Heat Exchanger Extraordinaire Expo

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Heat Exchangers

- Specifications
  - Temperature/Pressure Ratings
  - Design Selection
  - Testing
  - Configuration Options
    - Single Pass
    - Double Pass
    - Expandable Capacities
    - Double Wall

Heat Exchangers

- Diagnostics
  - Common Installation Errors
  - Pressure
  - Temperature
- Cleaning
  - Decision to Replace or Clean
  - Chemicals
  - Process

Temperature and Pressure Rating

- Heating
  - 250 Degree F.
  - 250 PSI
- Cooling
  - 180 Degree F.
  - 150 PSI

What Does that Mean?

Heating Design

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	Btu/h		850000	
Inlet temperature	°F	250.00		150.00
Outlet temperature	°F	160.00		180.00
Flow rate	US gpm	19.50		57.90
Max. pressure drop	psi	5.00		5.00
Thermal length		2.919		0.973

Heating Temperatures

Approach Temperature:
Minimum of 10 Degree F.

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	Btu/h		850000	
Inlet temperature	°F	250.00		150.00
Outlet temperature	°F	160.00		180.00
Flow rate	US gpm	19.50		57.90
Max. pressure drop	psi	5.00		5.00
Thermal length		2.919		0.973

Cooling Temperatures

Approach Temperature:
Minimum of 2 Degree F.

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	Btu/h		12.00e6	
Inlet temperature	°F	42.00		58.00
Outlet temperature	°F	56.00		44.00
Flow rate	US gpm	1709		1710
Max. pressure drop	psi	5.00		5.00
Thermal length		7.001		7.001

Heating Flow Rates

Heat Exchanger Flows

DUTY REQUIREMENTS		Side 1		Side 2
Heat load	Btu/h		850000	
Inlet temperature	°F	250.00		150.00
Outlet temperature	°F	160.00		180.00
Flow rate	US gpm	19.50		57.90
Max. pressure drop	psi	5.00		5.00
Thermal length		2.919		0.973

Heating Pressure Drops

Equal volumes on each side of the heat exchanger means that one side has a much higher fluid velocity. This is true for plate/frame and brazed plate heat exchangers but not shell and tube

Pressure drop -total*	psi	0.635		5.22
- in ports	psi	0.139		1.25
Port diameter	in	1.30		1.30
Number of channels		43H		44H
Number of plates			88	
Oversurfacing	%		3	
Fouling factor	sqrft.h.°F/ Btu		0.000	

Cooling Pressure Drops

Pressure drop -total*	psi	1.40		1.40
- in ports	psi	0.400		0.400
Port diameter	in	3.86		3.86
Number of channels		401		400
Number of plates			800	
Oversurfacing	%		0	
Fouling factor	sqrft.h.°F/ Btu		0.000	

Fouling Factor/Oversurfacing

Fouling factor is an engineering safety factory.

Pressure drop -total*	psi	0.635		5.22
- in ports	psi	0.139		1.25
Port diameter	in	1.30		1.30
Number of channels		43H		44H
Number of plates			88	
Oversurfacing	%		3	
Fouling factor	sqrft.h.°F/ Btu		0.000	

