



OIL TECH SERVICES, INC.

800 Wilcrest, Suite 100
Houston, TX 77042-1359
(713) 789-5144

E Mail: sales@oiltechservicesinc.com
Website: www.oiltechservicesinc.com

SPECIFICATION

Insulated Steam Injection Tubing

Revision 6, dated 24 July 2011

This specification is for vacuum insulated steam injection tubing manufactured by **Oil Tech Services, Inc.**, 800 Wilcrest Dr., Ste. 101, Houston, TX 77042.

The following U.S. Patents apply:

U.S. Patent 4,322,669 - Non-Evaporable Ternary Gettering Alloy and Method of Use for the Sorption of Water, Water Vapor, and other Gases; Issued Jan. 26, 1982; Assigned to SAES Getters S.p.A., Milan, Italy

U.S. Patent 3,608,640 - Insulated Tubing - Prestressing; Assigned to CONOCO (this patent has expired)

Specification

- I.) Tube Materials: Outer tube: J-55, API Specification 5CT, ERW, Range 2
Inner tube: L-80, API Specification 5CT, Seamless, Range 2

(Other tube materials are available, based on Buyers requirements.)

	O.D. Inches	Wall Thickness Inches	Weight #/ft
3.5" x 2.375"			
Outer Tube	3.5	0.254	9.5
Inner Tube	2.375	0.190	4.5
4.5" x 2.875"			
Outer Tube	4.5	.25	11.6
Inner Tube	2.875	0.217	6.5
4.5" x 3.5"			
Outer Tube	4.5	.25	11.6
Inner Tube	3.5	0.254	9.5
5.5" x 4.5"			
Outer Tube	5.5	0.279	15.35
Inner Tube	4.5	0.271	12.75

- II.) Connection: Connection options are:
 - a) API Buttress with AB Modified Seal ring threaded and coupled connection on the outer tube (4-1/2" outer tube and above.)
 - b) USS Buttress with seal ring modification threaded and coupled connection on outer tube (3-1/2" and below)
 - c) Heavy Duty 2-Step integral connection on the inner tube (interchangeable with Hydril CS). No coupling.

- II.) Tube Coupling: Coupling material shall be J-55 or better. Coupling will have Buttress thread (or USS Steel Improved Buttress) and be modified for API Teflon seal ring. Coupling will be supplied with seal ring



installed. Coupling will have anti galling preparation of Manganese Phosphate. Sealing ring shall be Teflon/glass composition for high temperature.

- III.) Thread Protectors: Thread protectors are installed on threads (both box and pin) after manufacture. Thread protector will be a composite protector providing maximum thread protection.
- IV.) General: Each joint shall have a unique serial number for traceability.
- V.) Coupling Insulator: The coupling insulator for the Buttress threaded and coupled connection is a short metal sleeve with a high temperature Teflon/Glass (PTFE) insulating donut around the middle. The I.D. of the coupling insulator is the same or slightly greater than the I.D. of the inner tube. The length is designed to provide minimal clearance when both its collar and tube threads are engaged at their maximum thread depths. The insert is supplied in one-piece and is installed into each collar during installation into the well.
- The connection insulator for the Heavy Duty 2-step integral connection is a metal sleeve the same OD as the outer tube with an insulated ID. This external sleeve is placed over the box end of the integral joint during make-up on the rig.
- The purpose of the Coupling Insulator is to insulate the collar from heat loss. Thermal resistance in the coupling area is from (a) steel sleeve, (b) Teflon/glass (PTFE) insulation, or the optional ceramic insulation for the external sleeve used with the integral type of connection system.
- VI.) Mechanical Design: The mechanical design is as follows:
- A.) Maximum well depth 5000 feet (1524 meters)
 - B.) Maximum temperature 670°F (354.4°C)
- VII.) Insulation System: Multi-layered High Vacuum GETTER maintained insulation system, according to the following:
- (A) Getter: The quantity of GETTER is determined by recommended practices provided by SAES Getters, Milano, Italy, and shall be a minimum of 350 to 550 grams per Range 2 joint. The GETTER shall be SAES Getter St-707 manufactured by SAES Getters, Milan, Italy. (Quantity of Getter installed is dependent on the surface area of the outer and inner tubes.)

If a manufacturer proposes to use a getter other than SAES St-707, the manufacturer shall provide independent documentation the getter proposed is equal or better than the St-707 product at the mechanical design temperature shown above.
 - (B) Multi-layered Insulation: The insulation system will have a minimum of seven (7) layers of aluminum foil each layer separated by binder free barrier material being either



ceramic paper, fiberglass, or equal. All materials will be specified as “vacuum grade”. All barrier materials separating the layers of foil shall be binder free to eliminate conduction heat transfer and reduce the quantity of gases that must be outgassed during the bake-out process (Temperature programmed desorption process).

