

# TUBING, MGO SHEATH, PROTECTION TUBE, AND DRILLED WELL MATERIALS

METALS		TYPICAL AREAS OF USE				APPLICATION GUIDELINE INFORMATION
MATERIAL / COMPOSITION	TUBING	MGO SHEATHS	PROTECT. TUBES	DRILLED WELLS		
304 Stainless Steel (UNS S30400) 18% Chromium 8% Nickel	✓	✓	✓	✓	Up to 997°C (1650°F) under oxidizing conditions. Has general good oxidation and corrosion resistance in a wide range of industrial environments. Subject to carbide precipitation, which can reduce corrosion resistance in the 47 to 538°C corrosion resistance in the 47 to 538°C (800 to 1000°F) range. Good mechanical properties from -194 to 788°C (-300 to 1450°F) range. Main areas of usage for thermocouple protection is in areas of usage for thermocouple protection is in chemicals, foods, plastics and petroleum. Generally regarded as standard protection tube material.	
304 Stainless Steel Low Carbon (UNS S30403) 18% Chromium 8% Nickel	✓	✓	✓	✓	Same characteristics as for 304 Stainless Steel except that low carbon allows corrosion resistant weld areas. Not recommended for use above 472°C (800°F). (0.03% maximum carbon)	
310 Stainless Steel (UNS S31000) 25% Chromium 20% Nickel	✓	✓	✓	✓	Up to 1038°C (1900°F) continuous, 1140°C (2100°F) intermittent. Mechanical and corrosion resistant similar to and better than 304 Stainless Steel.	
316 Stainless Steel (UNS S31600) 16% Chromium, 12% Nickel, 2% Molybdenum	✓	✓	✓	✓	Up to 927°C (1700°F) under oxidizing conditions. Same areas of applications as for 304 Stainless Steel. Has improved resistance to mild acid and pitting corrosion.	
316 Stainless Steel Low Carbon (UNS S31603) 16% Chromium, 12% Nickel, 2% Molybdenum	✓	✓	✓	✓	Same characteristics as for 316 Stainless Steel except that low carbon allows corrosion resistant weld areas. Not recommended for use above 472°C (800°F). (0.03% maximum carbon)	
446 Stainless Steel (UNS S44600) 27% Chromium	✓	✓	✓	✓	Up to 1093°C (2000°F) under oxidizing conditions. Excellent high temperature corrosion and oxidizing resistance. Main areas of application are: hardening, nitriding and annealing furnaces; salt baths; molten lead, tin and babbitt metal and sulfurous atmospheres. Not for carburizing atmospheres. Other areas are steel soaking pits, tinning pots, waste heat boilers, ore roasters, cement salt tubes, boiler tubes to 982°C (1800°F), incinerators to 1093°C (2000°F) and glass tank flues.	
Alloy 600 (UNS N06600) (Inconel 600) 72% Nickel, 15% Chromium, 8% Iron	✓	✓	✓	✓	Up to 1149°C (2100°F) under oxidizing conditions. Reducing conditions reduce temperature to 1038°C (1900°F). Must be placed in a reducing atmosphere during cooling and heating. Main areas of application are for thermocouple protection in furnaces, open hearth, flue stacks, steel soaking pits, waste heat boilers, ore roasters, cement exhausts, incinerators and glass tank flues.	
Alloy 601 (UNS N06601) (Inconel 601) 61% Nickel, 23% Chromium, 1.35% Aluminum	✓	✓	✓	✓	Similar applications to Inconel 600 but with superior resistance to sulphur. High temperature oxidation resistance to 1260°C (2300°F)	
Brass	✓			✓	Up to 538°C (1000°F) continuous. Good thermal conductivity and mechanical strength.	
Carbon Steel	✓		✓	✓	Up to 538°C (1000°F) in non-oxidizing environments. Main areas of usage are galvanizing pots, tinning pots, molten babbitt metal, molten magnesium, molten zinc, petroleum refinery applications such as dew axing and thermal cracking.	
Cast Iron			✓		Up to 704°C (1300°F) in oxidizing conditions. Main areas of usage is in molten non-ferrous metals, daily writing is recommended. Can be used to 871°C (1600°F) under reducing conditions.	
Copper	✓				Up to 260°C (500°F) continuous. Excellent thermal conductivity and mechanical strength.	
Tantalum	✓				Up to 2349°C (4250°F). Good resistance to corrosion and quick heat conductivity. Good mechanical strength. Used in chemical processes and high temperatures in vacuum or inert atmospheres.	
Titanium	✓			✓	Up to 1260°C (2300°F) in inert or vacuum atmospheres. Acid and chemical resistant. Oxidation resistance to 538°C (1000°F).	