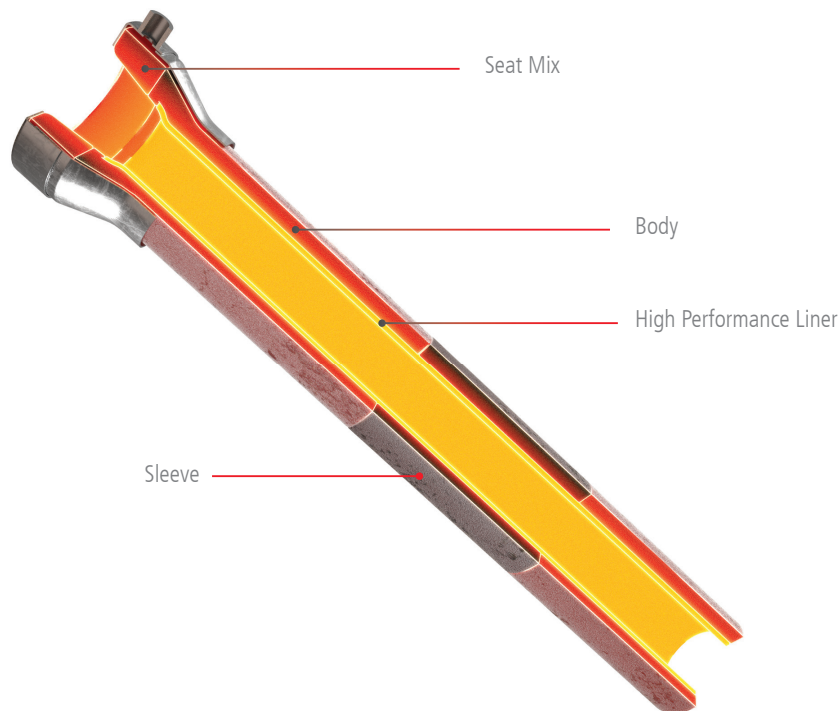


VISO Ladle Shroud

Ladle Shroud

The Vesuvius Ladle Shroud (LS) is an isostatically pressed ceramic tube custom designed for direct connection to the ladle slide gate collector nozzle, offering maximum protection of the steel stream from re-oxidation. Preheating is not required prior to use and the shroud can be oxygen cleaned for immediate re-use during sequence casting operations or for subsequent re-use during batch casting.

A range of mixes and designs are available depending on the particular steel composition and casting conditions applicable. New stress resistant flange designs have been developed using finite-element analysis (F.E.A.) for longer life. Each flange is custom designed to counteract the forces encountered by the ladle shroud in service.



Technologies: cold start solutions

Vesuvius offers several different technologies for ladle shroud products:

- Oxidized bore: the oxidized bore is our original cold start ladle shroud and is still our most commonly used ladle shroud technology. Through design and mix selection, this product is capable of servicing both long-life and single use applications.
- Cold Start Reliability (CSR) liner: CSR LS is our new state-of-the-art ladle shroud technology. This product uses a high performance low conductivity insulating liner to replace the oxidized bore of our standard ladle shrouds. Due to the improved erosion resistance of the liner compared to the oxidized bore, this product is best used for long-life applications, for customers with short sequences who have the potential for re-use, and customers who have low tundish drains during grade changes.
- New generation Cold Start materials: Vesuvius has developed a family of new materials with excellent thermal shock resistance that can be used in ladle shroud applications without the need of an oxidized bore or a CSR liner. Through the use of these new materials the ladle shroud can provide safe re-use after low tundish drains and long ladle exchanges.

Bore design

- Direct Taper Shroud: this is the most common shape and simplest design.
- Reverse Taper and Bell Shroud: more and more customers want to submerge open, meaning the ladle shroud is submerged into the tundish steel bath before opening the ladle gate. This practice requires the internal volume of the submerged section of the ladle shroud to be increased to avoid blowback of the molten steel. The reverse taper and bell shroud designs allow customers to open submerged.



Bell Shroud



Reverse Taper Shroud

Material selection

After designing the ladle shroud to suit the customer's caster configuration, the final step is to select the proper material for the steel grades being cast. In general, materials for the seat area must be abrasion resistant and capable of withstanding oxygen cleaning between heats. There are a number of choices for the body mix, and the selection is dependent on both the steel grade and target casting times. The performance of the body mix can be enhanced by adding an erosion resistant liner where needed. For the slag line, there are mixes available for acid tundish fluxes and basic tundish fluxes, depending on the customer practice.

