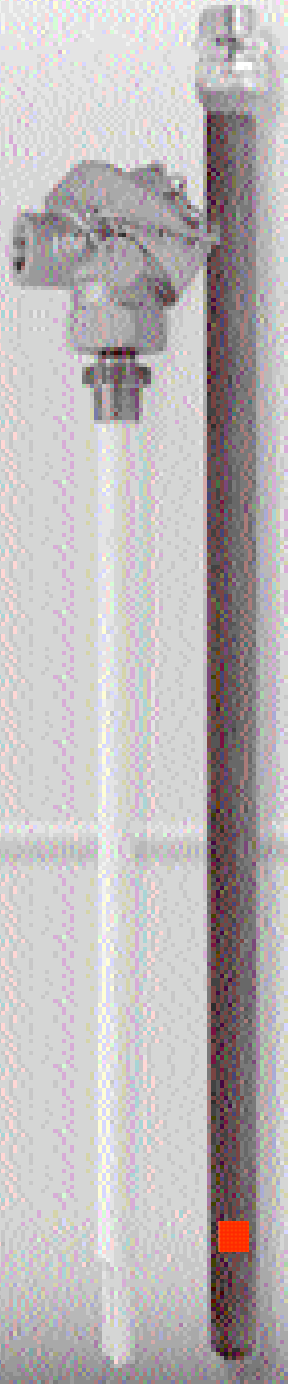
Protection Tubes



Introduction to Ceramic and Silicon Carbide Protection Tubes

In applications where contamination from hostile environments is a factor; the use of ceramic and silicon carbide protection tubes is recommended. Hostile conditions can also exceed the melting points of common metals and require the use of noble metal thermocouples (platinum and its alloys). Traditionally, such assemblies include one or two inner porcelain tubes and one outer silicon carbide tube.

Protection Tube Selection

Protection tubes must be selected based on the intended application and the maximum temperatures expected.

Tube materials react differently to high temperatures. At elevated temperatures certain ceramic materials pass through a glass phase. Alumina protection tubes and element insulators are recommended for applications with temperatures exceeding 2400˚F (1316˚C) Glazed tubes are not recommended for any application involving noble metals

Protection Tubes are made out of metal, ceramic (mullite), or metal-ceramic (LT-1) material. The table below will be helpful when selection metal or metal-ceramic protection tubes. On page 82, information pertaining to ceramic protection tubes can be found.

Metal and Metal-Ceramic Protection Tube Application Data

Material	Recommended Maximum Temperature	Remarks
Carbon Steel	1000˚F (540˚C)	Satisfactory in any except corrosive atmospheres.
Monel (67% Nickel, 30% Copper)	900˚F (480˚C)	Used where high strength and resistance to corrosion are required, such as sea water, dilute sulfuric acid and strong caustic solutions.
Yoloy (Nickel, Copper Alloy Steel)	1300˚F (700˚C)	Resistant to corrosion in both oxidizing and reducing environments. Ideally suited for use in condensate return lines, salt-water and brine solutions, condenser water lines, vent and waste piping, or corrosive water lines.
304 SS (18% Chromium, 8% Nickel)	1600˚F (870˚C)	Resistant to oxidation and corrosion. Generally used in wet-process applications such as steam lines, oil refineries and chemical solutions. Resists nitric acids well, halogen acids poorly, and the sulfur acids moderately.
316 SS (18% Chromium, 8% Nickel, 2% Molybdenum)	1600˚F (870˚C)	Superior to 304 SS in corrosion resistance. Resists pitting in phosphoric and acetic acids.
446 SS (28% Chromium, Iron)	2000˚F (1090˚C)	Excellent resistance to oxidation and corrosion at high temperatures. Used extensively in general-purpose alloy tubes. Highly resistant to sulfur attack.
Nickel	2000˚F (1090˚C)	Resistant to attack by many chemicals at high temperatures. Principally used for hot caustic and molten-salt baths. Should not be used where sulfur is present.
Inconel 600 (80% Nickel, 15% chromium)	2100˚F (1150˚C)	For general high-temperature use. Has greater mechanical strength than 446 SS. Should not be used where sulfur is present.
LT-1 (77% Chromium, 23% Aluminum Oxide)	2500˚F (1370˚C)	For high-temperature applications, Intermediate between metal and ceramic tubes, it has good thermal and mechanical shock resistance. See 7120 Series on page 83.

