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Plate Heat Exchangers (Liquid to Liquid):
Introduction to PHE, Types of PHE, and Service Techniques

Box Coolers (Marine hull):
Introduction to Box Coolers
w/ David Bienvenu on Service Techniques

Finned Tube Oil Coolers (Air to Liquid):
Fin Tube Technology Breakdown

Double Tube Safety Heat Exchangers (Shell & Tube):
Double Tube Safety Pros and Where to Use Them

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Kelvion

Kevin McGinnis
Kelvion Sales Director for Heavy Industries and Mining

Greg Lauderdale
Kelvion National After Sales & Service Manager

Kelvion is a globally active manufacturer of industrial heat exchangers for a highly diversified range of market segments. Since **1920**, the company manufactures and markets its products throughout many and various market segments – since November of 2015, under the new Kelvion brand. With plate heat exchangers, shell and tube heat exchangers, finned-tube heat exchangers, modular cooling towers, and refrigeration heat exchangers, the company supports customers in highly diverse global segments

We're Kelvion – ready to take on the challenges of heat exchange.

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David J. Bienvenu
President - Radiator Service Co., Inc.

Radiator Service Co., Inc.

Radiator Service Company, Inc. was founded in 1988 by Bill and Marie Berkel. From day one, the Berkels operated the company with a commitment to product and service excellence, rooted in customer satisfaction.

David and Jeanne Bienvenu assumed ownership in 1994, and continue to operate in the original spirit of honest, quality service.

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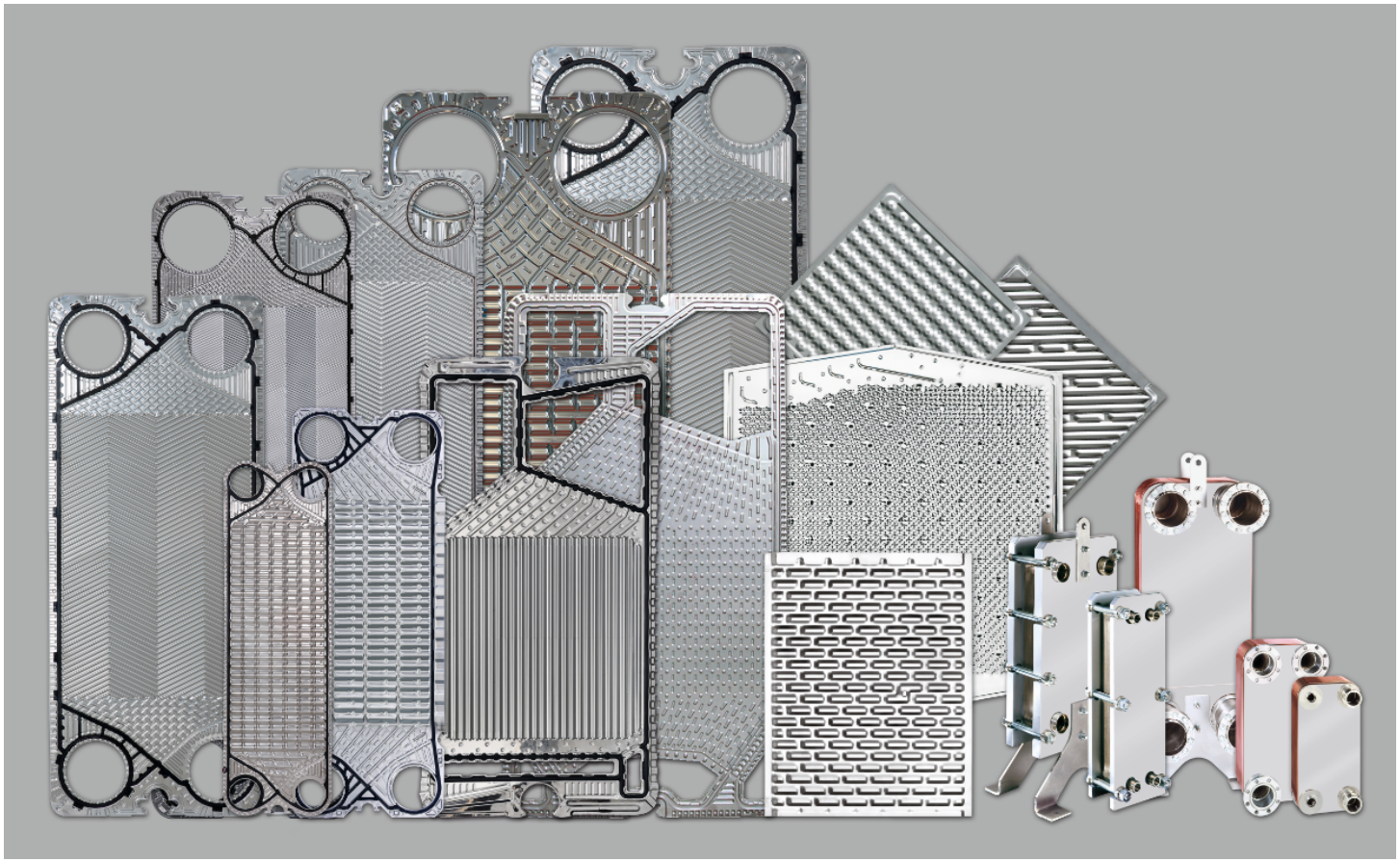
PLATE HEAT EXCHANGERS:

