

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.

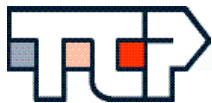
Tube materials react differently to high temperatures. At elevated temperatures certain ceramic materials pass through a glass phase. Alumina protection tubes and element insulators are recommended for applications with temperatures exceeding 2400°F (1316°C) Glazed tubes are not recommended for any application 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 <u>not</u> 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 <u>not</u> 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. |



Thermo-Couple Products Co.

Protection Tubes

Ceramic and Silicon-Carbide Protection Tube Application Data

| Material | Grade | Max. Use Air | Flexural Strength (x10 ³ psi) | 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 - - -

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:

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 - - - -

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" | Silicon Carbide |
| 5 | 1-3/4" | 1" | |

| CODE | CONSTRUCTION |
|------|--------------|
| P | Plain End |
| C | Collared End |

| CODE | MATERIAL |
|------|----------------------------|
| A | Aluminum Oxide |
| C | Ceramic (<i>Mullite</i>) |
| 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 - - - -

7120 - - - -

| 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 |