Heat Exchanger Turndown

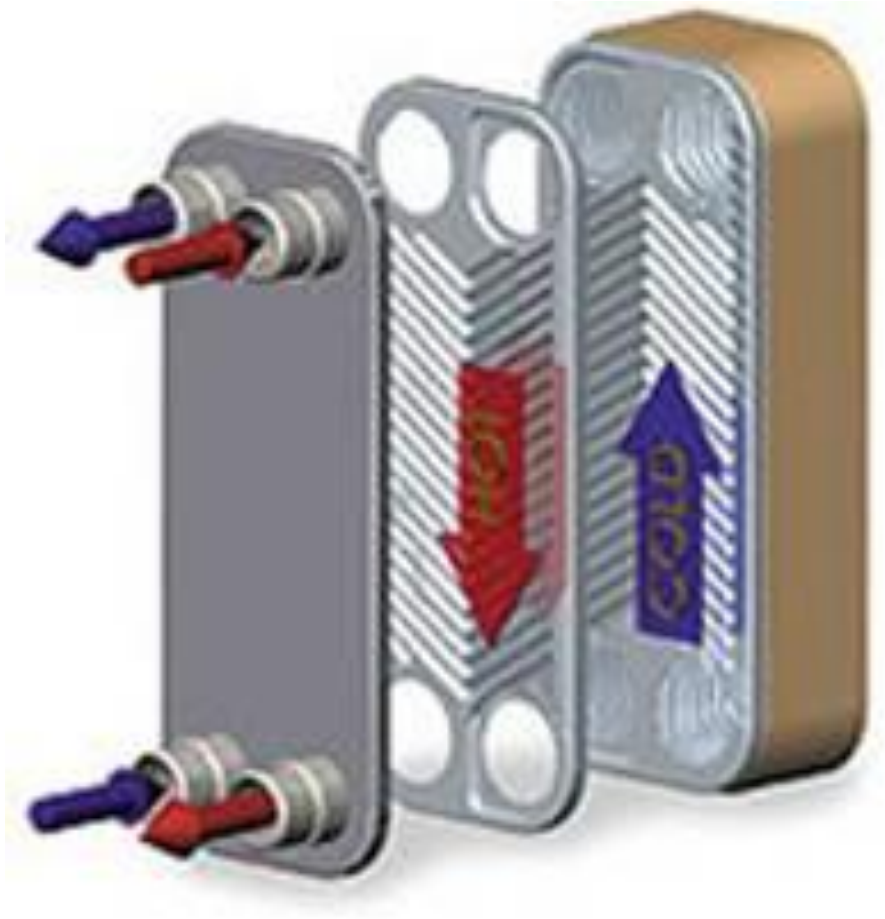
- Reynolds Number Below 2000 Is Laminar

Reynolds number		1656	3736
Port velocity	ft/s	4.72	14.0

Heat Exchangers Testing

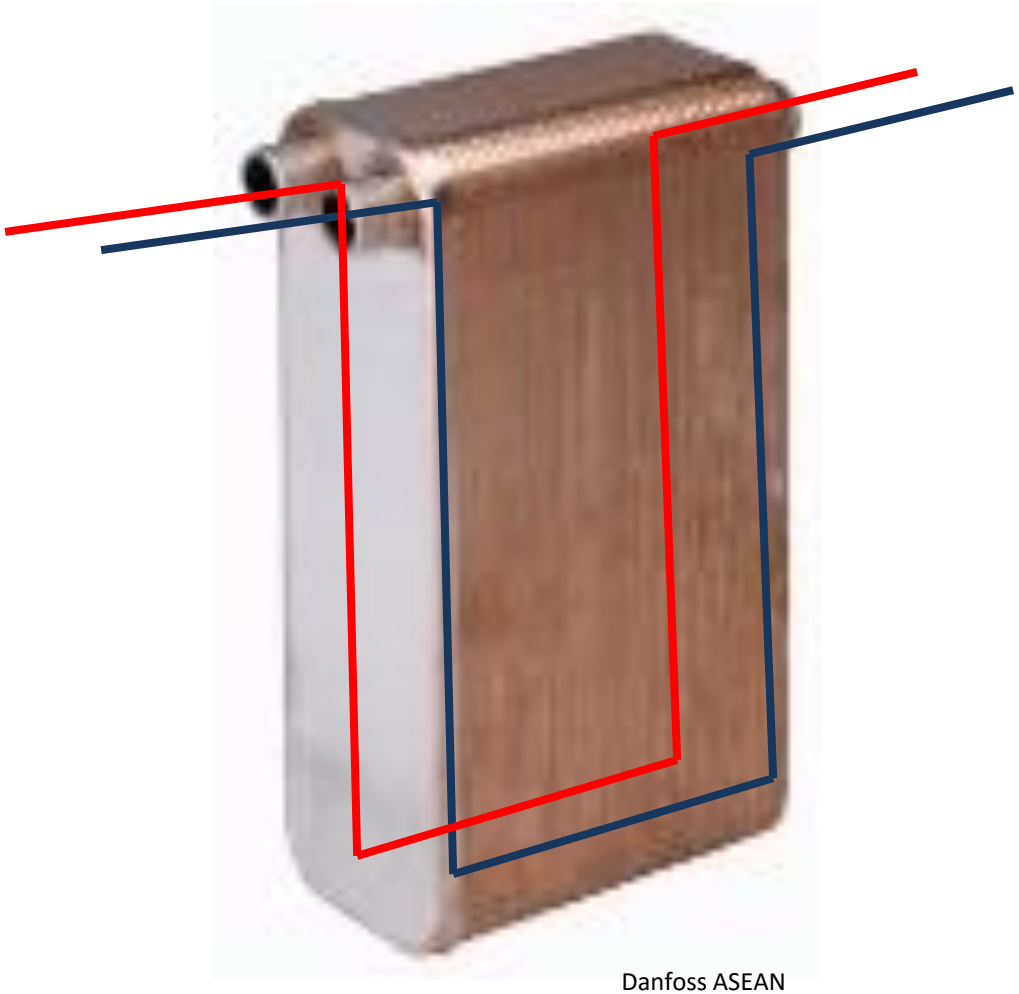
- Nameplate Pressure Rating (NPR)
  - Hydro Test Pipe to 1.5 X NPR
  - ASME Certifies Heat Exchangers as 1.3 X NPR
  - European Standard is 1.2 X NPR
- Heating Hydro Tests to 375 PSI
- Cooling Hydro Tests at 225 PSI