- INTRODUCTION TO PHE
- TYPES OF PHE
- SERVICE TECHNIQUES

What is a Plate Heat Exchanger? (PHE)



Three Main Types of PHEs

Brazed

-Pressures to 1200 psig

-Temperatures to 1000°F

-Flow rates to 800 gpm

Gasketed

-Pressures to 360 psig

-Temperatures to 370°F

-Flow Rates to 20,000 gpm

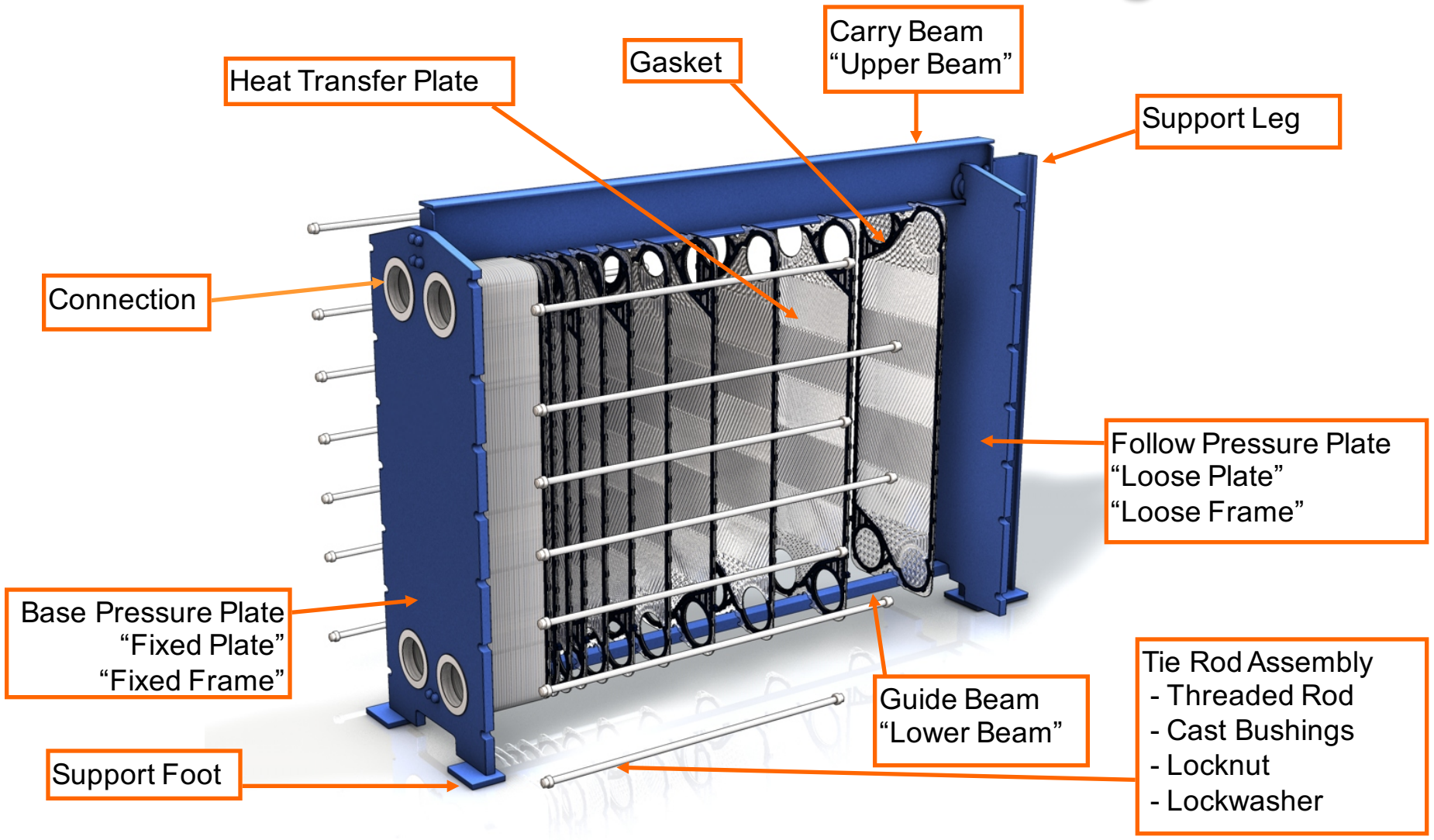
Welded

-Pressures to 450 psig

-Temperatures to 660°F

-Flow Rates to 30,000 gpm

Gasketed Plate Heat Exchangers



Gasketed Plate Heat Exchangers

- **Application**
  - High efficiency plate design.
  - Low to no fiber content.
  - Moderate viscosity media.
  - Special media.
- **Flow Rate**
  - Up to 20,000 gpm (4500 m^3/h).
- **Temperature**
  - Maximum standard design temperature 370°F (190°C).
- **Pressure**
  - Maximum design pressure up to 300 psig (20 bar).

Gasketed Plate Heat Exchangers vs Shell & Tube

Design Parameter	Gasketed Plate Heat Exchanger	Shell & Tube Heat Exchanger
Pressure Range	Up to 360 psig	> 1,000 psig
Temperature Range	-40°F to +410°F	< -150°F to > +1650°F
Cleanability	Easy	Difficult
Part Replacement	Easy	Difficult
Footprints	Small	Large
“Charge” Size	Small	Large
Weight	Low	High
Cost	Lower	Higher

