

Facility Dynamics

ENGINEERING

Introduction to the Controlled Systems

Heat Exchangers (Supplemental)

Presented By:

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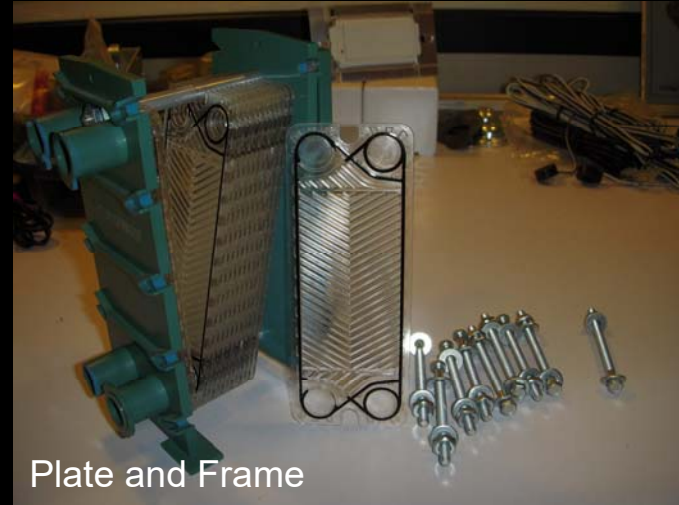
Senior Engineer

NAVFAC, San Diego

What We Will Cover in This Module

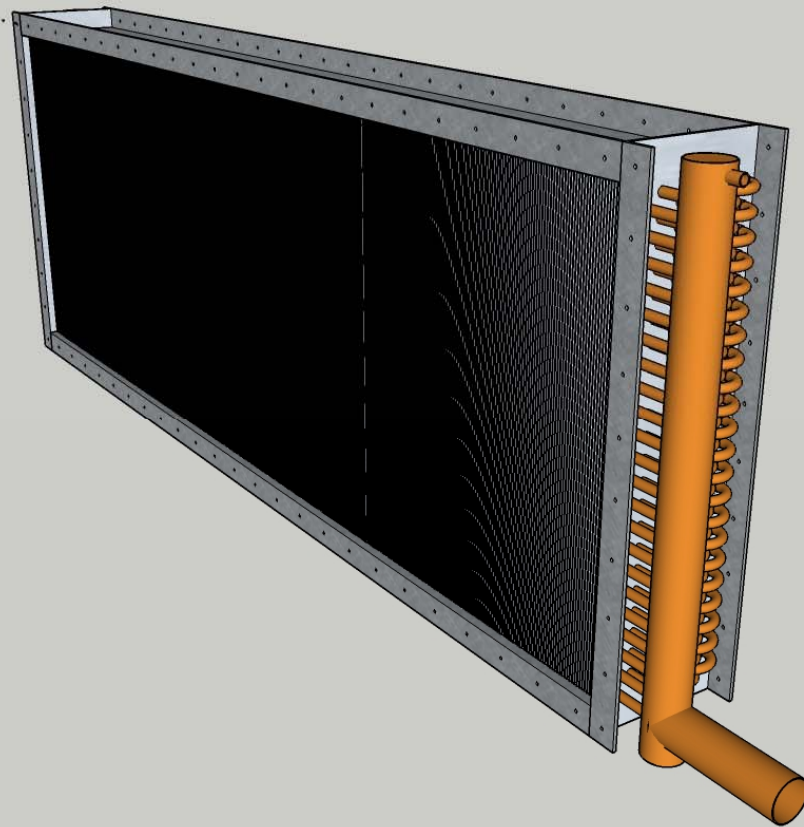
- Basic Heat Exchanger Construction
- How heat exchangers interact with our systems and the climate

Common 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 ...

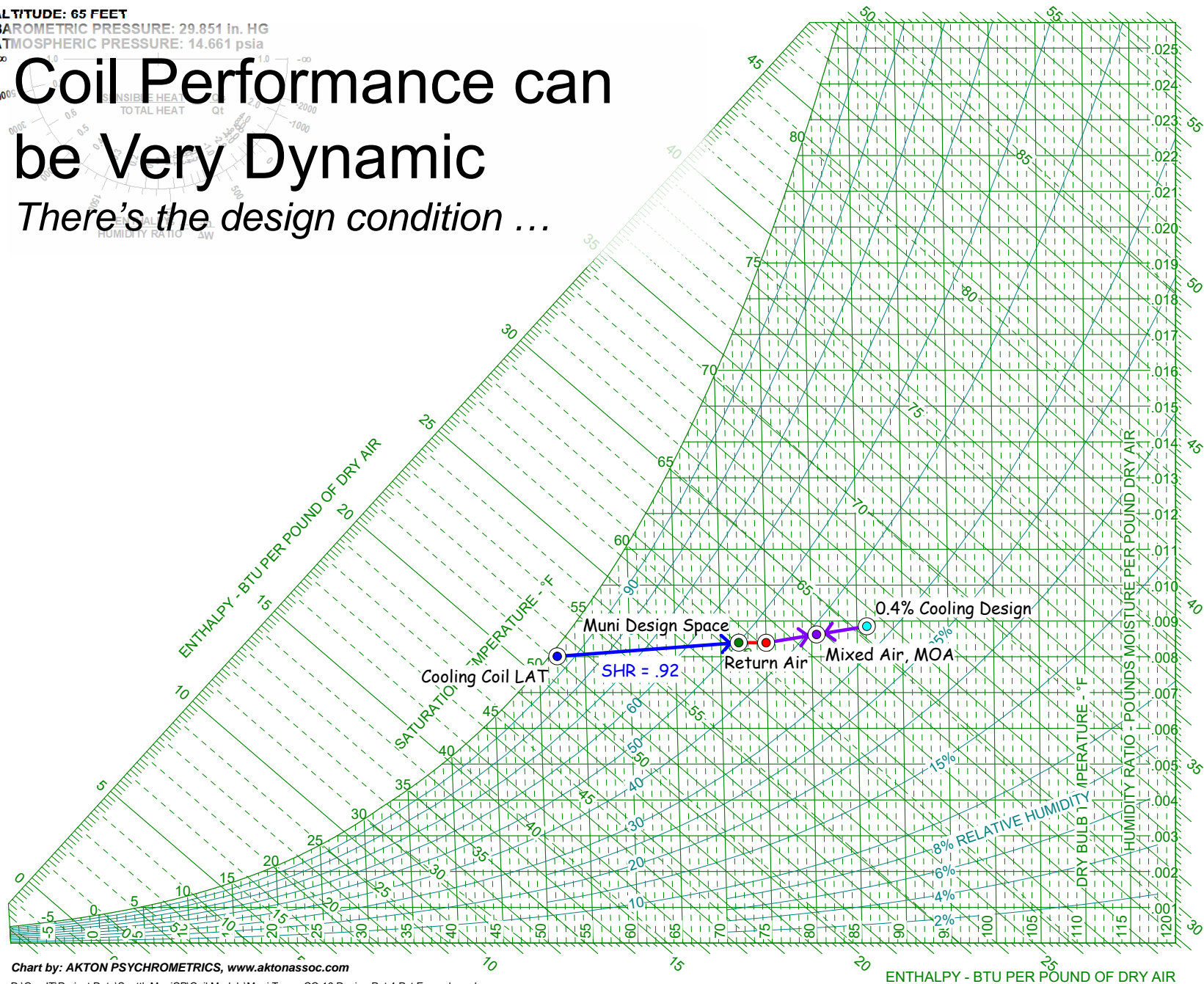


Chart by: AKTON PSYCHROMETRICS, www.aktonassoc.com

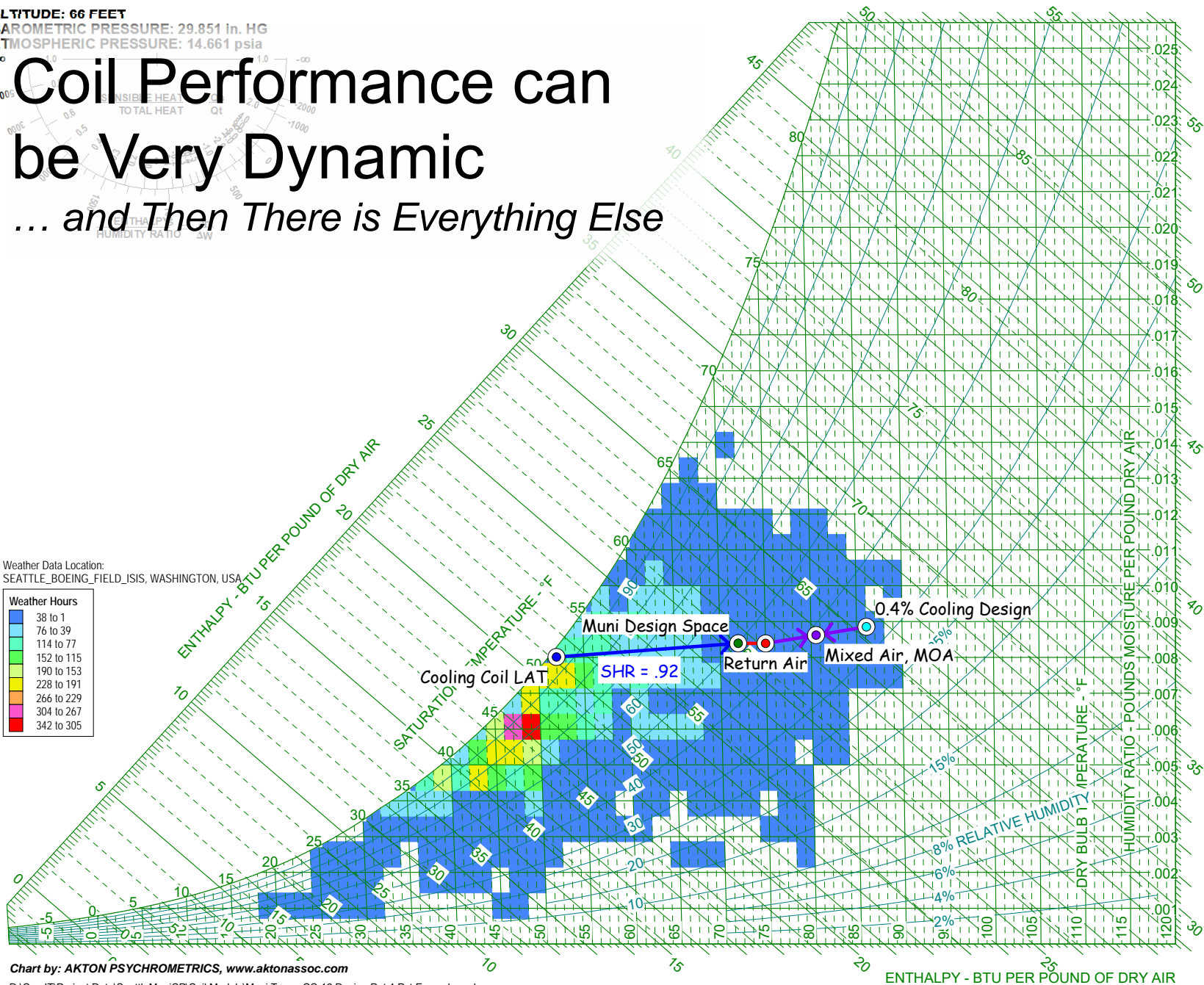
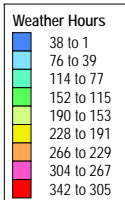
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TAB 3-5 - HEAT EXCHANGERS