Single-Pass Heat Exchanger



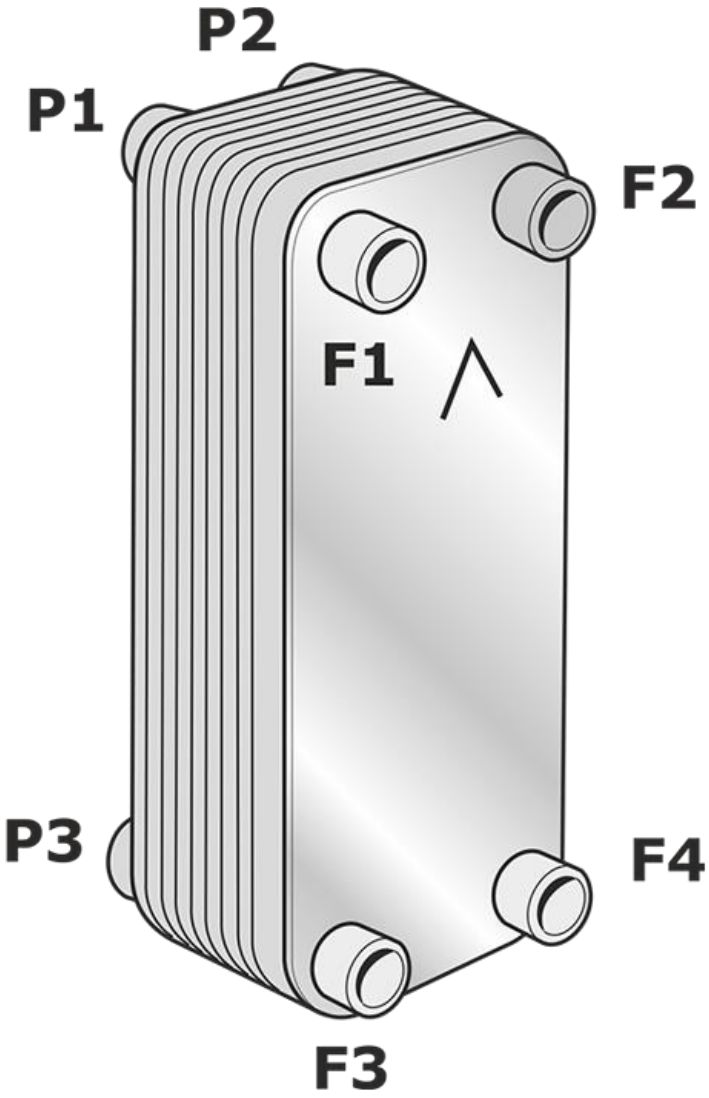
Linan Beta Mechanical & Electrical Co., Ltd

