Remove, Clean, and Re-Install Bundle from an Exchanger

APPROVED:_____ DATE APPROVED:_____ DATE EFFECTIVE:_____
Maintenance Manager

PURPOSE

This Procedure describes the steps required to remove the tube bundle from an exchanger. This procedure applies to all Maintenance personnel that perform or assist in this work.

REFERENCES

- MATERIAL SAFETY DATA SHEETS
- Hazardous Energy Control Procedure
- Safe Work Permit Procedure
- Lock Out/ Tag Out Procedure
- Lifting Procedure
- Safe Work Program for Handling Inorganic Metals in Process Scales
- Welding on Towers/Vessels or Exchangers Procedure

SPECIAL EQUIPMENT

Refer to proper MATERIAL SAFETY DATA SHEETS

PREREQUISITE

This procedure requires qualified craftsmen.

1. REVIEW this procedure with the Operations and Maintenance crews to ENSURE all steps and cautions are clear and all hazards have been DEFINED. Match the proper MATERIAL SAFETY DATA SHEETS with the equipment service.

2. Use special precautions defined on MATERIAL SAFETY DATA SHEETS and verify operation of all safety showers and eyewashes near the work area to ENSURE they are in good working order.

3. Field VERIFY with Operations that the equipment has been BLOCKED IN, DE PRESSURIZED, and BLED DOWN. VERIFY that block valves are HOLDING satisfactorily.

4. INSTALL locks and tags where required per the Lock Out/ Tag Out Procedure.

5. Maintenance personnel shall VERIFY with the unit operator that all applicable equipment is LOCKED and TAGGED OUT and is NON-OPERABLE (Lock, Tag, Test, Try).

6. REVIEW and OBTAIN Work Permit at this time.

PROCEDURE

REMOVE, CLEAN, AND RE-INSTALL TUBE BUNDLE FROM AN EXCHANGER IN THE VACUUM-I UNIT.

CAUTION
"First Flange Break" - Personnel must stand upwind of flange being broken to lessen exposure to hazard. Personnel shall loosen and remove bolts on far side of flange first to lessen chances of exposure.
CAUTION

1. INSTALL blinds on the shell side inlet and outlet nozzles if required.
2. REMOVE channel cover and channel head.
3. INSTALL blind flanges on the tube side inlet and outlet piping if required.
4. PULL bundle.
5. Hydro-blasters to CLEAN tubes, bundle and heads if required.
6. Inspection Department to INSPECT all parts.
7. REPAIR as needed per Inspection Memo.
8. RE-ASSEMBLE exchanger, except for channel cover.
9. OBTAIN test pressures from Operations.
10. HYDROTEST shell side and complete hydrotest forms. Cold gas oil must be used to test.
11. RE-INSTALL channel cover, Hydrotest tubes, complete Hydrotest forms. Cold gas oil must be used to test.

CAUTION
"First Flange Break" - Personnel must stand upwind of flange being broken to lessen exposure to hazard. Personnel shall loosen and remove bolts on far side of flange first to lessen chances of exposure.
CAUTION

12. REMOVE all blinds.
13. NOTIFY Operations that work is complete.
14. REMOVE all locks and tags.
15. After system is back in service, Operations will SIGN OFF the Work Order/Work Permit as completed.

*** Note:** During turnaround or complete unit shutdown with all isolation blinds in place, water may be used to Hydrotest exchangers if there is sufficient steam in the unit to effectively steam out exchangers after testing.

END OF PROCEDURE

APPROVED: _____ **DATE APPROVED:** _____ **DATE EFFECTIVE:** _____

Technical Writer: **Content Expert:**

Purpose

Establish inspection guidelines to ensure mechanical integrity and continued reliable operation of shell and tube heat exchangers. This procedure applies to the pressure containing parts of the exchanger alone with supporting structures.

References

Material Safety Data Sheets (MSDS) are electronically stored and can be referred to in the MSDS program by equipment number, MSDS can also be found by searching by manufacturer, product name, or chemical. The procedure user is responsible for referring to the appropriate MSDS.

Corporate Safety Procedures shall be referred to for all safety related issues. They are accessible electronically plant wide by going to the Health and Safety Services tab on the Intranet. Personnel are responsible for referring lo the appropriate safety procedures.