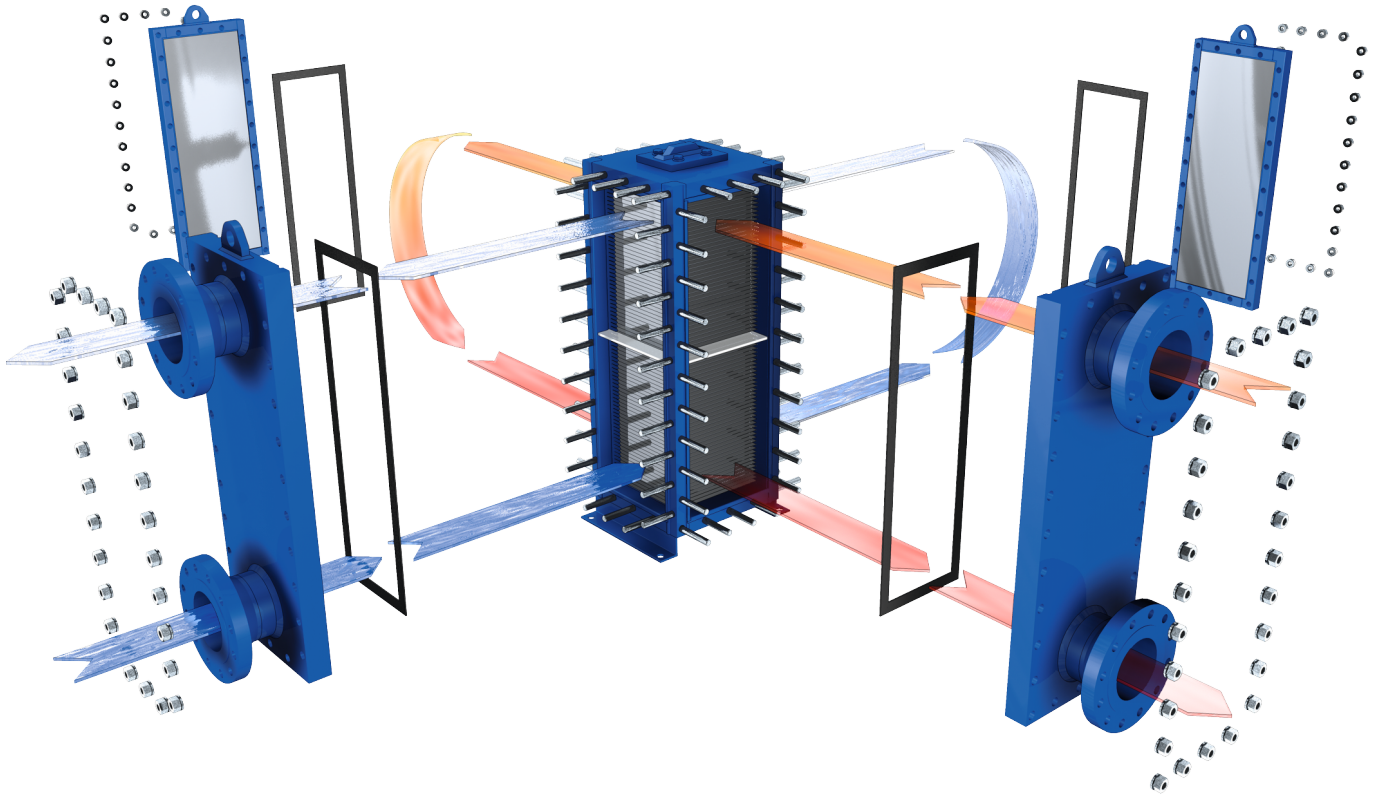
Welded Plate Heat Exchangers

1) Liquid capable style
(liquids, vapors, gases including multi-phase)

2) Air/Gas only style

Welded – Liquid capable style

(liquids, vapors, gases including multi-phase)



