

15 Technical Checks for Shell-and-Tube Exchanger Replacement During Planned Turnarounds

Overview

Replacing an exchanger bundle in an operating refinery or petrochemical facility introduces uncertainties that may not exist in a new equipment installation. The proposed replacement must satisfy design and operating requirements while remaining compatible with existing equipment, its current condition and installation constraints.

How to use this review

For each item, record:

V — Verified (documented evidence)

A — Assumed (unconfirmed)

U — Unknown (information unavailable)

N/A — Not applicable (technical basis recorded)

For assumed or unknown conditions, identify the investigation, owner and deadline. An unresolved item does not automatically prevent fabrication release; the responsible engineering and inspection authorities determine its disposition.

Equipment identification

Facility / Unit

Equipment Tag

Exchanger Type / TEMA Designation

Original Manufacturer / Year

Scope (Repair / Retube / Replacement / Other)

Planned Shutdown Date

Review Date / Revision: _____

A. Existing equipment geometry and interfaces

Replacement bundle clearance versus actual shell condition

Review question Has the bundle's maximum dimensional envelope been checked against the existing shell's internal condition, accounting for distortion, out-of-roundness, deposits and previous repairs?

Investigate: Shell deformation, corrosion products, internal weld protrusions, repaired regions or interference with the extraction path.

Potential consequence: A dimensionally compliant bundle cannot be inserted or removed as planned.

Evidence: As-built dimensions, prior bundle removal reports, inspection findings or field measurements.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Internal geometry and shell-side flow compatibility

Review question Have replacement baffle arrangement, baffle cut, spacing, sealing strips and bundle orientation been reconciled with the existing design and current process requirements?

Investigate: Changes affecting bypass flow, pressure drop, thermal performance or vibration.

Potential consequence: The bundle fits but does not reproduce intended hydraulic or thermal behavior.

Evidence: Original/replacement drawings, thermal rating, hydraulic or vibration assessment.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Stationary-head, tubesheet and gasket interface compatibility

Review question Have tubesheet geometry, pass-partition grooves, gasket contact surfaces, bolting and stationary-head interfaces been verified against retained equipment?

Investigate: Modified pass arrangements, damaged sealing surfaces, dimensional changes and interface incompatibility.

Potential consequence: Assembly or sealing problems after arrival on site.

Evidence: Interface drawings, measurements, inspection reports, assembly review.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

B. Thermal and mechanical design

Actual operating duty versus original design assumptions

Review question Has the replacement been evaluated using current process conditions rather than relying exclusively on the original exchanger datasheet?

Investigate: Changes in flow, temperatures, fluid properties, fouling, cycles and pressure-drop limits.

Potential consequence: Original geometry is reproduced without addressing current operating requirements.

Evidence: Updated process datasheet, operating history, thermal rating and calculations.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Tube vibration and unsupported spans

Review question Have tube layout, support spacing, baffles, fluid velocity and proposed material or geometry changes been evaluated for flow-induced vibration where applicable?

Investigate: Changes affecting natural frequencies, damping, excitation or susceptibility to vibration damage.

Potential consequence: Premature tube damage associated with operating conditions.

Evidence: Drawings, operating data and documented vibration assessment.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Differential thermal expansion and mechanical loading

Review question Have thermal expansion effects and associated stresses been evaluated for the replacement under operating, startup, shutdown and applicable upset conditions?

Investigate: Differences in shell/tube temperatures, expansion characteristics, restraint and component loading.

Potential consequence: Unaddressed mechanical loads caused by changes in material or configuration.

Evidence: Mechanical calculations, thermal design data, engineering review.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

C. Materials, fabrication and inspection

Material selection and current service conditions

Review question Have tube, tubesheet and other pressure-part materials been evaluated against current chemistry, temperatures, pressures and degradation mechanisms?

Investigate: Metallurgy changes, corrosion/erosion mechanisms, fabrication compatibility and restrictions.

Potential consequence: A procurement substitution creates service-life or fabrication concerns.

Evidence: Current service specification, inspection history, material-selection review.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Tube-to-tubesheet joint design and qualification

Review question Have joint configuration, welding/expansion methods, preparation, examination and leak-tightness requirements been defined?

