



Chilled Water Plants; Basic Principles, Ongoing Commissioning/Operation, and Optimization

Coils and Heat Exchangers



Presented By:

David Sellers

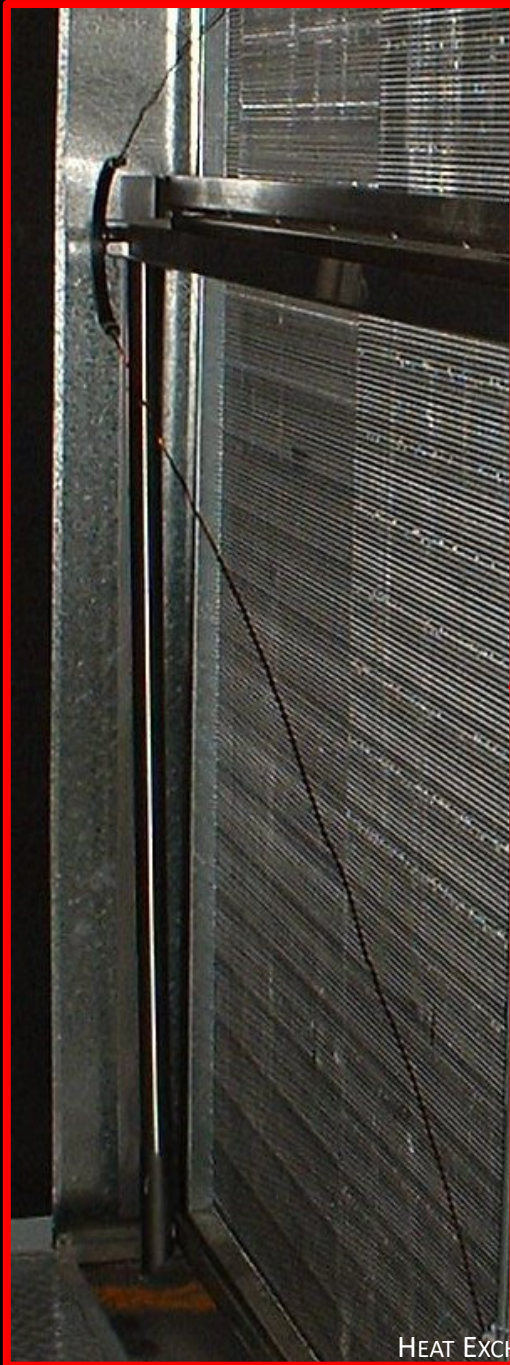
Senior Engineer, Facility Dynamics Engineering

Coils

- Typically applied at:
- 500 fpm face velocity or less
- 1 fps tube velocity or more



What's
this?

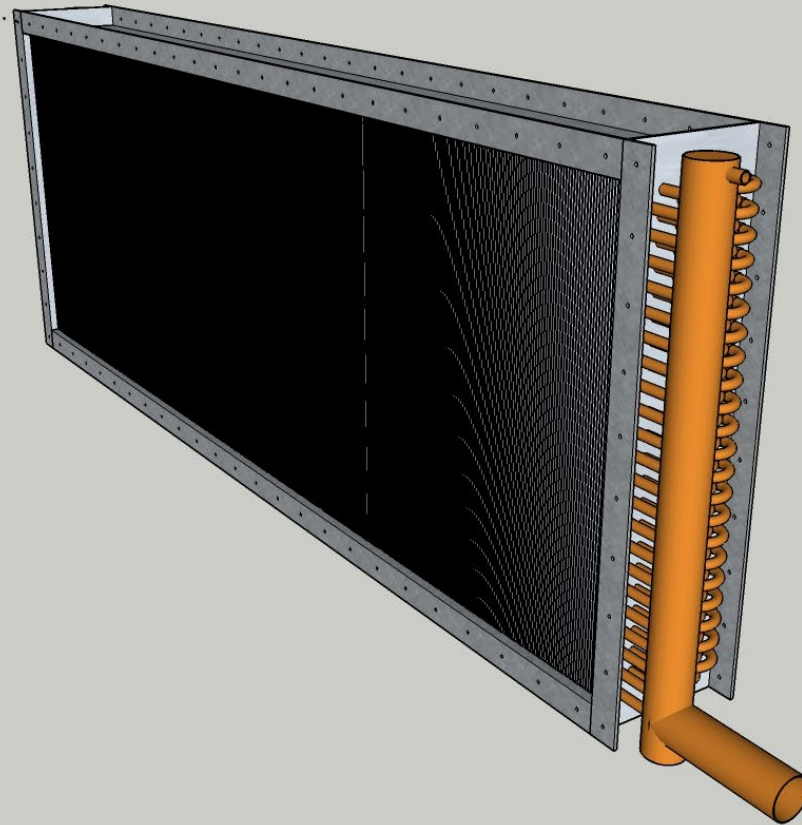


HEAT EXCHANGERS



Heat Transfer:

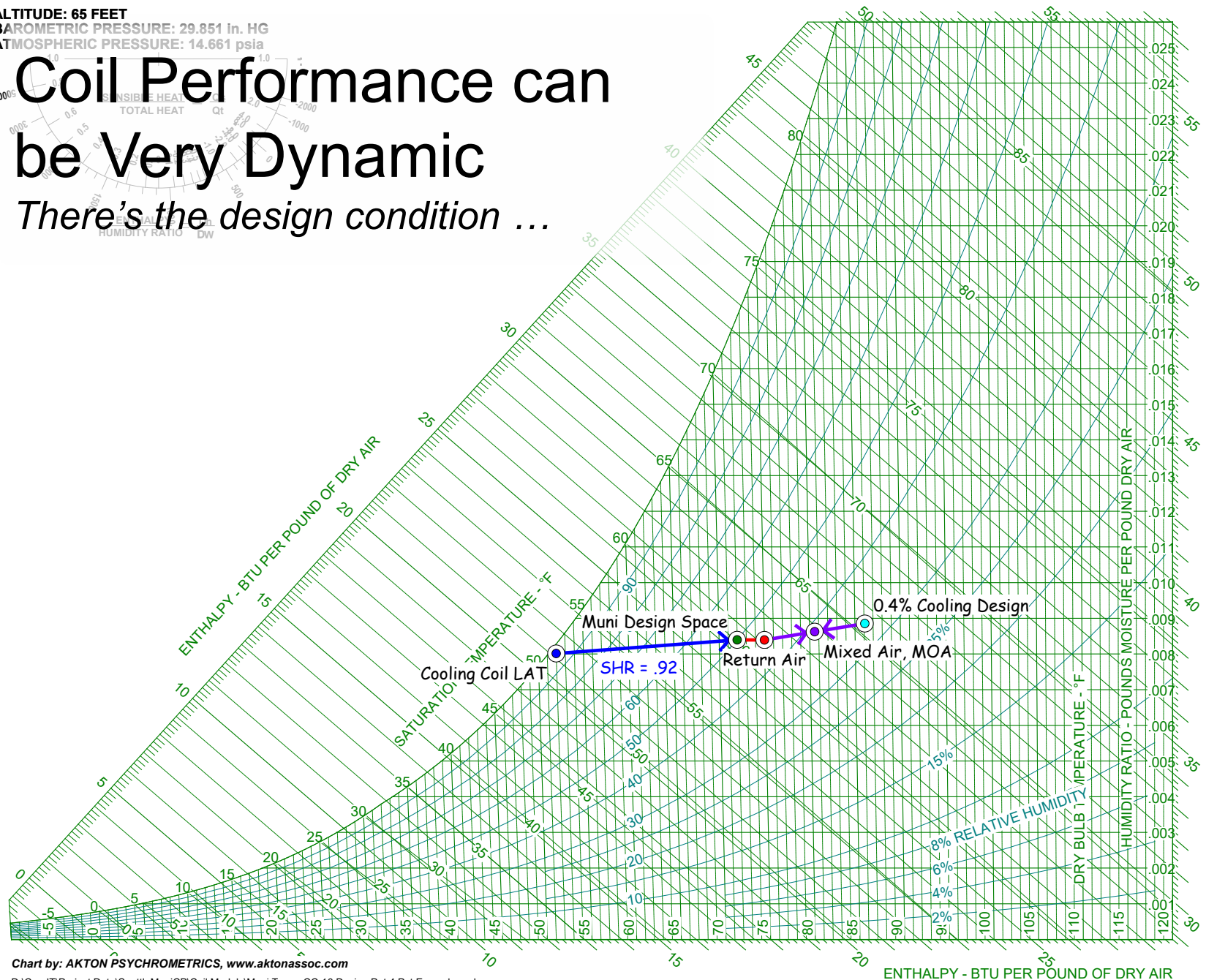
A Common HVAC System Goal



ALTITUDE: 65 FEET
BAROMETRIC PRESSURE: 29.851 in. HG
ATMOSPHERIC PRESSURE: 14.661 psia

Coil Performance can be Very Dynamic

There's the design condition ...



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Coil Performance can be Very Dynamic

... and Then There is Everything Else

Weather Data Location:
SEATTLE_BOEING_FIELD_ISIS, WASHINGTON, USA

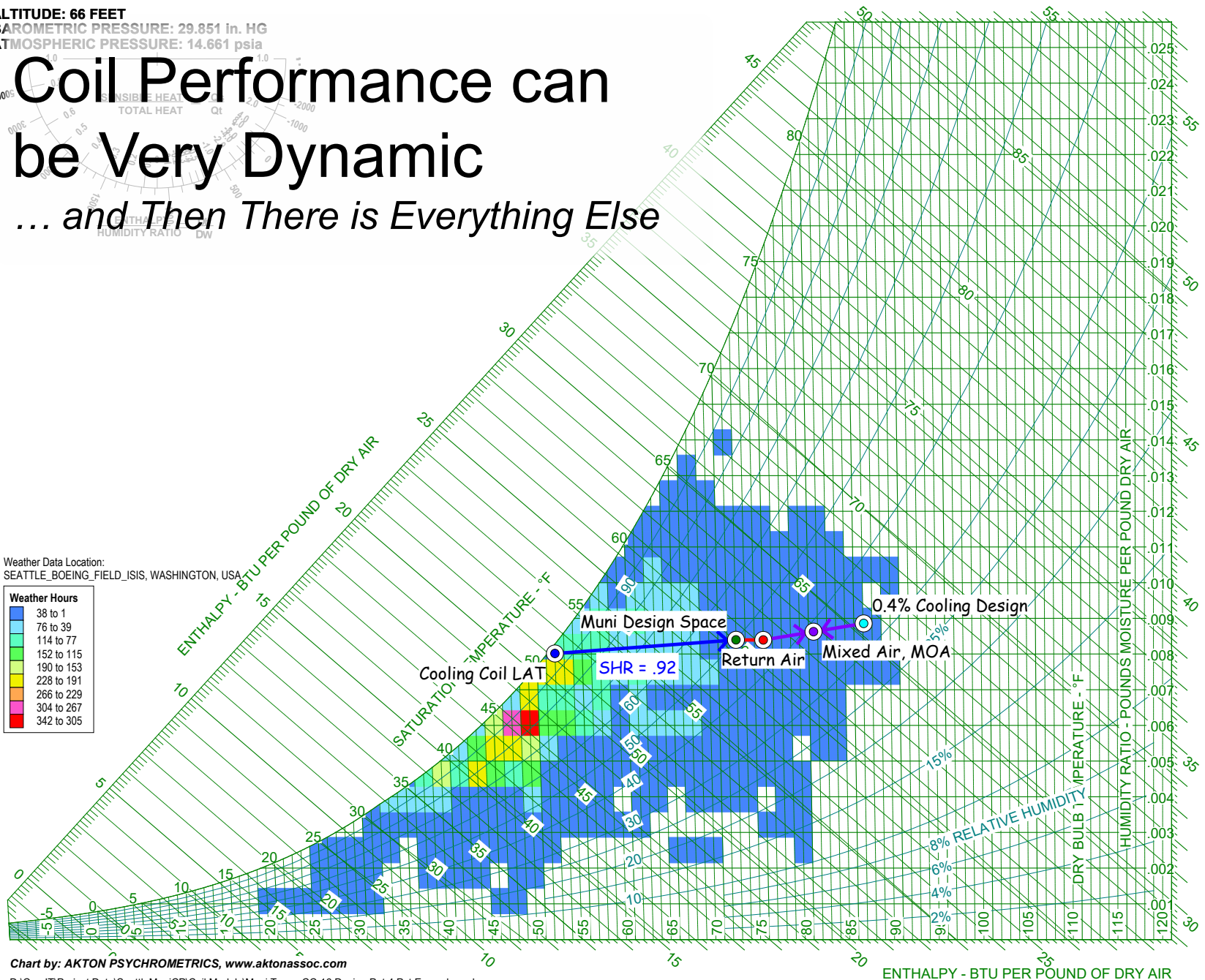
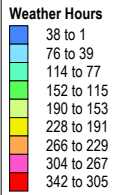


Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com

D:\ComIT\Project Data\SeattleMuniCP\Coil Models\Muni Tower CC-16 Design Pnt 4 Pct Example.aad

A Specific Coil's Performance at a Specific Design Condition

Coil Selection - C-1

Review Selection

Review the details of this selection. If everything is in order, press "Finish" to complete. Otherwise, press "Back" to revise your selection.