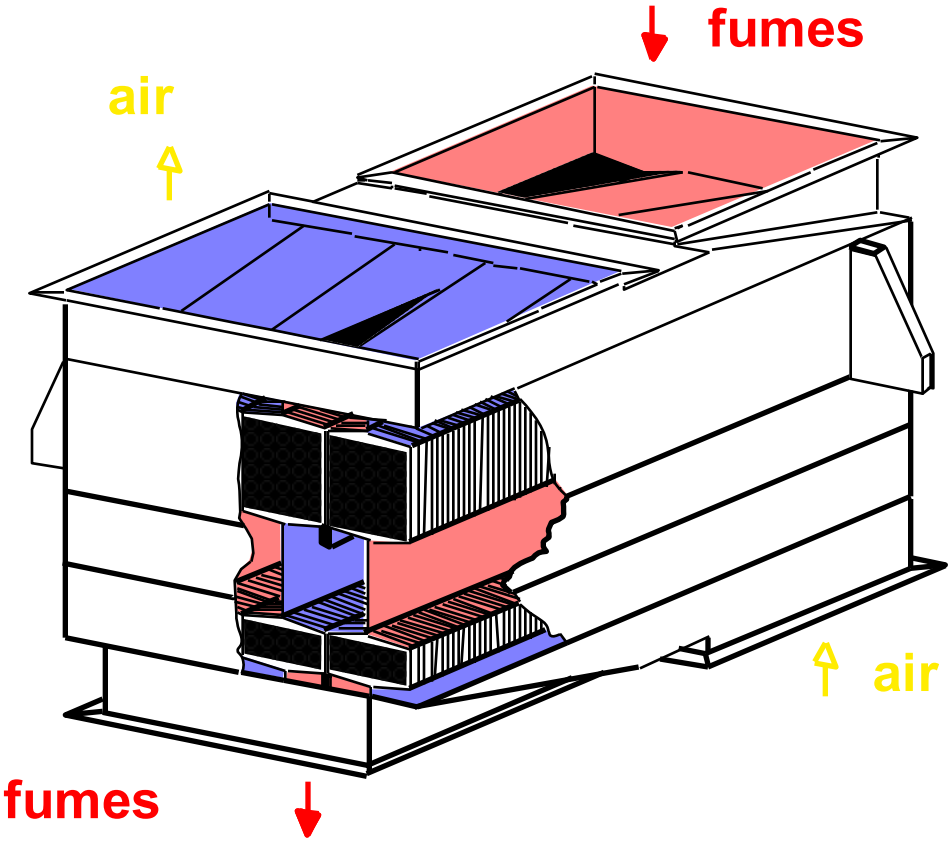
Welded – Liquid capable style

- **Applications**
  - Pressures or temperatures that exceed GPHE capabilities.
  - Most viscosity levels
  - Some fiber contents.
- **Flow Rate**
  - Up to 30,000 gpm (6800 m^3/hour) so far.
- **Design Temperature**
  - Up to 550°F (288°C)
  - Down to -20°F (-29°C)
- **Design Pressure**
  - Up to 450 psig (31 barg)

Welded – Liquid capable style vs Shell & Tube

Design Parameter	Gasketed Plate Heat Exchanger	Shell & Tube Heat Exchanger
Pressure Range	Up to 500 psig	> 1,000 psig
Temperature Range	-40°F to +1000°F	< -150°F to > +1650°F
Cleanability	Easy	Difficult
Part Replacement	Easy	Difficult
Footprints	Small	Large
“Charge” Size	Small	Large
Weight	Low	High
Cost	Lower	Higher

Welded – Air/Gas only style



Welded – Air/Gas only style

- **Applications**
  - Heat recovery from flue/exhaust gas to heat up a cooler air/gas
  - Dust content in flue gas up to about 100g per square yard
- **Flow Rate**
  - Min of 3000 CFM to Max 1.5M CFM
- **Design Temperature**
  - Up to 1472°F (800°C)
- **Design Pressure**
  - Range of -5.8 psig to +5.8 psig

Welded – Air/Gas only style

As small as pallet sized to as large as a building

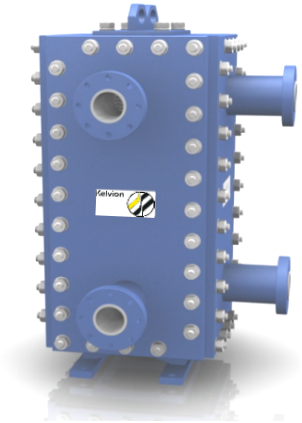
Brazed Plate Heat Exchangers

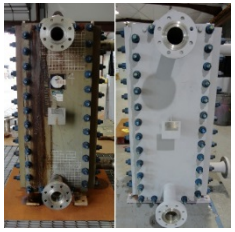
Brazed Plate Heat Exchangers

- **Applications**
  - Very wide range of various fluids: refrigerants; ammonia; corrosive fluids
- **Flow Rate**
  - Almost 0 flow up to around 800 GPM
- **Design Temperatures**
  - Generally -321°F to +392°F
- **Design Pressure**
  - Generally up to 460 psig
  - Some models up to 2000 psig

