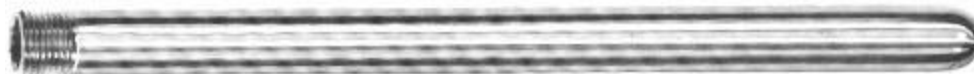


Protection Tubes

Stainless Steel, Pure Nickel, and Inconel



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
18, 19, 65, 66, 67	Food Preparation; Petroleum; Chemical Process; Mixed Acids; Lactic Acids; Dyeing Tanks.	304 Stainless Steel	Uncontrolled Amounts of nickel, Chromium, Carbon, Manganese, Silicon, Traces of Phosphorous & sulfur, Balance iron	Oxidizing 1600° F; Non-oxidizing 2300° F	Good resistance to Corrosion. For wet Process Applications such As steam, Oil, and Many chemical solutions.
44, 68, 69, 70	Petroleum Industry, Chemical process industries	316 Stainless Steel	12% nickel, 17% chromium, 2.5% molybdenum, 2% manganese maximum, .08% carbon maximum, Traces of phosphorous and sulfur, Balance of iron	Oxidizing 1600° F	Good resistance to Corrosion. Resists Pitting corrosion. More resistant to Acids than 304 stainless steel
11, 12, 13	High temperature Hardening, Nitriding, Salt baths, Vitreous Enameling, Non-ferrous Metals (tin, lead, zinc, or Babbitt metal). Smelting, Low temperature blast furnaces.	446 Stainless Steel	27% chromium, 0.25% nitrogen maximum, 0.20% carbon maximum, 1.00% silicon maximum, Traces of phosphorous & sulfur, Balance iron.	Oxidizing 2000° F Non-oxidizing 2300° F	Good resistance to Corrosion at high Temperatures. Impervious to Sulfurous atmospheres, Salt bath or low Temperature molten metals.
14, 15	Potassium Cyanide salt Baths 2000° F; Caustic and brines; High temperature Chemical applications 1200° F	Pure Nickel	Drawn or drilled 99.5 % nickel	Maximum Temperature 2200° F Oxidizing, 1000° F Reducing, 2400° F Neutral	For high temperature Applications. Will stand many chemical Actions but must not be Placed in the presence of Sulphur. Frequently placed In caustic and molten salt Baths. Drilled tube Recommended for hydrogen atmospheres.
16, 17 72, 73	High temperature heat Treating, carburizing, Nitriding, Salt baths, Blast Furnace operations, Gas generators, Ceramic kilns	Inconel 601	61% nickel, 23% chromium, 14% iron 1.35% aluminum	Oxidizing 2300° F	Excellent resistance to Corrosion and oxidation at High temperature. Good Mechanical strength. More Resistant to sulfur than Inconel 600. Hydrogen causes embrittlement.



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
06, 07, 08	Tinning, Molten non-ferrous Metals (Babbitt, Magnesium, Tin, etc.), Water lines, Petroleum applications.	SAE 1020 Or SAE 1018 Steel (black steel)	0.17% carbon, 0.75% manganese, 0.035% phosphorous maximum 0.045% sulfur maximum, Balance iron	Oxidizing 1000° F, Non-oxidizing 2000° F	Economical for low Temperature applications. Scales easily at higher temperatures. For non-corrosive atmospheres.
02, 03, 04, 05	Annealing, Drawing, Tempering, Glass lens, Power plant preheaters, Food baking ovens, Asphalt mixers.	Low carbon black steel	Uncontrolled amounts of carbon, Manganese, Silicon, and Copper, Traces of phosphorous and sulphur, Balance iron	Maximum Temperature 1250° F	For non-corrosive atmospheres and in low temperature molten metals. Black steel is a replacement for YOLOY and wrought iron. YOLOY is a trade name of Youngstown Steel and Tube.
01, 09	Chemical industry: Molten aluminum, die cast Metals	Cast iron	Cast iron	Maximum Temperature Oxidizing 1300° F non-oxidizing 2000° F Reducing atmospheres 1600° F	Will withstand sulfuric acid and caustic solutions. Process coated tubes are available for extra long life. Cast iron tubes should be painted daily with whiting when measuring aluminum or die cast metal temperatures. 01 tubes have a special coating to extend tube life in some conditions.

Metal-Ceramic



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
28	High temperature heat treating; Molten copper base alloys to 2100° F, Blast furnace and stack gases to 2400° F, Sulfur burners to 2000° F, Cement kilns to 2200° F, Chemical process reactors to 2500° F.	Metal ceramic tubes	(Slip cast composite of chromium & aluminum oxide) 77 % chromium, 23 % aluminum oxide.	2500° F	Superior oxidization resistance to 2500° F. Thermal conductivity equal to that of stainless steel. Good resistance to most molten metals to 2100° F. Not usable in molten aluminum, With a noble metal element, a ceramic primary tube is required.

Mullite, and Alumina



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
23, 24, 25	Ceramics industry; Bright annealing, Forging furnaces, Glass making, High speed salt baths	Mullite	63.5 % Al ₂ O ₃ , 34.2 % SiO ₂ , 6 % Fe ₂ O ₃ , 6 % TiO ₂ , 1 % CaO, 4 % MgO, 6 % Na ₂ O	Maximum Temperature 2900° F	Impervious to gases at high temperature. Possesses good thermal shock but mechanical shock. Often necessary to provide secondary tube protection. Should be mounted vertically. Usable in barium chloride salt baths to 2350° F
29, 30, 31	Induction melting up to 3200° F. Applications for metal and ceramic industry requiring extreme temperatures.	Alumina	99.8 % Al ₂ O ₃ , Trace SiO ₂ , Trace MgO, Trace Na ₂ O	3400° F	Fair resistance to thermal and mechanical shock. For very high temperature processes. Impervious to gases up to 3200° F

Ceramic, Silicon Carbide



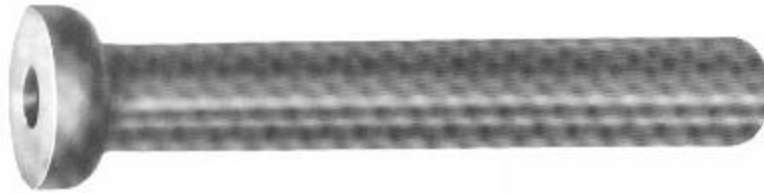
Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
21, 22	Brick and ceramic kilns, Steel soaking pits, Applications requiring resistance to cutting action of flames and gases.	Ceramic tubes silicon carbide	90% silicon carbide, 9% silicon dioxide, balance aluminum oxide and ferric oxide	3000° F	For molten non-ferrous metals, Also is a secondary protection tube for resistance to thermal shock.

Ceramic Clad



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
41,42	Foundries; Aluminum and other non-ferrous metals	Ceramic clad tubes	Composite fiberglass fabric, silicon carbide tip and ceramic coating.	Maximum Temperature 1700° F	Not wetted by molten aluminum and other non-ferrous metals. No contamination. Resists thermal and mechanical shock. Brittle after heating; handle carefully. Code 42 is spring loaded.

Silicon Carbide



Code	Typical Applications	Description	Composition or Form	Max. Temp.	General Comments
46	Molten tin, zinc, lead and aluminum	Silicon carbide over black steel	90% silicon carbide, 9% silicon dioxide, balance aluminum oxide and ferric oxide.	1600° F	For molten non-ferrous metals.

McGoff-Bethune, Inc.

5970-A Unity Drive
Norcross, GA 30071
+1-770-840-9811
www.mcgoff-bethune.com
sales@mcgoff-bethune.com