- (C) Vacuum Port: The outer tube shall have a vacuum port located at one end of the outer tube. This port is used for connection to a high efficiency vacuum pump. See Temperature Programmed Desorption (bakeout) below).
- (D) Tube Processing: The ID of the outer tube and the OD of the inner tube shall be grit blasted “white” or chemically cleaned to remove mil scale, oils, contamination, and surface gasses from the tube manufacturing process.
- (D) Temperature Programmed Desorption Process (Bakeout): After the inner and outer tube have been welded at both ends creating a sealed annulus space (excepting a vacuum port for connection to a mechanical vacuum pump), each joint shall undergo a Temperature Programmed Desorption Process whereby over an extended period of time the joint is heated to drive off and desorb surface gasses and contaminants from raw materials. During this process, the joint shall be connected to a high efficiency mechanical vacuum pump to withdraw the desorbed gases and contaminants from the annulus space between inner and outer tubes. The bakeout temperature shall be progressively elevated while mechanically pumping the annulus. When the mechanical vacuum pump has reached its lowest design input pressure the bakeout temperature shall be elevated to the “Getters” design activation temperature and held at this temperature to assure a 90%-100% “Getter Activation”. Every effort shall be taken during the Temperature Programmed Desorption Process to maximize the removal of surface gasses and contaminants from all materials. Manufacturer shall maintain documentation and test reports on the vacuum manufacturing process...
- (E) Getter Position: Getter shall be positioned within the annulus of each joint to maximize its effectiveness, prevent premature activation during the bakeout process, and maximize its residual capacity after the joint is sealed (vacuum port close-out)
- (F) Vacuum Port Closeout: The manufacturer shall provide a tool or device to surround the vacuum port and connect the vacuum port to the high efficiency vacuum pump. After Getter activation the vacuum port shall be mechanically sealed with a steel plug creating a metal-to-metal seal with the vacuum port. When the manufacturer is assured, there is zero leakage from this plug the connection tool shall be



removed and the steel plug shall be seal welded.

(G) Optional: A high temperature Aluminum base paint applied to the outer tube (3 to 5 mils thick).

VIII.) Prestress: Each joint of insulated steam injection tubing shall be prestressed for the design steam temperature.

IX.) Outer Tube Finish: After manufacture, the outer tube shall be coated with a protective high temperature aluminum based coating to avoid corrosion. (Optional process)

X.) Inspection: Welding: Elements shall be in place to assure proper performance of the welds connection inner to outer tubes including appropriate materials, people, appropriate equipment and programmed equipment, procedures, and assurance procedures are followed.

Elements	Documents
Materials	Certificate of Conformance and manufacturers' literature, standards, and practices.
Personnel	Welder Qualification Tests
Automatic Equipment	Welder Qualification Tests
Procedures	Welding Procedure Specifications and Procedure Qualification Test Records

Vacuum: After Getter Activation and vacuum port close-out each joint shall be tested for its individual conductivity value (K-Value). This value shall be recorded in a log maintained by the manufacturer. The Buyer shall receive a detailed K-Value report showing the individual K-Value for each joint purchased and listed by the joints serial number. The average K-Value for each string of tubing shall not exceed 0.003Btu/Hr.-Ft.-°F. Mill Test Certificates for all materials shall be maintained by the manufacturer and available for inspection by the purchaser and or purchaser's agent or provided to the Buyer upon request. The Buyer shall receive a Tube Tally showing the serial number and the measured length of each joint shipped.

XI.) Outer Markings: The outer tube shall be marked as follows:
 Size: (Outer Tube O.D.) x (Inner Tube O.D.)
 Thread: "Buttress" or "USS Steel Improved Buttress"
 Example: **4-1/2 x 3-1/2 - Buttress**

Additional markings shall include:

- a) Serial Number:
- b) Country of manufacturer

(Other markings required by the Buyer shall be noted in the Purchase Order or by specific instructions to the manufacturer.)



Recommended quality control steps for the Petroleum Engineer having responsibility for specifying and Purchasing Insulated Tubing:

1. Traceability of raw materials. Company shall have an internal system for traceability of Material Test Reports and Conformance reports on all raw materials used.
2. Inspection of welding procedures and welder qualifications.
3. Calibration records for all equipment used in the manufacturing operation:
 - a. Welding equipment.
 - b. Post weld heat treatment equipment.
 - c. Control of ambient temperature and humidity in the manufacturing space.
 - d. Leak detection equipment at the Bakeout oven.
 - e. Oven temperature controls.
 - f. K-Value checking equipment (thermocouples).
 - g. Thread gauging equipment.
4. Raw material storage. Adequate temperature and humidity control.
5. Confirm the insulating raw materials are manufactured for vacuum service and insulating materials are without binders or other contamination that will outgas into the evacuated annulus.
6. Joints shall have a unique serial number for traceability.
7. Confirm the OD of the inner tube and the ID of the outer tube are cleaned by suitable method to remove mill scale, oils, and other contamination prior to assembly.
8. General cleanliness of the tubing assembly area and procedures used to assure joints are assembled in a clean manner.
9. Observe welding and prestress operations.
10. Examine records for the Programmed Temperature Desorption Cycle and Getter Activation (Bakeout cycle). Confirm Getter activation is within manufacturers specifications and activation is within the specified time & temperature limit to become 90-100% effective.
11. Observe K-Value testing.
12. Observe threading operation.