Performance	Construction	Notes	Comment	Pricing
Style	Custom	Tube interior	Smooth	
Fin height (in)	30.0	Turbulators	No	
Fin length (in)	70.0	Connection hand	Right	
Rows	6	Supply conn. size (in)	2.000	
Fin spacing (fins/in)	12	Return conn. size (in)	2.000	
Face area (ft²)	29.17	Number of feeds	15 (Three quarter)	
Fin material	Aluminum	Number of passes	8	
Fin type	Sine-wave	Casing material	16 ga. galv. steel (std)	
Fin thickness (in)	0.006	Coating	None	
Coil type	5/8	Weight (lb)	297	
Tube wall thickness (in)	0.020	Est. Operating Wt. (lb)	400	

Help Go to < Back Finish Cancel

Flow in gpm

Tons

$\Delta t, ^\circ\text{F}, \text{Gpm per Ton}$

Design Condition Performance

Coil Selection - C-1

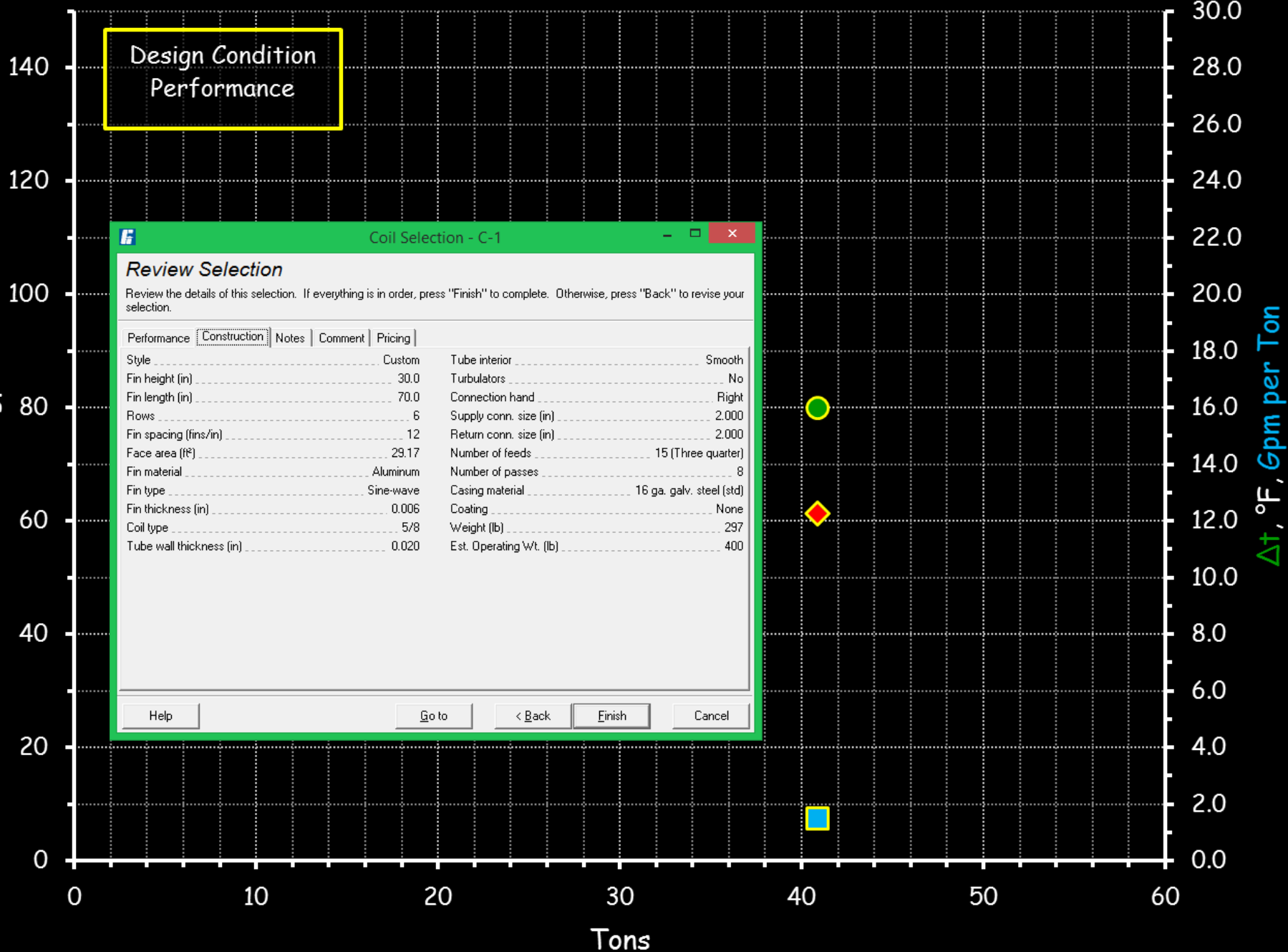
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Help Go to < Back Finish Cancel

Flow in gpm



Design Condition Performance

Coil Selection - C-1

Review Selection

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Performance	Construction	Notes	Comment	Pricing
Application	Chilled water	Fluid	100% Water	
Model	CW58S06T12-30x70-RH	Entering fluid temp. (°F)	44.0	
Air flow (SCFM)	14000	Leaving fluid temp. (°F)	61.1	
Capacity (MBH)	436.6 / 436.6	Fluid delta temp. (°F)	17.1	
Entering air temp. (°F)	80.6 / 63.4	Fluid flow rate (GPM)	51.0	
Leaving air temp. (°F)	52.0 / 52.0	Fluid velocity (ft/s)	1.86	
Face velocity (ft/min)	480	Fluid pressure drop (ft of water)	2.7	
Air pressure drop (in of water)	0.72	Fluid fouling factor (h·ft²·°F/Btu)	0.00000	
Air fouling factor (h·ft²·°F/Btu)	0.00000	Fluid freezing temp. (°F)	32.0	

