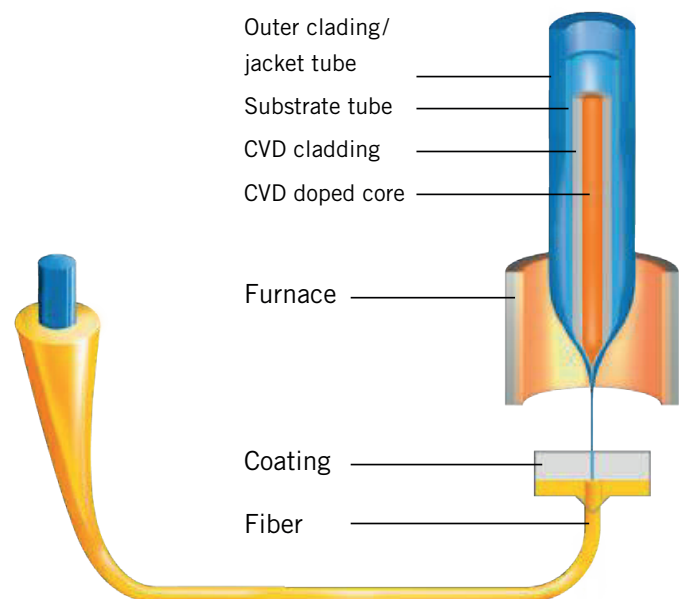


## High Purity Fused Silica Tubes

For high-precision optical fiber production

From the first natural fused quartz tubes in the early days of optical fiber production in 1976, Heraeus tubes were and are used as substrate and jacket tubes for the production of optical fibers. Heraeus has continuously improved the quality and performance of the tubes serving the fiber optics industry. Heraeus uses proprietary processes that allows the production of fused silica tubes without the use of forming tools. These processes yield tubes of excellent purity and high geometrical performance, as well as extremely low hydroxyl (OH) content. Trace impurities are below the detection limit of ICP-MS.



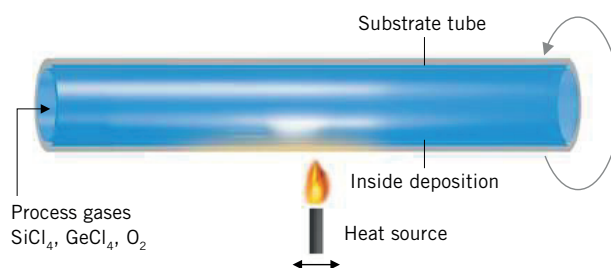
## Tubes for core rod production

Fused silica tubes are used in key steps of optical fiber preform production. Chemical Vapor deposition (CVD) processes rely on high purity and precise geometrical properties of tubes to produce excellent core rods. For all kinds of CVD processes that differ in the employed heat source (burners: MCVD, furnaces: FCVD or plasma: PCVD) Heraeus F 300® material with a specified OH content below 1 ppm is the material of choice and the established standard in the fiber optic community. For applications where the OH level is a critical parameter Heraeus has specifically developed F 500® material which is OH free. For applications requiring tight geometrical tolerances Heraeus has engineered an enhanced tube production process to improve ovality and siding characteristics. Tubes with these improved geometrical characteristics are indicated as “HP” for high precision tubes.

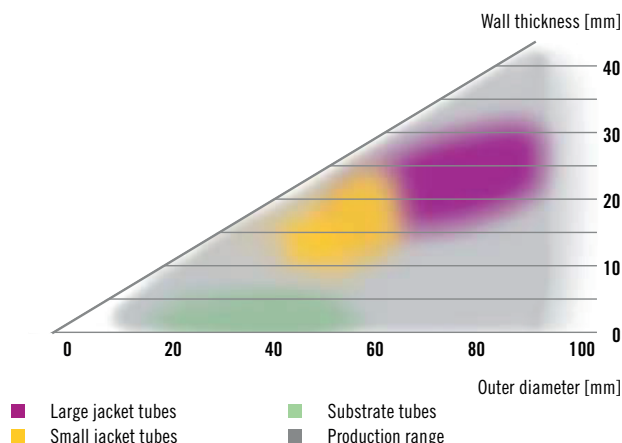
## Tubes used as cladding material

Heraeus fused silica tubes can be used not only for the manufacturing of core rods, in the deposition process, but also as cladding material, jacketing the core rod. The tubes are available in a wide range of sizes. Heraeus fused silica tubes can be tailored to customer specific requirements. Using Heraeus tubes as cladding material is attractive even for large volume fiber production. In addition to all the mentioned benefits Heraeus tubes have the advantage, that the interface of core and cladding stays free of Hydroxyl ions. The Rod in Tube process (RIT) and on a larger scale the Rod in Cylinder process (RIC®) yield preforms for the production of water free fiber. The RIC® process is used in large scale single mode fiber production with batch sizes up to 10,000 km.

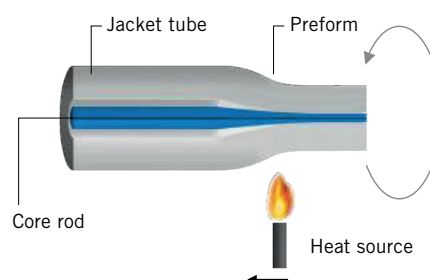
### CVD process inside a substrate tube



### Available tube sizes



### Cladding a core with a jacket tube



### Typical Geometrical Performance

Typical values	Small substrate tubes	Substrate tubes, (HP substrate tubes)	Small jacket tubes	Large jacket tubes
Outer diameter (OD)	10 – 20 mm	20 – 40 mm	40 – 60 mm	60 – 90 mm
Wall thickness (WT)	1 – 4 mm	1 – 4 mm	4 – 15 mm	15 – 30 mm
OD tolerance	± 0.02 ... 0.2 mm	± 0.03 ... 0.2 mm	± 0.1 ... 0.3 mm	± 0.2 ... 0.4 mm
WT tolerance	± 0.02 ... 0.2 mm	± 0.03 ... 0.2 mm	± 0.1 ... 0.3 mm	± 0.2 ... 0.4 mm
Ovality	0.03 ... 0.2 mm (HP: 0.01 ... 0.03 mm)	0.05 ... 0.2 mm (HP: 0.01 ... 0.05 mm)	0.1 ... 0.25 mm	0.15 ... 0.3 mm
Siding	0.05 ... 0.12 mm (HP: 0.02 ... 0.05 mm)	0.07 ... 0.12 mm (HP: 0.02 ... 0.05 mm)	0.1 ... 0.2 mm	0.15 ... 0.3 mm
CSA deviation	1 ... 3 %	1 ... 2 %	0.7 ... 2 %	0.5 ... 1 %
Bow	0.3 ... 0.5 mm/m	0.2 ... 0.4 mm/m	0.2 ... 0.4 mm/m	0.2 ... 0.4 mm/m

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