



EXCHANGER INSTALLATION / HANDLING & BOLT-UP CONSIDERATIONS

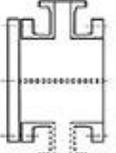
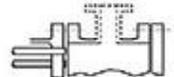
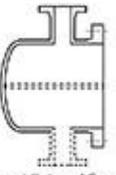
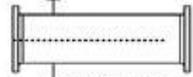
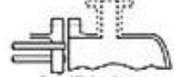
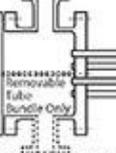
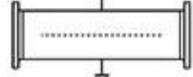
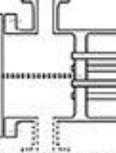
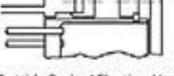
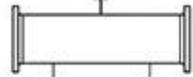
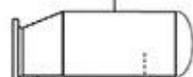
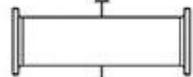
Mike Prevost, Vice President - Specialty Services - Ohmstede Industrial Services



SUMMARY OF TOPICS



- Various Exchanger Types
- Exchanger Installation & Handling
- Extractor Operator Qualifications
- Exchanger Bolt-up Considerations
-  PCC-1 Compliance

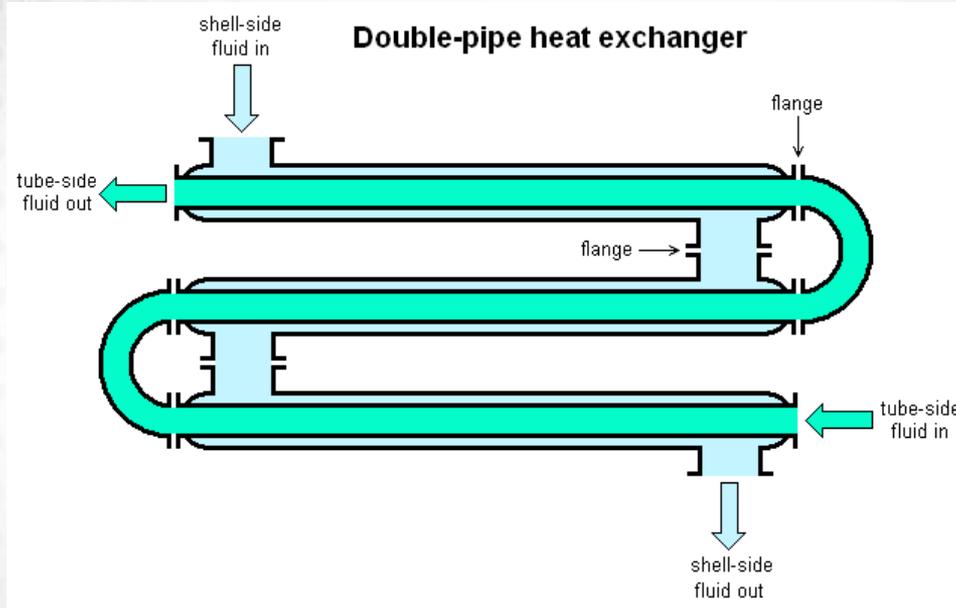
Front-End Stationary Head Types		Shell Types		Rear-End Head Types	
A	 Channel and Removable Cover	E	 One-Pass Shell	L	 Fixed Tubesheet Like "A" Stationary Head
B	 Bonnet (Integral Cover)	F	 Two-Pass Shell with Longitudinal Baffle	M	 Fixed Tubesheet Like "B" Stationary Head
C	 Channel Integral with Tubesheet and Removable Cover	G	 Split Flow	N	 Fixed Tubesheet Like "N" Stationary Head
N	 Channel Integral with Tubesheet and Removable Cover	H	 Double Split Flow	P	 Outside Packed Floating Head
D	 Special High Pressure Closure	J	 Divided Flow	S	 Floating Head with Basking Device
		K	 Kettle Type	T	 Pull-Through Floating Head
		X	 Crossflow	U	 U-Tube Bundle
				W	 Externally Sealed Floating Tubesheet

TEMA – Tubular Exchanger Manufacturers Association

QUICK REFERENCE CHART

Double-pipe heat exchangers

Exchanger Types



A double pipe heat exchanger, into its simplest form is one pipe within another larger pipe. One fluid flows through the inside pipe and the other flows through the annulus between the two pipes. The wall of the inner pipe is the heat transfer surface.

