

Brazed Plate Heat Exchangers – Reliable, Efficient, and totally cool!

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Alfa Laval Inc., Richmond VA



Introduction

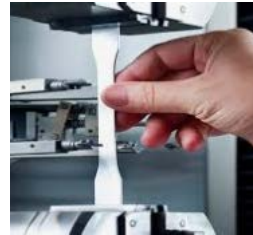
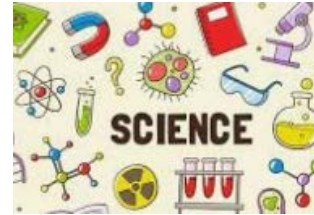
- * Thank you to the National Board for allowing the opportunity!
- * For the next 30 minutes...
 - Design features
 - Applications
 - Manufacturing
 - Regulations
 - Your questions



- * Who am I?

Who am I?

- * Stacey Marks
- * BSME from UVA
- * Inspecting metal since 1991
- * Alfa Laval since 1995
- * ASME VIII Stds Comm member
- * ASME IX Stds Comm member
- * Science rules!
- * 2 kids, 2 grandchildren



What is a BHE?



Insulated,
from the
field

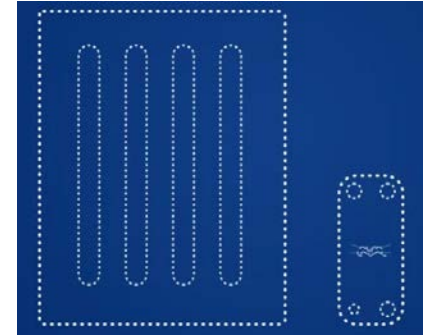
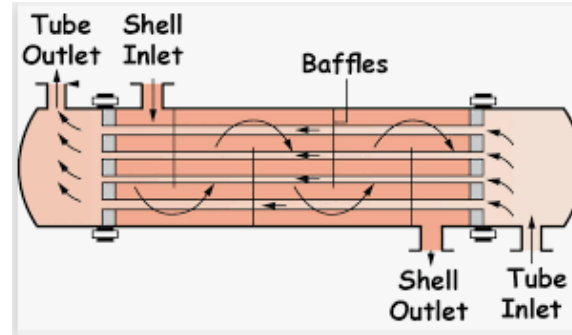


Brand
new



What this is not

- * A traditional shell-n-tube, which requires more surface area
- * Cow manure processing! 😊 Done with Alfa Laval equipment, and is great renewable energy (biomethane), but certainly is not as cool as our BHE's!