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Flow in gpm

140
120
100
80
60
40
20
0

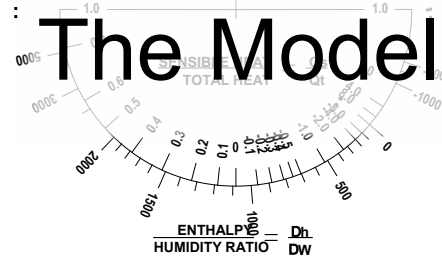
Tons

$\Delta t, ^\circ\text{F}, \text{Gpm per Ton}$

30.0
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0

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The Modeled Conditions



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 SEATTLE_BOEING_FIELD_ISIS, WASHINGTON, USA

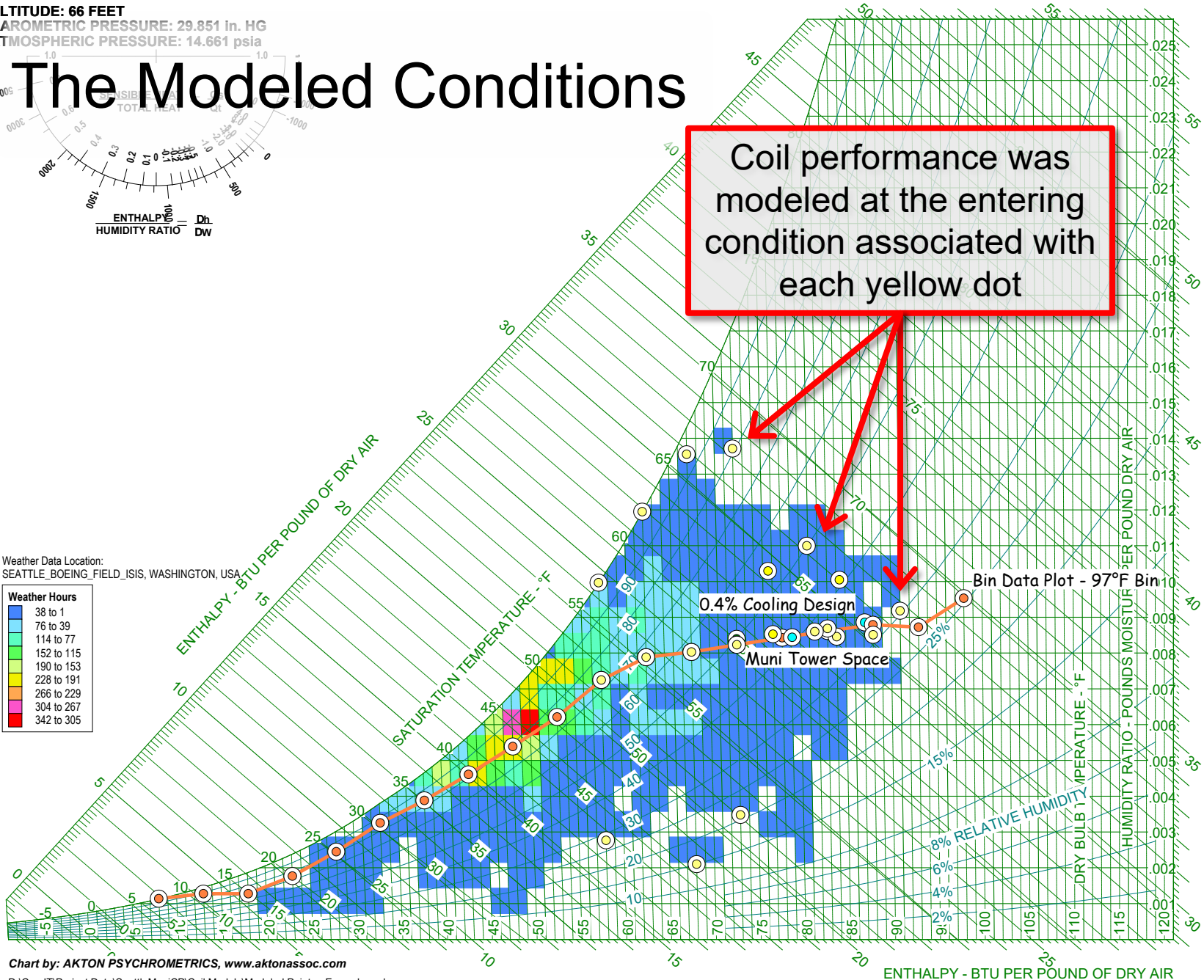
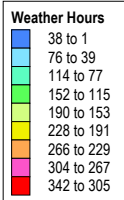
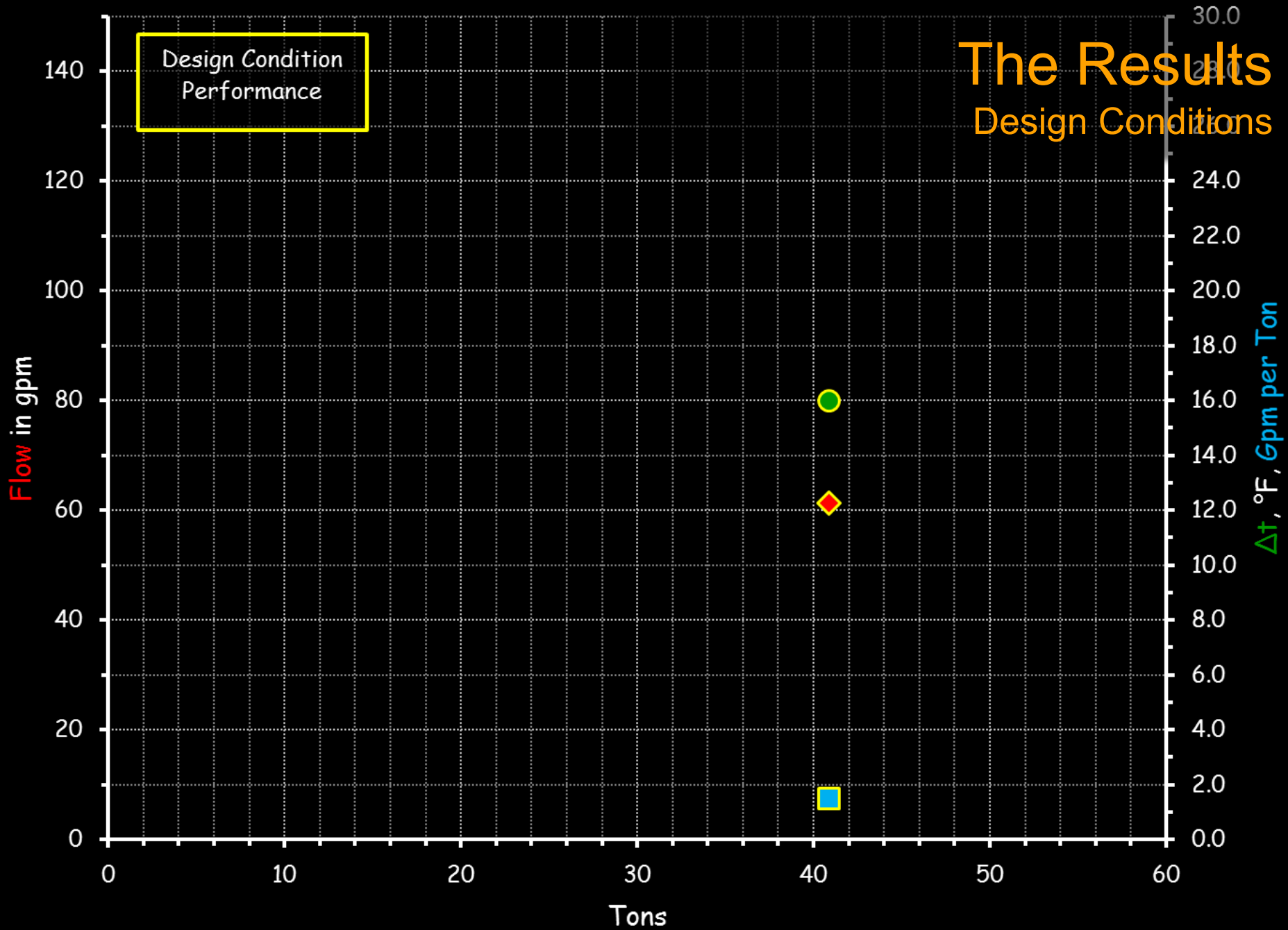
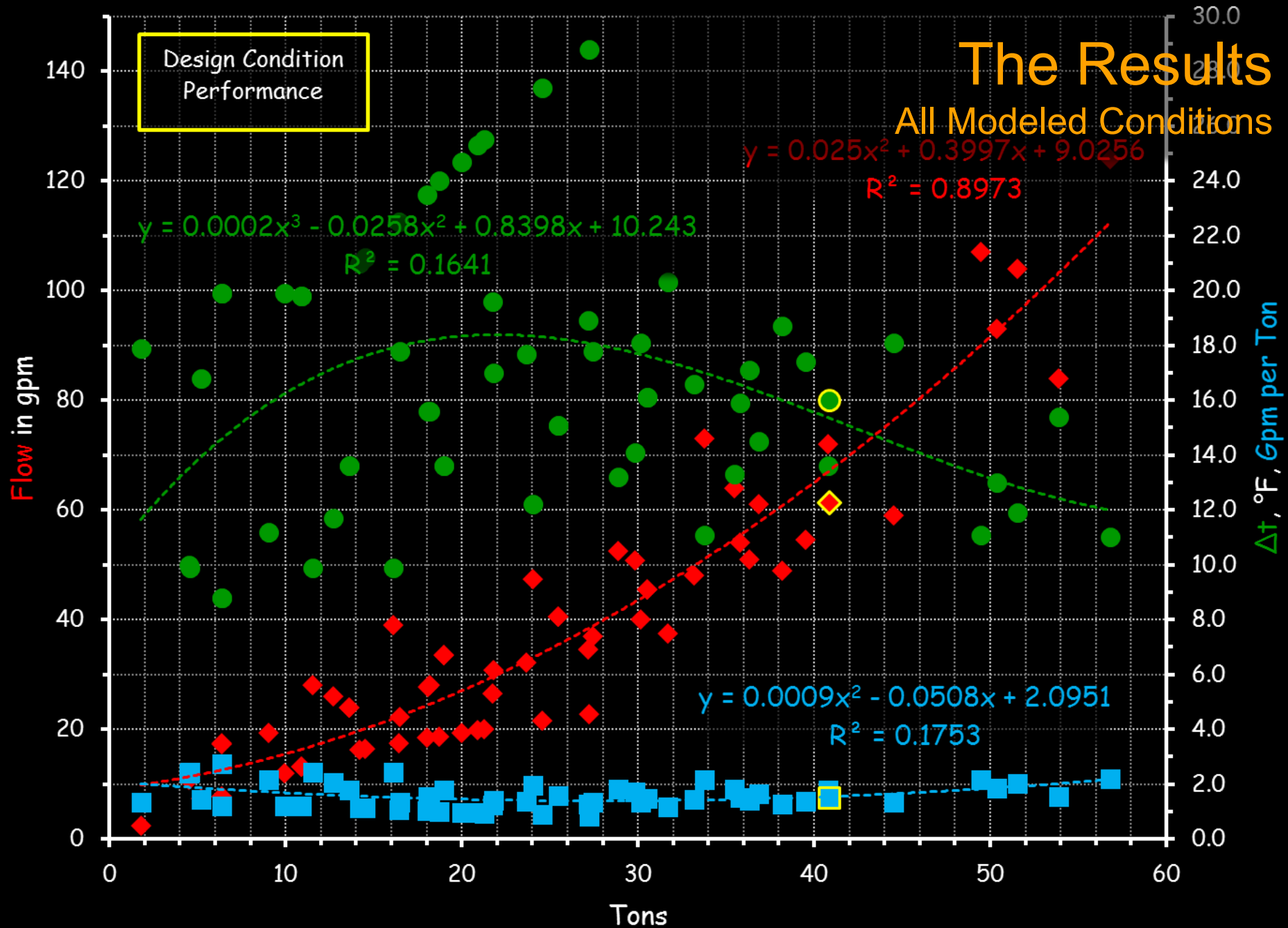
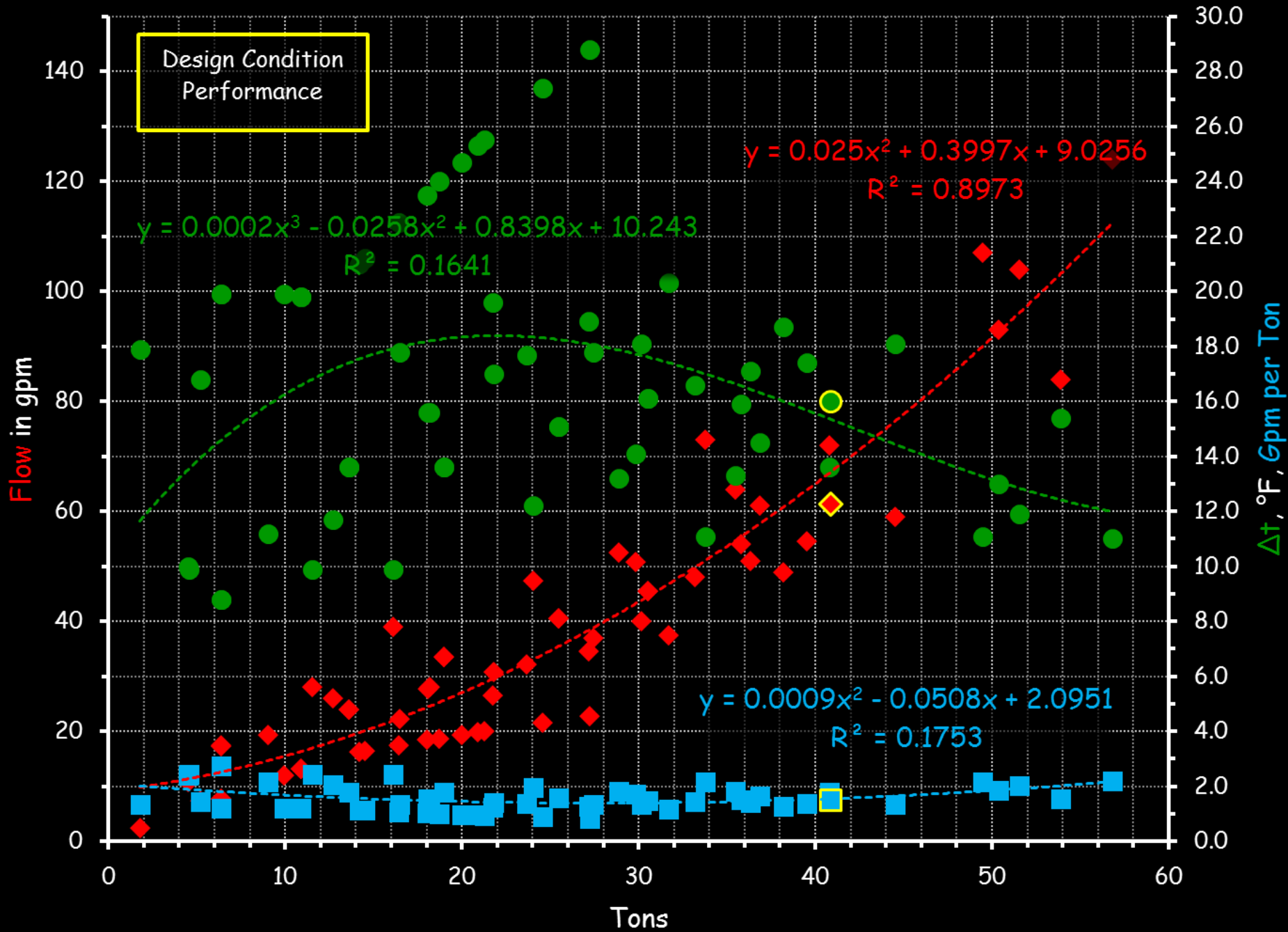


