Recommendations For Installation And Use Of Morgan Carbon Bonded Silicon Carbide Crucibles In Tilting Induction Furnaces

*Applicable for Excel, Hi-Melt, and Ultramelt crucibles.

Storage and Handling

Crucibles should be stored in a warm dry place, preferably above 20°C, and kept on pallets, never directly on the floor. Never roll crucibles on a hard floor as damage to the glaze could adversely affect the performance.

Installation and Backing Refractory

Carbon bonded silicon carbide crucibles are installed in conjunction with a backing of a suitable graded refractory material. This is essential to provide mechanical support for the crucible. The backing refractory should be carefully chosen to ensure that it would not sinter to a hard mass during normal use. Hard sintered backing material will restrict expansion of the crucible and will cause it to crack. We recommend the use of magnesia based backing refractories with no sintering additives. Morgan Starrvibe backing refractory is designed specifically for this purpose.

The thickness of the backing refractory will be determined by the size of the crucible. As a guide this will be as follows: Crucibles of up to 300Kg copper alloy capacity require approximately 40mm backing thickness Crucibles of 500-1000Kg copper alloy capacities require approximately 50mm backing thickness Crucibles of 1000Kg and above copper alloy capacity require approximately 60mm backing thickness

A slip plane should first be installed against the wall of the furnace to facilitate movement of the backing refractory. We recommend the use of mica sheet or a special type of glass fibre weave for this purpose. The slip plane is affixed to the coil grout using an appropriate proprietary adhesive to hold it in place whist the backing is being added. The use of ceramic fibre paper is not recommended, as this material is prone to tear during the installation and can over-insulate the refractory lining.

A quantity of the backing refractory should then be poured into the base of the furnace to support the crucible and establish it at the correct height in relation to the induction coil. This should be built up in layers of approximately 50mm, de-aired using a forked tool and then compacted using a compaction tool or vibrator. The “star wires” should be arranged such that earth leakage detection is provided. In practice one of the wires is normally left protruding from the refractory base and bent over such that full contact is made with the crucible base when it is lowered on to the refractory. The other wires can be cut off just above the surface of the refractory bed and bent over just under the surface. The outer surface of the refractory bed should then be scratched to provide a key for the material to be added for the sidewall. Alternatively in some furnaces the crucible may be installed directly onto a pre-cast refractory base into which “star wires” are embedded in order to provide earth leakage detection.

Lower the crucible in to the furnace, ensuring that the earth leakage probe is sited such that it is in contact with the base of the crucible as described above and that the crucible base is fully supported by the bed of refractory material. N.B. The furnace and crucible must be properly earthed at all times when melting is in operation.
Centralise the crucible within the coil. Uneven heating and localised erosion of the crucible wall will result if the crucible is not properly centred in the coil.

Add refractory backing material evenly around the crucible, de-airing with a forked tool and tamping and/or vibrating the lining firmly into place using an appropriate tool in order to achieve compaction evenly around the crucible. The backing refractory should be added in layers approximately 50-100mm in depth, according to the size of the crucible, scratching the surface of each layer in order to provide a key with the next layer prior to adding further material. Repeat this process until the top of the coil is reached. Finally de-air and compact the top surface of the refractory lining, which should finish just below the top edge of the crucible.
Any excess slip plane material protruding above the coil can now be cut off. Several options are possible for the pouring spout arrangement. Morgan manufactures a variety of cylindrical crucibles with an integral spout that can be seated

into plastic refractory. Separate pre-formed spouts can also be supplied. Alternatively a pouring trough can be fashioned in situ from plastic refractory. The top of the crucible and refractory lining should be sealed in position with a layer of capping material. A plastic ramming material such as Morgan Plastic HT is recommended for this purpose. The use of castable materials is not recommended as the backing material will become wet and moisture will also affect the rim of the crucible.

Moisture/Drying

Allow the furnace refractories to air-dry for 24 hours following repairs and installation. The furnace should then initially be run at a low power setting to ensure that any remaining moisture is removed. All refractories can absorb moisture from the atmosphere over a period of time. We therefore advise that the furnace should initially be run at a low power setting if the furnace has not been used for a significant period of time.

Charging, Heating and Melting

Never introduce moist charge material into the crucible. Use tongs to charge ingots or larger pieces of metal to avoid damage to the crucible. Place vertically to avoid wedging the charge. Do not pack metal tightly in the crucible. Always allow sufficient space for the metal to expand.
The exact heat-up procedure to be used depends on furnace frequency, coil dimensions, type of crucible, and the resistivity of the metal being melted. It is recommended where possible to initially preheat the crucible empty. The power input should initially be increased in stages up to a maximum value, depending on the afore-mentioned parameters, until the crucible becomes bright red over its entire surface. The maximum power level utilised at this stage would typically be in the region of 100Kw in a 1kHz furnace. The time taken will depend on the size of the crucible, but is usually in the range 20 40 minutes.

Carbon bonded silicon carbide crucibles absorb proportionally high levels of power from the induction field. Care should be taken not to overheat the crucible. The actual maximum power setting that can be used on a particular furnace whilst the metal is still solid can only be assessed from experience. Thus with a new furnace it is important to err on the side of caution when increasing the power to melt the metal. Where possible the appearance of the inside wall of the crucible should be monitored. Once the metal is molten and more than one third of the crucible is full of molten metal, power can be increased to a higher level. This higher level again is dependent on the size of the crucible, but should not exceed 250 Kilowatts for crucibles up to 300kg of copper capacity and 400 Kilowatts for crucibles up to 750kg copper capacity or greater. Further metal should be added as the charge melts until the working level is reached. When all the metal has become fully molten, the power level should be reduced to avoid excessive temperature overshoot. Unnecessarily high temperatures will increase erosion.
The internal appearance of the crucible should be observed when pouring and if the colour is bright yellow or lighter then it is advisable to reduce the maximum power for subsequent melts.
Avoid over-heating the metal. Always melt to the lowest possible temperature compatible with casting. Avoid stewing the metal for long periods as this will lead to increased wear of the crucible wall. Pour the metal as soon as it is ready. Empty the crucible as quickly as possible. Avoid delay between heats and use as continuously as possible. Always empty the crucible completely at the end of the shift. Never allow metal to solidify in the crucible, as expansion stresses generated through re-heating will crack the crucible.

Cleaning

Crucibles should be cleaned out by careful scraping in between melts whilst the crucible is still red-hot. Any slag that remains in the crucible will accelerate erosion of the wall during subsequent melts and shorten crucible life. Oxide dross, which remains in the crucible, will become extremely hard over a period of time. The presence of this material will increase melt times and could result in cracking due to expansion stresses.

Safety

Furnace operators should wear appropriate safety clothing and facial protection at all times.

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