Two-Pass Heat Exchanger



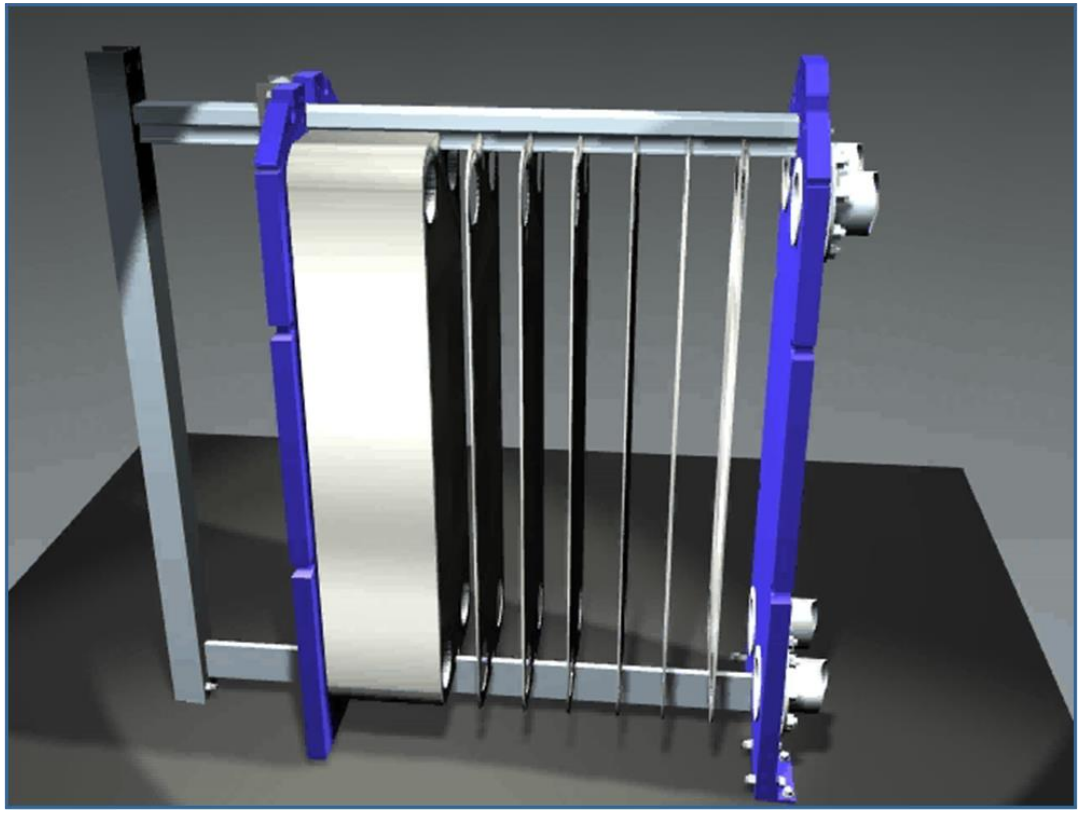
Danfoss ASEAN

Expandable Capacities



SWEP International AB

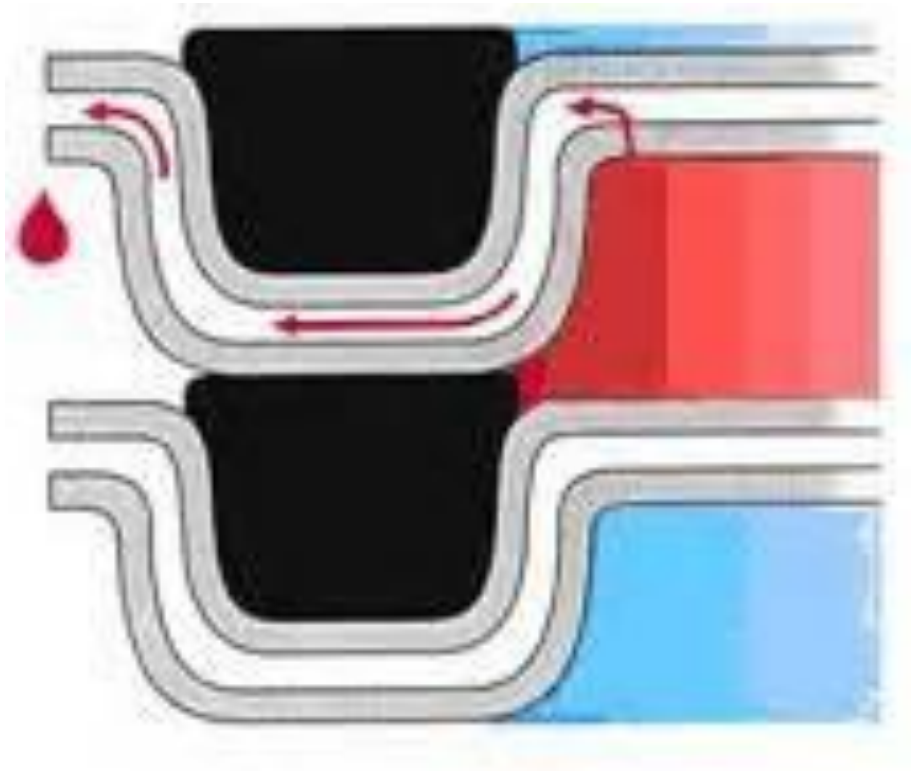
Expandable Capacities



http://1.bp.blogspot.com/_l-cNNS3j7UU/S7FhqbBQwII/AAAAAAAAAR4/AsODQ-al8k8/s1600/pack.png