ALTITUDE: 66 FEET
BAROMETRIC PRESSURE: 29.851 in. HG
ATMOSPHERIC PRESSURE: 14.661 psia

Coil Performance can be Very Dynamic ... and Then There is Everything Else

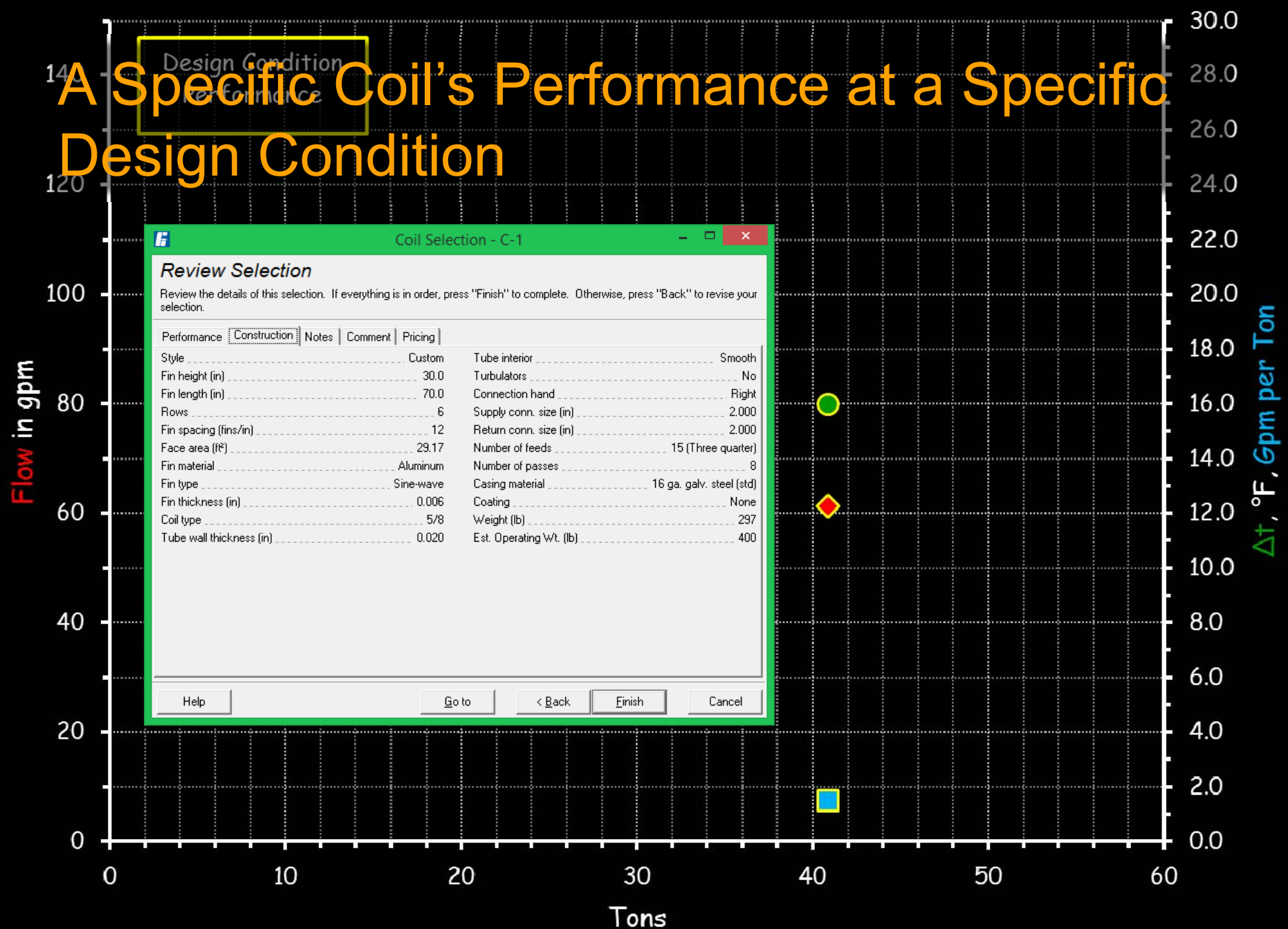
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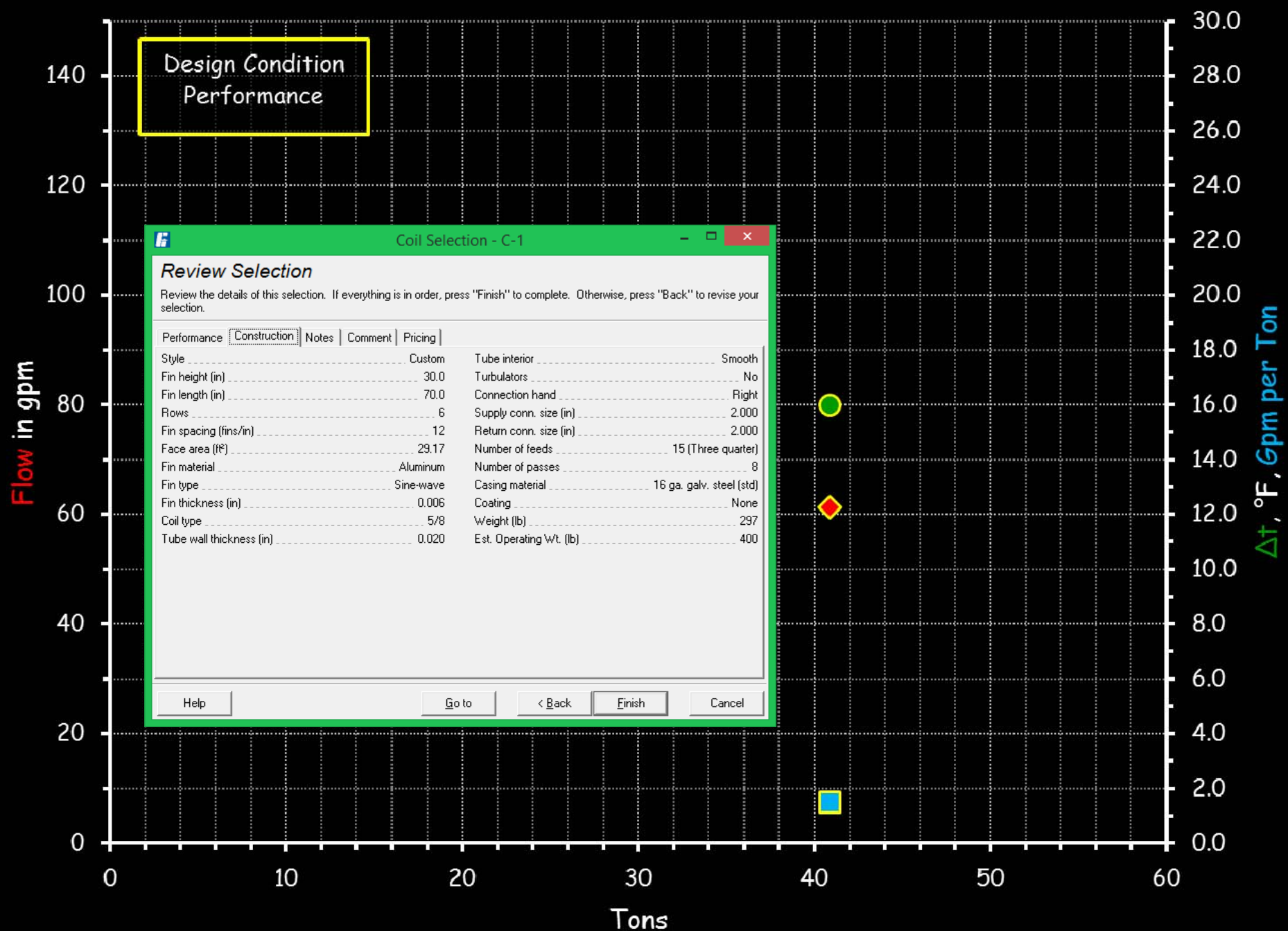


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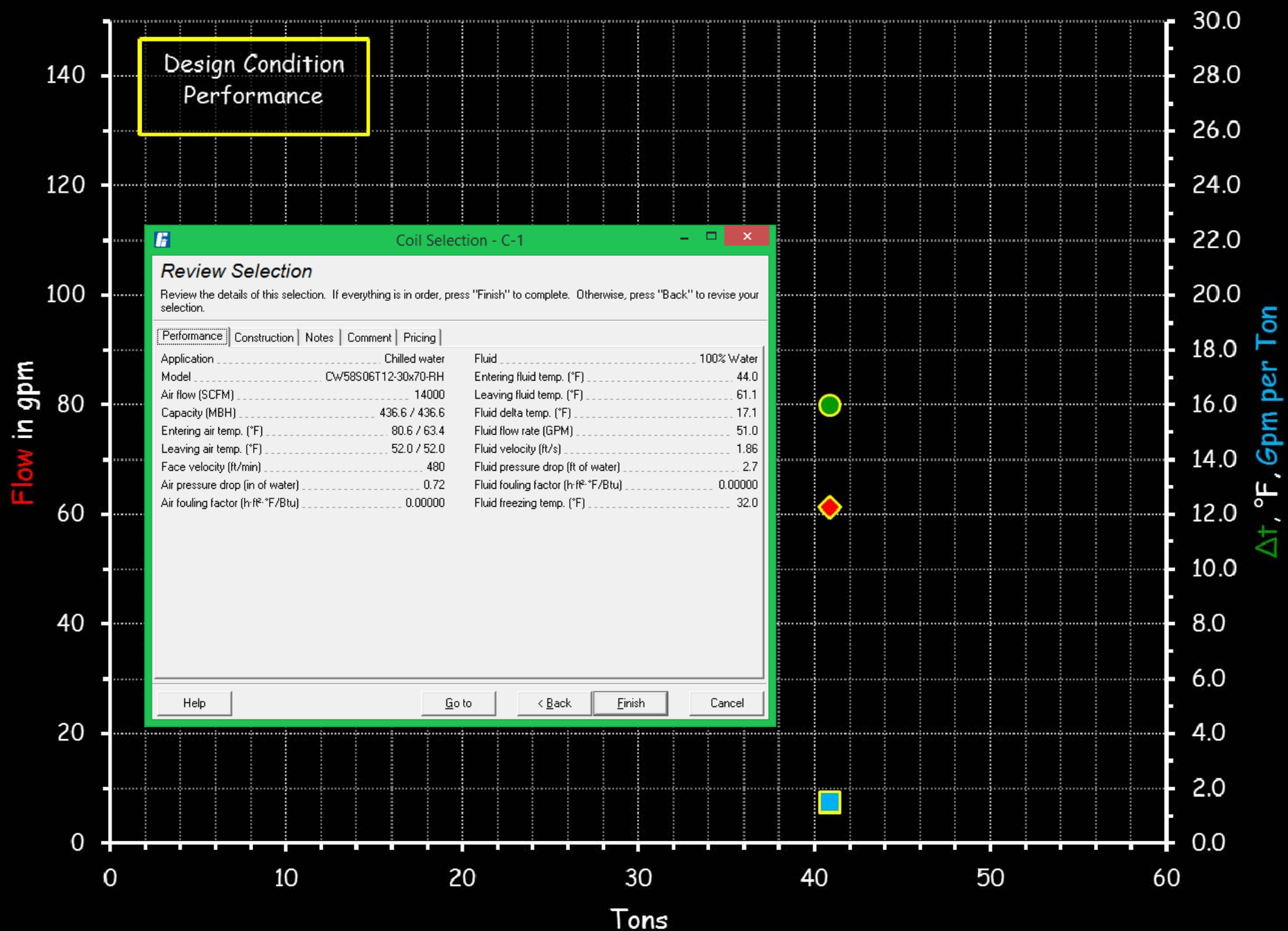
TAB 3-5 - HEAT EXCHANGERS