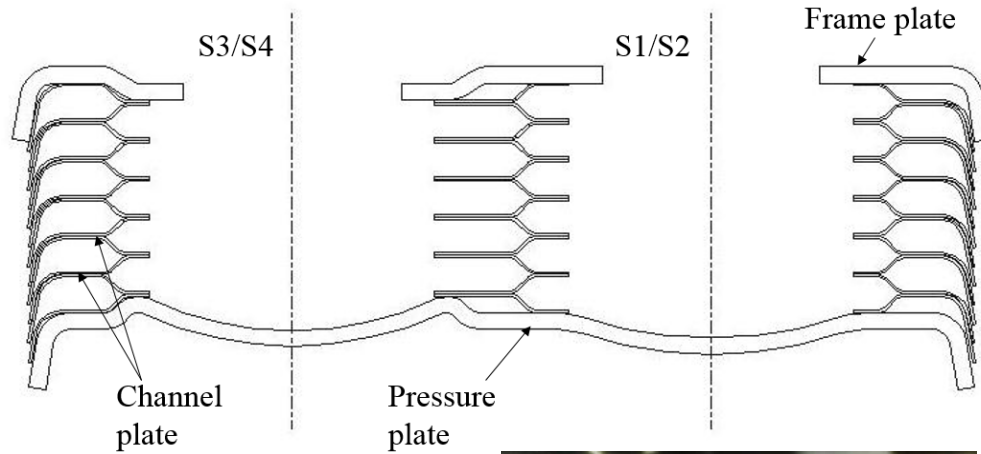


Design Features

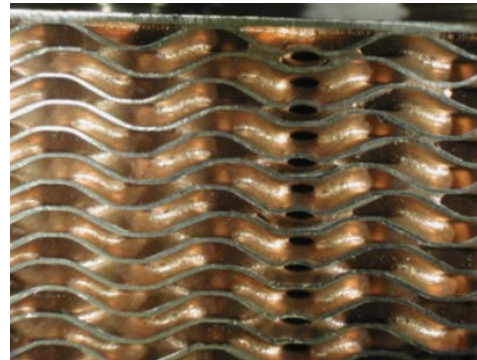
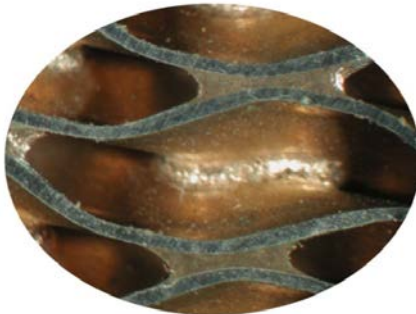


- * Stainless steel end plates, with 4 or 6 connections
- * Stainless steel heat transfer plates
- * Copper foil, as brazing filler
- * Studs for feet and lifting lugs

Design Features

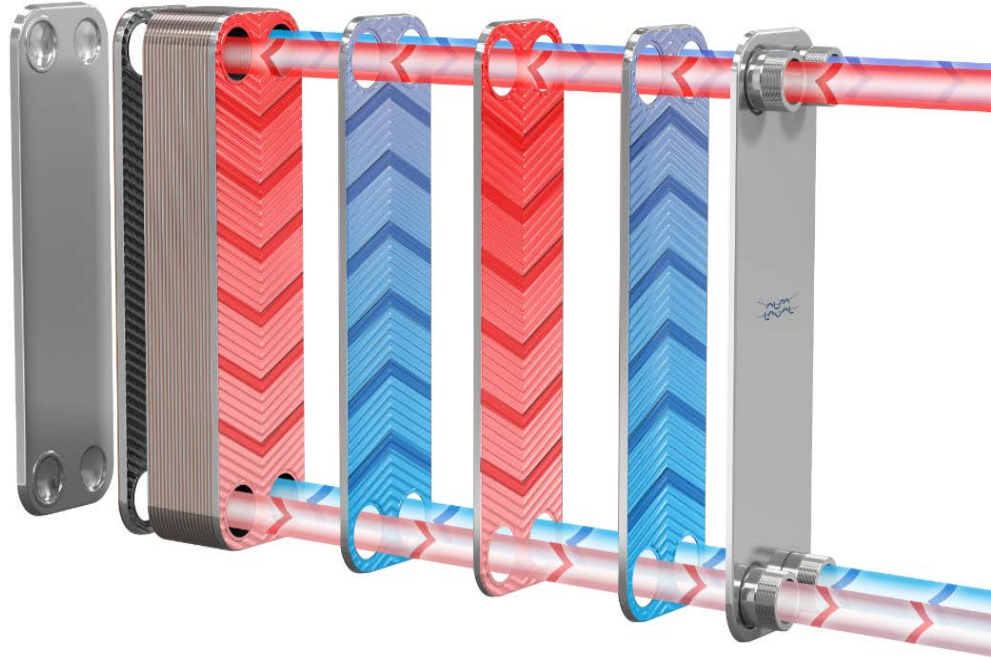


- * End plates (frame and pressure) are pre-formed for improved strength
- * Heat transfer plates (channel) are designed to fit with precision which ensures optimal flow of copper during brazing