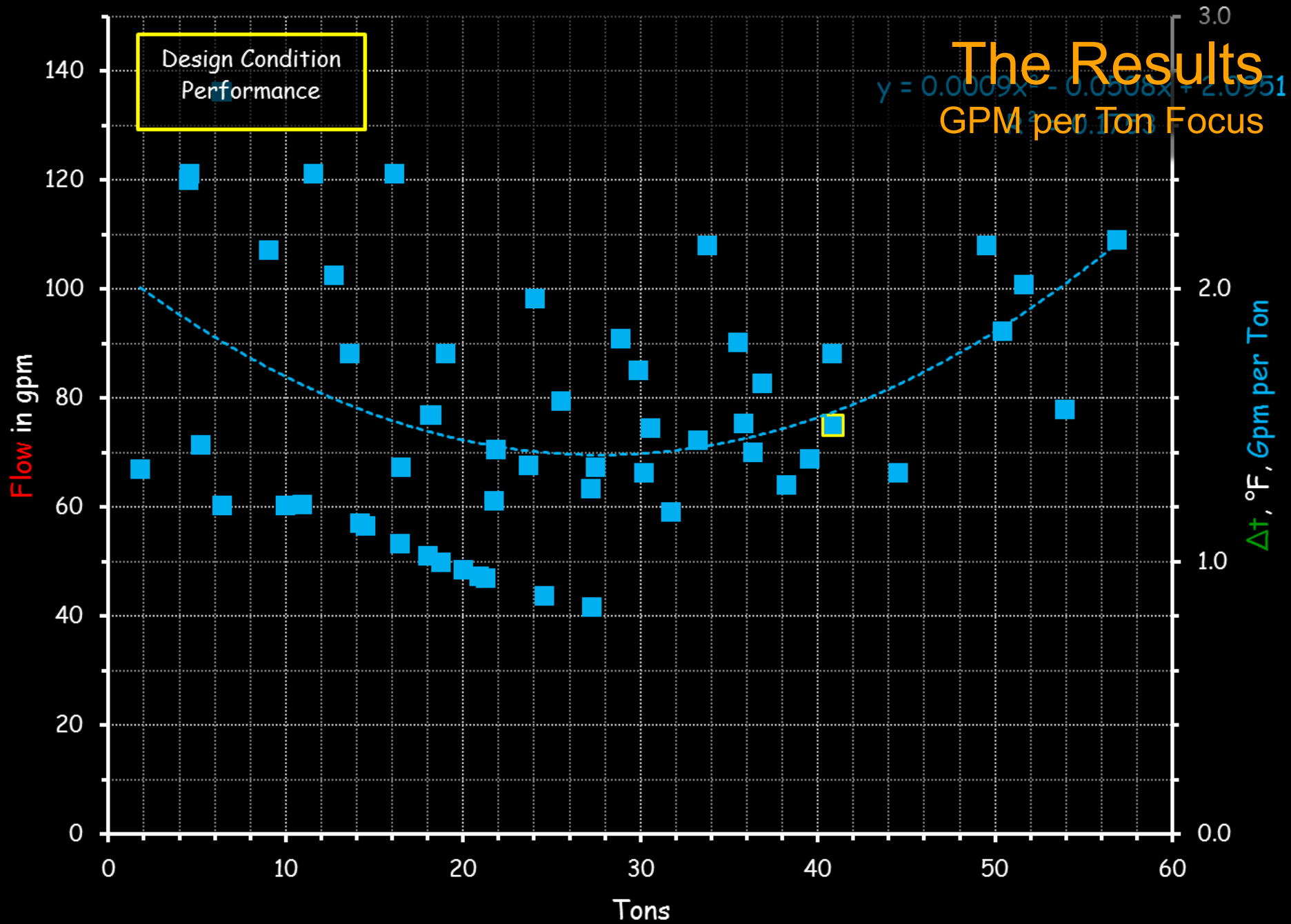
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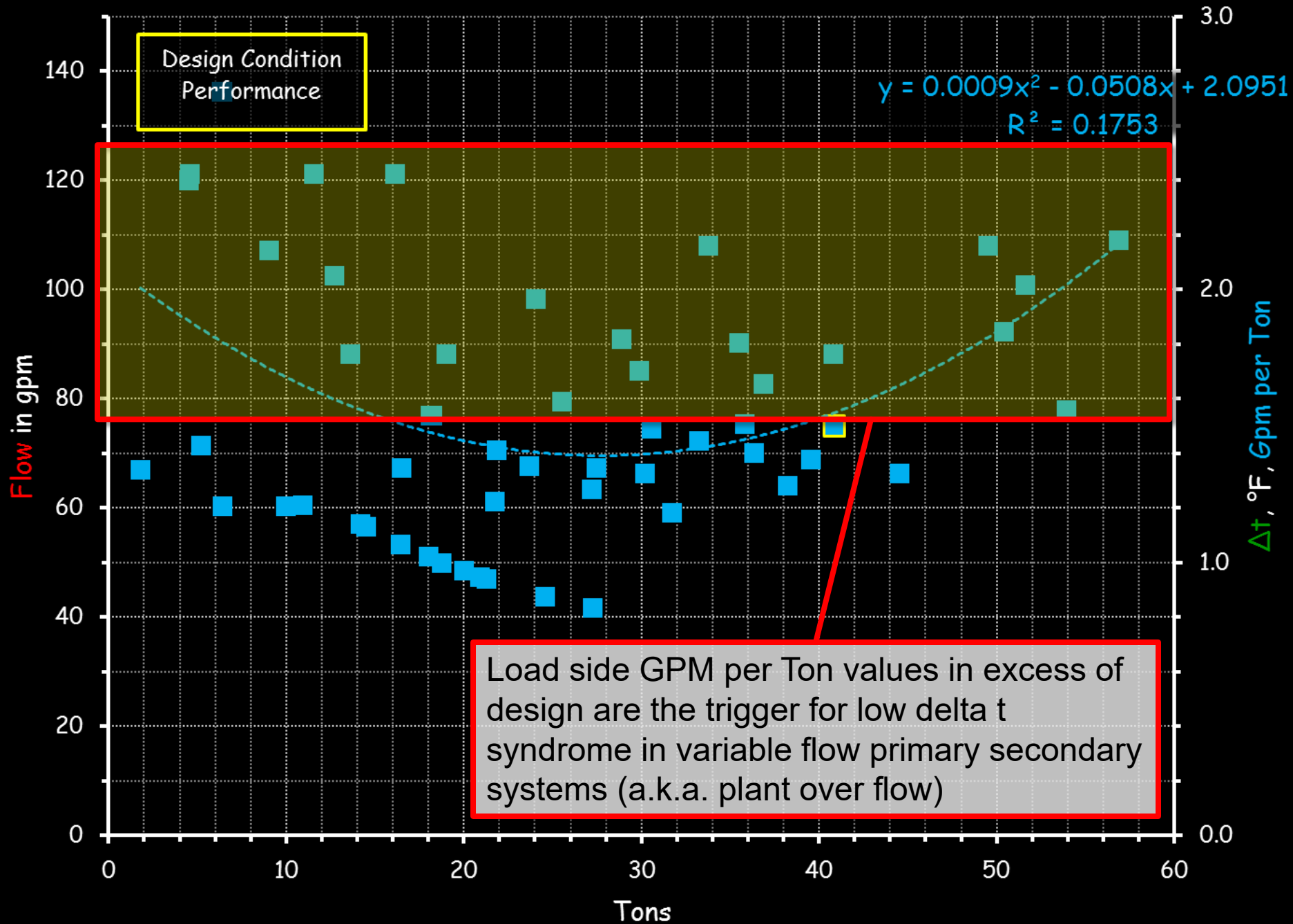
