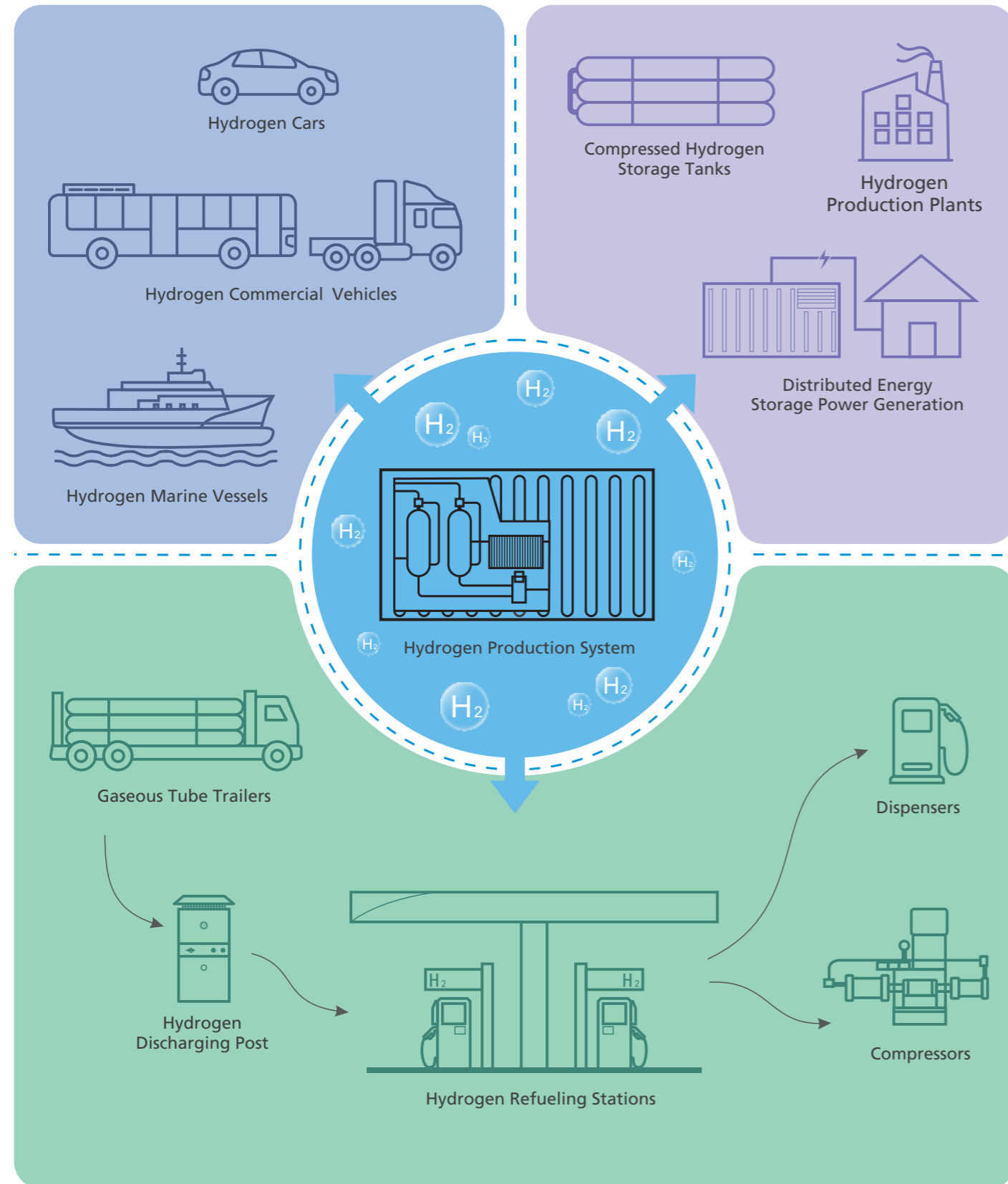
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**Specialized products and professional services
Meeting your needs in hydrogen applications**

Typical Hydrogen Applications



Our Services in Hydrogen Applications



Products for Hydrogen Applications

Features

★ Raw Materials

Experiments have proven that stainless steels with nickel content greater than 12% and nickel equivalent not less than 28.5% have excellent resistance to hydrogen embrittlement. FITOK has specially developed the raw material with designator SH for hydrogen applications in accordance with industry standards, which has good resistance to hydrogen embrittlement under high pressure and can meet the requirements of various international standards.