PLATE HEAT EXCHANGER SERVICING

- **Gasketed Plate**
- **Bloc/Welded Plate**

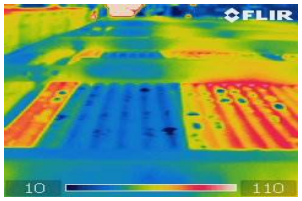




Complete Reconditioning

Chemical Cleaning

Hydro Blasting

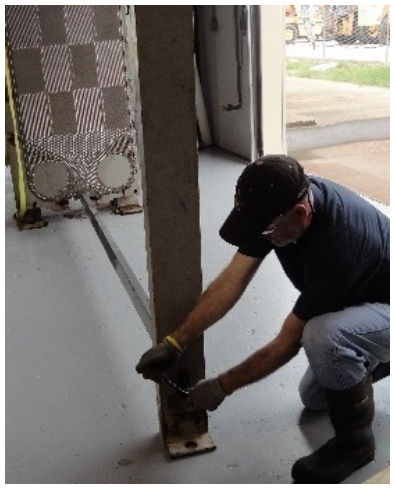


Trouble Shooting & Performance Audit

"R" Stamp Weld Repair

On Site Service

Gasketed PHE Frame Services

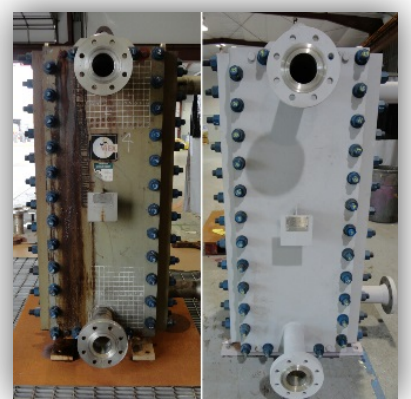


- Disassembly & Reassembly
- Frame Component Inspection & Replacement
- "R" Stamp Weld Repair – Certification for the repair and/or alteration of boilers, pressure vessels, and other pressure-retaining items

- Sand Blast and Painting
- Hydro Testing

  Hydro test to OE

  design test pressure



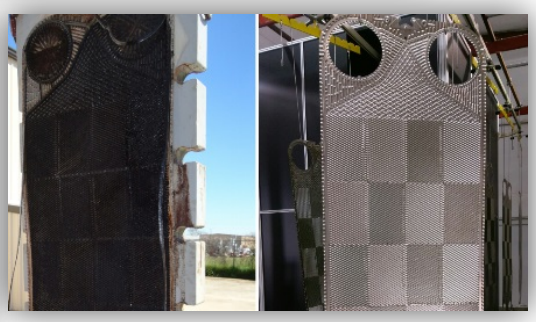
Gasketed Plate Reconditioning Service

- **Inspection of Received Plates**

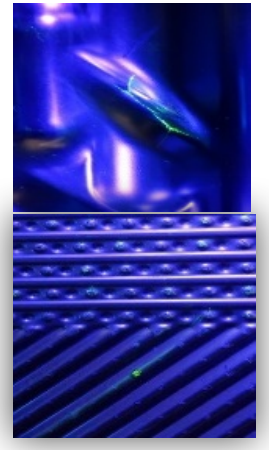
  Carefully inspected every plate for damage and log the plate and gasket material types.

- **Remove Old Gasket**
- **Chemical Cleaning**

  Plates are submerged in a series of chemical baths determined by the plate material and type of fouling. Ex: 2-stage cleaning process: (1) Sodium Hydroxide (2) Acid based solution. Level and type of fouling on plates determines time, temp of solutions.



Gasketed Plate Reconditioning Service



- **Dye Penetrant Failure Examination**

  Dye is applied to each plate and the plates are inspected for through defects

- **Final Rinse**

  Plates go through a final rinse and dry to ensure that dye and any remaining particulates are removed.

- **Gasket Groove Inspection**

  Gasket grooves are inspected for cleanliness and deformation.

