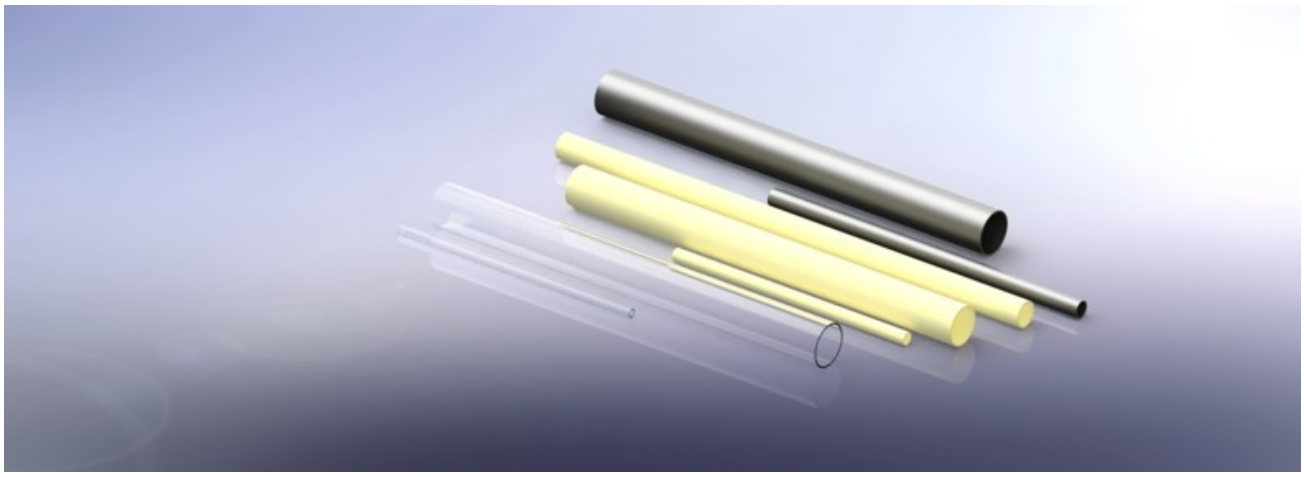
THERMANSYS®

Reactor/Tube Furnaces – Working Tubes

Description.

Tube Furnaces are designed to heat a working tube that fit inside its tubular heated zone and contain the treated load. Usually tube furnaces are open from both sides and the working tube is protruding from each side. Special designed tube furnaces have closed one end.

The working Tube is an in depended part from the tube furnace and its selection depending mainly on the maximum operation temperature and on the process/application characteristics. Metallic tubes are convenient since can be machined and weld easily proving a good solution but their usage is restricted to comparative low temperature levels. Common stainless steels can operate up to 700C while heat resistant steels are also limited close to 1000C. Special Ni alloys can operate up to 1100 -1150C continuously, while iron-chromium aluminum (FeCrAl) alloys tubes can operate up to 1250C. Quartz tubes are also an excellent option, especially due to the remarkable thermal shock resistance and their resistance against many atmospheres but their temperature continuous duty level goes up to 1100C. For operation temperatures above 1100 – 1200C the most common application is high purity Alumina. Can operate up to 1650C under atmospheric pressure but suffers from very low limits of resistance against thermal shock. Other possible option is Silicon Carbide for operation up to 1500C that also presents good thermal shock resistance. For applications requiring operation temperature higher than 1650C available options are Sapphire and Yttria Stabilized Zirconia tubes that can operate up to 1800C continuously at atmospheric conditions.



Useful notes

The maximum operation temperature is the most important factor when selecting a working tube for a high temperature application. Several restrictions exist however concerning the treated gaseous atmosphere compatibility with the tube material. The user should get advise from relative literature or technical chemical compatibility charts in relation with the process gaseous atmosphere before selecting the optimum material.
The pressure rating of the tube under the operation temperature should also taken into account. It should be pointed out that always the maximum allowable pressure at elevated temperature is much lower than the rating for the same material under atmospheric temperature conditions. For example Alumina tube operation is restricted to 1420C when operating under vacuum conditions while can operate up to 1650C under atmospheric pressure. Similar limits exists for all material.
Usually working tubes are protruding from both ends of the furnace and are used in combination with gas end sealing flanges to provide controlled atmosphere inside the tubes. These flanges are using elastomeric gaskets to seal and their temperature is restricted to 200-250C because of that. Therefore the temperature of the tube at its end should be lower than this limit. Many times it is advisable the temperature at the ends of the tube to be even lower than 80C for safety reasons since people are moving and working around it. The temperature at the end of the tube depends on the tube material thermal conductivity, possible gas flow rates inside the tube and the furnace orientation. It should be noted that for vertically operated furnaces natural convention inside the heated cavity is very strong due to extremely high temperatures and the upper part is suffering from excessive temperature, while

Contact details:
Ath. Stagiriti 7- Pilea, Thessaloniki Greece, 55534
tel. 0030 2310 942346, fax. 0030 2310 942336
e-mail: info@thermansys.com
www.thermansys.com

the lower part is cool. Gas flow rates are also very importation since high flow rates will transfer heat the tube and the flange downstream. Material of the tube is also highly important. Metallic or Silicon Carbide tubes have high heat transfer coefficient and their sides are overheated due to molecular heat transfer, while from the other hand ceramics like Alumina, and especially Quartz, present low thermal transfer. Generally a protruding length of about 200-300mm from both sides is adequate for horizontal operation and moderate gas flows for ceramic and quartz tubes.
Radiation shield positioned inside the working tube and water cooled gas end sealing flanges will reduce further the flange temperature and enhance safety and energy consumption. In such cases the protruding length could be reduced to 100mm.

Ordering Information.

Thermansys can provide many types of Working Tubes upon request. Most common material are:

- Dense ceramic Alumina work-tubes for applications up to 1650C or 1420C under vacuum. General purpose material used in most high temperature applications.
- Quartz work-tubes for maximum chemical inertia and for aggressive environments to work under vacuum or low pressure conditions up to 1100 ˚C continuously.
- KANTHAL® APM™/APMT metallic (FeCrAl based) work-tubes to serve under vacuum or pressure up to 1250 ˚C.
- Special ultra high temperature tubes (Sapphire or Yttria Stabilized Zirconia).

Please contact us at technical.support@thermansyscom or sales@thermansyscom for more information and specifications about the tubes. Specify desired tube material, outside diameter OD, inside diameter ID and tube length and send us your inquiry. Our team will contact you with the closest available option. Optionally send us a brief description of your application, our technical team could help on the optimum tube selection.

NOTE: Thermansys is not the producer of the working tubes. We are providing working tubes for our customers that are using our tube furnaces. We are using only selected manufacturers with well known quality standards based also on our long term collaboration with them.

NOTE: Usually working tubes are used in combination with Gas End Sealing Flanges and Radiation Shields. Thermansys is producing such accessories for all kind of applications. Please see our relative Technical Documents:

- GAS END SEALING FLANGES - Sealing Flanges for Tube Furnace Working Tubes -
  Doc. No. :GSF-A May 2024
- RADIATION SHIELDS - Internal Radiation Shields for Tube Furnace Working Tubes-
- Doc. No. :SHLD-AL-A1 May 2024

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