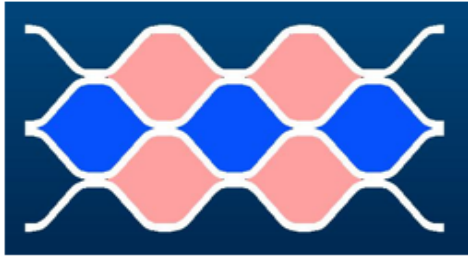


Design Features

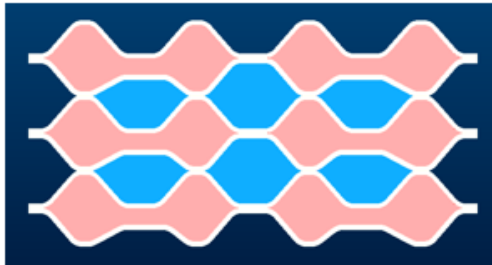
- * 2 independent chambers (some models have 3 for double-inlet refrigerants)
- * Heat transfer occurs across the thin channel plates which are designed to keep the fluids separated
- * Inlet/outlet diameters:
3/4" up 5" (none exceed 6")
- * Max. chamber volume:
7 cubic feet on our largest model
- * MAWP:
up to 1300 psi (90 bar)
from Richmond, our highest is 650 psi
- * Temp range, normally:
-320 °F to +400 °F (-196 °C to 204 °C)



Design Features



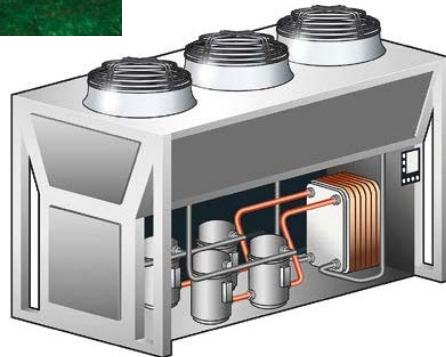
**Section through
symmetric channels**



**Section through
asymmetric channels**

- * Plate designs are patented
- * Asymmetry principle:
 - each second plate is formed in a way that creates refrigeration channels with differing cross-sectional areas
- * This increases performance!

Applications



* Chiller systems

- evaporator (dry expansion) to cool water
- condenser (to reject or recover heat to water)
- desuperheater (partial heat recovery to water)
- economizer (to cool liquid refrigerant and superheat vapor refrigerant)
- subcooler (to cool down the liquid refrigerant)
- oil coolers

Applications



- * natural refrigerants
 - ammonia, propane
 - R290, which is highly flammable, we designed a special plate just for this
- * gas cooler for transcritical CO₂
 - What is a transcritical CO₂ system? A system that uses carbon dioxide, which is environmentally safe, as a refrigerant. It requires equipment capable of high pressures, with superior fatigue strength.

Applications



- * Commercial refrigeration



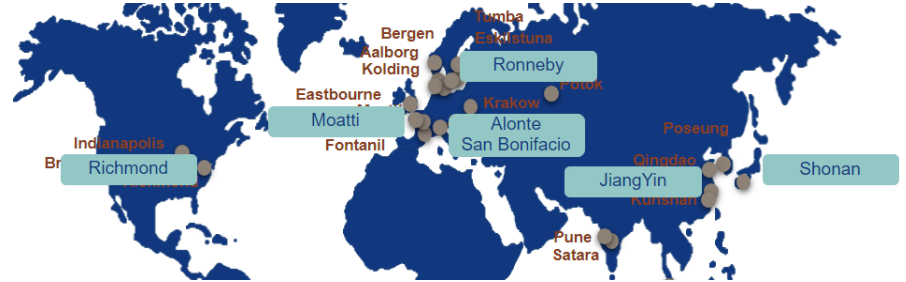
- * CBD extraction



- * Other cryogenic uses in the pharmaceutical industry, and elsewhere!