Ceramic and Silicon-Carbide Protection Tube Application Data

Material	Grade	Max. Use Air	Flexural Strength (x10³psi)	Thermal Conduct. W/m.K 1475˚K	Thermal Shock Resistance	Remarks	Typical Applications
Silicon Carbide	Oxide Bonded	3000˚F[1] (1650˚C)		15-20	Good	Permeable	Direct flame impingement and abrasion
Alumina	99.9%	3450˚F (1900˚C) supported, 3200˚F[1] (1750˚C) unsupported	50	6.3	Poor - must be preheated to 900˚F	Gas tight creeps (sags) at 2900˚F ferrous metals, dry H_2	Iron, barium, crown glass; non-ferrous metals; gas-tight protection for noble metal thermocouples in excess of 2400˚F (1316˚F)
	96%	2825˚F (1550˚C)	49	54	Poor - must be preheated to 900˚F	Creeps at 2900˚F	---------
Ceramic (Mullite)	---	3100˚F (1700˚C) supported, 2912˚F[1] (1600˚C) unsupported	12	2.1	Fair - preheating to 900˚F recommended	Gas tight creeps at 2642˚F, attacked by halides - contains silica	Non-ferrous metals; gas-tight protection for noble metal thermocouples to 2400˚F (1316˚C)

[1] Hot phase temperature. For additional application information, see tables on pages 67-69.

METAL PROTECTION TUBES

Series 7000

- Protection Tubes Help Insure Longer Life and Continued Accuracy
- Protects Against Physical Damage, Corrosion, and Contamination
- Generally Less Expensive than Thermowells

Enter a selection for each item, please fax your inquiry to TCP.

Example: 7000 | 1 | - | 24 | - | C | - | 0 |

7000 - | | - | | - | | - | |

CODE	PIPE SIZE	Tube Pipe O.D.	Wall Thk.
1	1/2", Sch 80	.840"	.147"
2	1/2", Sch 40	.840"	.109"
3	3/4", Sch 80	1.050"	.159"
4	3/4", Sch 40	1.050"	.113"
5	1", Sch 80	1.315"	.179"
6	1", Sch 40	1.315"	.133"

CODE	LENGTH "L"
12	12"
18	18"
24	24"
30	30"
36	36"
42	42"
48	48"
Consult factory for other sizes.	

CODE	OTHER PERTINENT DATA
0	NONE
999	Special Request Consult Factory

CODE	WIRE GAUGE SIZE
A	Inconel 600 (Seamless)
C	304 Stainless Steel (Seamless)
D	446 Stainless Steel (Seamless), formerly 28% Chrome Iron
Material A and D not available in Sch 80	
Consult factory for other materials	

Metric Orders Welcome

Place an **mm** in the appropriate selection box: 100 **mm**

CERAMIC PROTECTION TUBES

Series 7100

- Manufactured Under Rigid Controls to Maintain High Quality
- Provides Protection at High Temperatures
  - Alumina 3450˚F
  - Ceramic 3100˚K
  - Silicon Carbide 3000˚F

Enter a selection for each item, please fax your inquiry to TCP.

Example: 7100 | 1 | - | P | - | 12 | - | A |

7100 - [ ] - [ ] - [ ] - [ ]

PROTECTION TUBE SIZE			
CODE	DIMENSIONS		Material
	O.D.	I.D.	
1	3/8"	1/4"	Aluminum Oxide or Ceramic
2	11/16"	7/16"	
3	1"	3/4"	
4	1-1/4"	1"	
5	1-3/4"	1"	Silicon Carbide

CODE	CONSTRUCTION
P	Plain End
C	Collared End

CODE	MATERIAL
A	Aluminum Oxide
C	Ceramic *(Mullite)*
SC	Silicon Carbide

CODE	LENGTH "L"
12	12"
18	18"
24	24"
30	30"
36	36"
42	42"
48	48"
60	60"
66	66"

METAL-CERAMIC PROTECTION TUBES

Series 7120

- Material is LT-1 (77% Chromium, 23% Aluminum Oxide)
- Good Thermal and Mechanical Shock Resistance (Superior to Ceramic Tubes)
- High Temperature Applications Up to 2500˚F
- Excellent Oxidation Resistance for Temperatures Over 2200˚F

Enter a selection for each item, please fax your inquiry to TCP.

Example: 7120 | 1 | - | 24 | - | 1 | - | 0 |

7120 - [1] - [ ] - [ ] - [ ]

PROTECTION TUBE SIZE		
CODE	DIMENSIONS	
	O.D.	I.D.
1	7/8"	5/8"

CODE	LENGTH "L"
12	12"
18	18"
24	24"
30	30"
36	36"
48	48"

CODE	OTHER PERTINENT DATA
0	NONE
999	Special Request Consult Factory

CODE	MOUNTING ADAPTOR
0	None
1	3/4" NPT EMT Connector