

Fans, Ducts and Air Handling Systems: Design, Performance and Commissioning Issues

Coils



Instructor:

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Facility Dynamics Engineering

November 7, 2017

Coil Types

Water

- Chilled Water
- Hot Water
- Well Water

Refrigerant (Dx; a.k.a Direct Expansion)

Steam

Coil Functions

Cooling

Heating

Preheating

Reheating

Heat Recovery

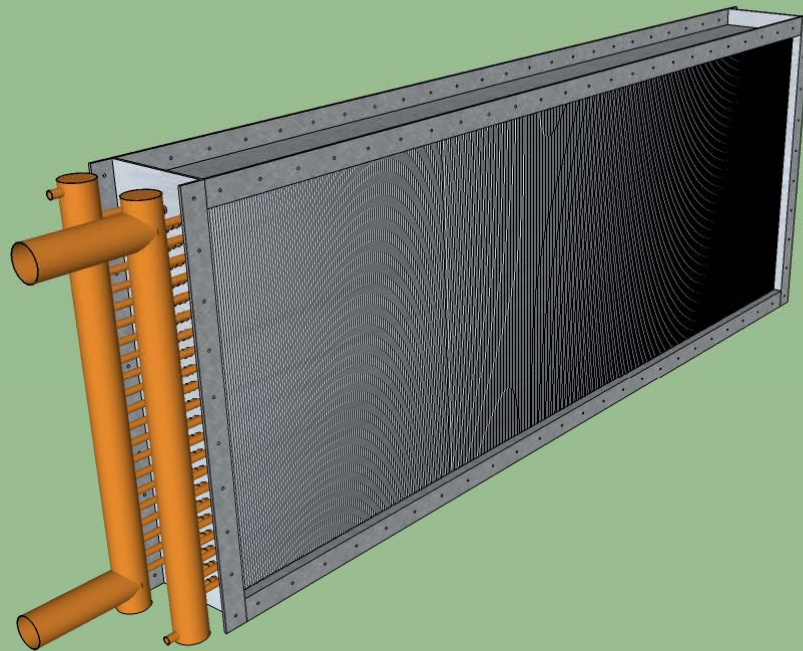
Heat Rejection

Dehumidification