- **Gasket Application**

  Options for clip-on, solvent based adhesives, and two part epoxy

- **Optional Adhesive Thermal Cure**

  Advanced adhesives can be thermally cured

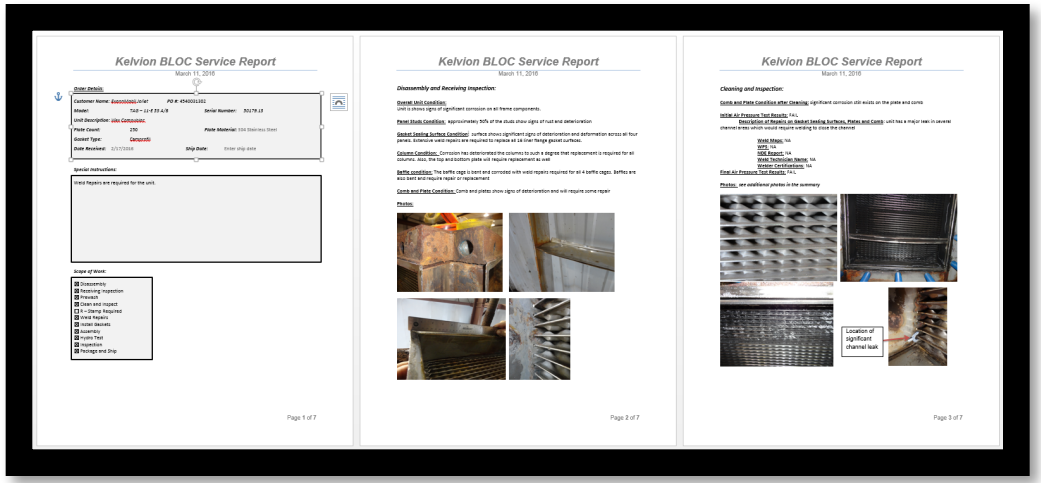
Gasketed Plate Reconditioning Service

- Final Inspection of Plates

  Insure every plate is inspected for cleanliness, proper gasket installation, and material verification prior to being packaged for shipment or reinstalled in the heat exchanger frame.

- Insure Service details are maintained in a database and can be retrieved at any time.
- Service Report Generating

  A detailed report including services performed, applicable certifications, instrument traceability, and test results is issued for every heat exchanger or plate pack.



Bloc/WPHE Reconditioning Service

- **Inspection of Received Unit**

  Exterior inspection of frame components, studs, and nozzles is performed.

- **Disassembly and Internal inspection**

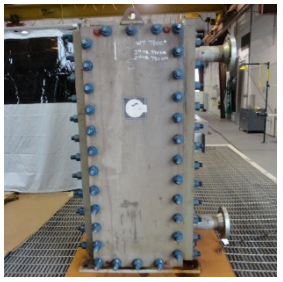
  The cover plates are removed and an internal inspection is performed to document condition of baffles, gasket flange, welds, plates and liners, and type of fouling.

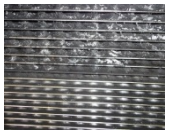