A Specific Coil's Performance at a Specific Design Condition





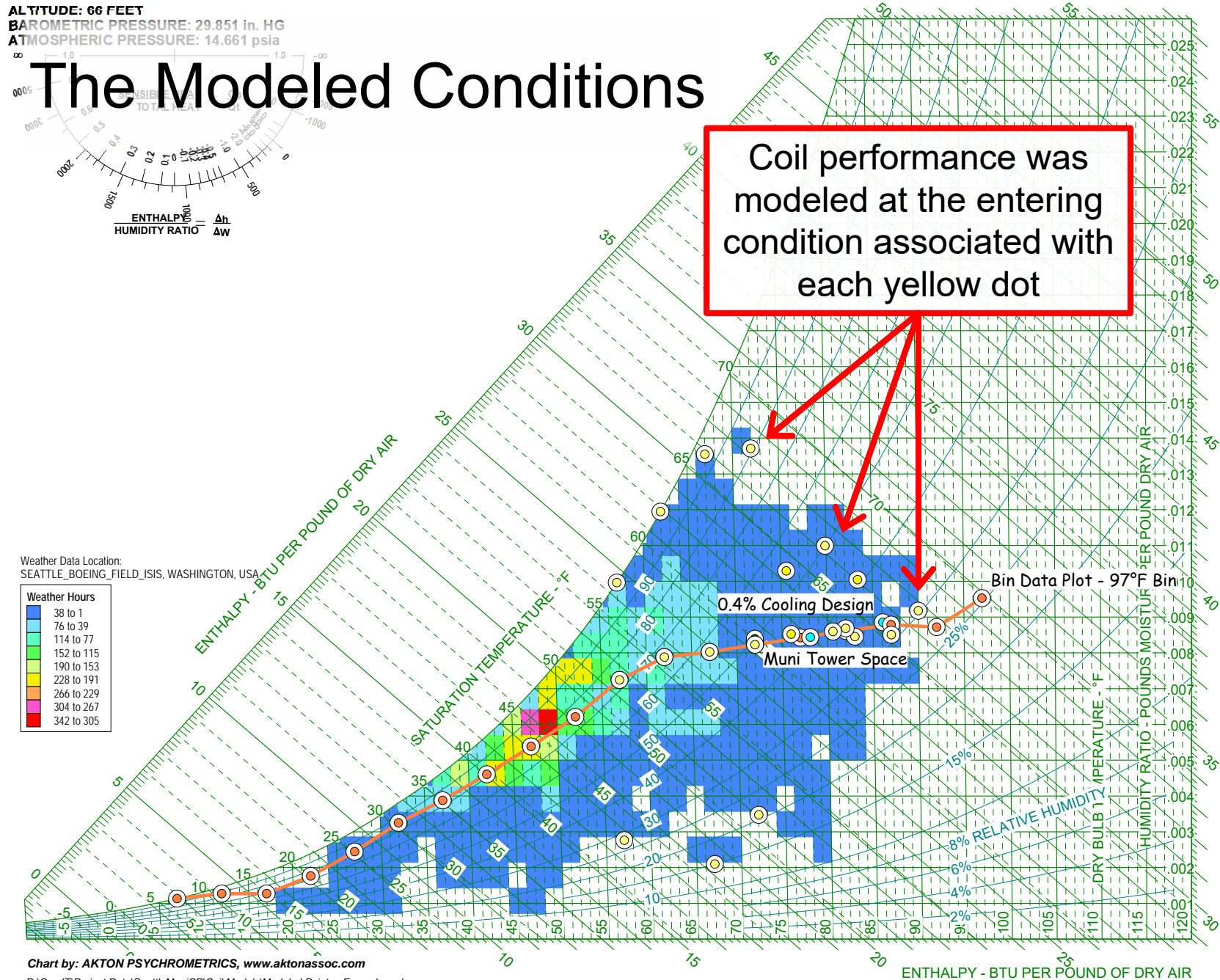
TAB 3-5 - HEAT EXCHANGERS



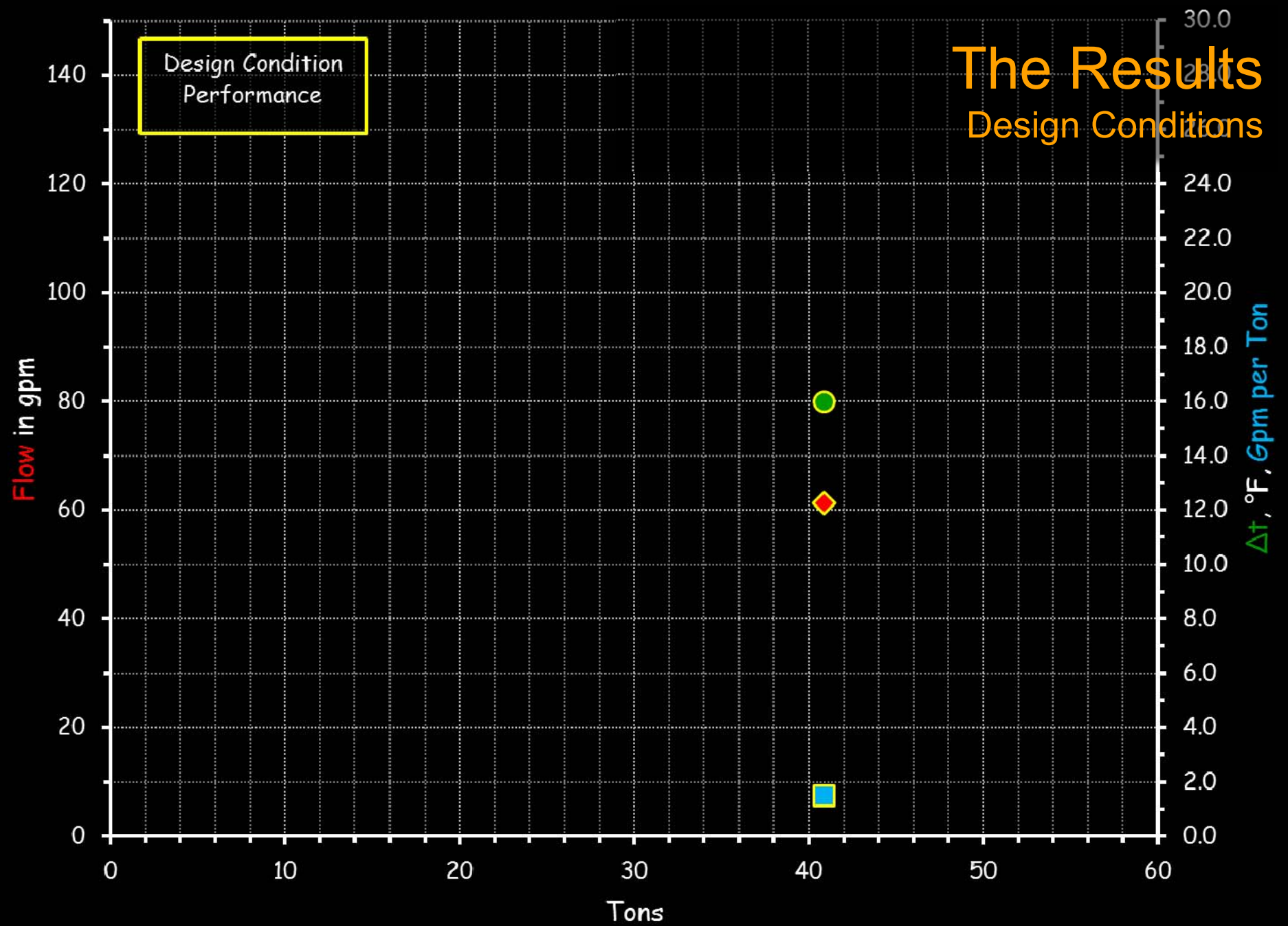
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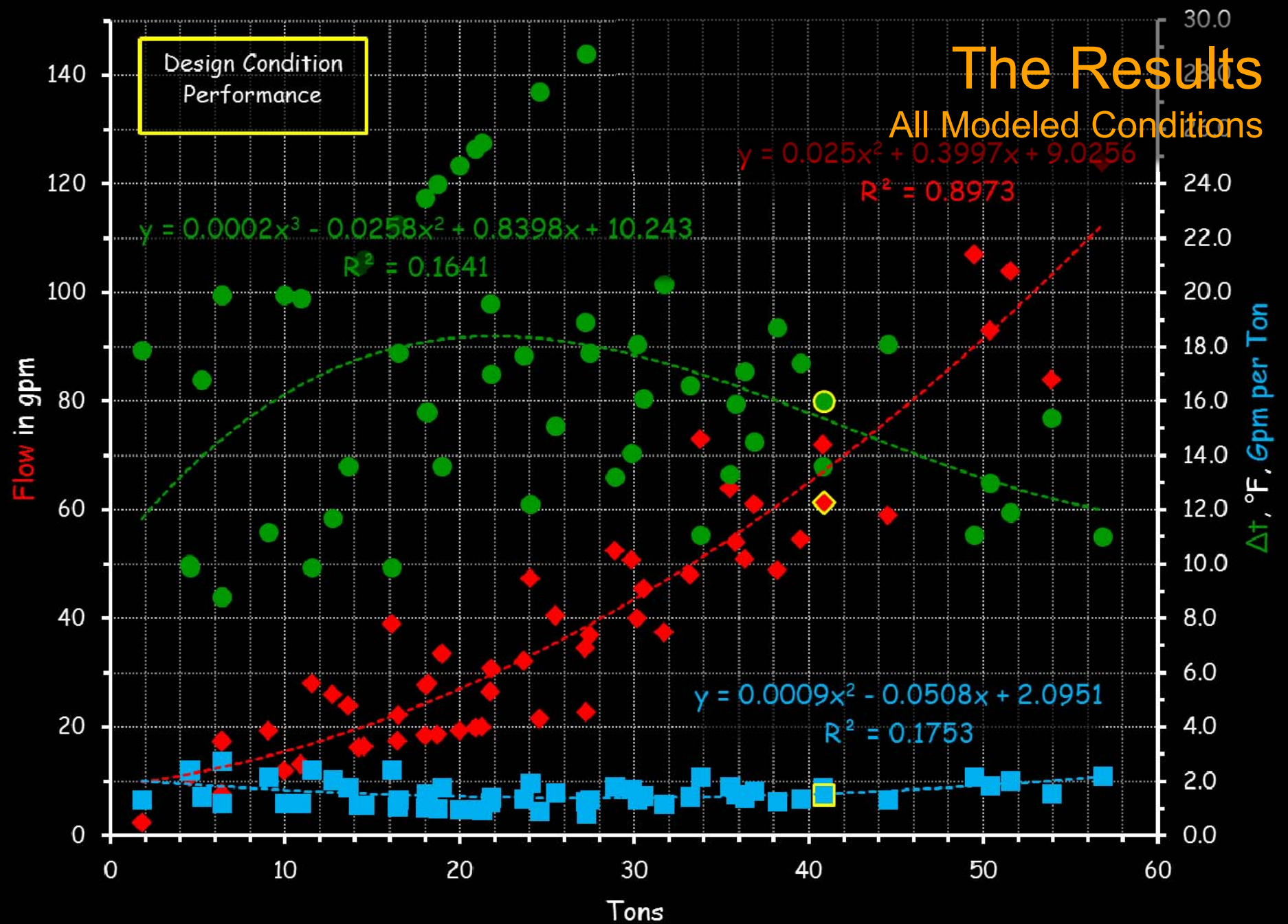
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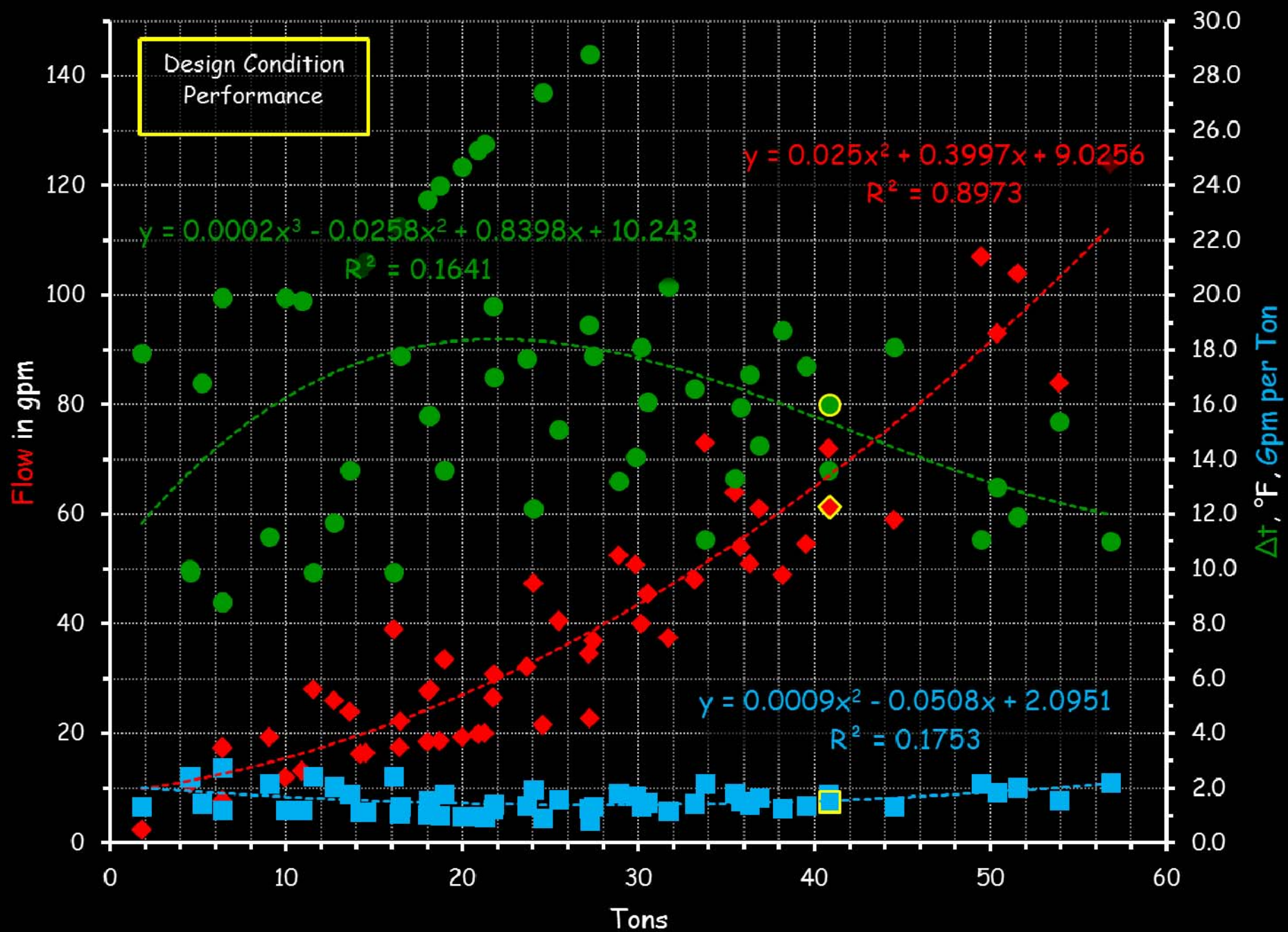
The Modeled Conditions