Humidification

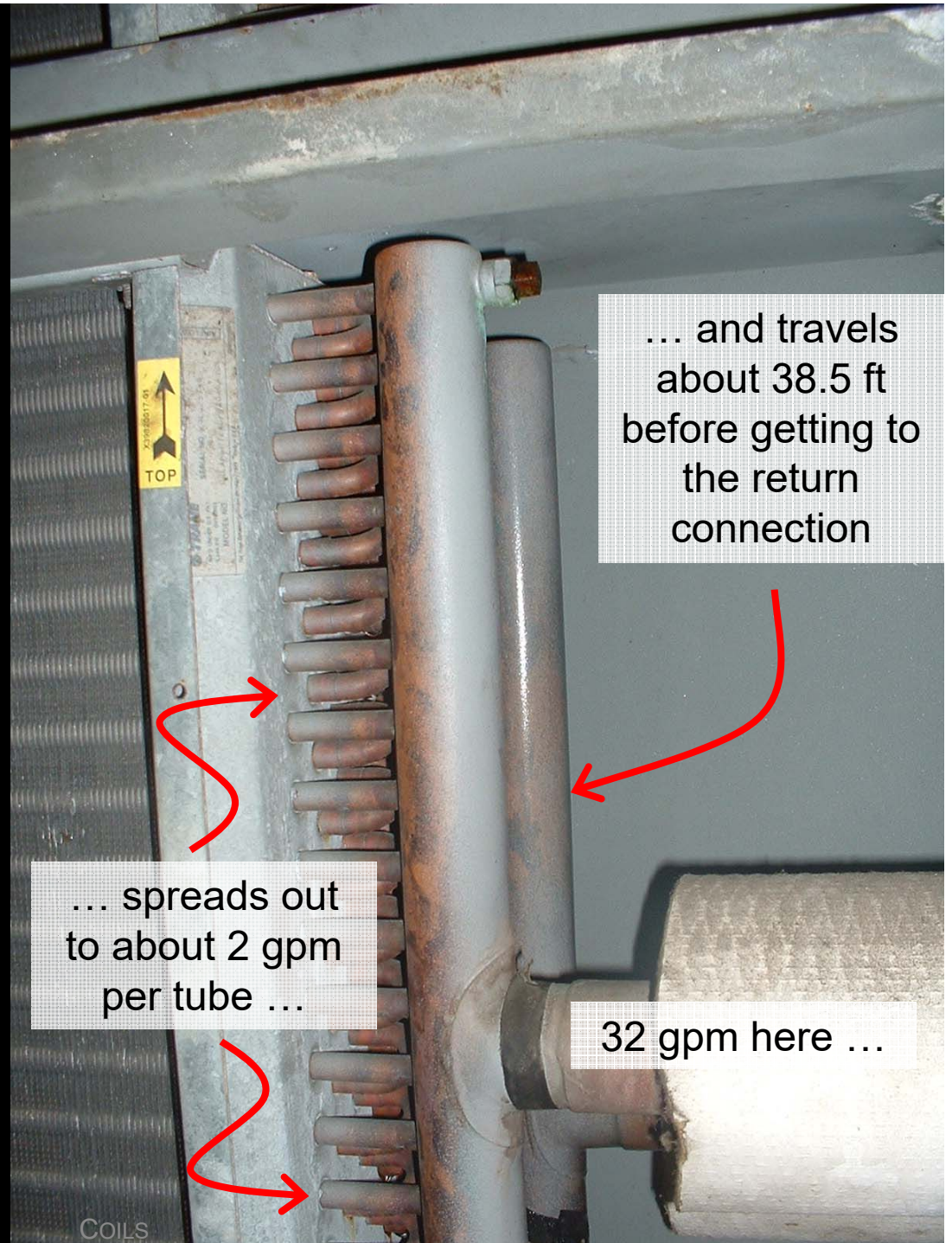
Heat Transfer

How Coils Work



How Coils Work

The PEC AHU1 Chilled Glycol Coil



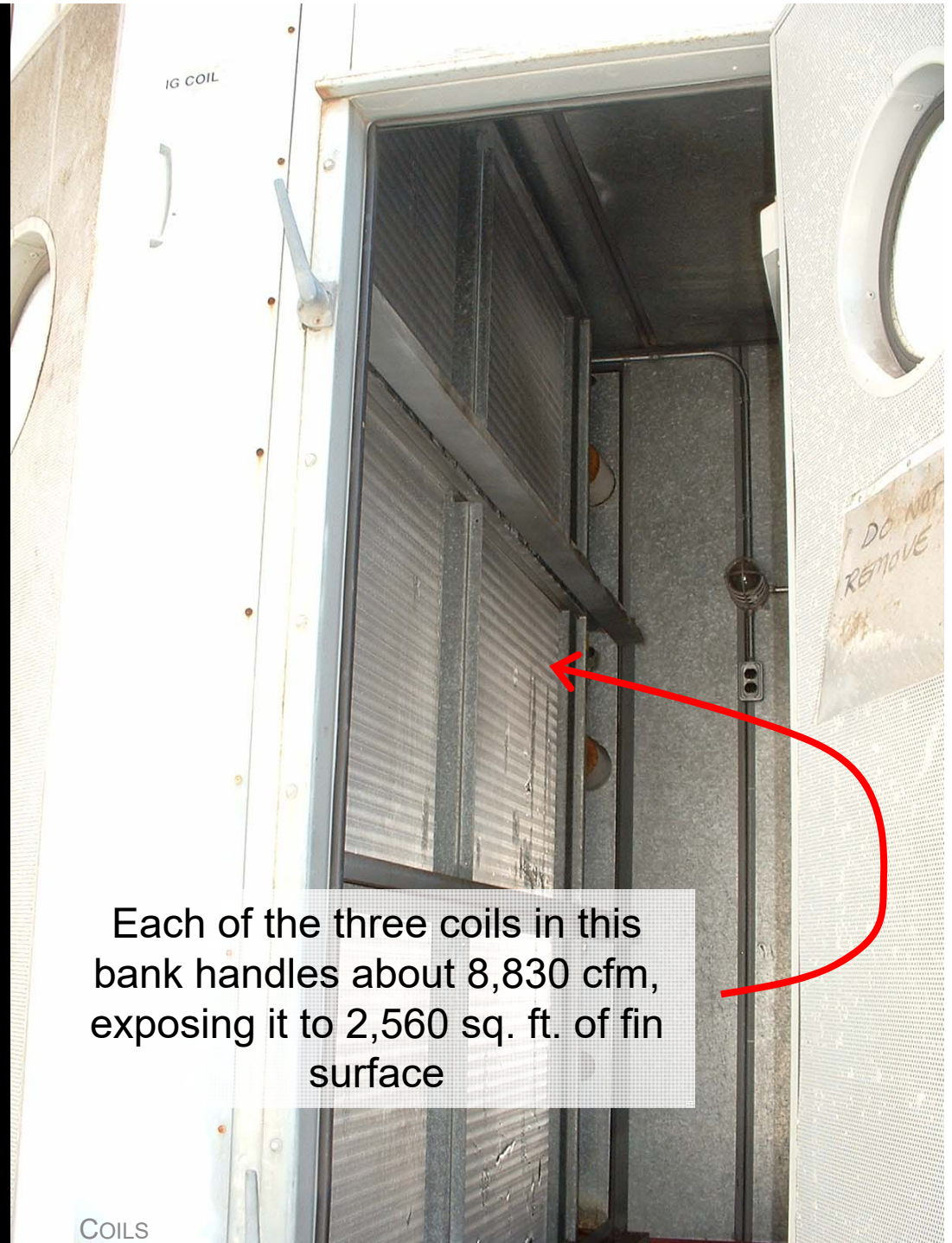
How Coils Work

The PEC AHU1 Chilled Glycol
Coil



How Coils Work

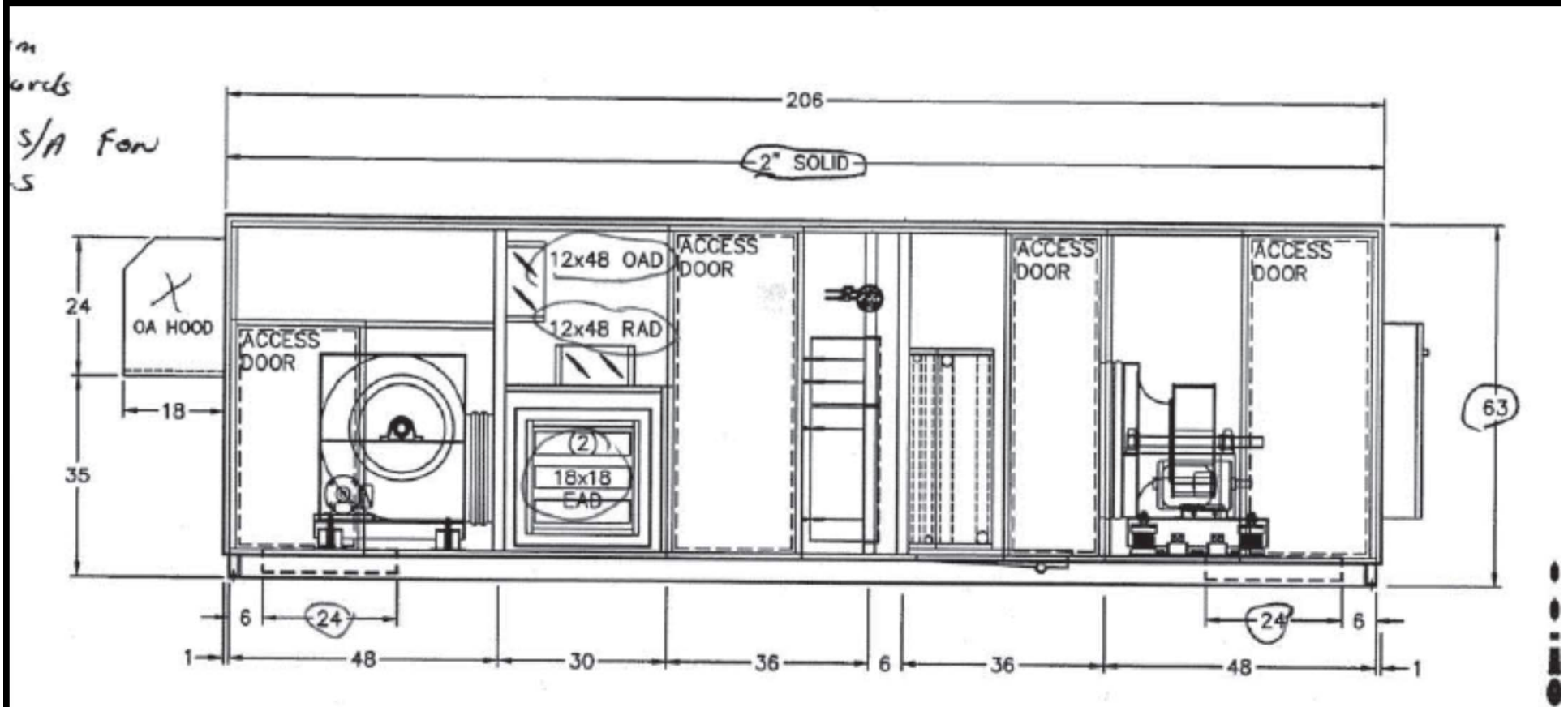
The PEC AHU1 Chilled
Glycol Coil



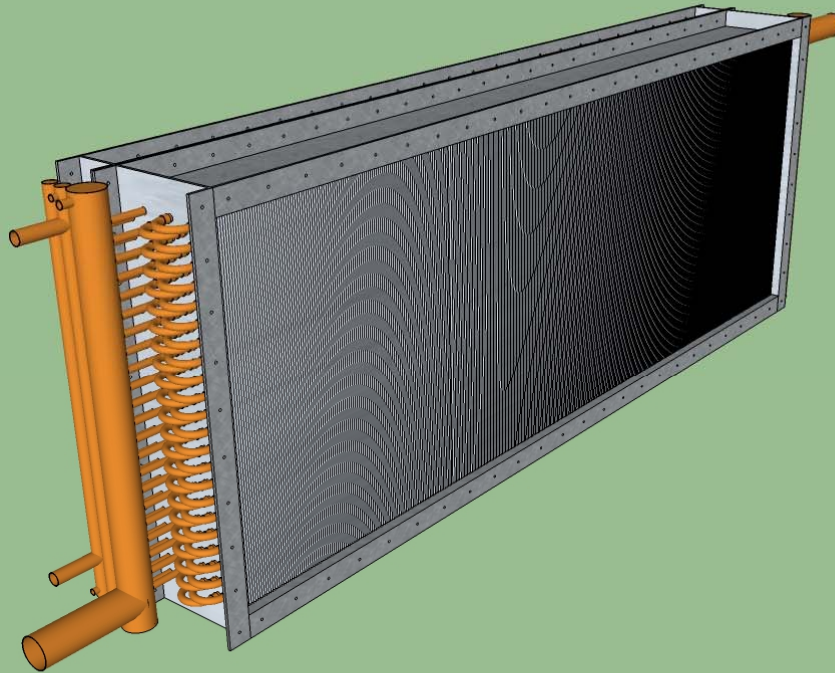
Each of the three coils in this bank handles about 8,830 cfm, exposing it to 2,560 sq. ft. of fin surface