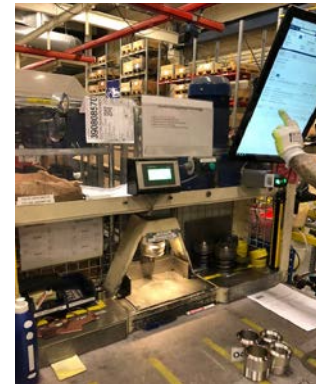
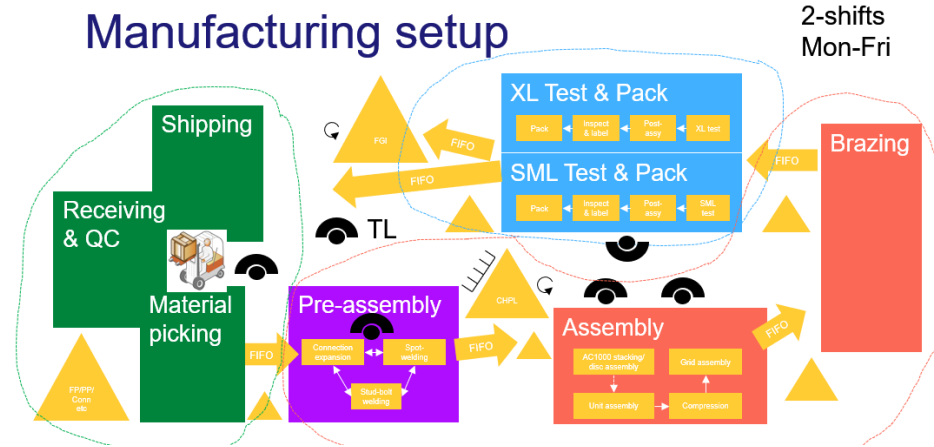
Manufacturing

- * We have 4 sites around the world and make over 3 million BHEs a year
 - Richmond VA USA (newest)
 - Sweden, Italy, China
- * Furnace brazing, partial vac
- * 24-hour production, 3 shifts
- * Lean manufacturing, one piece flow, 5S
- * ISO 9001 Certified
- * ASME U & UM Stamps
- * PED Mod B and D
- * UL Certified



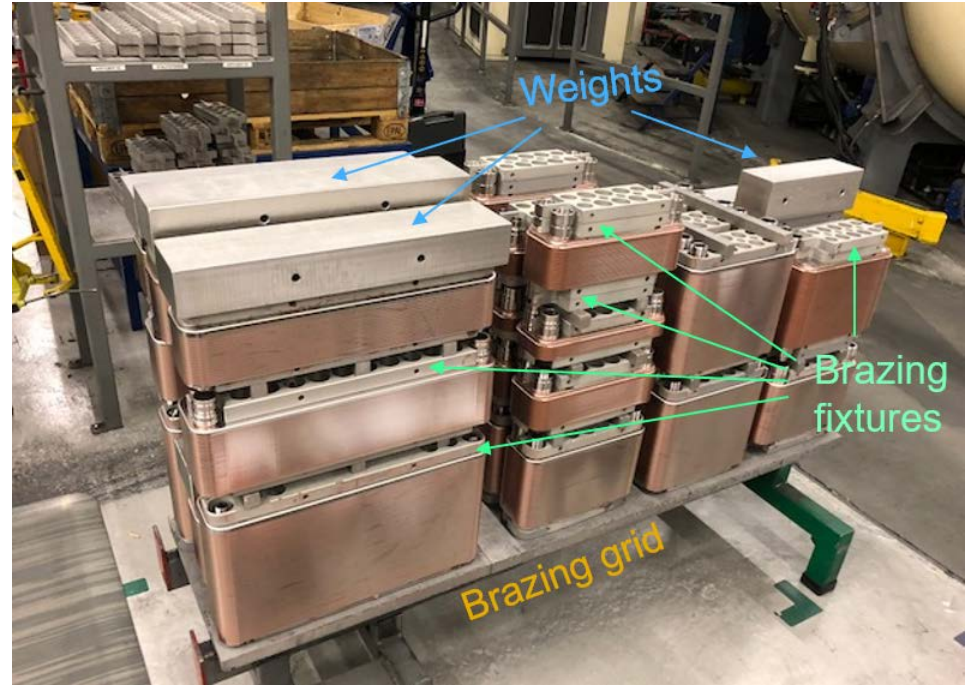
Manufacturing

- * U shaped flow with stations
 - frame pre-assembly
 - unit assembly & grid building
 - brazing
 - testing & packing
- * Material traceability through QR codes
- * Touchscreens at every station for quick access to information
- * SOPs for critical steps