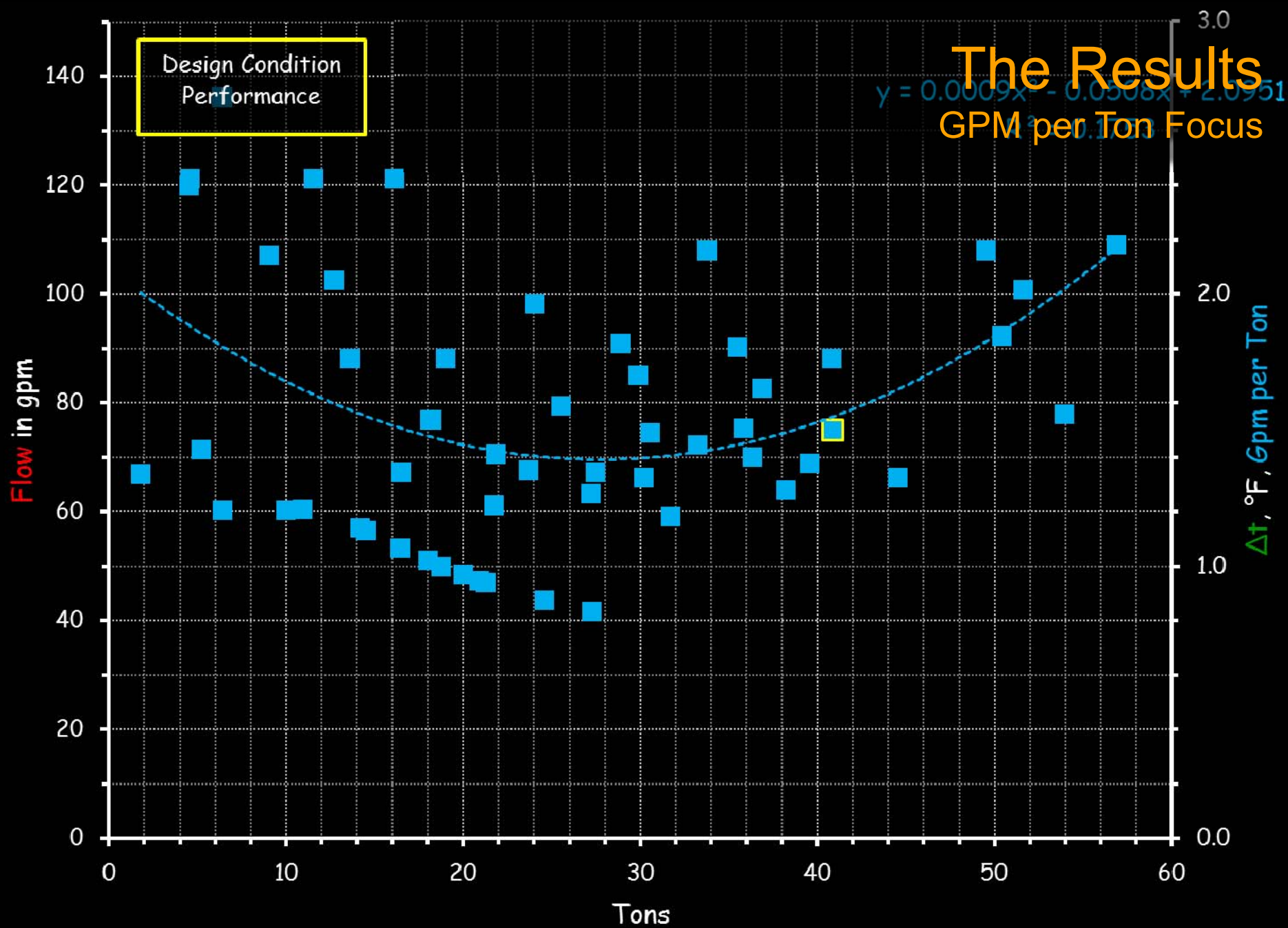
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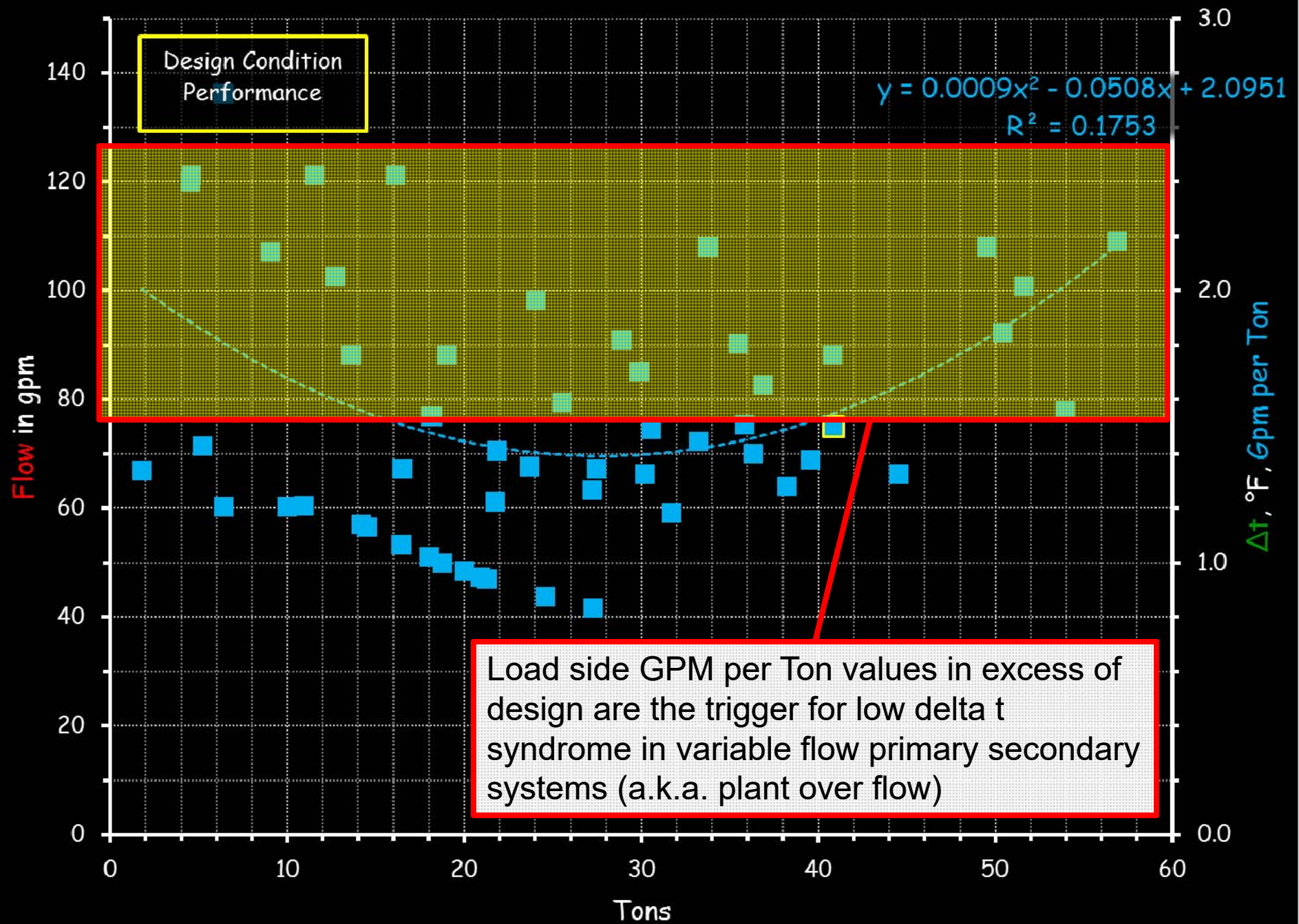