COILS

A Common Application Problem

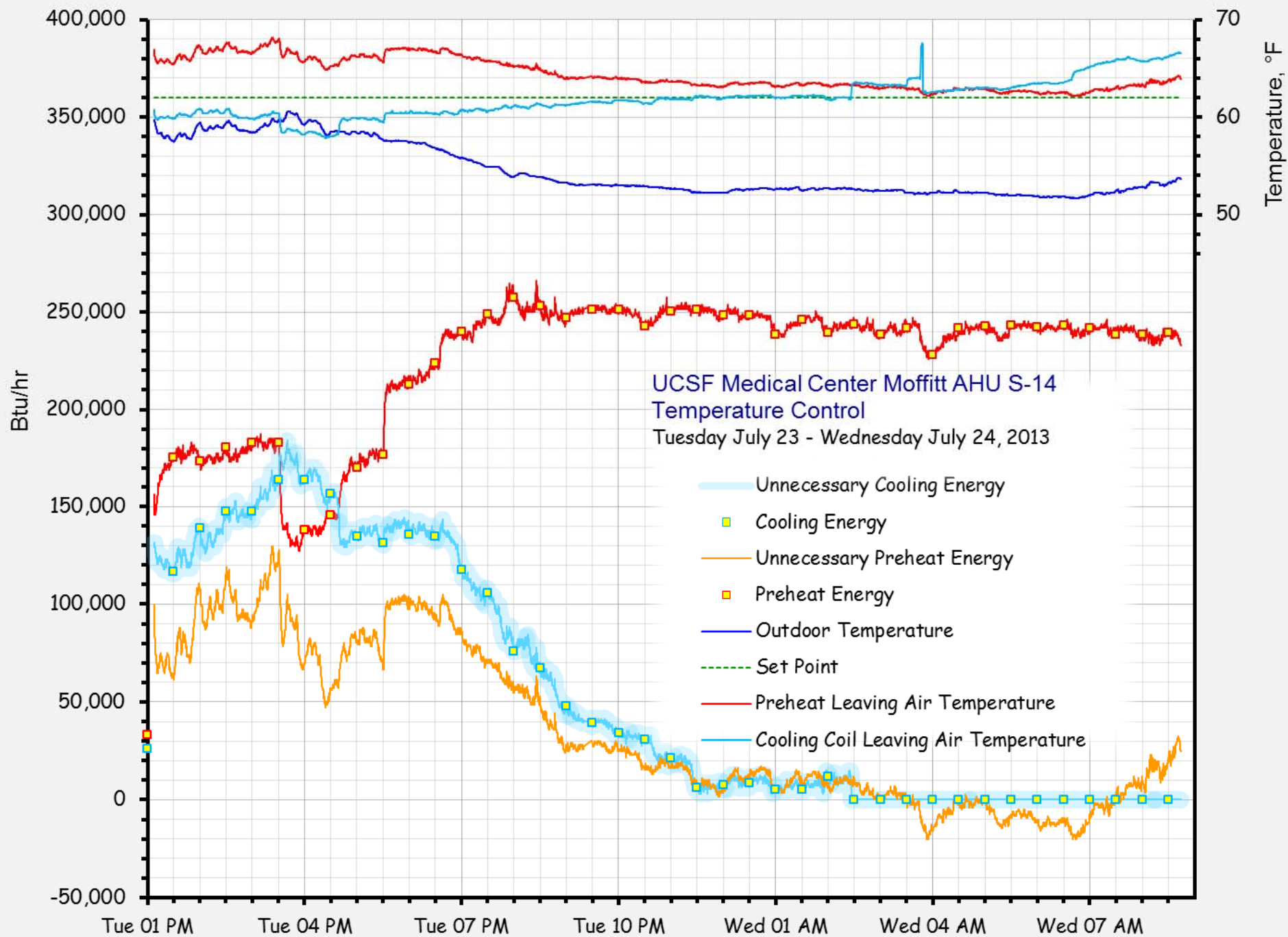


A Common Application Problem

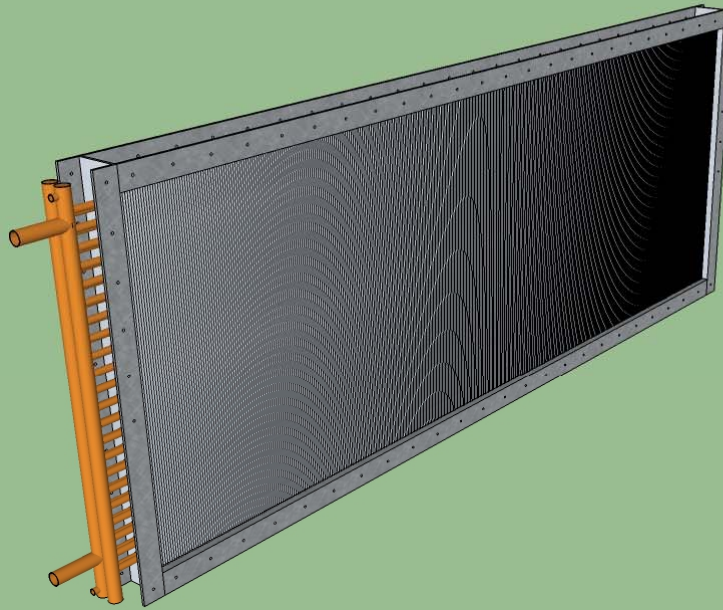


A Common Application Problem





A Hot Water Coil



Refrigeration Coils

Special Considerations

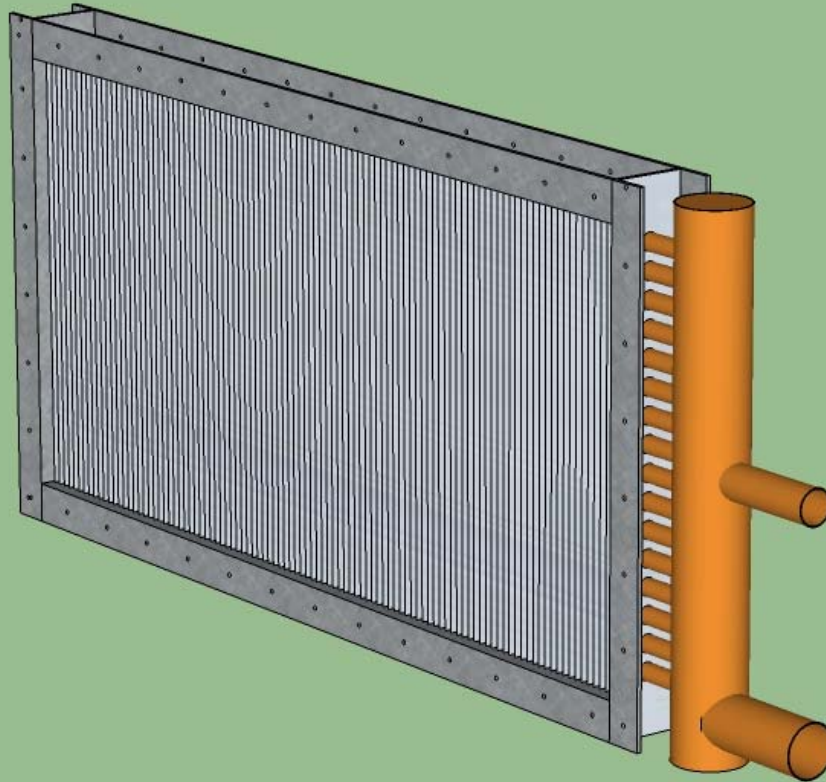
- Fluid/vapor mix
- Uniform distribution of refrigerant
- Oil return
- Active face area
 - Row split
 - Face split
 - Intertwined

