GrafTech™ LT1™ MetalCeramic Protection Tubes

GrafTech International is a global leader in graphite and carbon products. We enable customer leadership better and faster than our competition, through the creation, innovation and manufacture of carbon and graphite material science based solutions.

General Information

GrafTech™ LT1™ MetalCeramic is a combination of a metal matrix, chromium, and a pure ceramic phase, aluminium oxide (alumina). The material is slip cast, sintered, and then oxidized. Although the exact nature of the bond between the phases is not known, a physical-chemical bond may be formed through the sharing of oxygen by the chromium and the alumina. There is no evidence of wetting or solution.

Slip casting is a process whereby finely divided solid constituents are put into a liquid vehicle to form a colloidal suspension called a "slip". The slip or suspension is poured into a porous plaster mold. The mold absorbs the liquid leaving the solids in the shape of the mold cavity.

Physical Appearance

In general, GrafTech™ LT1 MetalCeramic Protection Tubes are a dull grey color in the as-produced condition and are metallic in appearance when either ground or machined. After the oxidizing heat-treatment, the surface color is generally a very dark green to black.

Properties

By the very nature of its constituents, GrafTech™ LT1 MetalCeramic Protection Tubes exhibit properties that are not found solely in either a metal or pure ceramic alone.

LT1™ MetalCeramic Protection Tubes have excellent oxidation resistance and also resist wetting by many metals and alloys, as well as basic furnace slags. The chromium-metal phase takes on a very tightly bonded layer of chromium oxide which, together with the naturally inert nature of the alumina, provides this material with its remarkable resistance to oxidizing atmospheres over 1200 ˚C, good corrosion resistance, and the ability to resist wetting by molten metals.

High thermal conductivity and the resultant excellent sensitivity to temperature changes accounts, in part, for its demand in the high-temperature pyrometry field as a thermocouple protection tube.
LT1™ MetalCeramic Protection Tubes have good strength at temperatures where many high-temperature metals melt. Above approximately 1540 ˚C, it begins to soften and becomes plastic. LT1™ MetalCeramic Protection Tubes have, however, been used successfully for dip immersion at a temperature of 1650 ˚C.

In use or service of the tubes, care must be taken to avoid conditions of extreme thermal shock, extreme thermal gradients, mechanical shock, and impact.

GT-5065
Rev. 1

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Although LT1™ Metal Ceramic Protection Tubes are superior to ceramics in most important properties, it is less resistant to shock and impact than the metallic alloys. Therefore, *a standard thermocouple protection tube should be preheated to about 480 ˚C before immersion in molten metal at 1100 ˚C or higher.* Whenever practical the following preheat procedure can also be used: Hold the tube immediately above the molten metal for approximately one minute before immersing. In tests this procedure proved to be adequate to prevent thermal shock failure.

LT1™ MetalCeramic Protection Tubes exhibit excellent resistance to wear under conditions of sliding friction, as well as resistance to abrasion at high temperatures. The hardness of this material (Rockwell C 37) is more indicative of the crushing strength of the material than its true hardness because the individual particles have a greater hardness than the combined body.

GrafTech™ LT1™ MetalCeramic Protection Tubes are less porous than most compacts. There is no significant passage of gases through the body at high temperatures, except under high vacuum. For the usual industrial applications, it is sufficiently impermeable. For example, $S0_2$ and $S0_3$ gases have not penetrated LT1™ thermowells over a three year period to affect thermocouple wires.

In summary, GrafTech™ LT1™ MetalCeramic Protection Tubes possess several attractive attributes:

- Non-wetted by most molten metals and basic slag
- Good erosion resistance
- Good abrasion resistance
- Excellent oxidation resistance
- High thermal conductivity
- High strength above the temperature at which most materials melt or otherwise fail.

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Recommended Applications

1. Molten copper and brass to 1150˚C intermittent and continuous immersions.
2. Corrosive $S0_2$ and $S0_3$ gas (to 1375 ˚C and $S0_3$ and HF gas (to 1100 ˚C).
3. Steel mill soaking pits to 1375 ˚C.
4. Pelletizing charter of Taconite refining operation to 1150 ˚C.
5. Molten zinc to 875 ˚C.
6. Molten lead to 350 ˚C.
7. Basic steels and slags to 1735 ˚C (intermittent) and 1375 ˚C (continuous) in open hearth and general foundry practices.
8. Calcining kilns to 1200 ˚C.
9. Barium titanate (barium oxide service) to 1200˚C.
10. Magnesium oxide calcining kilns.
11. Fluid bed cement process with severe corrosion and temperature to 1315 ˚C (fluid method of producing builders cement).
12. Gas and ethylene cracking atmosphere.
13. Atmosphere directly above burning sodium (975-1375 ˚C).
14. Oil fired furnace chambers.
15. Molten silver solder.
16. Molten tin.
17. Borax flux.
18. Copper matte.
19. Boiling sulphuric acid – 97%.
20. Blast furnace stove dome and bustle pipes.

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