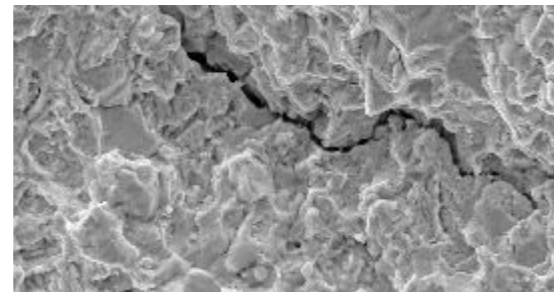
Chromium (Cr): To improve corrosion resistance, chromium can form a dense, stable protective film of chromium trioxide, leaving the steel in a passivated state.

Nickel (Ni): To form and stabilize austenite so that stainless steel to obtain a complete austenitic structure. Stainless steel with increased nickel content improves the strength and low temperature and welding mechanical properties, as well as improve the resistance to high temperature oxidation and hydrogen embrittlement.

Hydrogen Embrittlement

Hydrogen embrittlement is a phenomenon in which hydrogen atoms enter the lattice voids of a metal and move diffusely, causing cracks in the material at the defective location after the atoms have recombined or reacted with other substances to form gaseous molecules, resulting in rapid volume expansion leading to cracks at this location. The hydrogen embrittlement cannot be eliminated once it occurs, so it can only be prevented.

Standard	ASTM A479	FITOK Standard
Type	316	Enhanced-316/316L (Designator SH)
Element (%)	Ni	10-14
	Cr	16-18
	Mo	2.0-3.0
Ni _{eq} (%)	>22.4	≥28.5



★ O-ring

Special working conditions for O-rings used in hydrogen applications

Low temperature: Hydrogen needs to be cooled (-40 °C) before it is filled into the hydrogen-powered vehicles to prevent the risk of tank rupture due to exothermic expansion, and O-rings may lose elasticity and sealing performance at too low operating temperatures.

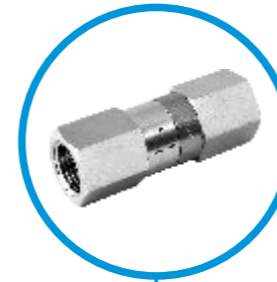
Pressure cycle: From the filling of hydrogen to the pressure relief, the non-metallic O-rings of valves and fittings will undergo repeated pressure changes under 0 MPa to the maximum working pressure, and the small molecules of hydrogen will leak into the inside of O-rings under violent pressure changes.

FITOK provides low-temperature O-rings compatible with hydrogen applications to products suffixed with -H2 and -EC79, which maintain consistent high reliability under extremely harsh working conditions.

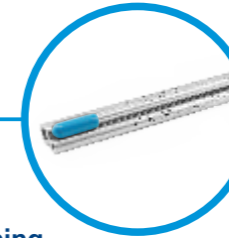


Common Products

- ◆ Products with -EC79 suffix are designed, manufactured and tested in accordance with EC79 standards and have obtained EC79 certification
- ◆ Products with -H2 suffix are designed, manufactured and tested meeting EC79 standards
- ◆ Standard products for general hydrogen applications
- ◆ If UN/ECE R134, ANSI HGV or other certificate is required, please contact FITOK



Excess Flow Valves
(EV Series)



Tubing
(TMP Series / TCT Series / T15 Series / T20D Series / T20M Series)

From 35 MPa on-road vehicles to 100 MPa hydrogen compressors, available in a variety of ODs, wall thicknesses and different connection types.



Check Valves
(CH Series)



Needle Valves
(10N Series / 15N Series / 20N Series)

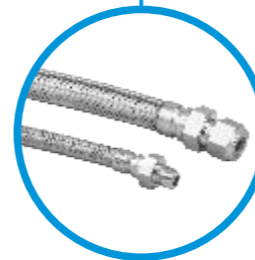
Maximum working pressure 138 MPa. Special treated surface of the stem tip and hydrogen-compatible packing provide better sealing, structure design provides long service life.



Tube Fittings
(6 Series / 20D Series)

Maximum working pressure 138 MPa. Quick and easy installation, high reliability in a variety of harsh working conditions. EC79 certified.