Steam Coils

Special Considerations

- Fluid/vapor mix
- Uniform distribution of steam
- Condensate return
- Freezing

Steam Coils



Fans, Ductwork, & Air Handling Components:

Supplemental Information

More on Coils



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November 12, 2013

Central Plant Hot Water Load Considerations

Definitions

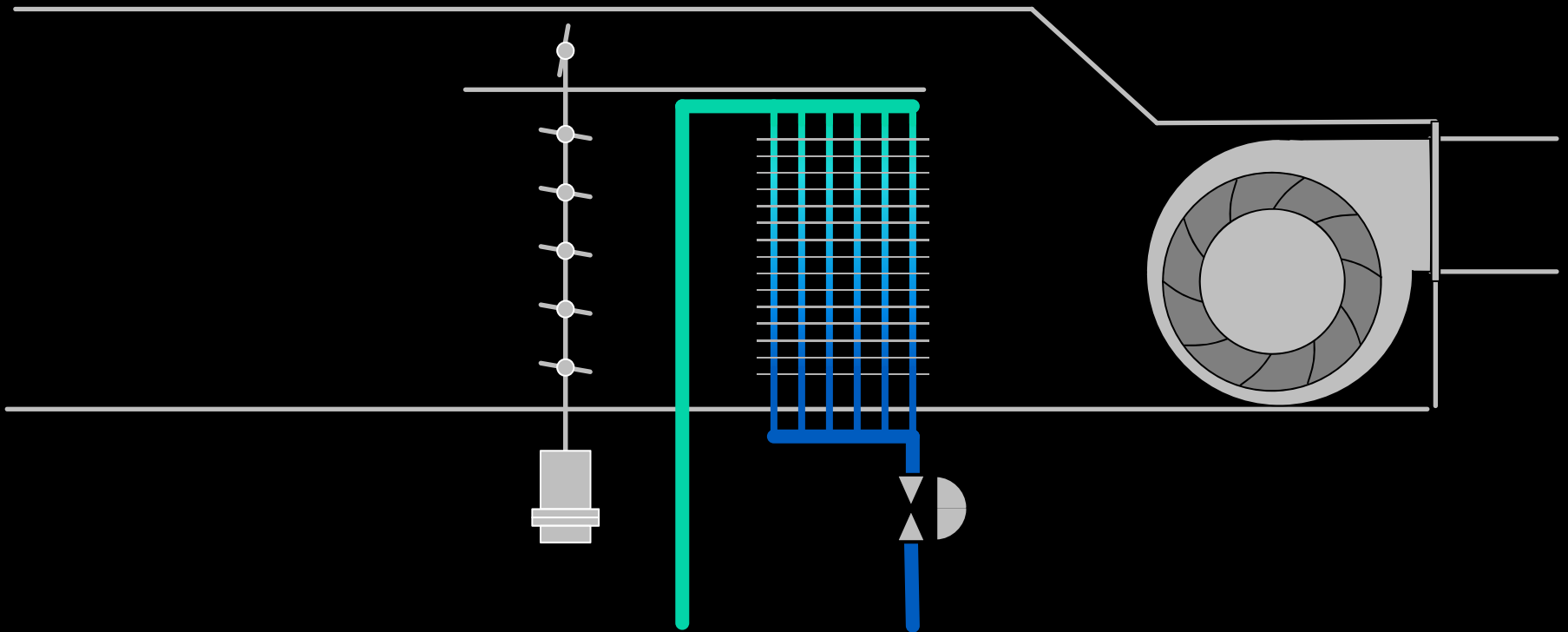
- Preheat

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

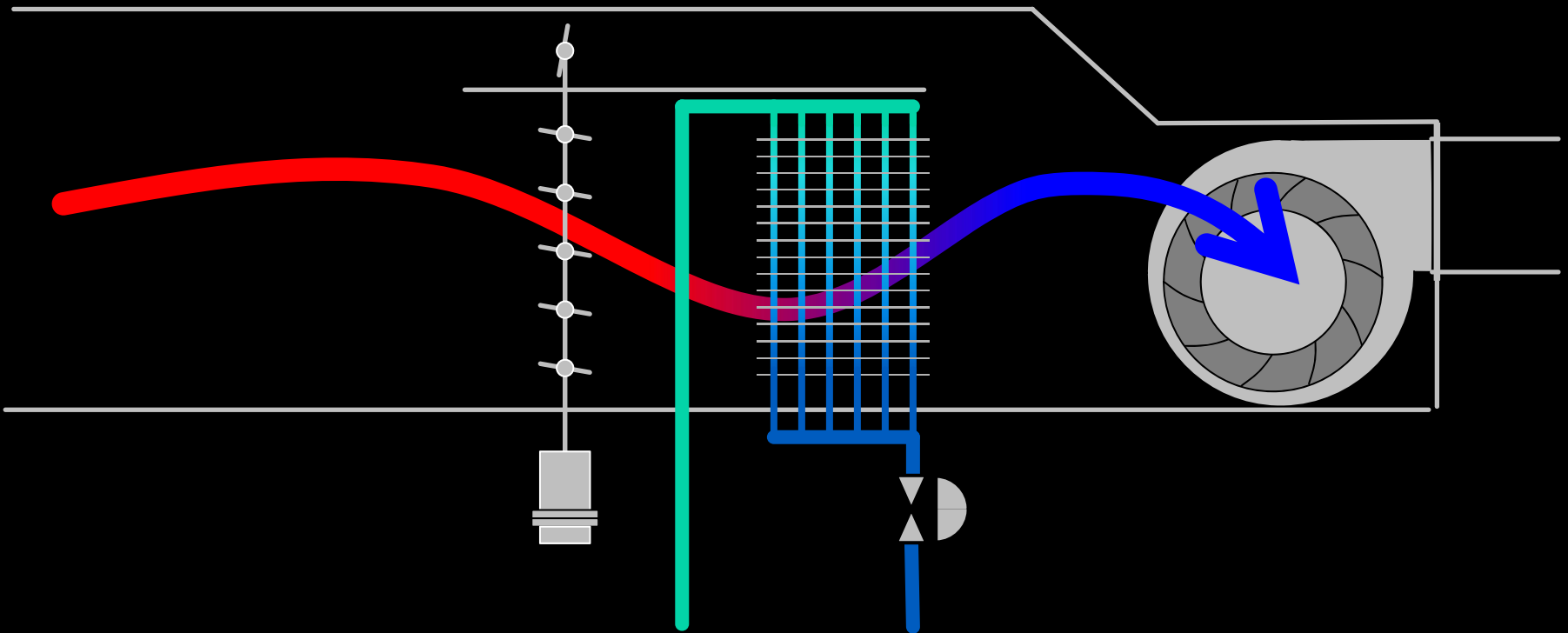
Face and Bypass Damper Control

Coil discharge temperature regulation strategy



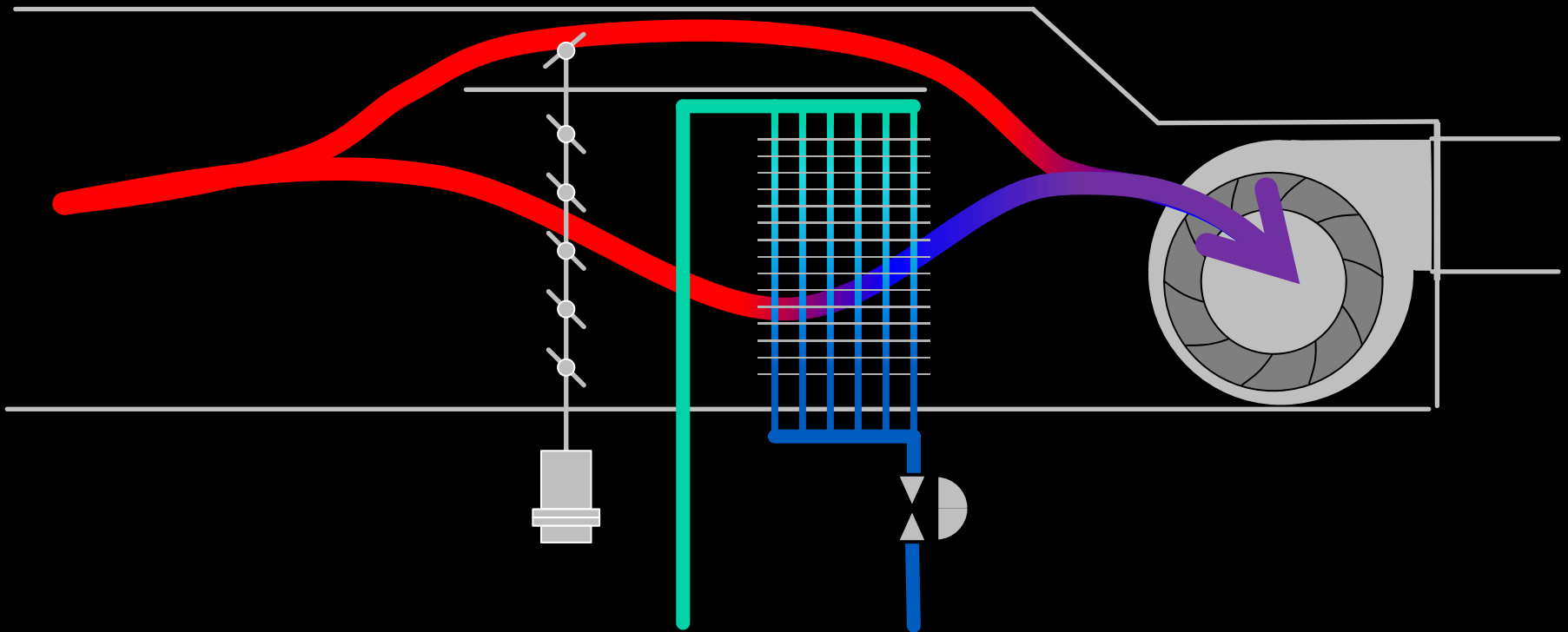
Face and Bypass Damper Control

Coil discharge temperature regulation by mixing **air that passes through the coil**