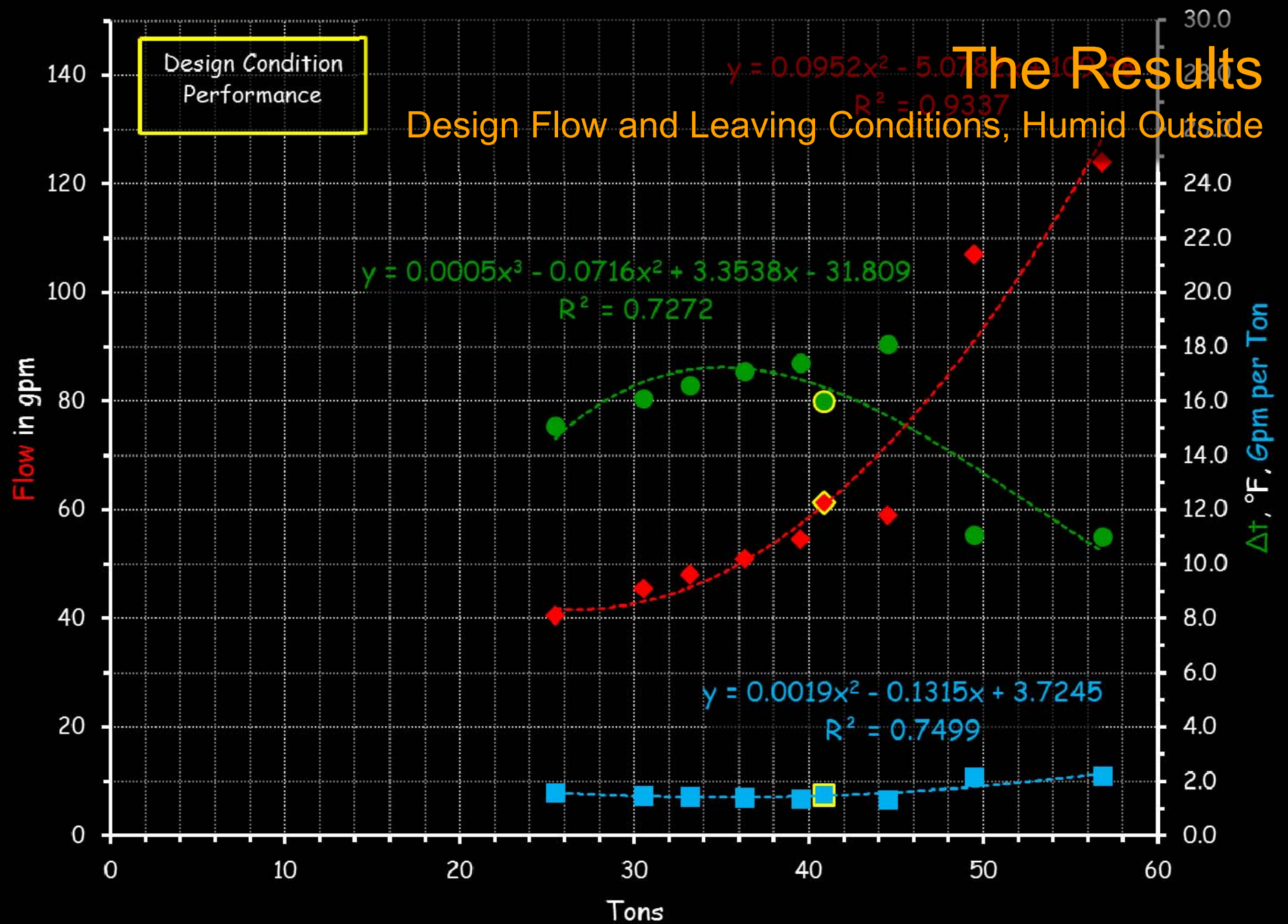




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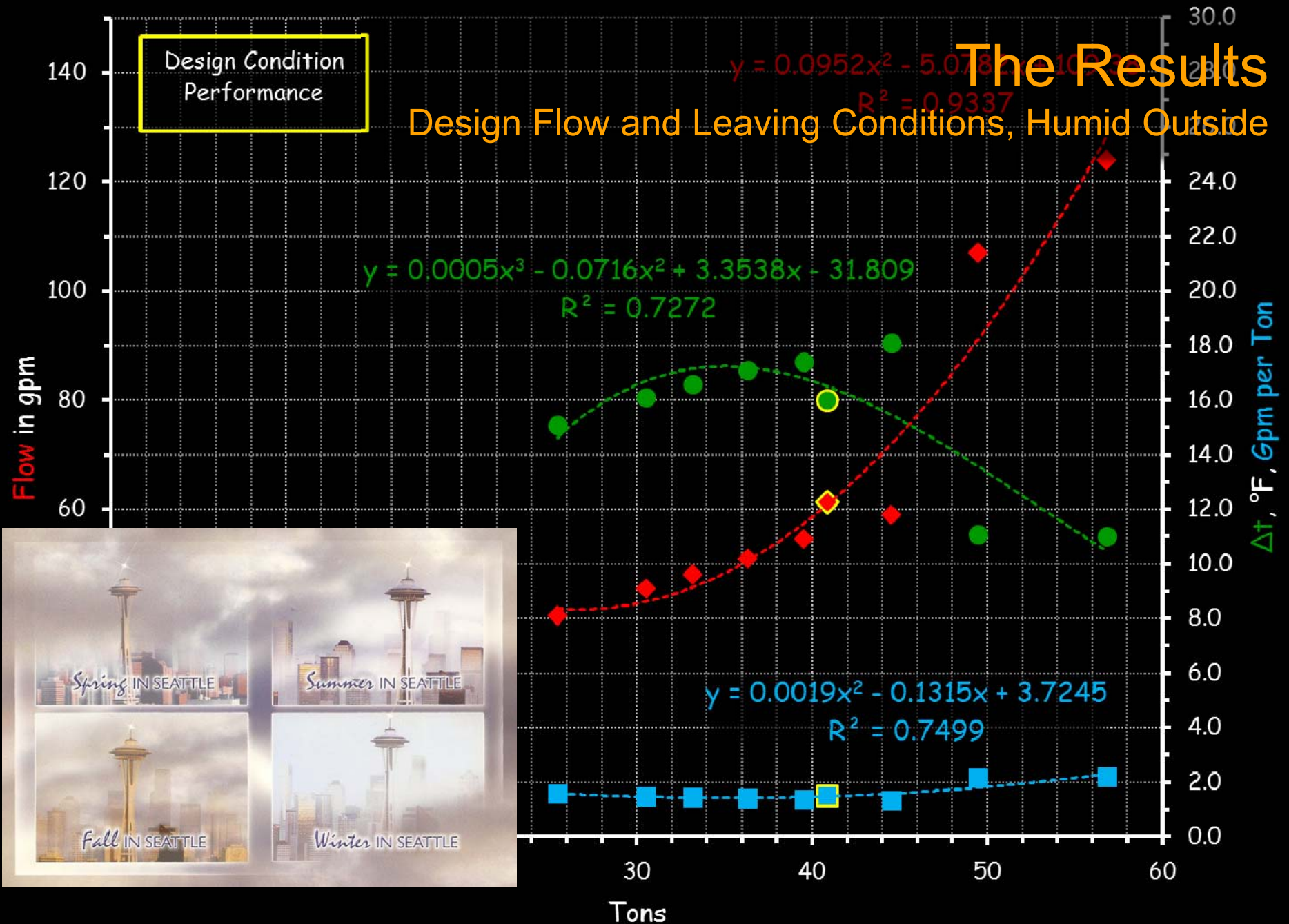






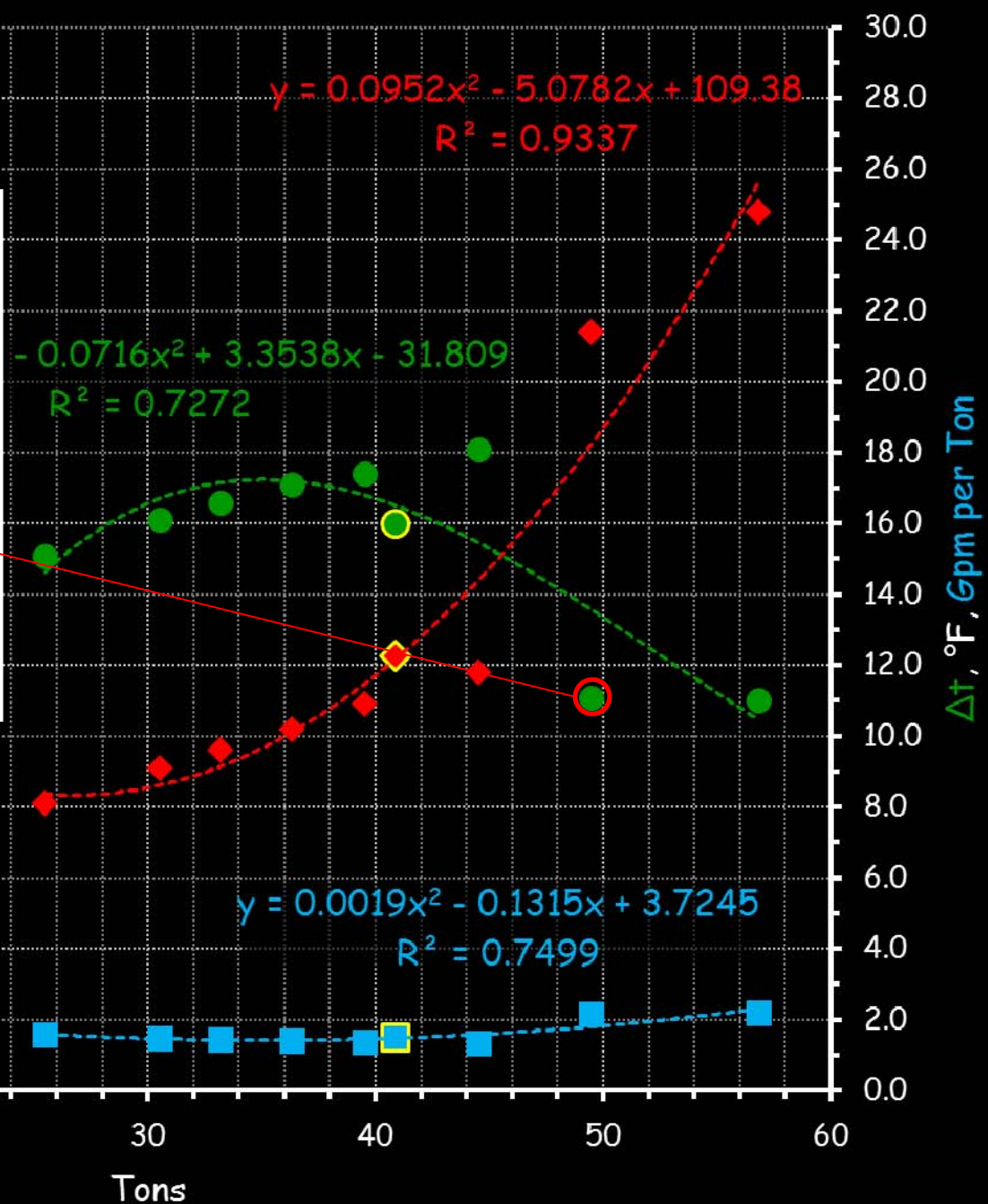
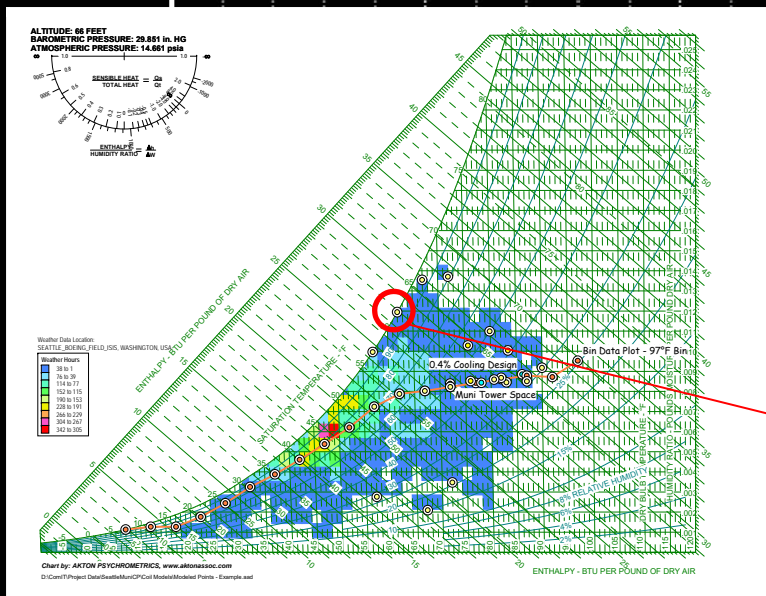
The Results

