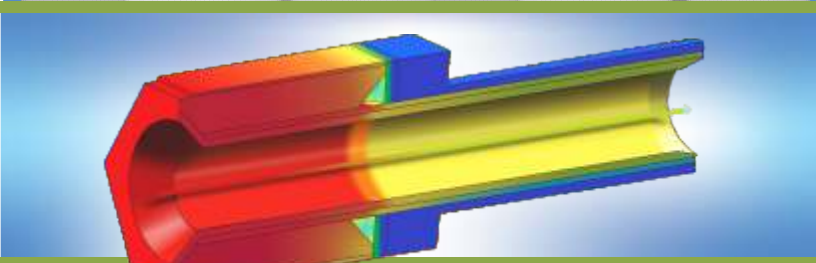


Trusted Experience for over 65 years



CERAMIC FIBER SLEEVES AND GASKETS

- Insulates ferrules from tubesheet metallurgy
- Ensures even heat distribution
- Increasing overall thermal shock resistance
- Improves unit reliability



THERMAL ANALYSIS

- Thermal modelling optimizes ferrule system and reduces tubesheet temperatures
- Recommendations to protect your boiler tubes and minimize corrosion
- **Please contact our technical department for additional information.**

Industrial Ceramics Limited

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Industrial Ceramics Limited

Est.1946

A number of factors go into ferrule design:

- Unit construction
- Tubesheet design
- Service conditions
- Operating parameters and historical performance
- Pressure drop and gas velocities
- Shell and tube side conditions

Our ferrules incorporate **generous radii and inlet tapers/bevels, with key structural components** to produce tubesheet refractory solutions that:

- Enhance gas flow
- Increase structural integrity
- Enable good fit, and
- Ensure reliable installation in the field

All factors are critical to unit performance and reliability.

Material selection should be based on the operating conditions and ICL offers an array of high temperature ceramic materials to suit these severe environments.

Contact Industrial Ceramics for details.

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INDUSTRIAL CERAMICS LIMITED

- World leader in the custom manufacture of ceramic ferrules
- Superior technical support based on over 65 years' experience in SRU's
- High quality materials
- Strong customer support
- Expedited delivery when need is urgent

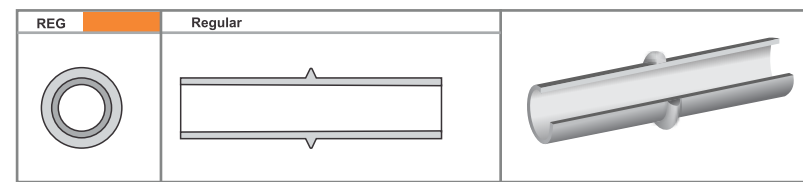
EXPERIENCE

EXPERTISE

SUPPORT

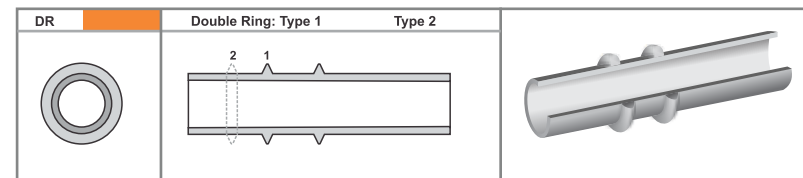
WORLDWIDE

The styles below are schematics to illustrate approximate shapes and are not final manufacturing drawings.



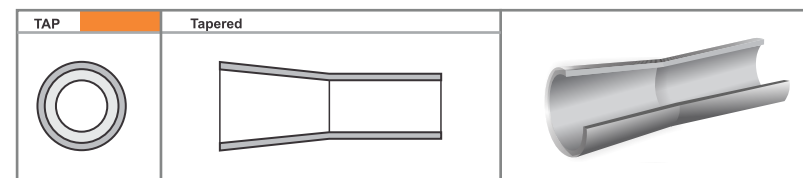
REGULAR STYLE

- Moulded stop ring sets refractory depth and anchors the ferrule in place.
- Ring keys the ferrule into the refractory.
- Ferrule replacement necessitates removal of the entire refractory lining.
- Good reliability in service is why this style has stood the test of time.