National Board Inspection Code ANSI-NB-23, Latest Edition

API-510 Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration; Latest Edition

American Society of Mechanical Engineers (ASME), Section VIII, Division 1

American Society of Mechanical Engineers (ASME), Section IX, Latest Edition

Applicable Local, Stale and Federal Regulations

Applicable Engineering Standards and Practices API

RP571 Conditions Causing Deterioration and Failure

API RP572 Inspection of Pressure Vessels

API RP750 Management of Process Hazards

Applicable Maintenance Inspection Procedures

Vendor Drawing for the vessel being inspected.

Precautions

The Authorized Inspector should assure that all work permits, isolation and entry procedures/permits are current.

Prerequisites

Prior to any inspection, a review should be done through Reliability Equipment Files and facility databases:

- Inspection history
- Current mechanical design requirements
- Previous repair history
- Re-rating history material degradation
- Corrosion rates

The Authorized inspector should take into consideration operating conditions and the process chemistry the equipment is subjected to and determine potential degradation mechanisms.

Procedure

External Inspection

- External inspection of an air cooled exchanger is part of the determination of mechanical integrity.
- Then Authorized Inspector should examine platforms, ladders, stairways, and their supports (including fireproofing), to assure their serviceability.
- The concrete pedestals, foundations and steels structures should be examined for cracks, chips, spalling, or deterioration. Grounding connections should be inspected to insure that they are attached
- The Authorized Inspector should ensure that the exchanger is properly stamped or identified.
- Nozzles should be examined for distortions, cracks, corrosion and other degradation.
- Examinations should be made to determine the header boxes wall thicknesses using Ultrasonic testing. Applicable thickness data should be entered into the facility database.
- If access is provided, examine fan blades and hubs for cracking.
- Examine hold down bolting arrangement-slots should be free of material that would restrict thermal growth.

Procedure

Inspection Intervals

Inspection intervals for Shell and Tube exchangers will be in accordance with pressure vessels as defined in API 510 Vessel Inspection Code, Generally, this means inspection at vessel half remaining life, up to a maximum of ten years. Same Code also provides for extensions based on historical findings.

External Inspection intervals for Shell and Tube Exchangers will be in accordance with pressure vessels as defined in API 510 Vessel Inspection Code. Generally, this interval is 5 years.

Internal Inspection

NOTE: The below scopes for Internal and external Inspection should not be considered the limits of inspection. Inspector is responsible for inspecting in accordance with and on the basis of referenced Code Documents.

Internal Inspections should be performed by or under the directions of an Authorized Inspector as defined by Code. An External Inspection should be performed in conjunction with each Internal Inspection.

- The Inspector should examine the internal walls of the shell, channel and nozzles for cracking, pitting, general corrosion and erosion. Indications should be quantified through use of pit depth gages, or ultrasonics (straight or angle beam). Locations and depths should be plotted on an equipment drawing
- Scale buildup or sludge deposits should be noted along with their location on the shell or nozzle.
- All gasket surfaces should be examined for any signs of damage.
- Examine condition of pass partition plate and weldments (typically for cracking) and gasket surfaces for metal loss.
- When the tube bundle is removed from the shell, a visual examination should be done before cleaning noting the amount of scale, sludge and general fouling products. Also, if variations of deposits exist, note locations.
- Baffles and tie-rods should be examined for loose nuts as well as metal loss. Also check for tube OD wear where the pass through baffles.
- Verify proper location of impingement plate and for tube OD erosion in the vicinity of inlet nozzles.

- After the bundle is cleaned, a thorough examination should be performed on tubes, tube ends and tube sheets for pitting, thinning and general corrosion. A representative portion of the above should be measured using appropriate instruments. Data should include ID and OD tube measurements, and pit depths. Findings should be noted on equipment drawing.

Internal Lining Inspection

- Metallic and nonmetallic linings (e.g. strip and plate linings, overlays, internal coatings, refractory) shall be examined during internal inspections of pressure vessels.

- The inspection scope and methods recommended in API RP 572 for metallic and nonmetallic linings should be followed to assess the condition of the lining and the vessel surface beneath.