Double Wall

(Domestic Hot Water)



http://tse2.mm.bing.net/th?id=OIP.M9b673b3070f9375fc0f985629f5c35b1o0&pid=15.1

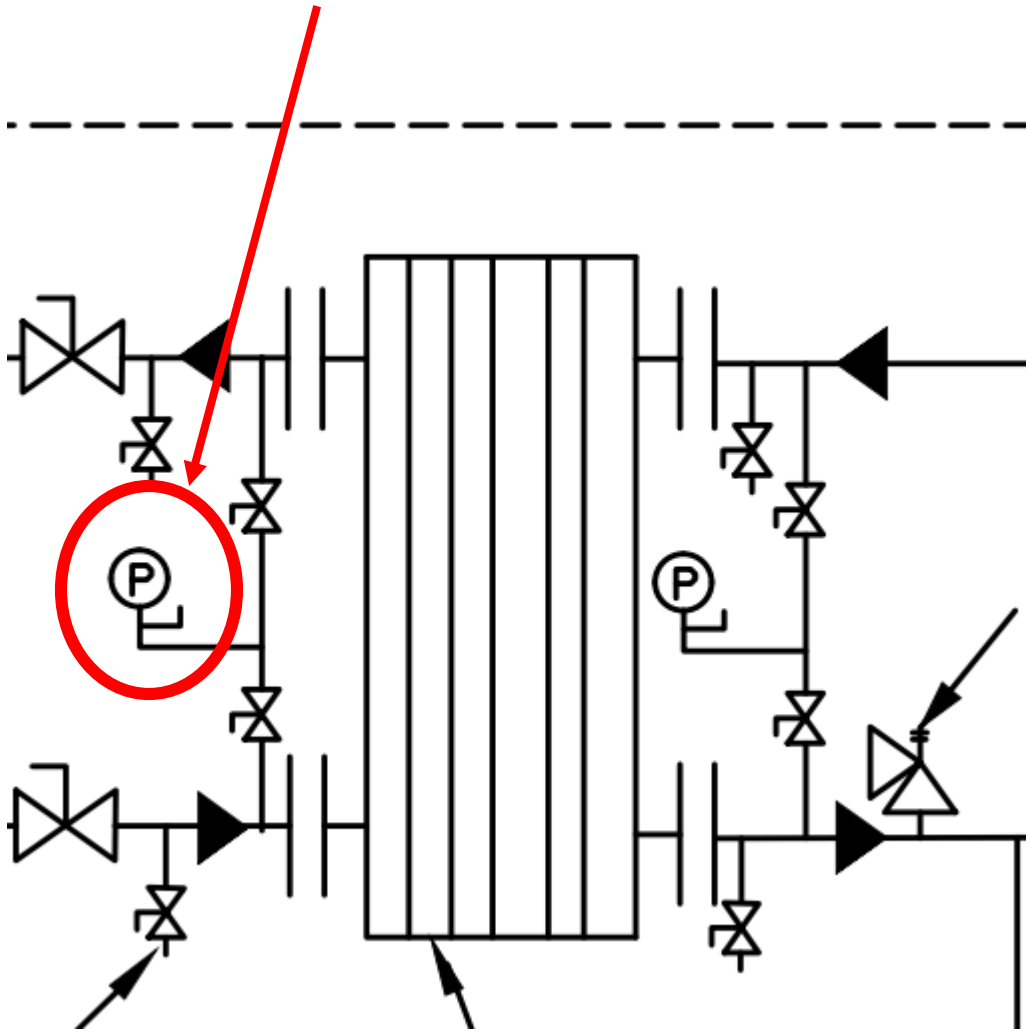
How often to clean if no signs of trouble?

Your Preventative Maintenance Friend

- Building Hx
  - House side - 1x/5yrs
  - District side – 1x/5yrs
- DHW Hx
  - House side – 1x/yr
  - District side – 1x/5yrs
- Process Cooling Hx
  - Process side – 1x/yr
  - District side – 1x/yr

Pressure Diagnostics

High Pressure Drop on either side of the heat exchanger.