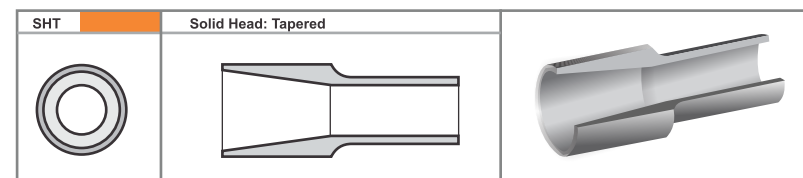
DOUBLE RING STYLE

- First ring is fixed (usually at 4 inches) and sets the refractory depth.
- Second ring provides additional anchoring in the castable refractory.
- Installing ferrules with staggered ring placement will relieve stress planes and enhance structural integrity of the whole lining.



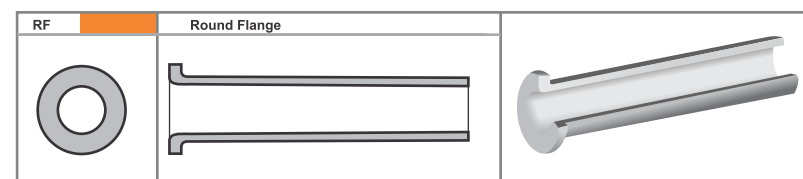
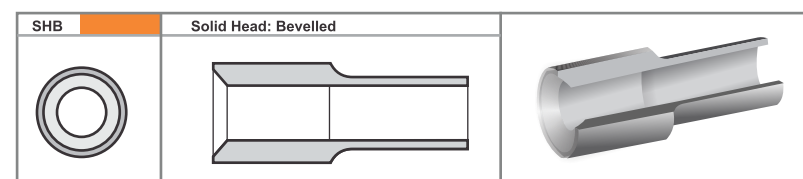
TAPERED STYLE

- Tapered inlet facilitates gas flow and reduce turbulence at the entrance.
- Installation of castable and anchor placement are more difficult because of the decreased space between tube ligaments.



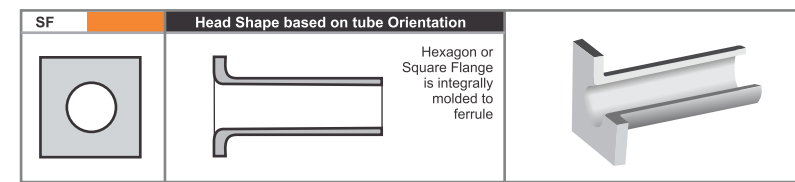
SOLID HEAD STYLE

- Increased wall thickness of refractory end of the ferrule.
 - Ferrule less resistant to crushing and cracking due to thermal expansion mismatch between ferrule and refractory castable.
 - Traditionally used in combination with a bubble alumina, light weight insulating castable or in areas where tight tube pitch prohibits the use of anchors.
- Tapered and beveled inlets reduce gas turbulence, without compromising compressive strength.



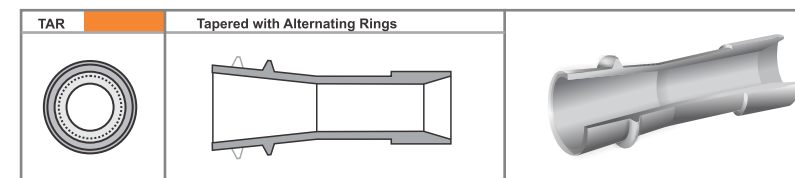
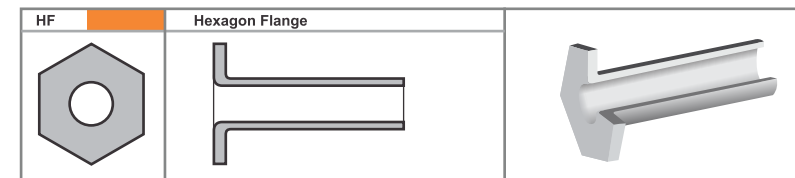
FLANGE STYLE

- A variation of the regular style with stop ring at the ferrule inlet
- Replicates a two-component lining on the tubesheet: lightweight insulating castable refractory is covered with a dense erosion resistant layer.
- Ceramic fibre board can be used instead of the insulating castable layer.
- Flange shape should match tube pitch and layout
 - Round flanges for parallel triangle or irregular tube pitches