- A visual inspection of the accessible internal lining should take place at each internal inspection interval. The lining should be inspected for damage such as separation, bulging, spalling, holes, blisters, cracks, chipping, and erosion.

- If lining damage is detected, representative portions of the internal liner should be removed to assess the condition/effectiveness of the liner and the metal beneath the lining. Alternatively, ultrasonic scanning from the external surface may be used to asses the damage beneath the lining,

- Thermography (IR) is an accepted on-stream inspection method to detect refractory damage. Reference Maintenance Procedure; MNT-INSP-029, Infrared.

External Inspection

The following items should be included among those Items checked during external Inspections:

NOTE: It is preferred that an External Inspection Checklist is utilized for recording the results.

- Platforms, ladders, stairways, and their supports, to assure their serviceability.

- Concrete pedestals, foundations, skirt fire proofing should be examined for cracks, chips, spalling, or deterioration. Grounding connections should be inspected to insure that they are attached.

- Paint coating should be examined for blister and chipping that would expose the vessel to corrosive elements Insulation and metal jacketing

should be examined for integrity of sealing and for indications of corrosion under insulation.

- Condition of Data Plates and ID Markings.
- Nozzles should be examined for distortions, cracks, corrosion, and other degradation. Reinforcements should be examined for evidence of leakage. Weep holes should be open.
- Any ancillary equipment such as level bridles, temperature or pressure gauge connections, should be inspected for external corrosion, signs of leakage, and condition of support
- The Inspector should examine the surfaces of the shells, channel covers, and heads for possible cracks, bulges, and other evidence of deterioration. Attention should be given to support saddles and other external supports.
- Follow-up examinations should be made to determine the shell and channel wall thickness (using Ultrasonic testing) in significant wall toss is observed.

Repairs and Alterations

- All repairs end alterations performed on shells, channels and heads will be done in accordance with Maintenance Procedure; MNT-INSP-015, Vessel Repair/Alteration Procedure, and in accordance to applicable Codes.
- Repairs to bundles (tube pluggings) or bundle replacements are lo be documented by the Inspector in the equipment file. Location of plugged tubes should be mapped on equipment tubesheet drawing along with date plugged.
- All repairs, whether to shell or bundle, are to be approved by the Reliability Authorized Inspector Maintenance Engineer should be consulted with for repairs not of a routine nature.
- Repair, alteration and bundle replacement documentation is to be kept in the Reliability Equipment Files or Plant Condition Monitoring System (PCMS).

Nonconformities

- Definition - Any change in the condition of an item described on the original Manufacturer's Data Report (U-1A), NBIC-R1 or API 510 Repair/Alterations Reports that affects the pressure containing capability of the pressure vessel.

- Non-conformance conditions will be reviewed by a designated Technical Team (typically Area Inspector and Area Maintenance Engineer) who will make repair or alteration recommendations in accordance with Maintenance Procedure; MNT-INSP-027, Inspection Recommendation Process, to assure continued integrity and Code compliance.

- Non-conformance issues should be forwarded to Refinery Management if proper resolution is not reached in a timely manner.

Reports

At a minimum, condition of the following should be indicated on Inspection Report:

1. Recommendations and Repairs Completed during current Maintenance Event.

2. Condition of the following:

    a. Bundle

        i. Tubes (ID and OD)

        ii. Tubesheet (face a, baffle and gasket surfaces)

        iii. Floating Head (ID and OD, pass partitions, gasket surfaces)

        iv. Spacers, baffles, impingement plates

    b. Shell

        i. Shell Can Section and Body Flanges

        ii. Nozzle Necks and gasket surfaces

        iii. Shell Cover and gasket surfaces

        iv. Small bore Taps

    c. Channel

        i. Dollar Plate (Channel Cover) and gasket surfaces

        ii. Pass Partition and gaskets surfaces

        iii. Nozzle Necks and gasket surfaces

    NOTE: External Checklist should be used for External Inspection Topics

Documentation

Inspection Reports should become a part of the Equipment Items Progressive Inspection Records.

Documentation and results on inspections should be kept in Reliability Equipment Files and/or in Plant Condition Monitoring System Data Base.

END OF PROCEDURE