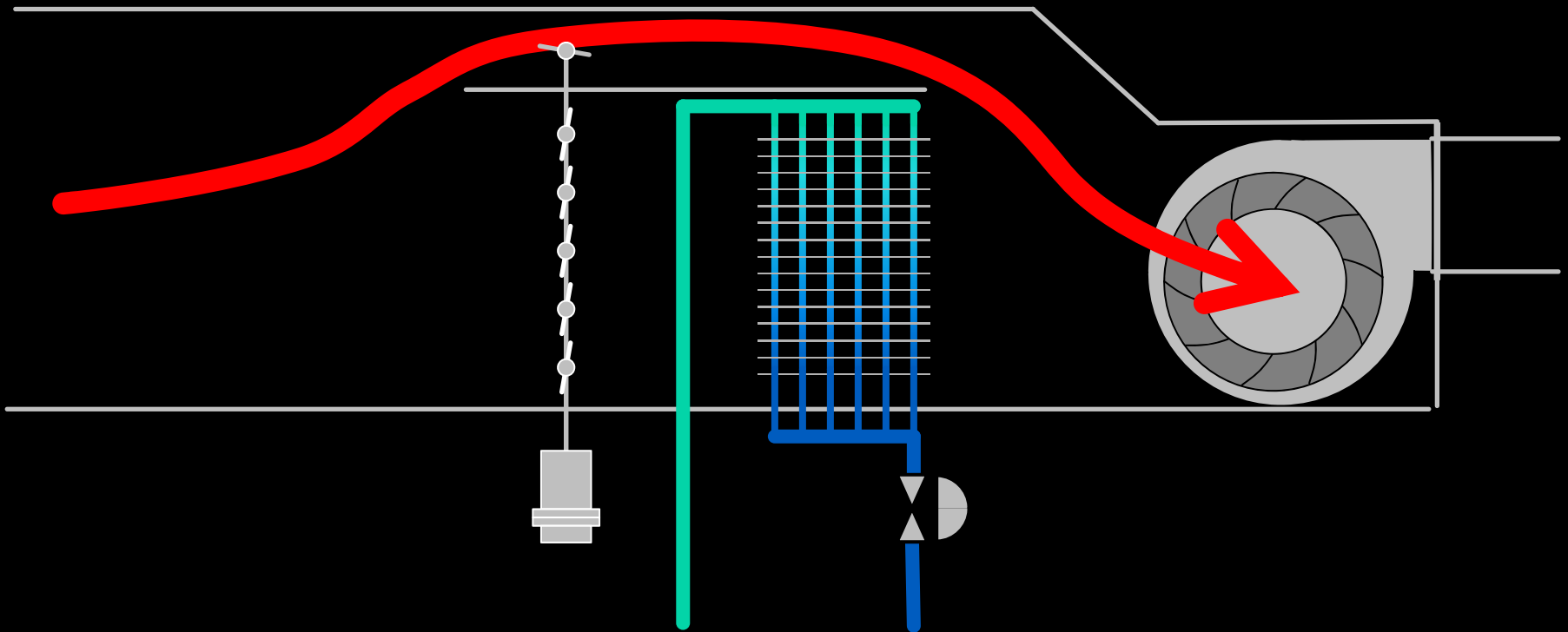
Face and Bypass Damper Control

Coil discharge temperature regulation by mixing **air that passes through the coil** with **air that bypasses the coil**



Face and Bypass Damper Control

Coil discharge temperature regulation by mixing **air that passes through the coil** with **air that bypasses the coil**



Why Face and Bypass

Flow remains steady in the refrigerant/water side of the coil

- Keeps the coil face active
 - Ensures dehumidification for cooling and dehumidification applications
 - Ensures freeze protection for preheat applications
- Moving water is less likely to freeze
- Compatible with water systems requiring constant flow



Bypass Damper

The Traditional Approach

Face Damper (Covers the Cooling Coil Face)