Investigate: Tube fit, tolerances, geometry, accessibility, sequence and qualifications or tests.

Potential consequence: Joint requirements change after tooling or production methods are established.

Evidence: Joint details, qualifications, procedures and inspection/test plan.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Welding, heat treatment and examination sequence

Review question Are welding requirements, procedure/personnel qualifications, heat treatment, examination hold points and repair procedures set before fabrication sequencing?

Investigate: Weld access, alloy requirements, dissimilar materials, examination feasibility and PWHT.

Potential consequence: Late rework or difficult examination/heat-treatment steps.

Evidence: Welding and inspection documentation, sequence and quality plan.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

D. Removal, handling and installation

Full bundle extraction and insertion envelope

Review question Has the complete removal and insertion path been verified using actual site constraints rather than exchanger dimensions alone?

Investigate: Adjacent piping, structures, platforms, foundations, equipment and extraction movement.

Potential consequence: Unexpected field modifications or revised handling methods.

Evidence: Site survey, verified dimensions, rigging and extraction plan.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Bundle handling loads and support arrangements

Review question Have weight, center of gravity, lifting arrangements, temporary supports and transport constraints been checked against the proposed handling method?

Investigate: Changes from original bundle, extraction loads, and site access limitations.

Potential consequence: Planned lifting, extraction or transport cannot be used.

Evidence: Approved handling data and engineered lifting plan where required.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Field assembly and retained-component condition

Review question Have assumptions about retained components been documented, including interfaces that cannot be inspected until disassembly?

Investigate: Corrosion, seating-surface damage, misalignment, fasteners and reassembly condition.

Potential consequence: Retained equipment requires unplanned repairs even though the bundle is ready.

Evidence: Inspection history, site observations and post-opening inspection plan.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

E. Inspection findings and turnaround contingencies

Defined repair-versus-replacement decision criteria

Review question Have criteria for continued operation, repair, retubing, partial replacement or complete replacement been established with responsible authorities?

Investigate: Degradation, damage limits, repair feasibility, remaining service life, acceptance criteria.

Potential consequence: Technical decisions must be made after the shutdown begins.

Evidence: Inspection plans, assessments and documented decision responsibilities.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Findings outside the planned bundle replacement scope

Review question Have possible findings in the shell, channels, heads, nozzles, supports and retained components been accounted for?

Investigate: Damage demanding more engineering, materials, testing or a changed work sequence.

Potential consequence: Bundle replacement alone cannot restore required operating condition.

Evidence: Damage-mechanism review, inspection history, contingency scope.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Approval, examination and pressure-test contingencies

Review question Are engineering reviews, approvals, jurisdictional requirements and testing decisions established for anticipated scope changes?

Investigate: Repair documentation, authorized inspection, NDE and pressure-testing needs.

Potential consequence: Technically feasible repairs are held up by approval or testing decisions.

Evidence: Inspection/test plan, repair procedures, quality requirements, approval owners.

Status: ☐ V ☐ A ☐ U ☐ N/A Evidence / Action: _____

Pre-Fabrication Review Summary

Verified	_____
Assumed	_____
Unknown	_____
Not applicable	_____
Items requiring action before fabrication release	_____
Items assigned to shutdown inspection / contingencies	_____

Unresolved items and decision owners

Item #	Required investigation or decision	Responsible party	Deadline

Review outcome: ☐ Approved for release ☐ Conditional release ☐ Further engineering review required

Engineering reviewer: _____ Inspection / Owner representative: _____

Date: _____

Engineering & Fabrication Support

Alliance Fabricating provides thermal and mechanical design support, fabrication, replacement bundles, retubing, heat exchanger and pressure vessel repairs, and overhaul services. For planned turnarounds, early coordination can identify dimensional, material, fabrication and installation issues before they affect the outage.

Discuss a Planned Exchanger Repair or Replacement

(519) 336-4328

alliancefabltd.com

Technical note: This review aid is not a substitute for equipment-specific engineering, inspection, applicable codes, standards, owner specifications or jurisdictional requirements. Responsible engineering and inspection authorities determine applicability, acceptance criteria and disposition of findings.