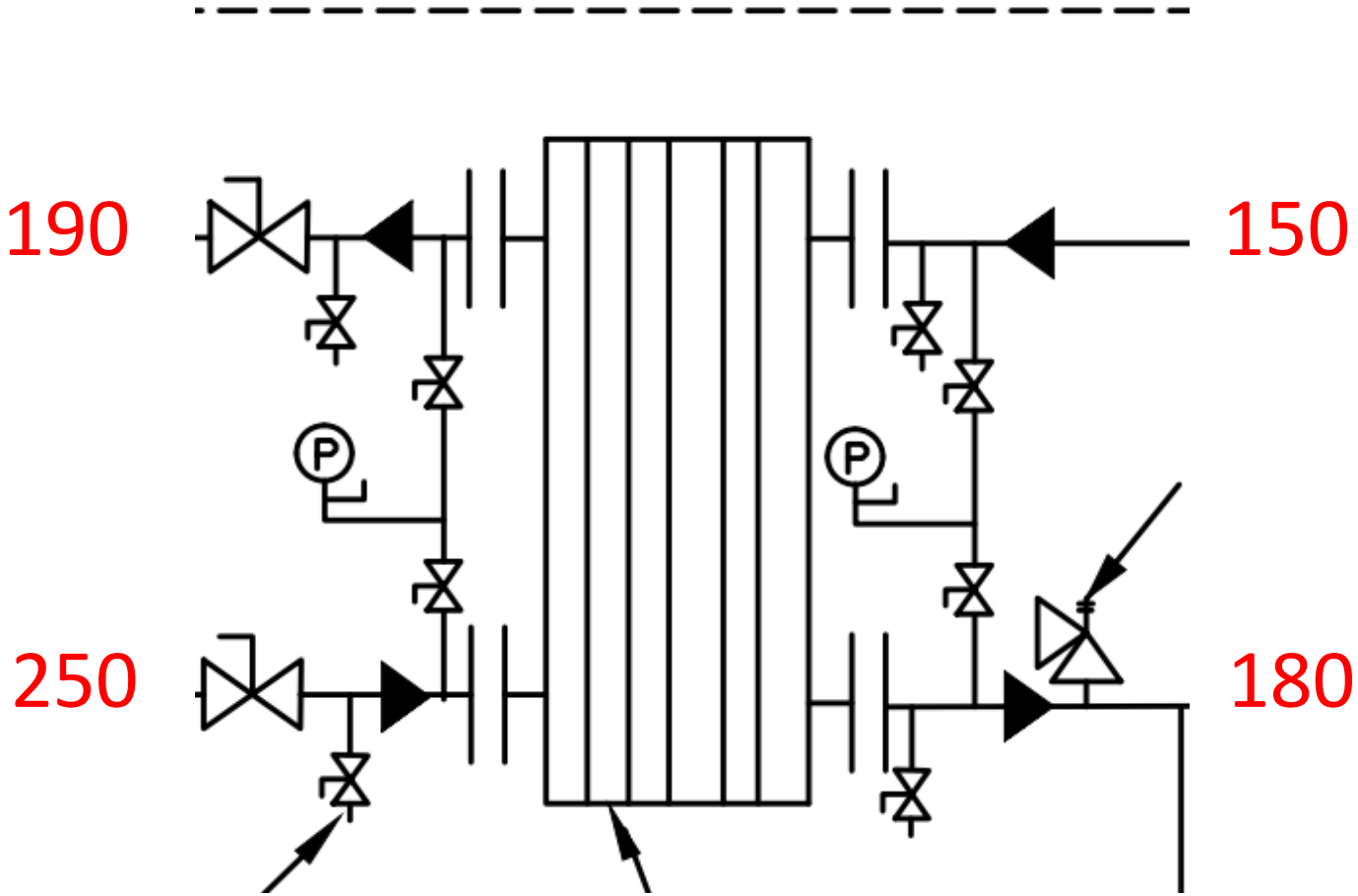


Pressure Mechanical Rating

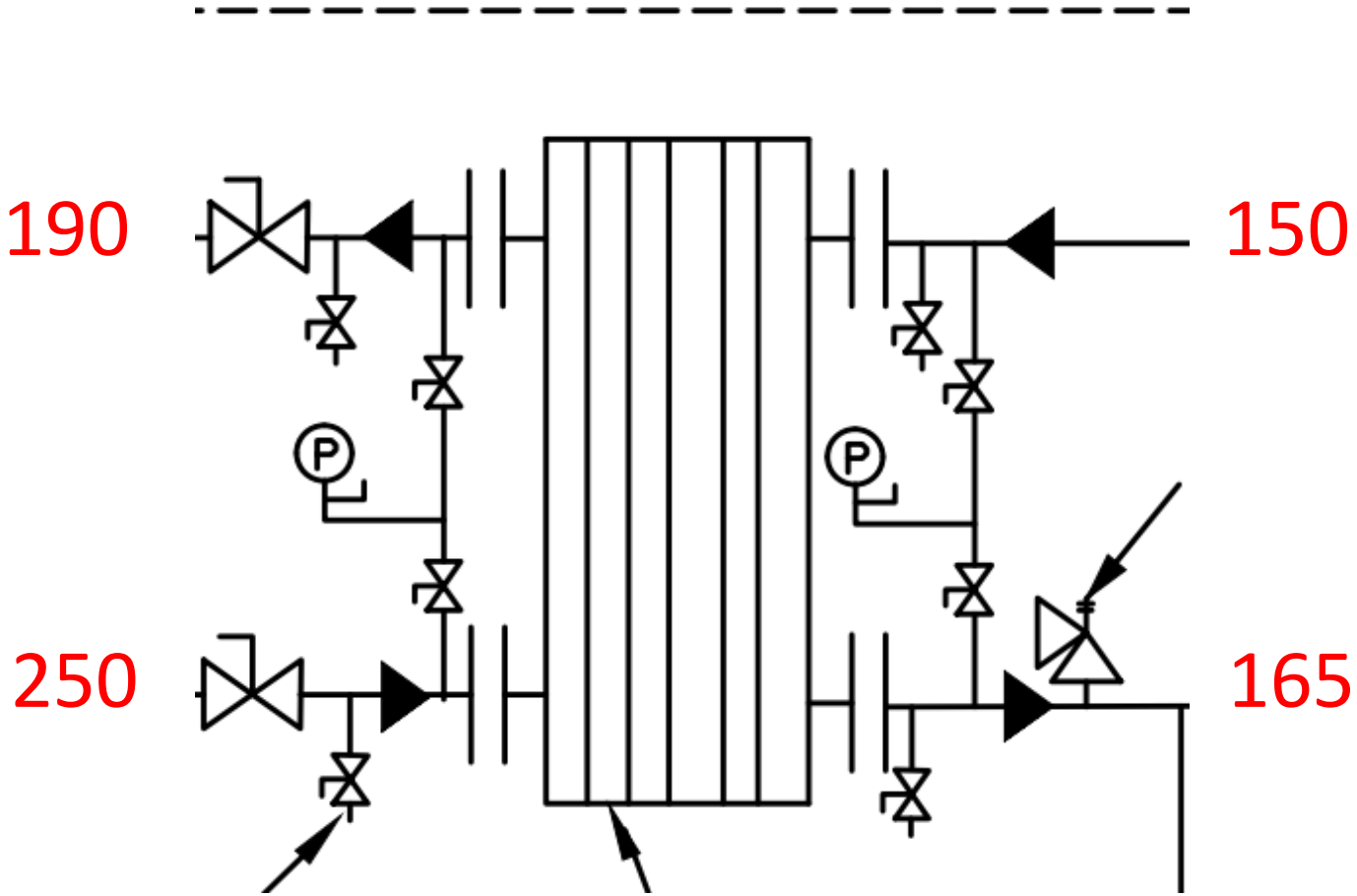
PLATE HEAT EXCHANGER SCHEDULE

TAG	LOCATION	SOURCE SIDE				LOAD SIDE			
		EWT (F)	LWT (F)	GPM	PRESSURE DROP (PSI)	EWT (F)	LWT (F)	GPM	PRESSURE DROP (PSI)
HX-1	BUILDING HEAT EXCHANGER BASEMENT	250	157	20.9	1.74	147	180	57	11.4
HX-2	BUILDING COOLING WATER BASEMENT	42	58	75.2	5.19	60	44	80	7.27
HX-3	BUILDING DOMESTIC	150	80	12.21	4.16	50	120	12	5
HX-4	AHU HOT WATER COIL	177	147	20.9	4.44	140	167	24	6.89

Low Temperature Differential



Low Temperature Differential



Temperature Mechanical Schedule

PLATE HEAT EXCHANGER SCHEDULE

TAG	LOCATION	SOURCE SIDE				LOAD SIDE			
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How often to clean if no signs of trouble?

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  - District side – 1x/5yrs
- DHW Hx
  - House side – 1x/yr
  - District side – 1x/5yrs
- Process Cooling Hx
  - Process side – 1x/yr
  - District side – 1x/yr

Installation SNAFUs:

- Horizontal Installation
- Piped from Bottom of Header
- Thermal shock
- Oversized (+2x needed capacity)
- Parallel flow
- No P/T gauges
- No CIP ports

http://www.corrview.com/images/phocagallery/109-Improper_Dielectric_Fittings/thumbs/phoca_thumb_l_109_001.jpg