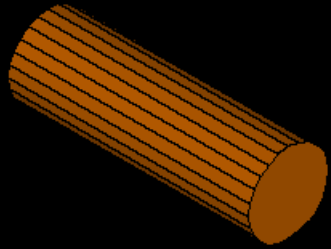
Integral Face and Bypass

“Wing” coil

Targeted at preheat applications

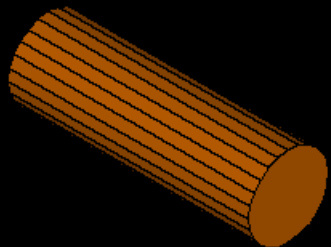
Ensures steam coils will not freeze

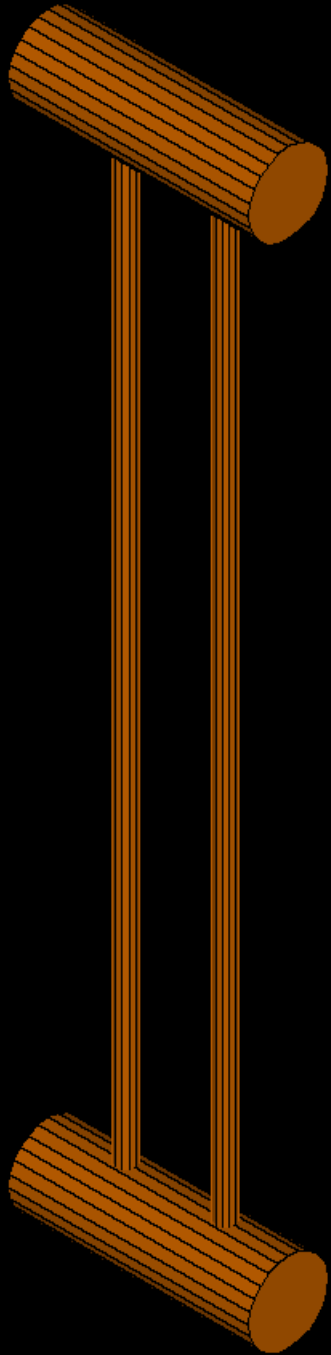
**An
Alternative
Approach**



Integral Face and Bypass

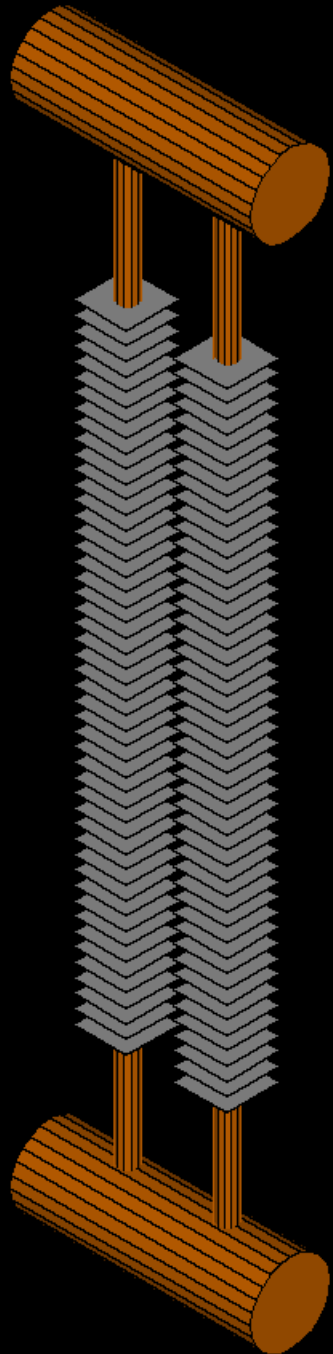
Horizontal supply and return headers are located out of the air stream





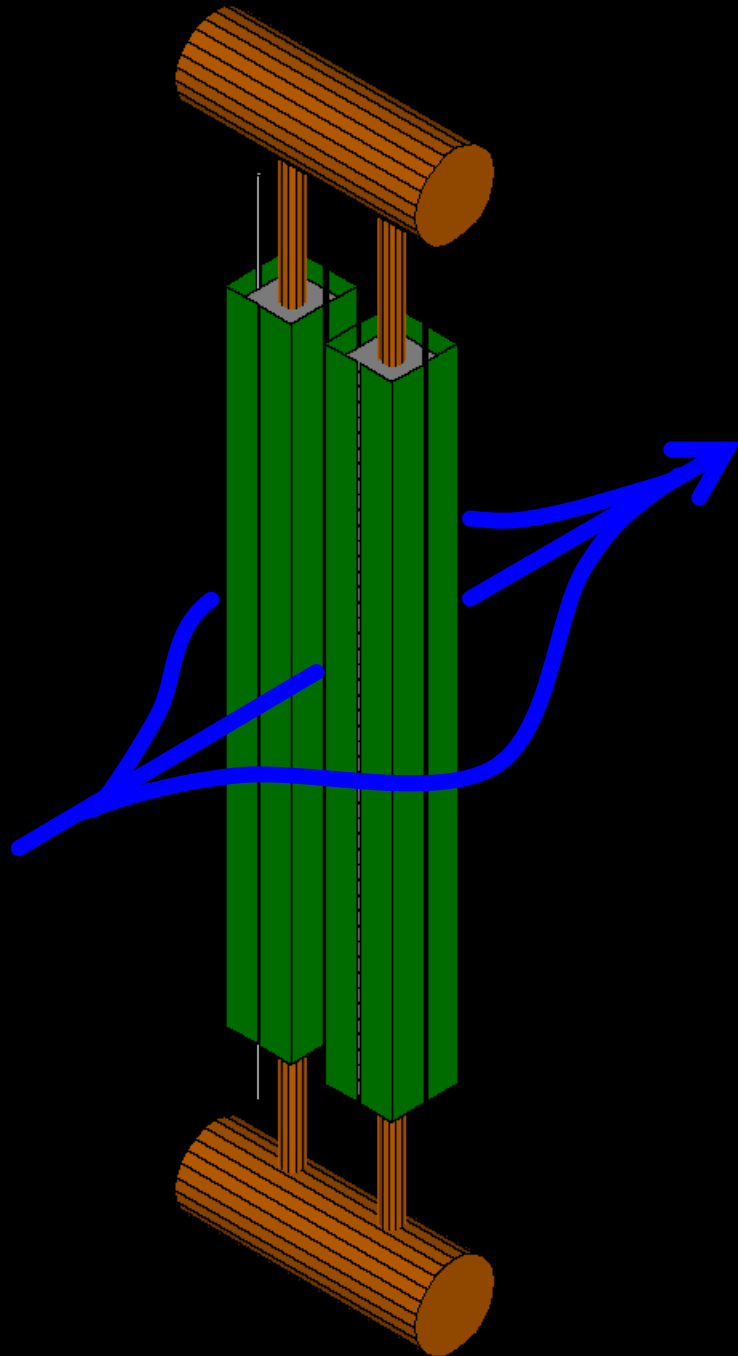
Integral Face and Bypass

- Horizontal supply and return headers are located out of the air stream
- Vertical tubes connect headers and ensure condensate drains out of the air stream