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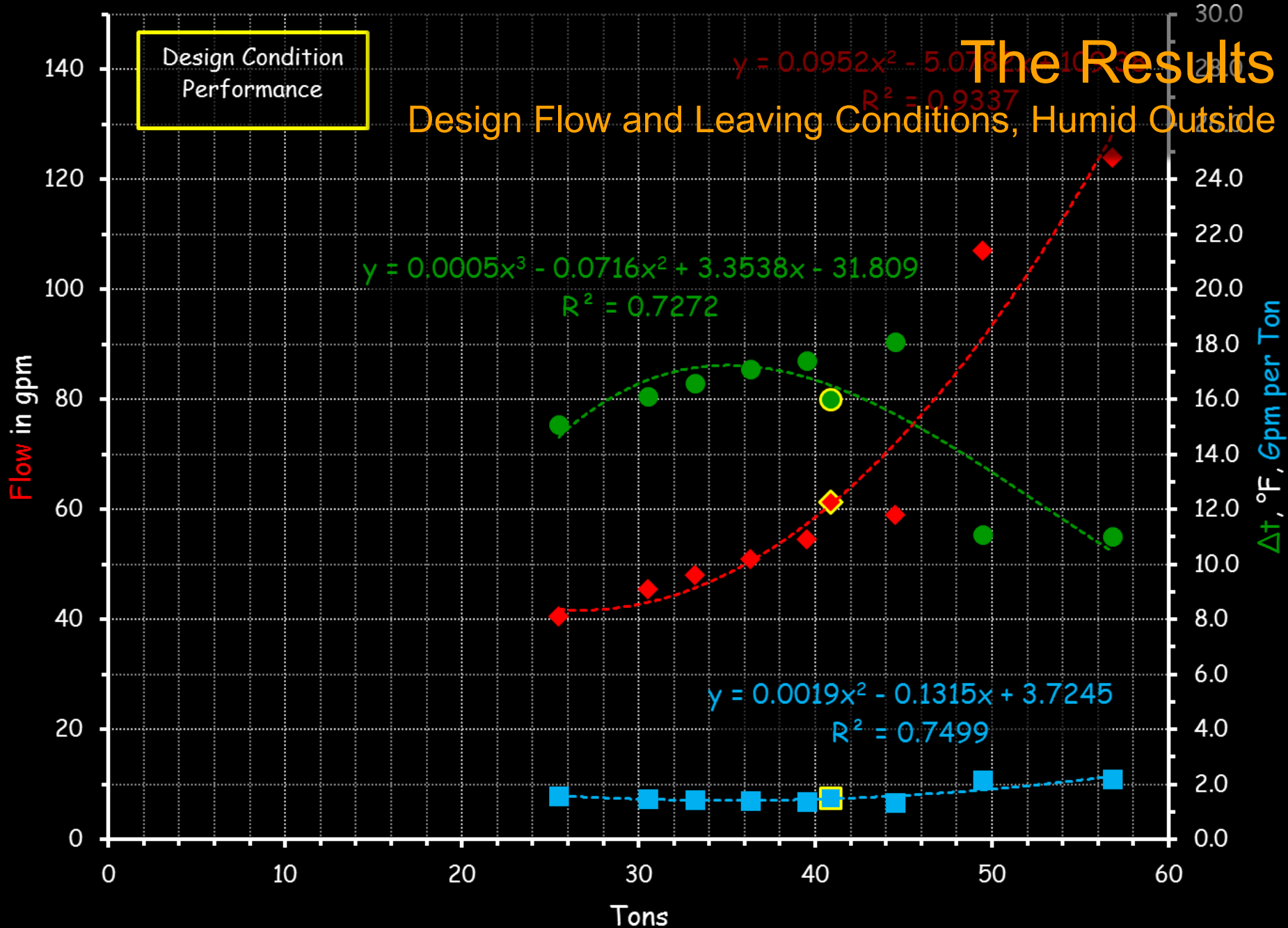




