

INSTAPLUG™ TUBE PLUG INSTALLATION PROCEDURES

Follow these procedures for the proper installation of the InstaPlug™ tube plug.

WARNING

FAILURE TO OBSERVE ALL SAFETY RULES, REGULATIONS, INSTRUCTIONS, AND PRECAUTIONS APPLICABLE TO YOUR INDUSTRY, YOUR PLANT, AND THE UNIT AND EQUIPMENT YOU ARE OPERATING, MAINTAINING, AND USING, AS WELL AS THESE INSTALLATION PROCEDURES MAY RESULT IN SERIOUS INJURY TO YOU OR OTHERS.

You must be a suitably trained and qualified operator, familiar with the correct operation, maintenance, and use of the unit in which the InstaPlug™ tube plug will be installed and the tools and equipment with which the installation will be performed. If you are not suitably trained and qualified, you should not attempt to install the InstaPlug™.

You have the responsibility to ensure that all personnel using or servicing the unit, or working in an area of the unit, in which the InstaPlug™ tube plug is being used, have the appropriate safety training and are equipped with the appropriate safety equipment.

You must read and thoroughly understand these installation procedures before proceeding with any work.

The information contained in these installation procedures does not create any expressed or implied warranty or guarantee with respect to the InstaPlug™ or its use or suitability for your situation.

Douglas L. Hollaender Enterprises, Inc. is committed to continuous improvement of the InstaPlug™. Douglas L. Hollaender Enterprises, Inc. reserves the right to modify or improve the design and the technical specifications of the InstaPlug™ and these installation procedures at any time without notice.

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Background

The InstaPlug™ tube plug is a positive, reliable, and rapid means for stopping leaking tubes in heat transfer devices, such as feedwater heaters, condensers, heat exchangers, oil coolers, and pre-heaters. The plug is made of NiTiNOL, a “memory metal” that can exist in two distinct metallurgical states and “remember” its first shape after being deformed into a second shape. This very unusual material property enables the InstaPlug™ tube plug to be readily inserted into a tube bore and then, through mild heating, to “remember” its larger diameter and cause an interference-fit with the tube bore.

The InstaPlug™ tube plug is machined from one solid piece of NiTiNOL stock. It consists of a central cylinder having several concentric circular “fins” along its length that are machined to be a little larger than the (largest) bore of the tube to be plugged. After machining, the plug material is stress relieved in its first or “austenitic” state. Prior to installation, the plug is chilled, which causes the material to convert to a second or “Martensitic” state. In this state, the fins are deformed backward slightly by a swaging process to reduce the effective diameter of the plug. With its new, smaller effective diameter (and with its unswaged, larger diameter being “remembered” during the stress relief memorization process in the metal itself) the InstaPlug™ tube plug is ready to be placed inside a prepared tube end.

Once in place, the InstaPlug™ tube plug is heated (using the method identified in this instruction.) This heating causes the NiTiNOL to “remember” its original, undeformed larger diameter and revert to its first (or “Austenitic”) state, dynamically moving the fins back to seek their unswaged, interference-fitting positions. This movement occurs with a very high, but closely controlled, internal force. This initial transformation is usually more than adequate to seal 250 psi, nominally $\frac{1}{4}$ of the proof pressure for “Thin Fin InstaPlug™.”

Removal of the plug is a destructive and permanent process.

A used InstaPlug™ may not be reused under any circumstances.

Installation Procedures

The following recommended procedures must be followed to assure proper selection of a correctly sized plug, proper preparation of the tube surface, and proper heating to assure a lasting, effective InstaPlug™ tube plug seal.

1. **Identify** the leaking tube. **Inspect** the tube end to determine its size and whether there is any anomaly in the internal surface of the tube that would interfere with the successful installation of the plug. ***Longitudinal defects can prohibit an effective InstaPlug™ seal; make sure that no such defects exist.*** Mark the tube end to be plugged.
2. **Measure** the tube end with an inside tube micrometer or a gauging block to determine the actual diameter of the tube end. **Select** the INSTAPLUG™ tube plug of the correct size using the “InstaPlug™ Order Sheet Size Chart”) based on that measurement.

WARNING! *Incorrect selection and incorrect or improper use of the InstaPlug™ tube plug may cause damage to property and personal injury. Douglas L. Hollaender Enterprises, Inc. and its distributors have no responsibility whatsoever for the selection and use of the InstaPlug™ tube plug. You have sole responsibility for the correct selection and use of the InstaPlug™ tube plug.*