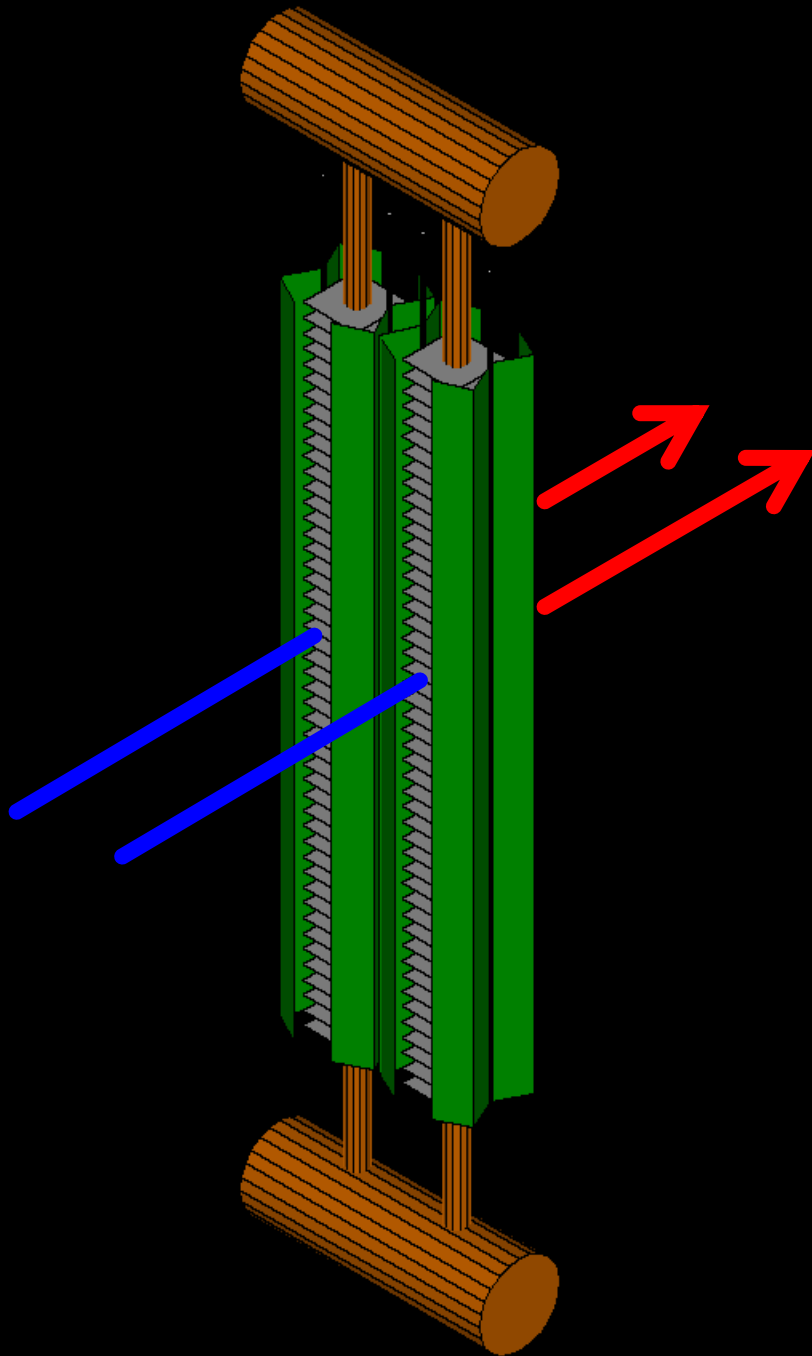
Integral Face and Bypass

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- Fins make tubes heat transfer elements



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- “Clam shell” dampers around finned tubes direct air around the tubes ...



Integral Face and Bypass

- Horizontal supply and return headers are located out of the air stream
- Vertical tubes connect headers and ensure condensate drains out of the air stream
- Fins make tubes heat transfer elements
- “Clam shell” dampers around finned tubes direct air around the tubes ...
... or through the tubes

Integral Face and Bypass

“clam-shell”

Typical
“bypass”
section

“clam-shell”

Typical “face”
section with
heating
element inside
“clamshell”
dampers

“clam-shell”

Typical “face”
section

“clam-shell”

Typical
“bypass”
section

Heating
element

Control Considerations

Damper sizing is critical for linear control response

- Low velocity required at the coil face to minimize coil pressure drop and carry over
- Deep coils have high pressure drops
- The bypass side needs to be sized for the combined pressure drop of the coil and face damper

Control Considerations

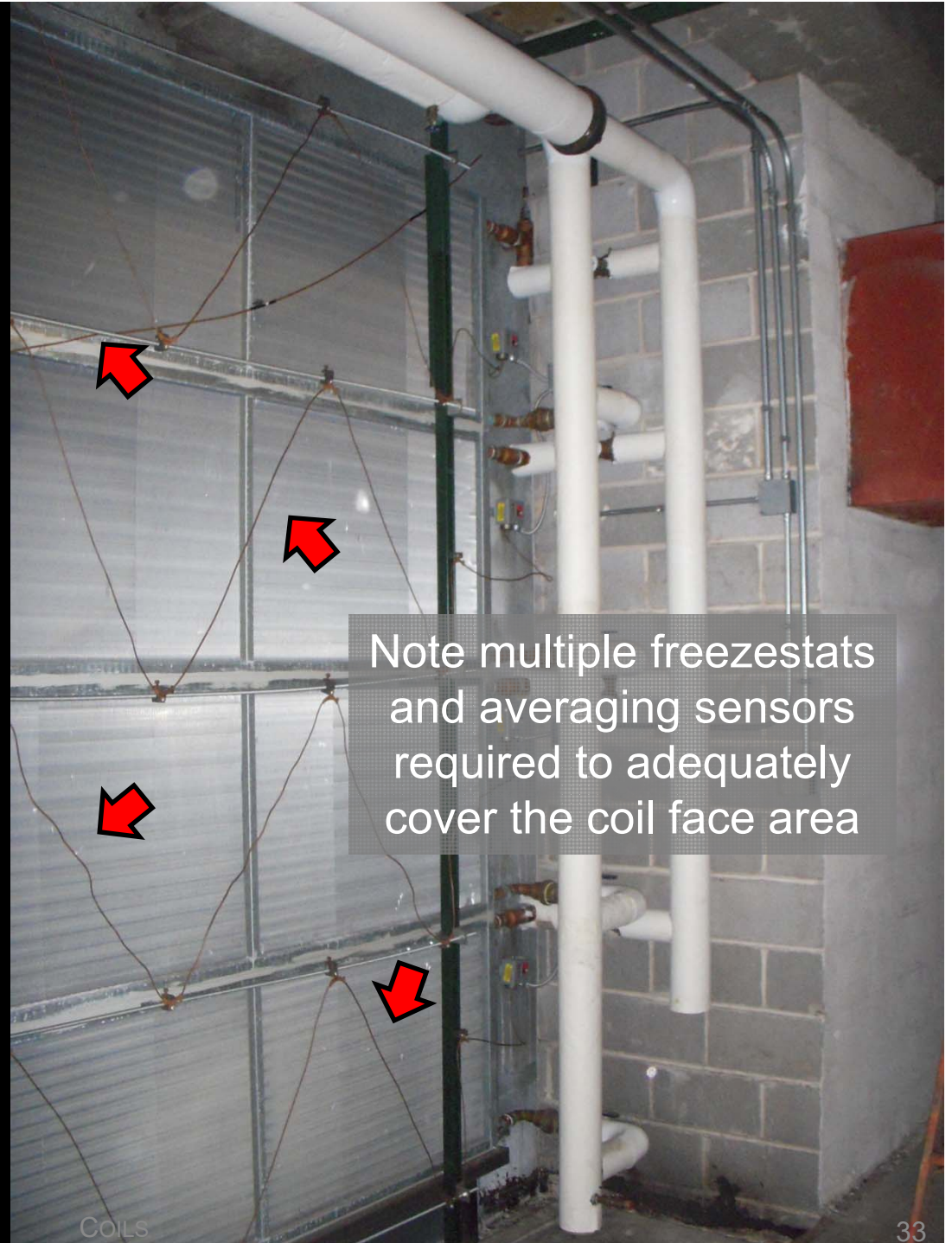
Water/steam side is typically on or off

Temperature control achieved via damper modulation

Hot water and steam coils can see significant temperature rises in full bypass

- 4°F or more
- Parasitic load
- Shut down heat source when its not needed

Constant Volume Pumped Hot Water Preheat Coil



Note multiple freezestats and averaging sensors required to adequately cover the coil face area

Preheat Bottom Lines

- Just because a coil is piped to hot water or steam does not mean it can safely deal with subfreezing air
- Freeze protection and sensing elements need to be installed to reflect/compensate for:
 - Non-uniform flow conditions
 - Temperature stratification
- The control system can not compensate for equipment that is not configured and piped to handle sub-freezing air
- The control system will be the first thing blamed if a coil freezes

Impact of Glycol (Anti-Freeze)

Good News

It doesn't freeze solid

Bad News

Increased viscosity changes the friction rate and droops the pump curve

Increased density increases the brake horsepower requirement

Lower specific heat increases the flow requirement for the same amount of heat transfer