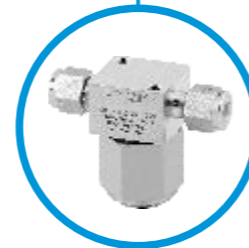
Metal Hoses
(MH and MM Series)



Line Pressure Regulators
(HPL Series)



Filters
(FT Series)



Ball Valves
(BU Series)

Ball valves designed for the harsh working conditions of hydrogen-powered vehicles. Non-metallic materials compatible with hydrogen for reliable performance. Applicable for 35 MPa hydrogen-powered vehicles.



Other Products

Pneumatic Ball Valves

Face Seal Fittings

Diaphragm Valves

Quick-Connects

Sampling Systems

FITOK

EC79 Certified Products

★ **About EC79 Approval**

EC79 Approval means European Council (EC) Regulation No. 79/2009 on the type approval of hydrogen-powered motor vehicles, which specifies a series of tests to verify the reliability of hydrogen-powered vehicles' components, and its extensions such as UN/ECE-R134 and ANSI HGV have become important references to hydrogen-powered vehicles' standards in numerous countries.

Durability Test

Components are subjected to 25 times connection / disconnection cycles before perform the external leakage test.

Corrosion Resistance Test

Components are subjected to external leakage test after 144 hours of salt spray test according to ISO-9227 standard.

External Leakage Test

Components are subjected to gas leakage test at room temperature and 0.02 times rated working pressure, room temperature and rated working pressure, minimum temperature and 0.02 times and rated working pressure, maximum temperature and 0.02 times and 1.25 times rated working pressure, respectively. No bubble occurs within 3 minutes.

Hydraulic Cycle Test

Components are subjected to external leakage test after several hydraulic cycles from 2 MPa to 1.25 times rated working pressure.

Ozone Compatibility Test

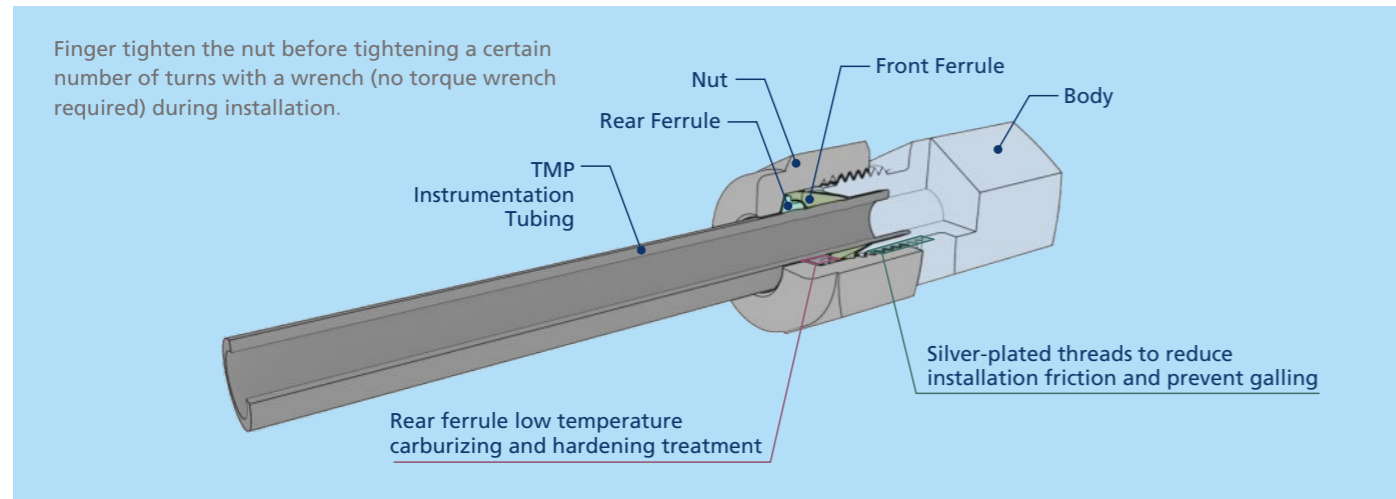
The tested products are stretched by 20% and then exposed to the air with an ozone concentration to 50 per billion for 120 hours. No visible cracks.

Aging Test

The tested products are continuously exposed to 2 MPa of oxygen at specified temperature for 96 hours, the physical properties performance shall meet the requirements and no visible cracks.