Plate and frame heat exchangers

Exchanger Types

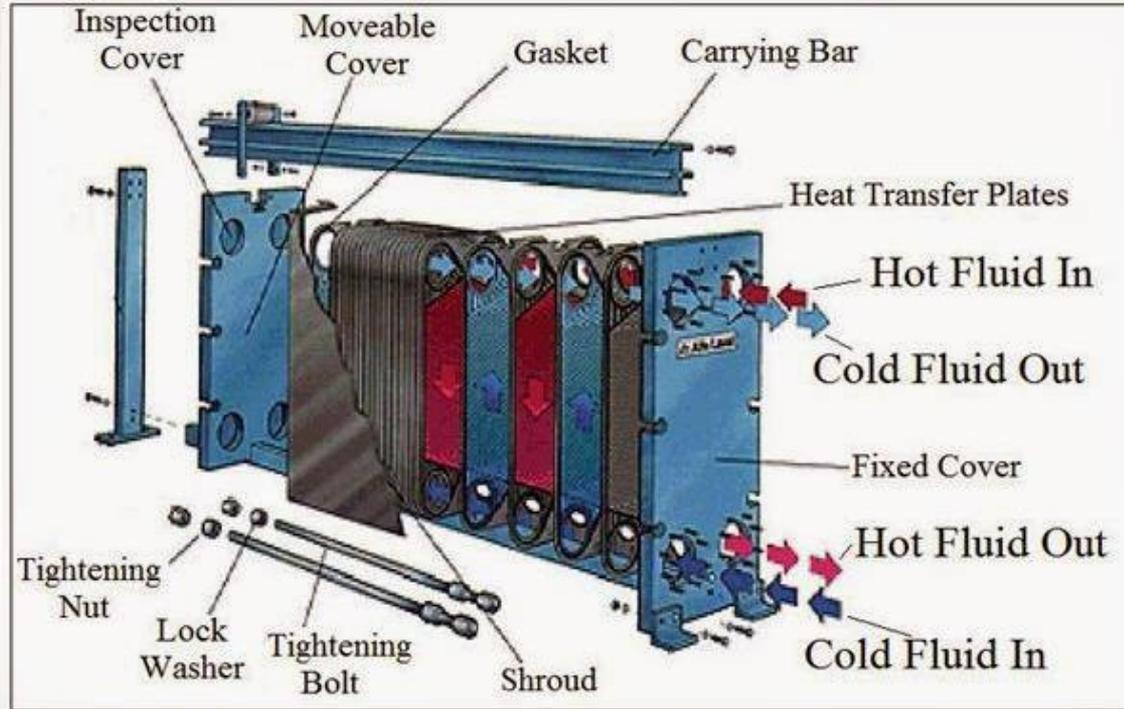


Plate and frame heat exchangers are mostly used for HVAC systems and gear box cooling. They are not used much in refineries / petrochemical plants as they are not designed for the temperatures and pressures required. Thus most use Shell and Tube exchangers.

Fin Fan heat exchangers



Fin Fan Plugs

Exchanger Types

Fin Fan heat exchangers typically force air over a set of coils to cool the process. It is also referred to as an air cooled heat exchanger. Fin-fan heat exchangers are generally used where a process system generates heat which must be removed.

Breech-lock heat exchangers

Exchanger Types



Breech-Lock exchangers are very unique and require specially trained / experienced personnel to effectively disassemble, maintenance and reassemble with leak free results.

Fixed Tube Sheet Exchangers

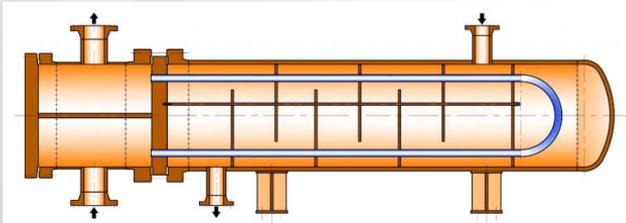
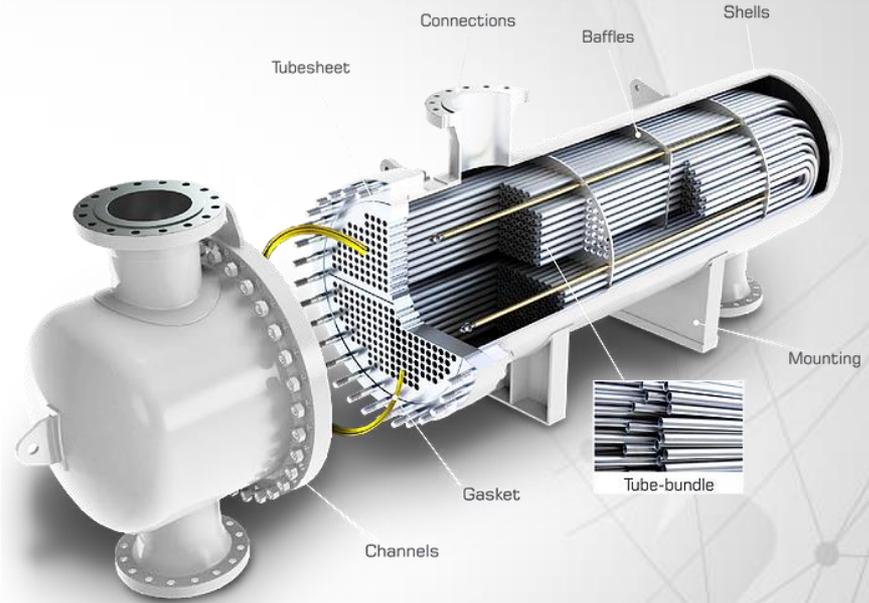
Exchanger Types