Time to Replace

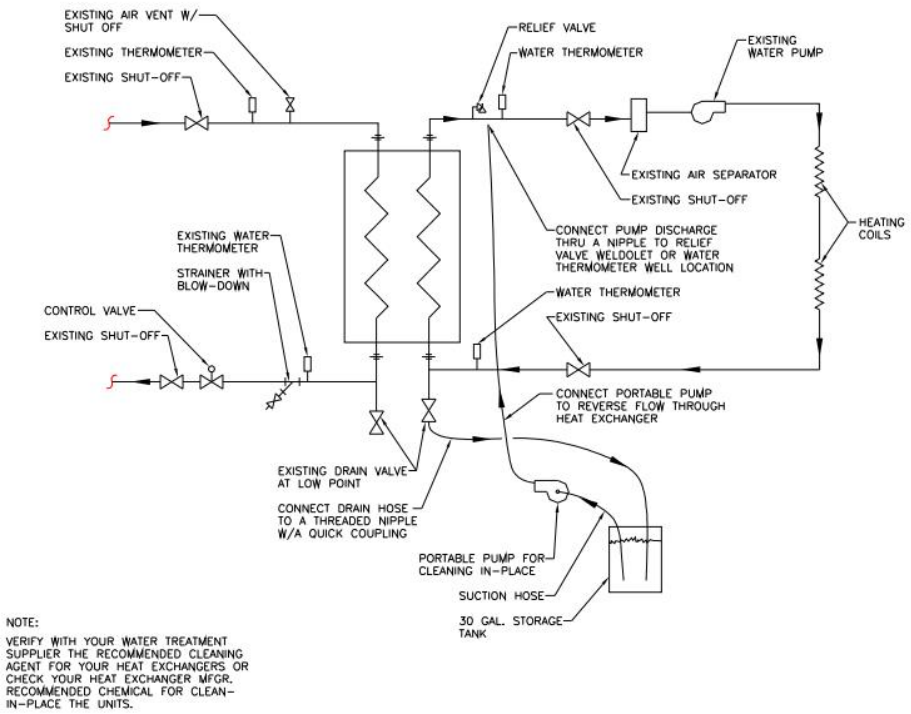
Signs of physical damage or leaks

Time to Clean Vs. Replacement

- Doesn’t meet the criteria of one of the common installation errors
- No signs of Physical Damage or Leaking
- Heat Exchanger Replacement is > 3 X Cost to Clean

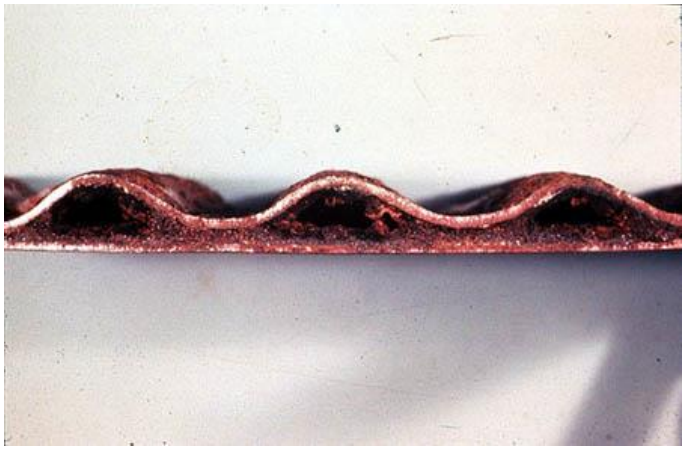
Cleaning: The Process

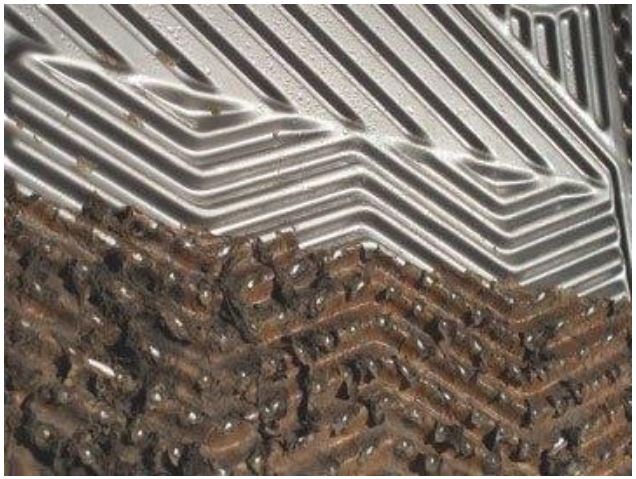
- Test loop water sample to identify the foulant
- Mix chemicals to appropriate concentrations – excessive pH in either direction can adversely accelerate corrosion rates
- Connect pump in reverse of typical flow
- Note:
  - Do not exceed 100F
  - Target flow rate: 2 – 9 ft/sec
- Flush hx with city water until conductivity of rinse water matches city water



Cleaning: Determining the Foulant

- Iron Oxides
- Hardness (Calcium, Magnesium, etc.)
- Biologicals





$$3Fe_2O_3 + H_20 \rightarrow 2Fe_3O_4 + 2OH^-$$

Chemical Flush Time Lapse - 5 Minutes

Chemical Flush Time Lapse - 15 Minutes

Chemical Flush Time Lapse - 30 Minutes

Chemical Flush Time Lapse - 40 Minutes

Questions?

Thank you!