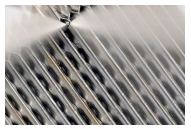
- **Mechanical and/or Chemical Cleaning**

  Type of cleaning is determined based on materials of construction and type of fouling. The unit is either mechanically cleaning using high pressure hydro blasting or chemically cleaned in a series of carefully selected baths.

- **Air Bubble Leak Test**

  Each side of the unit is subjected to an air bubble leak test to identify and locate cracks, corrosion, or failed welds.



Bloc/WPHE Reconditioning Service

- "R" stamp Weld Repair

  Damages to the frame components, liner, gasket flange, or plates can be evaluated and repaired depending on severity and location.

- NDE of Weld Repairs
- Post Repair Air Bubble Leak Test

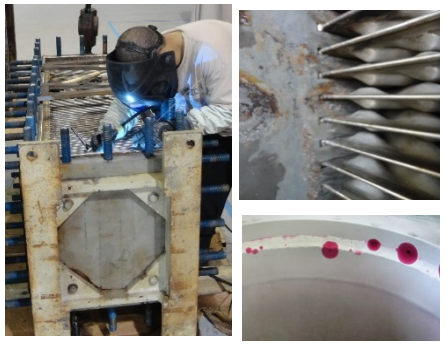
  Each side of the unit is subjected to an air bubble leak test after repairs to test the integrity of the repairs.

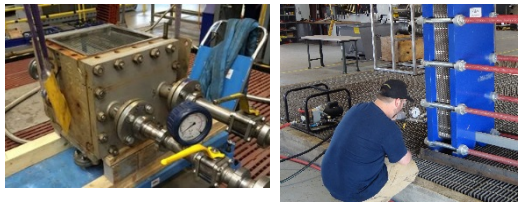
- Hydro Test

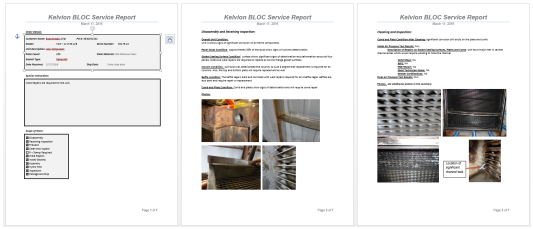
  Units are hydro tested to design test pressure

- Service Report Generated

  Welder and technician certifications, equipment calibration data, and unit design specification records are maintained in your database and reported for every job.