A fixed tube-sheet heat exchanger has straight tubes that are secured at both ends to the tube-sheets welded to the shell.

Shell and Tube Exchangers U-tube

Exchanger Types



TEMA type AEU

Exchanger Bundle Extraction / Installation Methods

Conventional

Truck Mounted Hydraulic Extractor

Aerial Hydraulic Extractor

Semi-Robotic Hydraulic “Crawler”

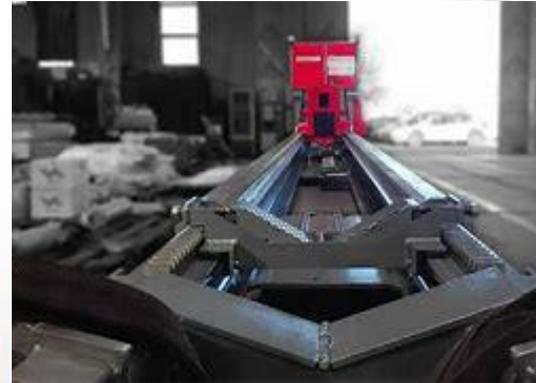


Truck Mounted Exchanger Bundle Extractor



Must use outriggers and bundle weight not to exceed 25 tons on Truck Mounted extractor and must follow length and diameter specifications.

Aerial Heat Exchanger Bundle Extractors



Aerial extractors are used in conjunction with cranes to facilitate the safe extraction / removal of exchanger bundles.

“Crawler” Exchanger Bundle Extractors

Semi-robotic hydraulic extractors can gain access where overhead obstructions prohibit use of an Aerial Extractor or where logistics won't allow maneuvering of a Truck Mount.



Exchanger Bundle Handling / Transport

Tractors / Bundle Dollies / Mobile Transport



Environmental Transport of Exchanger Bundles to Repair Shops



Future Extractor Operator Qualifications

Prerequisites to this training

- NCCER Core
 - Advanced Rigging or equivalent Certificate
 - Signal Person Certificate
 - DOT driver's license
 - Minimum 2 years BM experience or Extractor Operator helper
- **Module 1 - Heat Exchanger Types (Shell and Tube Heat Exchangers)**
 - Purpose of Heat Exchangers
 - Why extract a heat exchanger
 - Introduction to TEMA exchanger documentation
 - **Module 2 - Bundle Extraction Basics**
 - Describe the methods for extracting Exchanger Bundles
 - Describe a pre-job work review
 - Describe pre-shift routine and checklist (checklists in appendix)
 - Risk Recognition and Management
 - Extractor Maintenance
 - **Module 3 - Aerial Bundle Extraction**
 - Describe the extractor parts, their function, and associated hazards
 - Extracting the Bundle
 - Procedure for pushing/insertion

- **Module 4 - Truck Mounted and Self-Propelled Bundle Extractor**
 - Describe the extractor parts, their function, and associated hazards
 - Procedures for extraction
 - Procedure for pushing/insertion
 - Transporting a bundle on the extractor
- **Module 5 – Conventional Exchanger Extractions**
 - Collect worksite and bundle information
 - Create Lift Plan and schedule
 - Execution of plan
- **Module 6 - Advanced Topics**
 - Advanced Extraction and Insertion Methods
 - Advanced Connection Methods
 - Describe extractors with unique capabilities

Considerations for Bolt-up of Heat Exchangers

Bolting Up Exchangers

Gasket selection is considered **THE MOST** important consideration for leak free performance. Proper bolted flange joint assembly insures the proper clamping force on the gasket.



