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K-Factor Testing

An integral part of the manufacturing process and quality control program is the necessity to detect the presence or non-presence of vacuum at the end of the manufacturing cycle. OTSI uses a thermal process to accomplish the test providing a thermal insulation K-Factor for each joint manufactures which is further recorder for each joint according to serial number.

Once the insulated joints are removed from the oven after the bake-out process (temperature programmed desorption process), they are subjected to ambient temperatures and the outer tube will cool quickly while the inner tube remains at oven temperature because of the vacuum insulating system. Insulated plugs are installed into each end of the joint to maintain the high inner tube temperature. The outer tube is subjected to ambient temperatures and differential temperature between the inner and outer tubes rapidly reaches approximately 500-550°F (260°C - 337.5° C)[1]. *(Outer tube cools to ambient temperature of approximately 100°F and the inner tube temperature cools slowly from the final oven removal temperature of approximately 650ºF[2]-[3].)*

[1] The bake-out process is a controlled ramp-up and hold to the desired temperature before removal from the bakeout oven. After removal from the bake-out oven the outer tube will cool to ambient temperature very quickly, while the inner tube will remain at an elevated temperature for a considerable period of time due to the insulating performance of the high vacuum insulation system.

[2] The maximum differential temperature of 550°F is an estimate. OTSI believes this estimate is conservative and defensible based on our manufacturing plant being located in Houston, Texas where based on experience even on a cold day, the outer tube normally does not cool below 100°F prior and during the K-Value test cycle.

[3] SPE Paper No. 112981, New Advances and a Historical Review of Insulated Steam Injection Tubing, page 5, GETTER activation temperatures. Maximum GETTER activation temperature is 850ºF (450ºC) for SAES ST707 and lower for other GETTER compounds. The temperature value used above is conservative and based on manufacturing experience.

Thermal couples are installed on both the inner and outer tubes and the temperature differential is measured and recorded over a prescribed period of time. These temperature readings are then used to calculate an average thermal conductivity value (K-Factor) for each joint.