3. **Prepare** the inner surface of the tube. Use an aggressive, power wire brush to thoroughly provide a bright metal surface to the tube. Be careful that you do not cut so deeply into the tube that you weaken the tube wall. The surface must be free of all loose scale and have no extraordinary pitting.
4. **Clean** the tube end thoroughly. Use a clean swab to remove all loose material including any remaining reaming remnants or scale, corrosion, deposits, or other anomalies that may have been loosened by the surface preparation process. As close to the time that the plug is to be inserted, wipe clean the newly prepared tube surface using a non-residue cleaning solution. (ZEP™505 is a suitable non-flammable, environmental friendly solution for this purpose.) **BE ABSOLUTELY CERTAIN THAT THE SURFACE IS FREE FROM ANY LUBRICANTS, OILS, ETC.**

CAUTION: *If you should deviate from the recommended cleaning solutions, we warn that certain solvents (like MEK or ACETONE or other organic distillates,) while very commonly used, are extremely flammable and potentially explosive. While freedom from oil and contaminants is imperative, do not use these hazardous solvents.*

5. **Inspect** the tube end to assure cleanliness and the absence of any anomalies such as grooving (particularly longitudinal grooving), ovality, deep scratches, etc. that could keep the plug from sealing properly. When working on carbon or low alloy steel tubes or tube sheets, make sure that the newly prepared surface is free of rust, particularly if there any appreciable time has elapsed since the surfaces were prepared.

DO NOT USE OIL, "WD-40" OR SIMILAR ON THE CLEAN SURFACE.

NOTE! *If any anomalies exist, do not install the InstaPlug™ tube plug until the anomalies are eliminated. To eliminate the anomalies, you may need to remove the end of the tube in the tube sheet by internally cutting the tube and extracting the tube stub from the tube sheet. After eliminating the anomalies, repeat the procedures described in steps 3, 4, and 5.*

6. **Install** the InstaPlug™ tube plug so that the plug is inserted totally within the tube and that it is set deeply enough to be entirely within the tube sheet thickness; This should still allow the extension rod to protrude so that it can be connected to any welding rod holder. Under some circumstances there may be as much as 0.010 of interference between the InstaPlug™ and the tube bore; if this exists, just tap the InstaPlug™ lightly; it will conform to the bore without loss of effectiveness.
7. **Heat** the InstaPlug™

NOTE! The following procedure is new. It uses electrical resistance heating which can be provided by any available electric arc welder. The procedures are given for, and have been tested extensively using, a simple, maintenance type AC welder. (These welders are commonly available at "box store" contractor suppliers.) However, D.C. welding current works equally well.

*There should be no arcing, **but there may be initial sparking** (particularly if the voltage supply is below 30V) associated with establishing good contact between the InstaPlug™ and the tube bore.*

The heating of the InstaPlug™ occurs by the resistance of the plug fins with the tube surface.

- a. Set the welder to nominally 170 amps \pm 10%. Do not turn it on!
- b. Establish ground connection on material that will conduct to the tube/tubesheet, usually anywhere on the heat exchanger, and usually conveniently between any adjacent tube bores
- c. Clamp the InstaPlug™ heating collet (or similar means for conducting electricity into the nub on the end of the InstaPlug™).
- d. Turn on the welder and allow the current to flow for 30 to 45 seconds. **Do not let the InstaPlug™ even approach getting red hot!** (Getting red hot is very unlikely; the plug should be several hundred degrees (F) below that limit if the current is set as directed and the current is allowed to flow for the recommended time.) IF you do experience such overheating, cut down the current, the time, or both and install a new plug.
- e. ALLOW the plugged tube to cool down naturally; do not suppress cooling. *Because the NiTiNOL transformation is time and temperature dependent, slow cooling allows for the maximum amount of metallurgical recovery at the installation heating. The plug will, in fact, continue to transform to its full metallurgical potential as the unit itself is heated above 200°F.*

8. The InstaPlug™ now should be securely locked in the tube; it should not move. If the installation results in a loose plug, the selected InstaPlug™ was too small. (This will be a very rare occurrence, as the InstaPlug™ will conform to approximately 1/32 inch of variation in tube-to-tube bore variation.)

Should this rare instance occur, remove the small plug or drive it deeper into the tube. **Do not try to re-use it.** Re-measure the hole and repeat the installation process using the larger InstaPlug™ (usually the “heavy erosion” plug for your nominal O.D. and BWG weight) provided for that tube diameter/BWG combination. There are only two plug sizes for each diameter/BWG as shown on the “Plug Order Sheet,” and they will cover the entire range of erosion, usually past 70% wall thickness reduction.)

9. **Pressure Test** the integrity of the plug seal by pressure testing the unit in the same manner that was used to identify the leaking tube. Once the plug seal has been tested and determined to be secure, vacate the unit, seal its channel end, and return the unit to service.

WARNING! Pressure testing is inherently dangerous. Strictly adhere to these installation procedures and all industry safety practices. Such adherence could prevent injury to personnel. All personnel must be clear of plug being tested when pressure testing and when heat exchanger is under pressure.

If you have any condition that is not addressed in this document, or if you require additional information when using the InstaPlug™ tube plug, contact Douglas L. Hollaender Enterprises, Inc.

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