Design Flow and Leaving Conditions, Humid Outside



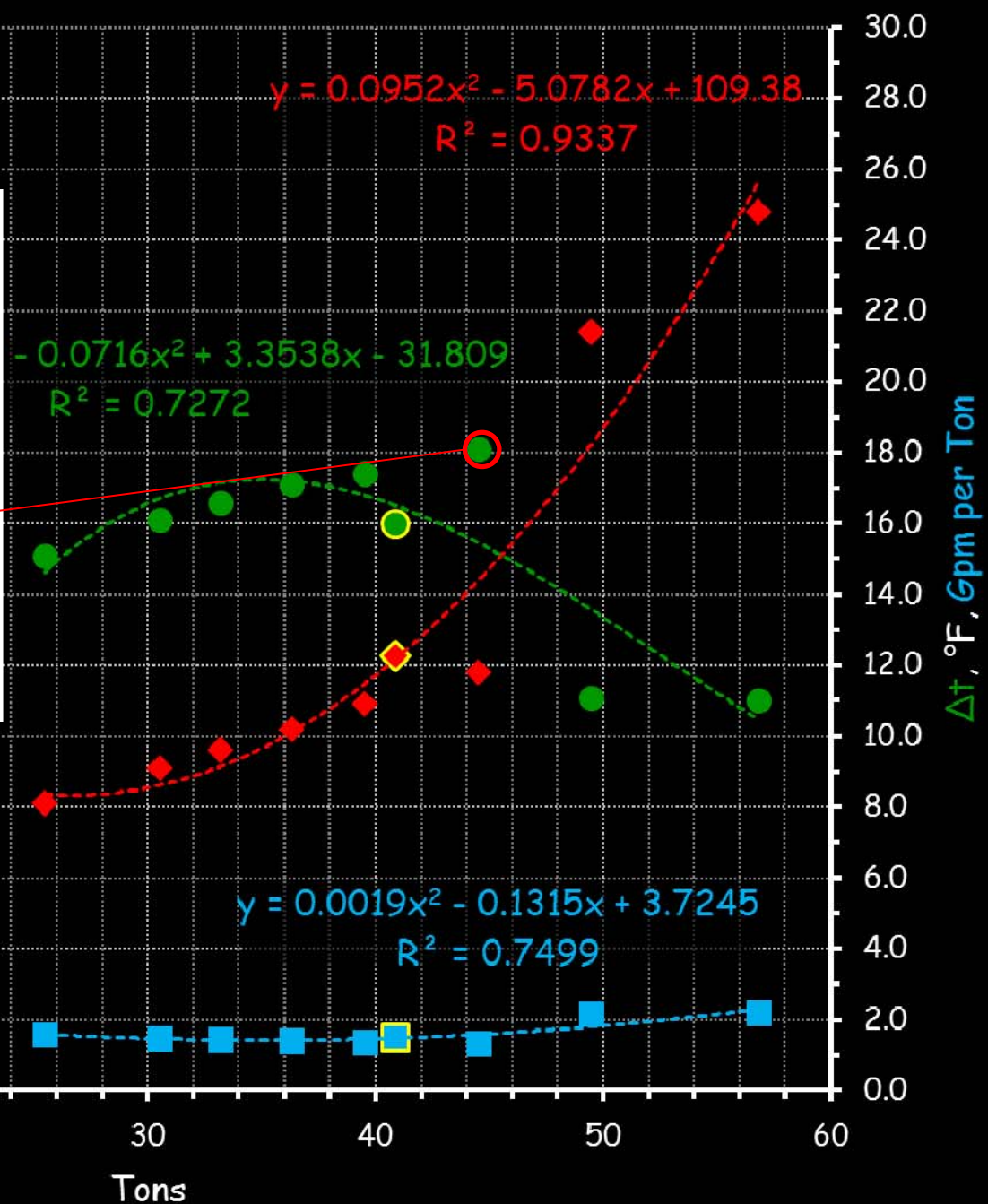
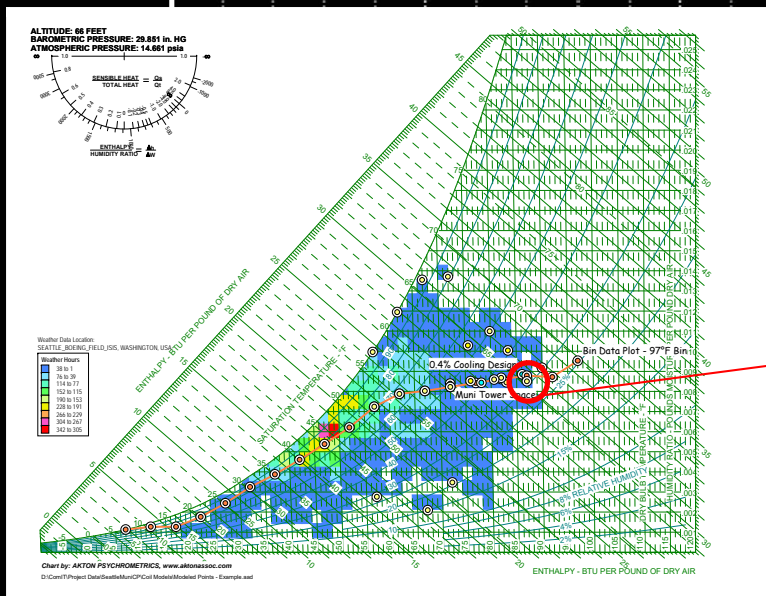
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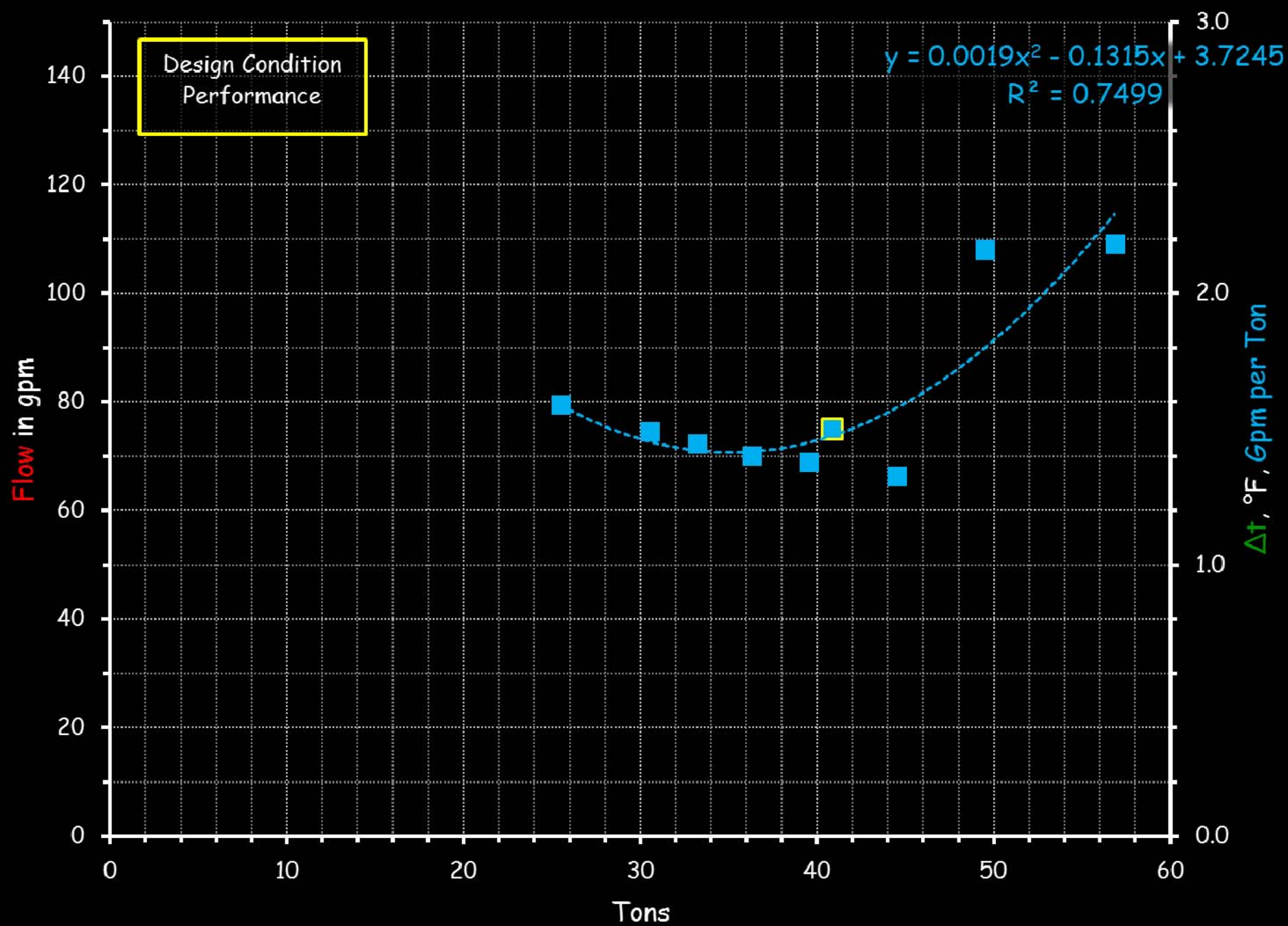
Design Condition Performance



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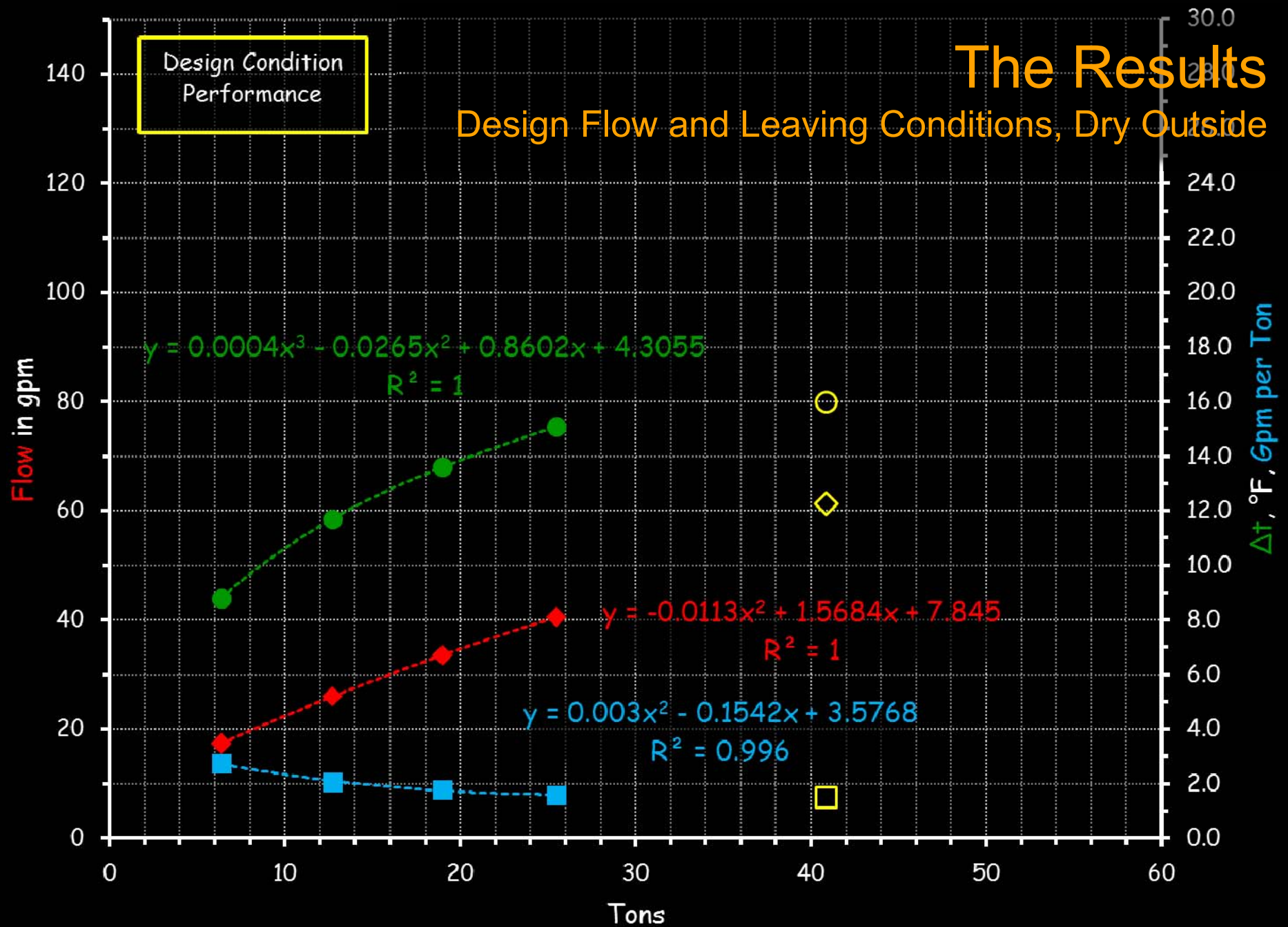
Design Condition Performance