		SOP2	
Doc. no:	SOP2 73524	Rev. no:	0
	Quality Control		Caution

Manufacturing - Brazing

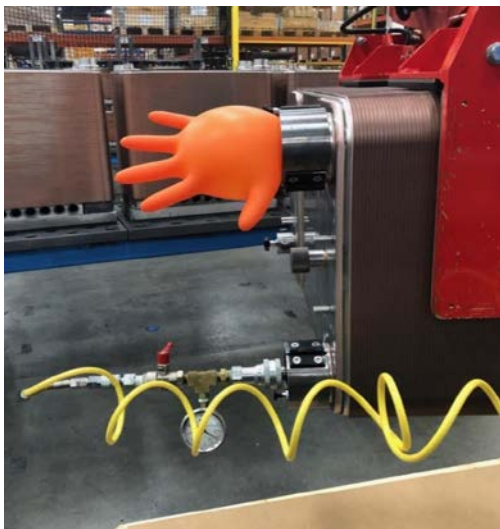
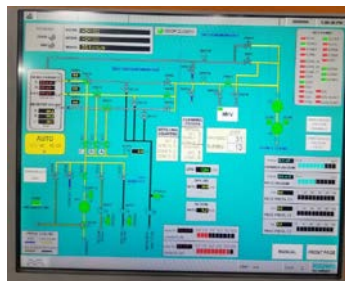


Manufacturing - Brazing



Manufacturing

* Pressure and Leak Testing



Manufacturing




* Typical Field Failures

- Crack around connection at base - from excessive loads applied by customer during installation
- Internal cross-over leak - caused by cracks that originate from freezing of process fluids
- Copper corrosion – brought on by environmental conditions
- Our #1 complaint – transportation damage

Regulations

- * UL1995 & ASHRAE 15
 - Over 100 years successfully regulating refrigerant containing equipment
 - Requires:
 - periodic manufacturing audits
 - 100% pressure and leak testing by the manufacturer
 - annual fatigue testing
 - Required by most building codes



Heating and Cooling Equipment

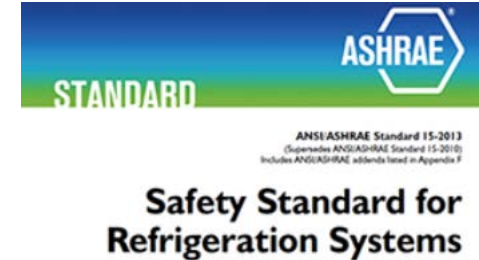
UL Standard

- 📄 Scope
- 📄 Summary of Topics

Standard 1995, Edition 5

Edition Date: July 31, 2015

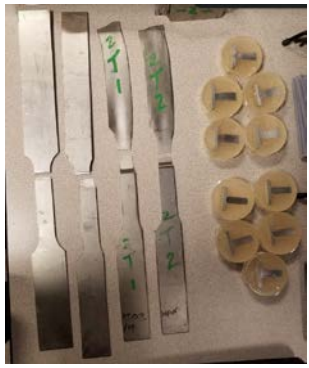
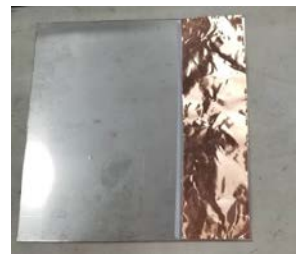
DOD Approved: March 09, 1992



Regulations

* ASME Section VIII

- For pressure vessels with an inside diameter exceeding 6"
- Requires:
 - contract with a 3rd party AIA
 - documented certification of all materials
 - welding and brazing qualifications
 - 100% witnessing of pressure tests by an Inspector
 - use of a metal nameplate
 - annual audit of the manufacturer's QC system



Summary

- * BHEs are reliable, efficient, and totally cool!
 - Applications – mostly HVACR
 - Patented design features
 - Manufacturing – 100% pressure and leak testing + annual fatigue testing
 - Regulations – UL, ASHRAE, ASME
- * Any questions? I'm here all week!
- * You can reach me at stacey.marks@alfalaval.com
- * Thank you, National Board!

