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

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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: ¾” 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

- 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
Manufacturing - Brazing

Certified Brazing Operator

Weights

Brazing fixtures

Brazing grid
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
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!*

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*Thank you, National Board!*