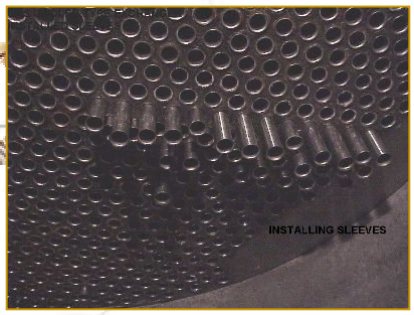
Magnetec Inspection, Inc.

EXCHANGER TUBE SLEEVING / FERRULES

FINFAN

View of Finfan being sleeved due to severe inlet thinning - Sleeve length 2'

View of process gas cooler in sleeving process - Sleeve length 3'



Full length sleeve expansion
921 tubes completed in 27 hours

NOMENCLATURE

Load pressure – 2000 PSIG
Yield Pressure – Calculated and field tuned
(8000 PSIG - .750 X .030 wall – 316l Stainless Steel)
Interference fit pressure - Yield pressure + 1000 PSIG
Tube O.D. – (Eg - . . 1" O.D.)
Tube I.D. - (Eg. - .782 I.D.)
Tube wall Thickness – (Eg. - .109)
Tube Material – (Eg. – SA-178)
Sleeve O.D. – (Eg. - .593 " O.D.)
Sleeve I.D. – (Eg. - .495" I.D.)
Sleeve wall thickness – (eg. - .049")
Sleeve Material – 316 L Stainless steel)

Heat Exchanger Tube Sleeving

The installation of…

...a protective sleeve into pre-existent equipment is an accepted process to protect tubing from active corrosion and/or erosion mechanisms. Thin walled metal inserts can be hydraulically expanded into existing tubes to add additional years of service to a process exchanger.

Inlet erosion is…

...a common problem found in process exchangers due to entrained abrasive solids or turbulent flow conditions (non-laminar conditions). Header box and channel designs can also add to the turbulence that is primary cause of erosion/corrosion to the tube ends. Metallic inserts can shield and protect the tube ends from wear caused by these factors. Selection of proper sleeve material, wall thickness and length is required to provide complete cover age of corrosion zone.

Tube sleeving by…

...metallic sleeving inserts is a cost effective and quick repair method that will return your equipment to reliable service. Sleeve can be scheduled during routine maintenance schedules to avoid last minute retubes or impacting plant operation.

Sleeving Reduces…

...the need to re-tube exchangers that have localized corrosion or damage. The cost savings are significant as the exchanger does not have to be disassembled or shipped to complete the sleeving operation. Sleeves can be removed at a later date and new sleeves installed.

To extend the…

...service life, some sleeve materials can be easily inspected under to allow for continued inspection and document corrosion rates. Sleeving can add additional benefits such as, add structural integrity to rolls and tubesheet joints, reduce "Cold" zones where increased corrosion can occur & tighten loose packed tube joints.

SLEEVE INSTALLATION

Tubes should be clean from all debris and the tube ends free of dings, weld spatter, ect. The parent tube is prepared for sleeve installation – measurements are re-confirmed as correct on the parent tube I.D. surface and sleeve. A sleeve is installed onto the sleeving tube – Expansion pressure is brought to 2000 PSIG to lock sleeve on installation tooling. The sleeve is installed into the parent tube section and set to the predetermined position (Flush or protruded). The sleeve is raised to it's expansion/yield pressure where the stress pressure begins to yield the tube and reacts in a fully elastic condition. The sleeve is brought to it's interference pressure (IP). The sleeve is held as it's IP for a predetermined time (Dwell Time)during which there is elastic material recovery (Spring back). The pressures are released and installation tool removed. The flared sleeve end is rolled into the parent tube (Soft Roll). The straight sleeve end is expanded to the tube parent tube.

PROCEDURE FOR HYDRO-EXPANSION

Correct design information is required to insure a high strength sleeve to tube joint by the use of hydro-expansion techniques. The frictional interference fit between the installed sleeve and the parent tube produced by hydro-expansion is governed by many variables. These variables are listed below.

It should be noted that specific tube heats may vary the expansion to a great degree. Calculated and actual expansion pressures might be different and the calculated pressure is meant as a guide line for installation. Determination of the actual field installing pressure are to be determined by calculated and field tuned pressures that yield the proper fit.

Sleeve expansion develops interference fit pressure that expands the sleeve for its entire length within the parent tube. The appropriate calculation's for specific material yields, material compatibility, and sleeve installation pressure are reviewed prior to sleeve installation to insure proper fit. Expansions of the sleeve test coupons are shown to have wall reductions of between 2% and 5%. These wall reductions are approximately 1/3rd to 1/2 of the wall reductions found in hard rolled tubes.

ADDITONAL NOTES

Thorough review of corrosion mechanism, location and extent allow for the sleeving of tubular process equipment to be fully effective. The correct sleeve metallurgy being selected, the sleeve being positioned with-in the corrosion area, and the correct sleeve length to cover the corrosion area must all be considered when planning a sleeve operation.

Conditional analysis of heat transfer tubing is a major concern due to budgeted funding, repair, retube, and or modification of your heat transfer equipment to return it to 100 percent capacity. For this reason a comprehensive Eddy Current inspection should be performed to allow your plant personnel to make wise decision's concerning tubular equipment.