To enable the use of the ladle shroud for longer casting times, a special material can be used in the submerged portion of the design to offer greater corrosion and thermal shock resistance.

Argon technologies

If the connection between the collector nozzle and the LS is not tight, air ingress occurs often resulting in steel re-oxidation and nitrogen pick-up. The Venturi effect caused by the steel flow inside the LS increases the risk of air ingress.

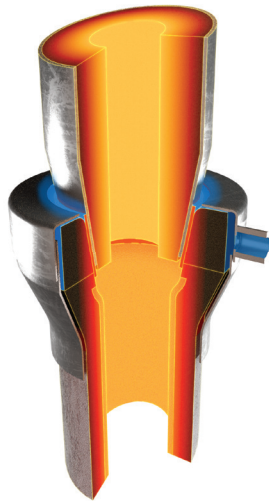
To minimize air aspiration between the two refractory components (collector nozzle and ladle shroud), argon sealing and argon injection may be used in conjunction with sealing gaskets (Sealbind™ or fiber). Argon is used to compensate for the negative pressure inside the ladle shroud (Argon injection) and to create an argon shield around the junction (Argon shielding).

Multiple material and design options to meet customer target needs:

- Cold Start practice
- Submerged opening
- Reduce nitrogen pickup
- Long life
- Fast and secure connection
- Efficient, reliable argon use

Argon shielding

To minimize argon action in the tundish, shielding can be created by blowing argon through a permeable ring located at the ladle shroud-collector nozzle mating surfaces. An alternative is to introduce argon through an annulus formed within the steel can for “over-the-top” shielding. Both options minimize the potential of air ingress.

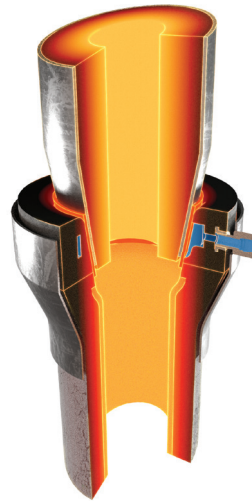


“Over-The-Top”

Argon injection

Argon is injected into an annular cavity in the flange of the LS and passes through a series of slots in to the steel stream. A positive argon pressure is created inside the ladle shroud giving two benefits:

- The argon flows as bubbles entrained in the steel stream, rising quickly to the tundish surface and assisting flotation of inclusions.
- The argon pressure prevents any possible air ingress at the joint between the collector nozzle and the ladle shroud seat.

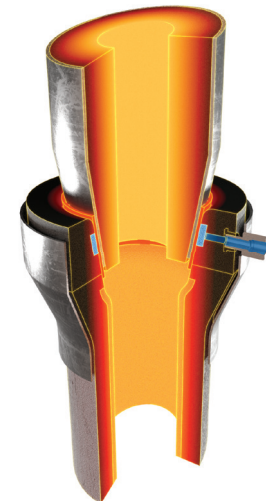


“Annular Cavity”

Argon monitoring

The efficiency of the argon delivery during casting can be monitored and controlled by the back-pressure and/or the flow rate of argon, depending on customer requirements.

Flow and pressure limits can be set so that shield quality is constantly monitored and evaluated, alarming to notify operators if the shield has deteriorated.



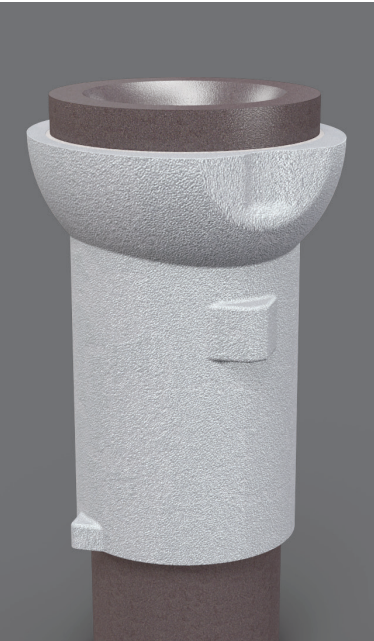
“Permeable Ring”

Ladle Tube Changer

Combining CSR ladle shroud technology and our vast experience on tundish tube changer refractory we have successfully developed a new concept in ladle shrouds to use with the revolutionary LTC (Ladle Tube Changer) mechanism. When used in conjunction with the Vesuvius Robotic Casting technology the LTC provides steelmakers with a safe and reliable submerged ladle opening and optimized air tightness between ladle and tundish, delivering premium quality slabs even during ladle transitions.

Refer to FLOW CONTROL SYSTEMS brochure for further detail and information.





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