Design Condition
Performance

Design Flow and Leaving Conditions, Humid Outside

The Results



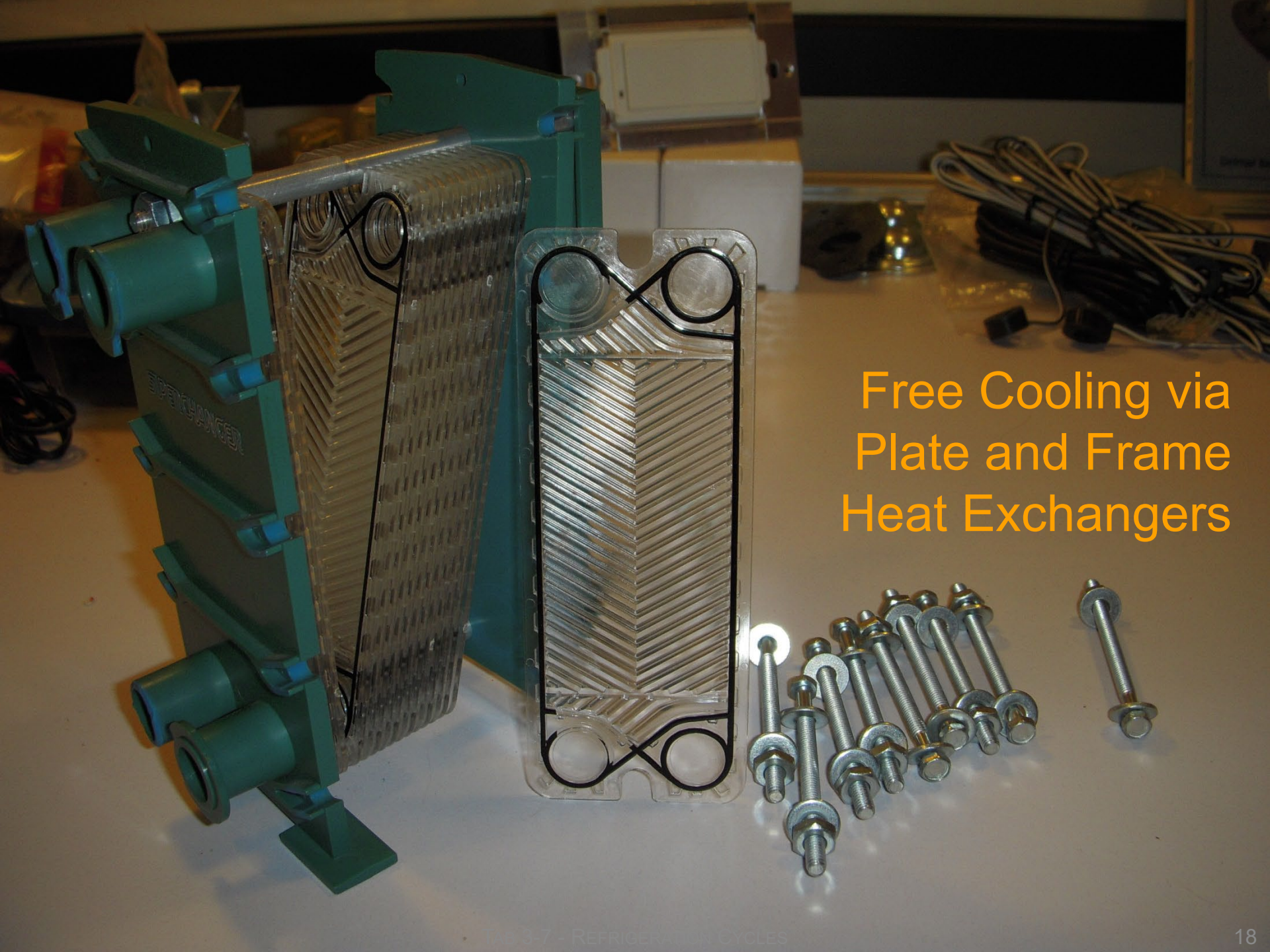
Other Types of Heat Transfer Elements will Exhibit Similar Variability

Characteristics will vary with

- Changes in flow
- Changes in entering conditions
- Transitions from turbulent to laminar flow
- Phase changes on either side of the heat exchanger
 - Condensing water from air
 - Steam condensing to water
- Age
 - Corrosion
 - Fouling

1. The control system will have to deal with all this
 - A loop that was tuned today may not be stable tomorrow
 - Logic that makes good sense under some conditions may not work under others
2. The control system can introduce additional variables
 - Reset strategies
 - Elements with non-linear output or response characteristics

Free Cooling via Plate and Frame Heat Exchangers





Free Cooling via Plate and Frame Heat Exchangers



Free Cooling via Plate and Frame Heat Exchangers

A Really Big Shell and Tube Heat Exchange Can Also Give a Close Approach