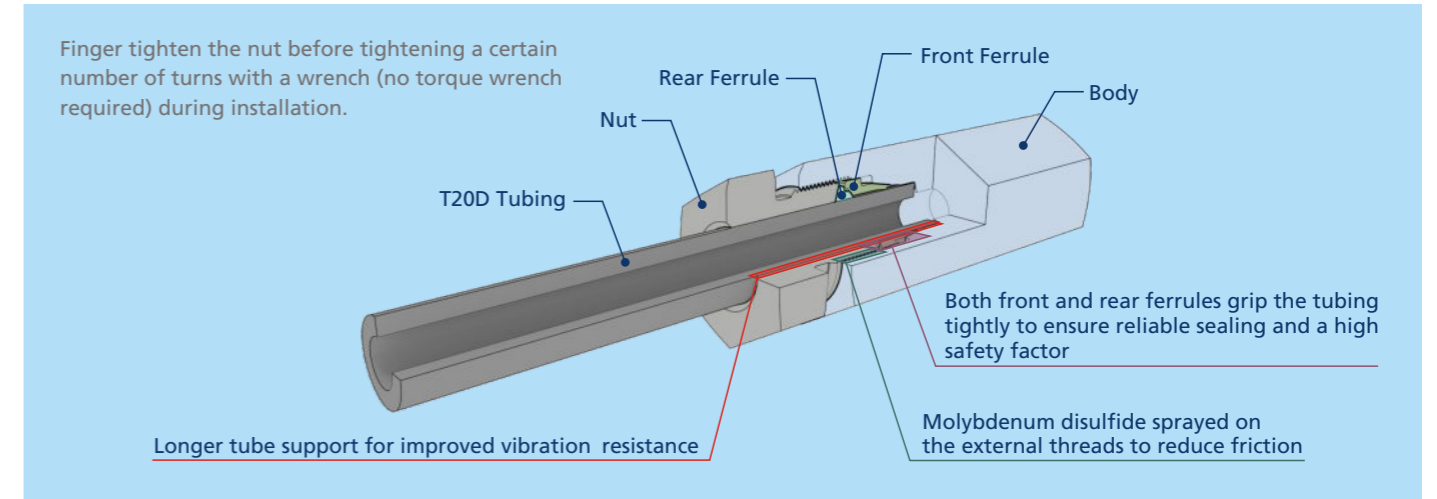
★ 6 Series Tube Fittings (35 MPa)

FITOK 6 series tube fittings are used in a wide range of applications in thermal power, nuclear power, petrochemical, semiconductor and hydrogen applications due to their excellent product performance. For the highest level of performance, use with FITOK TMP series tubing.

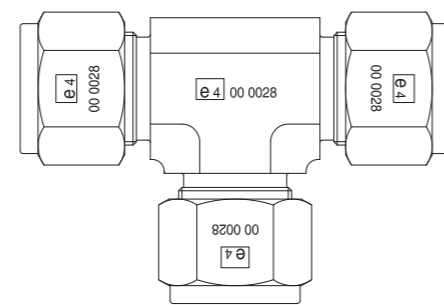
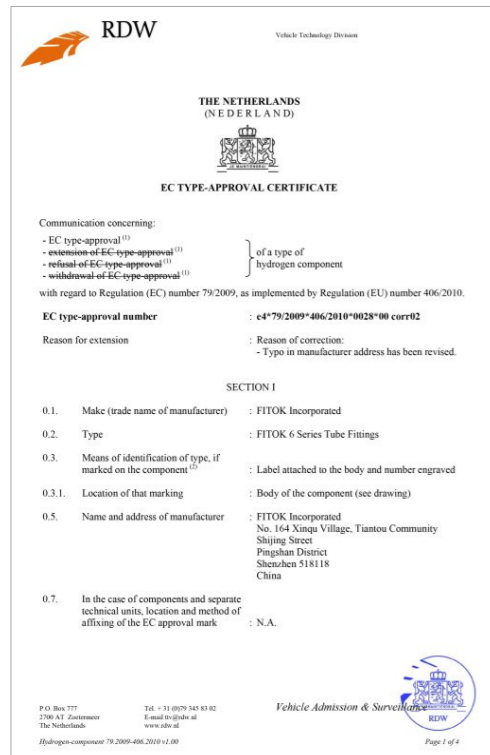


★ 20D Series Tube Fittings (70 MPa)

FITOK double-ferrule tube fitting can be installed with a wrench only, just like conventional tube fittings. Best match with FITOK T20D series tubing for hydrogen applications. Or used with FITOK T20M series cone and thread (C&T) tubing. Please contact FITOK for details as installation methods vary slightly.