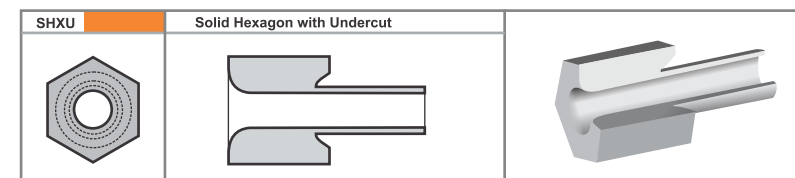
FLANGE STYLE

- Hexagon flanges for triangular and/or rotated square pitches.
- Square flanges for in-line square pitches.
- Installation details.
 - Refractory is first applied around dowels. Dowels are removed when the refractory has just set.
 - Ferrules are then inserted.
 - Ferrules easily removed for inspection of tube/tubesheet
 - Ferrules removed/replaced without destruction of the entire castable lining.



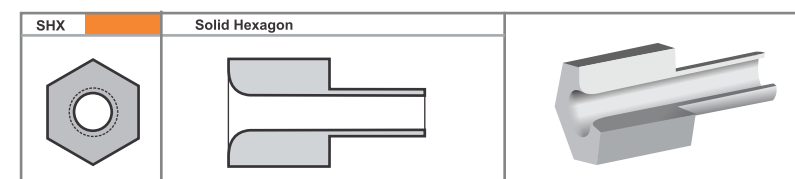
TAPERED STYLE WITH ALTERNATING RINGS

- Custom ferrule specially designed for use in high temperature, oxygen enriched units.
- Ceramic fibre insulation is recessed into ferrule to allow for thicker insulation.
- Staggered ring placement provides a discontinuous stress plane in the refractory.

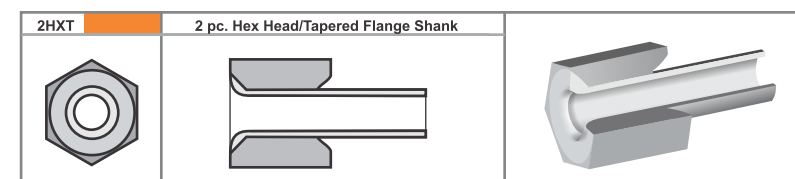


SOLID 1-PIECE HEXAGON (OR SQUARE) HEAD STYLE

- Industrial Ceramics Limited Solid Hexagon Head Ferrule has been used **successfully for over 35 years**.
- Head of the ferrule is extended to replace castable refractory.
- Ferrules are easily removed for inspection or replacement.
- Ferrule entrance may be tapered to facilitate gas flow.
- A generous radius cast under the head will accommodate boiler tube protrusions.
- Castable refractory is installed only around the periphery of the tubesheet.

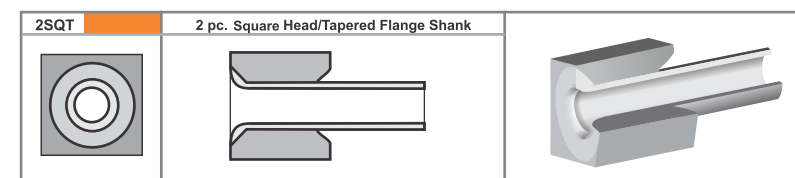


NOTE: INDUSTRIAL CERAMICS has been making the solid hexagon ferrule for over 35 years. It has a strong track record of service in certain types of units. The solid 1-piece hexagon ferrules are not ideal for certain units and we recommend consultation with INDUSTRIAL CERAMICS LTD prior to the installation of this style.



TWO PIECE SQUARE / HEXAGON HEAD STYLE FERRULES (Patented Design)

- The Industrial Ceramics Two-Piece Square / Hexagon Head Style Ferrules have been successfully used for 20 years in over 600 installations worldwide.
- The two-piece square / hexagon have all the advantages of the solid hexagon but are well suited to environments that are not suited to using 1-piece solid square or hexagon styles.
- The separate square / hexagon nut fits over the shank of the ferrule, and
 - Is better able to handle thermal expansion mismatch
 - Evenly distributes mechanical load over the length of the ferrule insert.
- Two-part ferrules are especially well suited to high-temperature oxygen enriched units, as well as very large tubesheets.



*The two-piece square / hexagon head ferrules has been used for more than 20 years and in greater than 600 installations worldwide. Contact INDUSTRIAL CERAMICS LTD to discuss this leading technology and why so many users prefer this style.