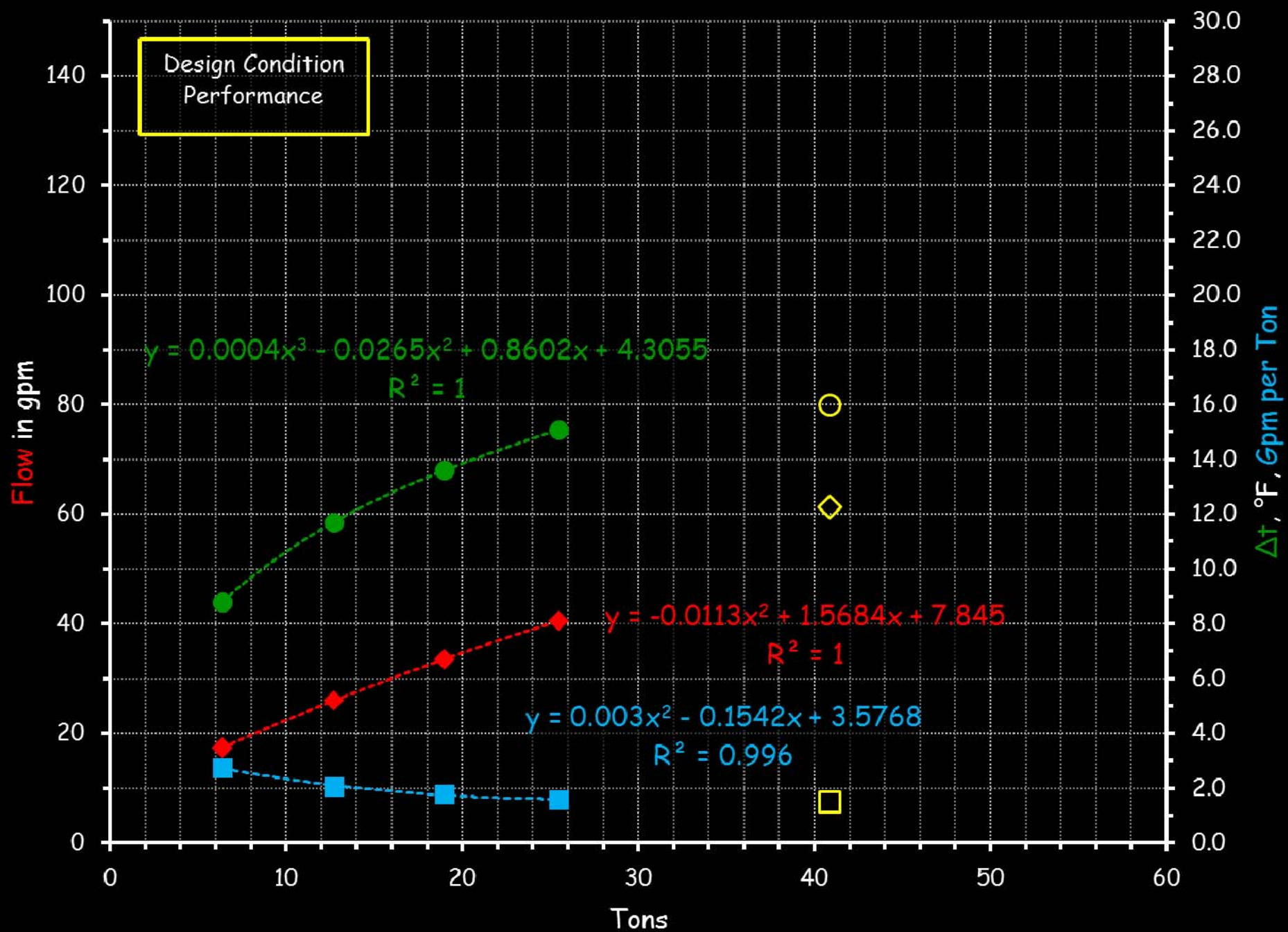


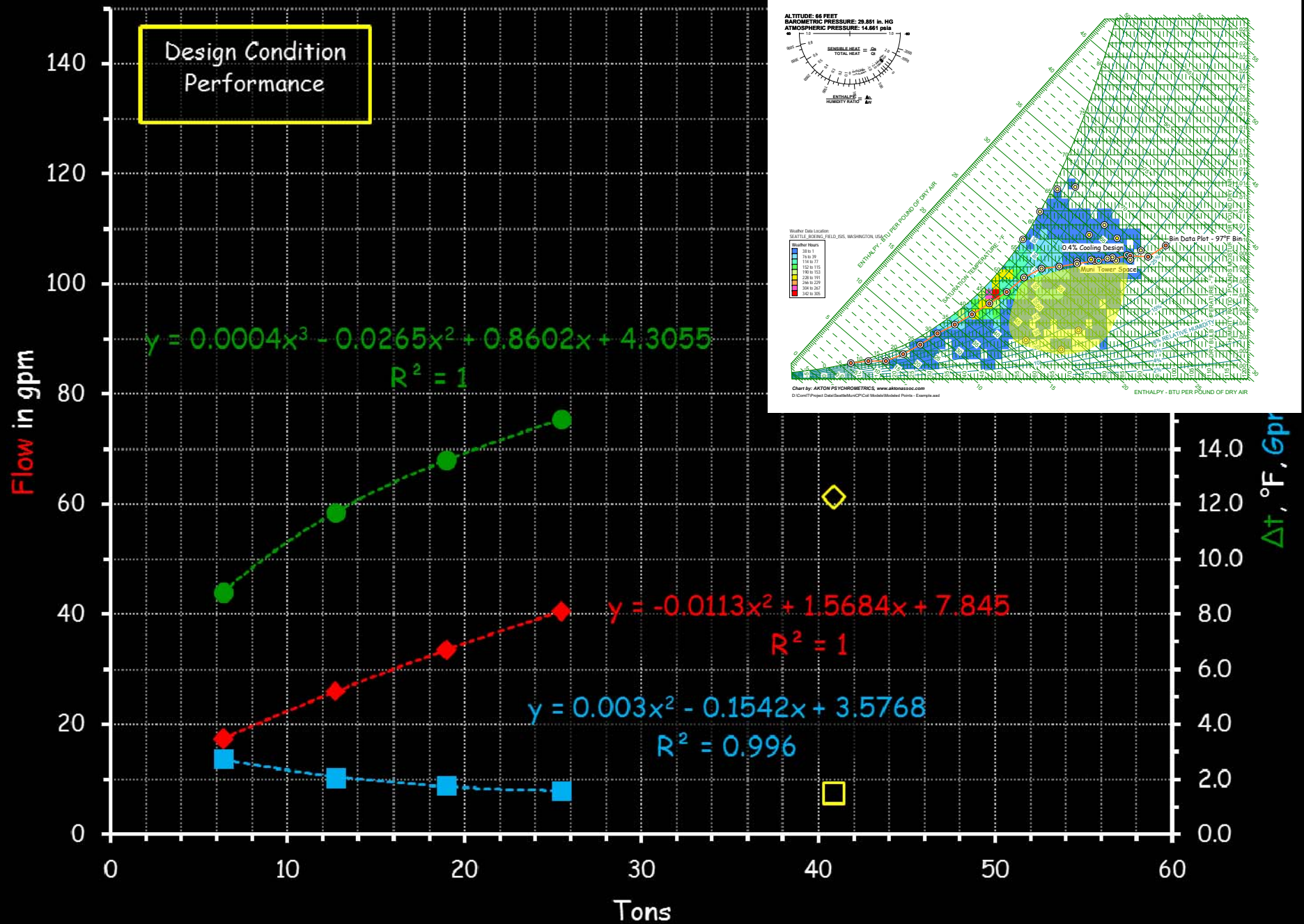


The Results

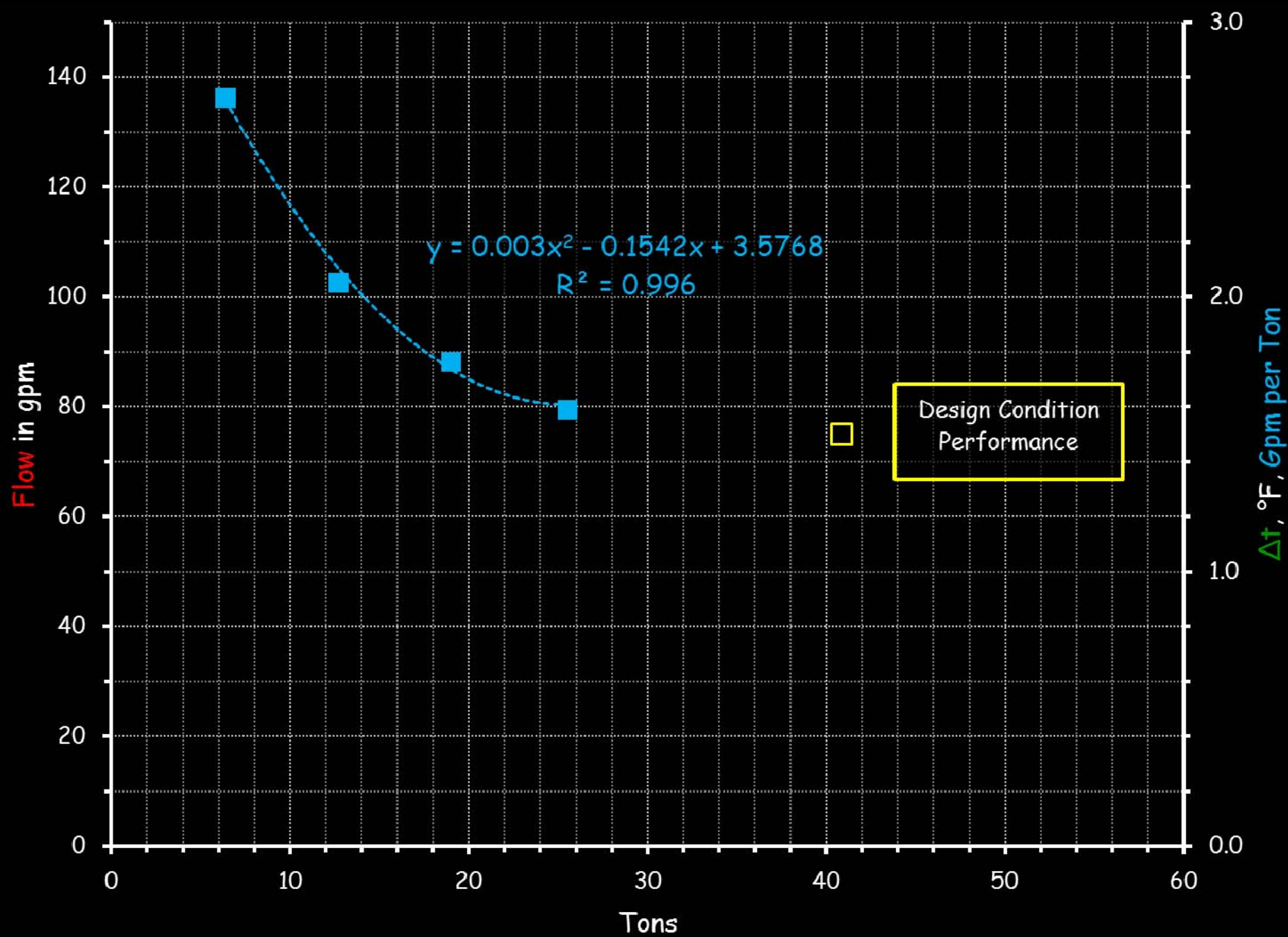
Design Flow and Leaving Conditions, Dry Outside