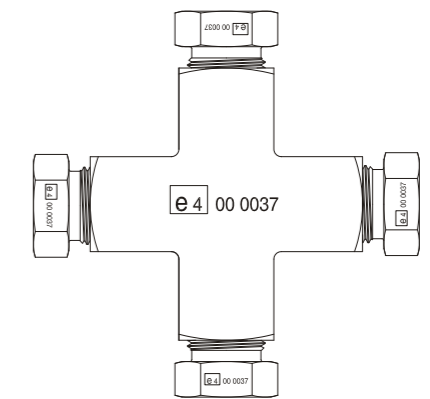
EC79 Approval & Certificate



- ◆ Excellent sealing performance in extreme environments
- ◆ Proven high reliability

6 Series Tube Fittings

EC79 Approval & Certificate



- ◆ Fixed installation turns for easy, fast and high consistency installation
- ◆ High reliability under extremely demanding conditions

20D Series Tube Fittings

■ Tubing for Hydrogen Applications

Ni > 12%, Ni_{eq} ≥ 28.5%



T20D Series Medium Pressure Tubing
(138 MPa)

- ◆ Cold-drawn seamless tubing
- ◆ Tighter O.D. tolerances and wall thickness range to reduce installation torque and number of turns
- ◆ Best match with FITOK 20D series tube fittings, or use with other popular medium and high pressure tube fittings
- ◆ Hardened to meet higher working pressure (138 MPa) requirements with smaller wall thickness and larger flow area



T20M Series Medium Pressure Cone and thread (C&T) Tubing
(138 MPa)

- ◆ Cold-drawn seamless tubing
- ◆ Best match with FITOK 20M series cone and thread (C&T) fittings, or with other popular medium and high pressure cone and thread (C&T) fittings. Or use with FITOK 20D series tube fittings
- ◆ Hardened to meet higher working pressure (138 MPa) requirements with smaller wall thickness and larger flow area
- ◆ Customized nipples are available upon request for easy installation and use
- ◆ Prefabricated bended tubing and tubing assemblies available to improve installation efficiency



TMP Series Instrumentation Tubing
(83 MPa)

- ◆ Tighter O.D. tolerances and wall thickness range to reduce installation torque and number of turns
- ◆ Solution annealed with better flexibility, easy for bending and ferrule type connections
- ◆ Best match with FITOK 6 series tube fittings, or use with other popular tube fittings



TCT Series Instrumentation Tubing
(83 MPa)

- ◆ Tighter O.D. tolerances and wall thickness range to reduce installation torque and number of turns
- ◆ Solution annealed with better flexibility, easy for bending and ferrule type connections
- ◆ Best match with FITOK 6 series tube fittings, or use with other popular tube fittings

Material:

316/316L: Ni ≥ 10%

Enhanced-316/316L: Ni > 12%, Ni_{eq} ≥ 28.5%

Standard Length:

T20D Series T20M Series TMP Series	Supplied in fractional sizes up to 20 ft and metric sizes up to 6 m. No minimum order quantity. Customized lengths are available upon request (Tubing length ≤ 6 m)		
TCT Series	1/4" × 0.035" 183 m/coil	1/4" × 0.049" 122 m/coil	3/8" × 0.065" 92 m/coil
	1/2" × 0.065" 67 m/coil	1/2" × 0.083" 67 m/coil	

Specification:

T20D Series Medium Pressure Tubing (138 MPa)		T20M Series Medium Pressure Cone and thread (C&T) Tubing (138 MPa)	
1/4" × 0.065"	3/8" × 0.083"	1/4" × 0.0705"	3/8" × 0.086"
1/2" × 0.109"	9/16" × 0.125"	9/16" × 0.125"	3/4" × 0.156"
3/4" × 0.165"		1" × 0.219"	

※ As O.D. tolerance ranges and hardness ranges of T20D and T20M series tubing are different, interchangeable use of these two tubing is not recommended.

TMP Series Instrumentation Tubing (83 MPa)		TCT Series Instrumentation Tubing (83 MPa)	
1/4" × 0.035"	1/4" × 0.049"	1/4" × 0.035"	1/4" × 0.049"
5/16" × 0.049"	3/8" × 0.065"	3/8" × 0.065"	1/2" × 0.065"
1/2" × 0.065"	1/2" × 0.083"	1/2" × 0.083"	

※ TMP and TCT series tubing can reach a maximum working pressure of 83 MPa, please refer to the FITOK product catalog for working pressure of tubing in different specifications.