KAG (**K**Amprofile **G**raphite covered) are the most reliable in for Breech Lock service



SW Gaskets are not reliable and break apart under high assembly loads

3 MAJOR GASKET TYPES

Non-metallic

Fiber / Teflon / Graphite

Semi-metallic

Spiral Wound / Kamprofile
Corrugated Metal Jacket

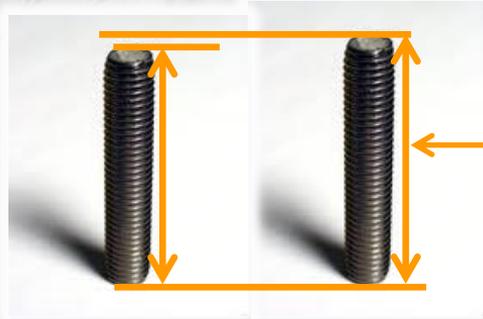
Metallic

RTJ – Ring Type Joint

Bolt Torque / Tensioning on Exchangers

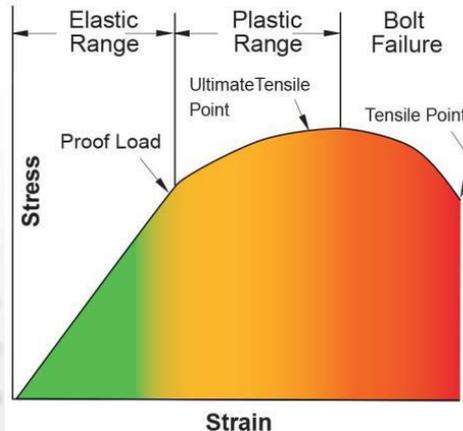
Bolted Flange Joint Dynamics & Bolting Methods to Achieve Clamping Force

Bolts Work as Springs



Axial stress is applied North and South

Hooke's Law of Physics



Ultrasonic Bolt Elongation Verification



Manual Torque Wrench

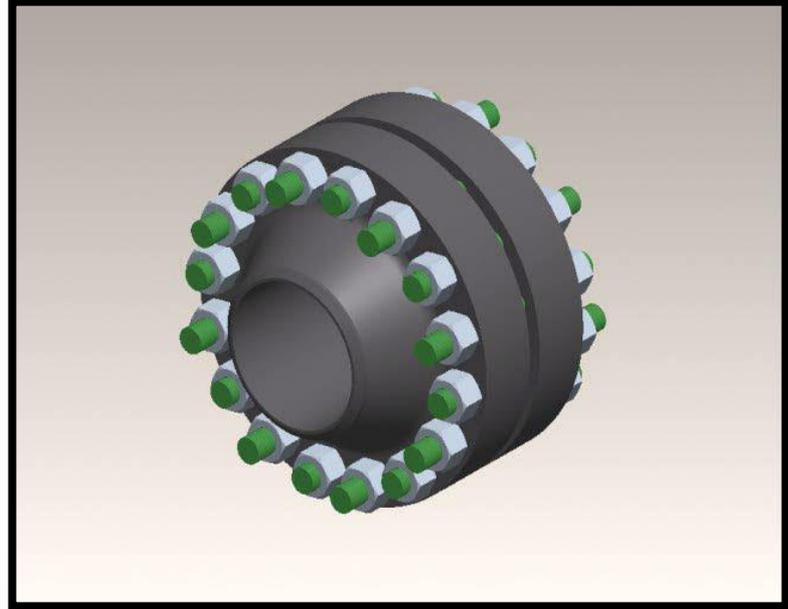
Bolt Torque / Tensioning on Exchangers

Methods to Achieve Gasket Compression

Hydraulic Torque (Socket / Square Drive)



Hydraulic Bolt Tensioning Example



Bolt Tensioning



Key Considerations for Exchanger Bolt-up

- Flange face flatness / Partition passes (flatness and surface quality)
- Inspect gasket surfaces for deformities (Indicate for flatness)
- Nuts / bolts / washers
- Are bolting technicians qualified per ASME PCC-1?
- Do the gasket, nuts and bolts adequately address the operating pressure / temperature?
- What method of bolt-up should be used? (Manual or Hydraulic Torque)
- If manual or hydraulic torque is used, what type of lubricant should be used?
- What bolting pattern will be used? / Is the bolting equipment calibrated to insure proper bolt load?
- When should I consider Hydraulic Tensioning?
- What QC documentation is required now and in the future?

Questions?

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References

KidExtractor, Ltd. Operating and Maintenance Manual – Safety precautions during operation; pre-job checklist; Load limits and specifications;

Sealing and Bolting Technologies, LLC – David Reeves – Breech-lock Exchangers reliability and leak free performance.

American Society of Mechanical Engineers. AMSE PCC-1 2013 Appendix A Training and Qualification of Bolted Flange Joint Assembly Personnel

ASME PCC-1 2013 Guidelines for Pressure Boundary Bolted Flange Joint Assembly