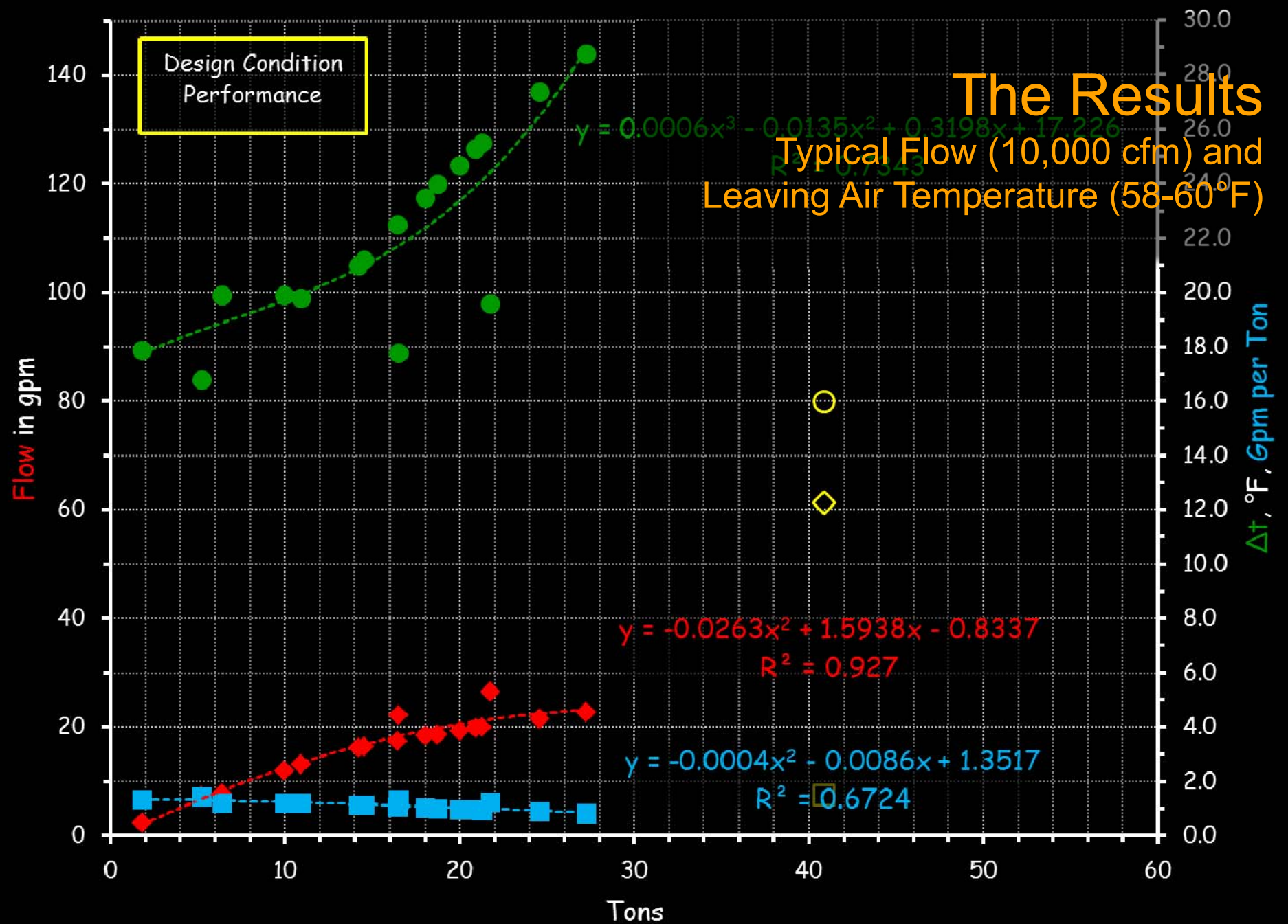


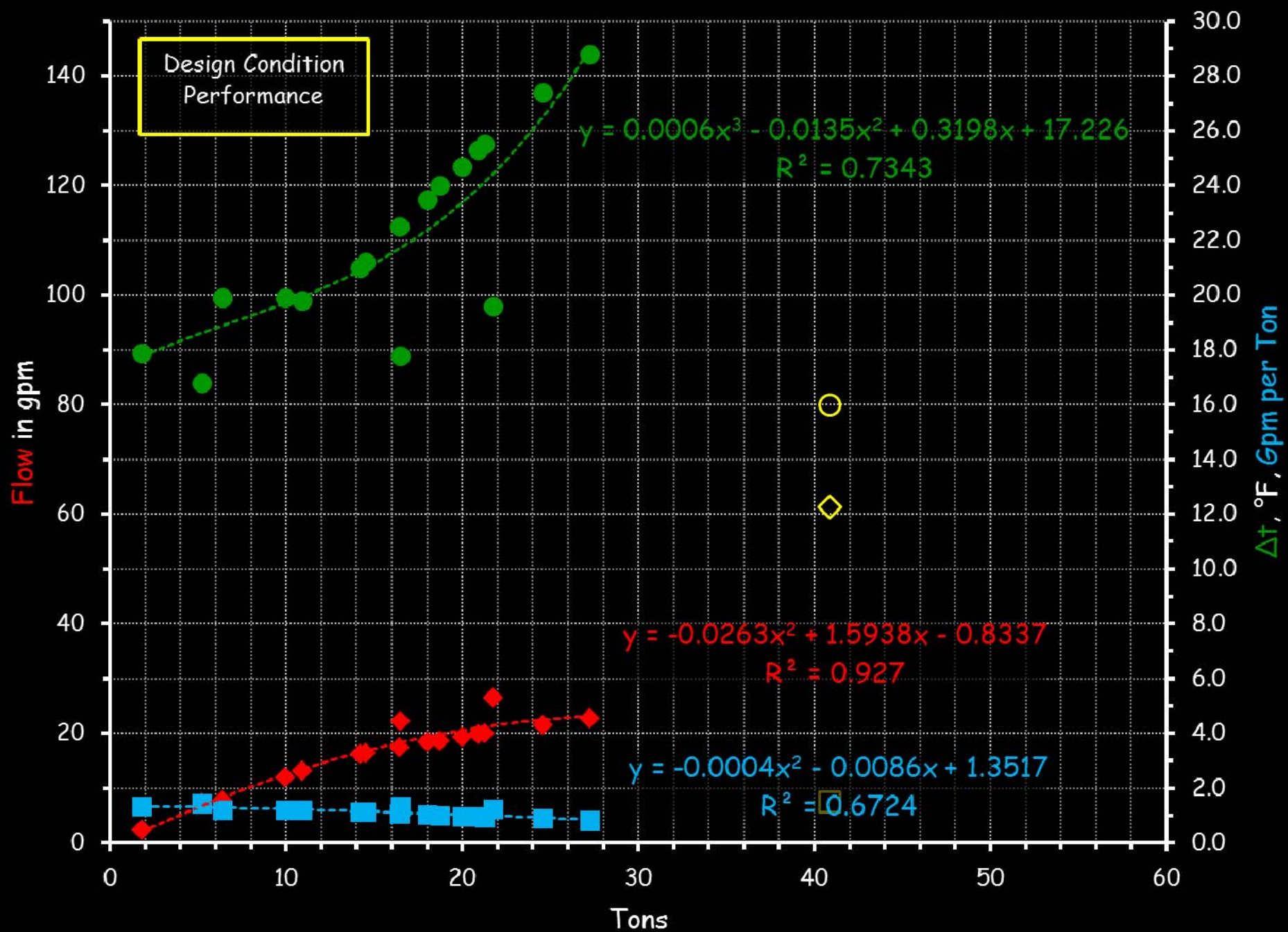


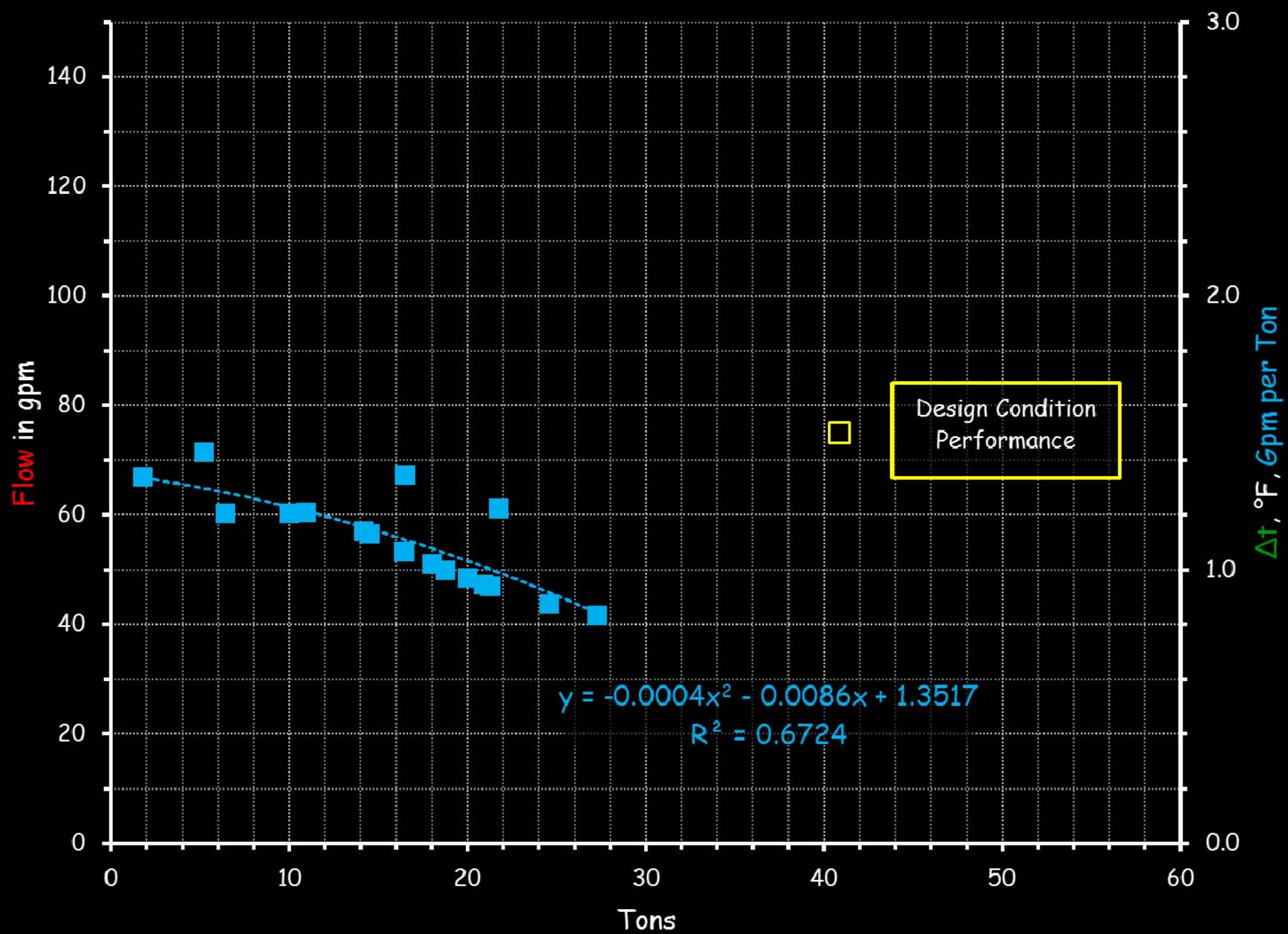


TAB 3-5 - HEAT EXCHANGERS









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

Different Heat Transfer Processes Require Different Control Strategies

Heating is not the same as Preheat, which is not the same as Reheat

Heating vs. Preheat vs. Reheat

Definitions

- Heating

A process that adds energy. For a space, this is often accomplished by circulating air through it at a temperature above the required set point. For an airstream, this is often accomplished by passing it over a surface that is above the required supply temperature.

Heating vs. Preheat vs. Reheat

Definitions

- Freezing

A condition that occurs when water is cooled to the point where it changes phase from a solid to a liquid.

Heating vs. Preheat vs. Reheat

Definitions

- Water Damage

A condition that occurs after frozen water contained in a HVAC coil changes back to the liquid phase.

Heating vs. Preheat vs. Reheat

Definitions

- Expletive

A generic reference to the field terminology used to describe and discuss water damage when it occurs.

Heating vs. Preheat vs. Reheat

Definitions

- Preheat

A process that heats a fluid stream to prepare it for a subsequent HVAC process. In air handling systems, this process is used to raise subfreezing air above freezing to protect water filled elements down stream from damage due to freezing.

See the Functional Testing Guide (www.peci.org/ftguide) Air Handling System Reference Guide Chapter 5 – Preheat, Table 5.1 to contrast preheat, reheat and heating applications

Heating vs. Preheat vs. Reheat

Definitions

- Reheat

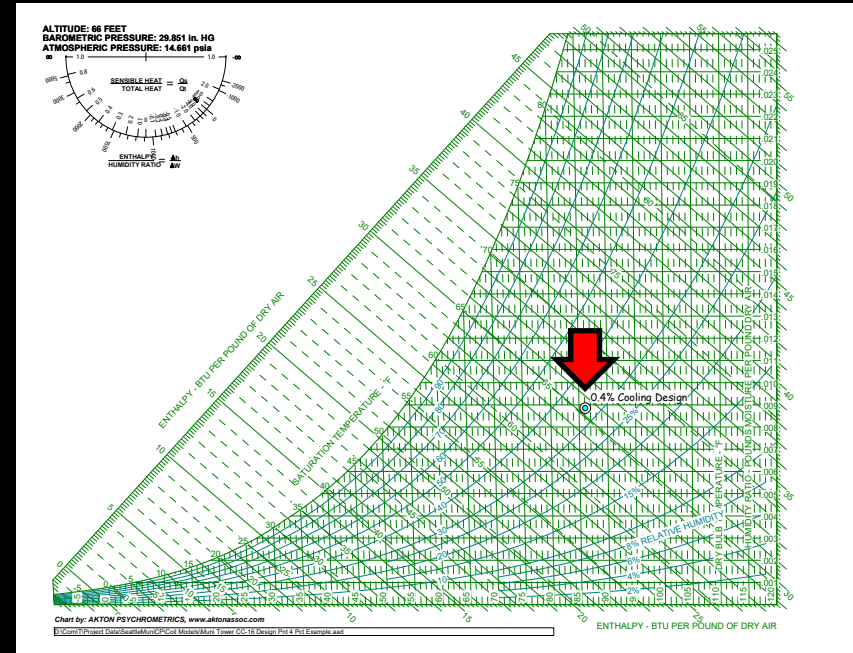
A process that uses heat to warm air being delivered to a zone to prevent over cooling. The temperature of the air was set by the need to hit a dehumidification target or by the requirements of another zone, so it can not be raised at the central system. The volume can not be reduced because it has been set to assure proper ventilation (contaminant control). In the limit, reheat will raise the supply temperature to the zone temperature but not above it.

Bottom Lines

- Heat transfer and processes and heat exchangers are very common in HVAC
- Process requirements dictate the type of heat exchanger
 - Construction details vary
 - Performance requirements will vary
 - Performance characteristics will vary

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- Heat transfer and processes and heat exchangers are very common in HVAC
- Process requirements dictate the type of heat exchanger
 - Construction details vary
 - Performance requirements will vary
 - Performance characteristics will vary
- Heat exchangers are typically selected for the design day
- The control has a critical role to play in making it work all of the other days