On-Site Services

Gasketed Plate Heat Exchanger

- Troubleshooting
- Plate Pack Replacement
- Gasket Replacement
- Hydro Blasting
- Pressure Testing

Bloc & Welded Heat Exchange

- Troubleshooting
- Hydro Blasting
- Pressure Testing

- **Plant planned outage or an emergency need.**
- **All Technicians must maintain all national and local safety, security, and service certifications.**

Replacement/ Spare Parts

Gasketed and Bloc Parts –

- Extensive stock keeping and intelligent logistics put us in a position to deliver any spare part you need to any point in the world on schedule
- Wide range of plates and gaskets available for every brand

PHE Final Report

Order Details:

Customer Name:	Bob's Chem Plant	***PO#:***	MPC10252299
Receiving Date:	2/8/2017	***Ship Date:***	3/8/2017
Model:	B134	***Serial #:***	44756.1
Plate Count:	405	***Plate Material:***	***Gasket Type:*** NBR

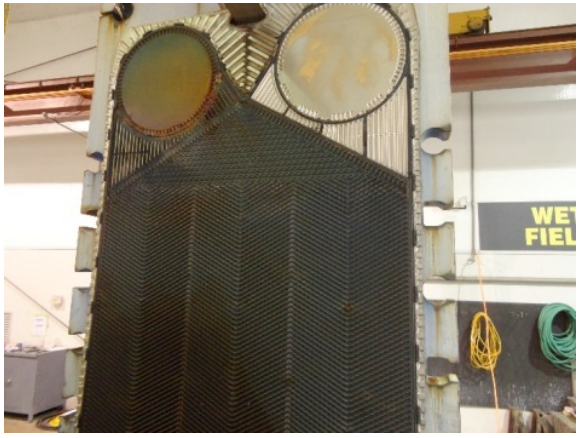
Special Instructions:
[FEB-09-17 Parts Services] 2 Units with 405 Plates in each.

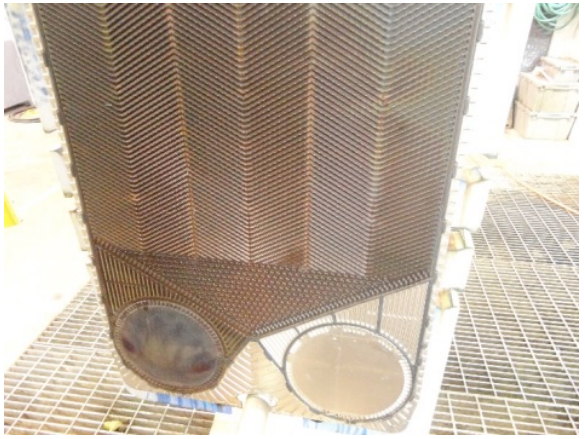
Scope of Work:

Blast & Paint Frame	☐
R-Stamp	☐
Receiving	☒
Pre Wash Plates	☐
Chemical Tanks	☒
Clean and Inspect	☒
Install New Gaskets	☒
Oven Cure Adhesive	☐
Assembly	☒
Hydro Test	☒
Final Inspection	☒

Receiving and Disassembly:

Unit Condition	Unit condition fair, with normal signs of use. Unit arrived without bore flanges.
Frame Condition	Frame is structurally sound with faded paint and minimal rust noted.
Tie Rod Condition	Tie rods in good condition, minimal rust
Plate Condition	Heavily Fouled. Gaskets are "tab in" without glue, with exception of end plate which gasket is glued down.





Chemical Cleaning and Inspection:

Fluorescent die penetrant used for plate inspection

Passed Inspection	392
Failed Inspection	13
Total Plates Inspected	405

Failed Plate(s) Disposition

Plate's inspection completed with 13 failures due to cracks/pin holes. Plates replaced.