Some compounds are toxic

Draining

From vented header

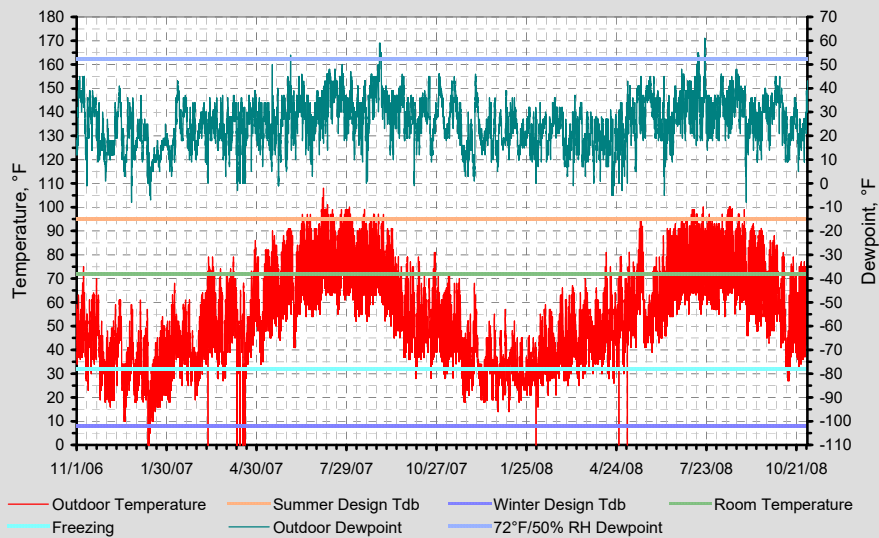
To drained header

Tube rises here

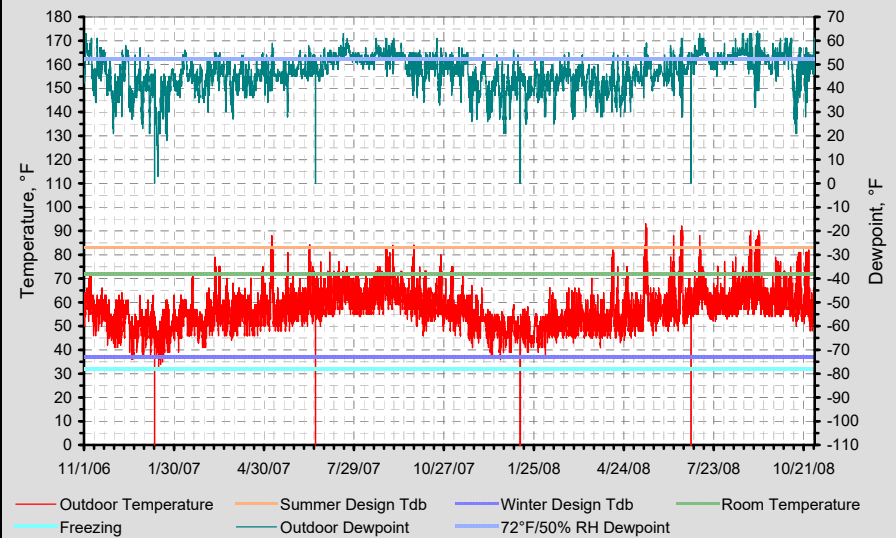
Water can be trapped and freeze, even with the drain and vent opened

Bottom line; to drain a coil as a freeze protection strategy, you need to blow it out with air and flush it with anti-freeze

Reno, Nevada Temperature and Dewpoint



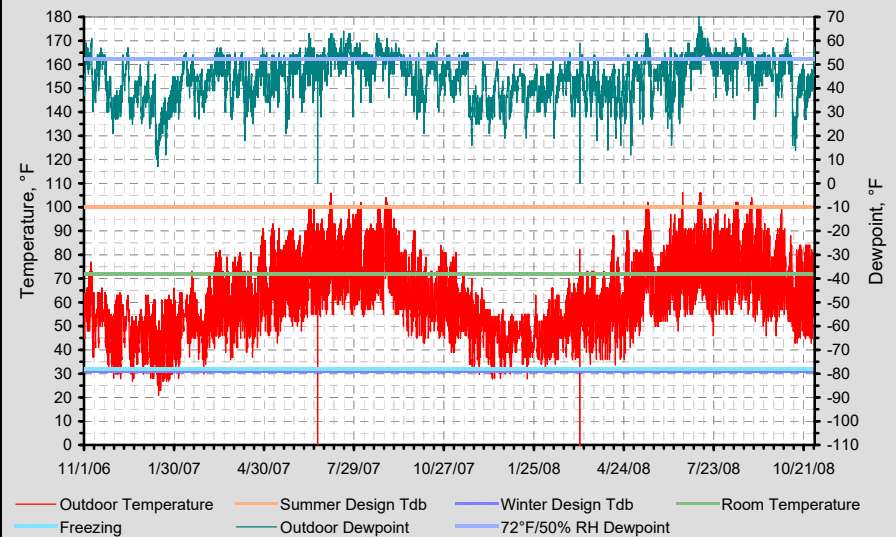
San Francisco, California Temperature and Dewpoint



... even in California

- All line colors code for the same thing
- All temperature scales are the same
- Dry bulb temperatures are the left axis
- Dew point temperatures are the right axis

Sacramento, California Temperature and Dewpoint





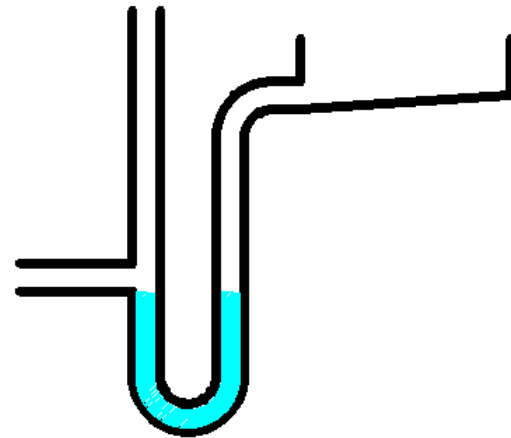
Marine Air;
Another Environmental Impact on Coils

COILS

Draining Condensate

UNIT OFF

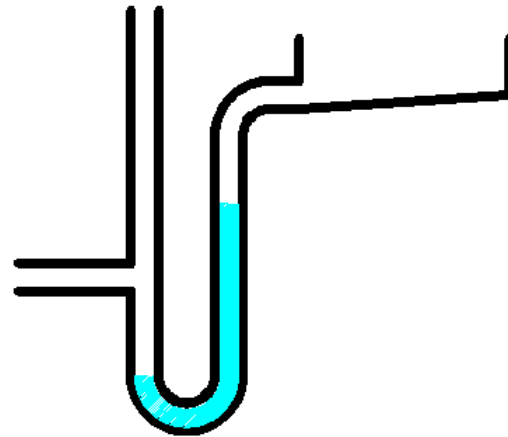
Water level on both sides of the trap equalizes because the pressure inside the unit is the same as the pressure outside the unit.



Draining Condensate

UNIT STARTS

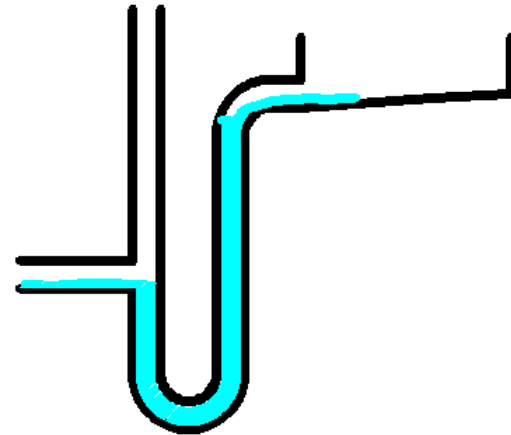
When the unit starts, the water level on the leaving side of the trap drops by an amount equal to the pressure drop through the unit to the drain pan location. The water level on the entering side of the trap rises by the same amount.



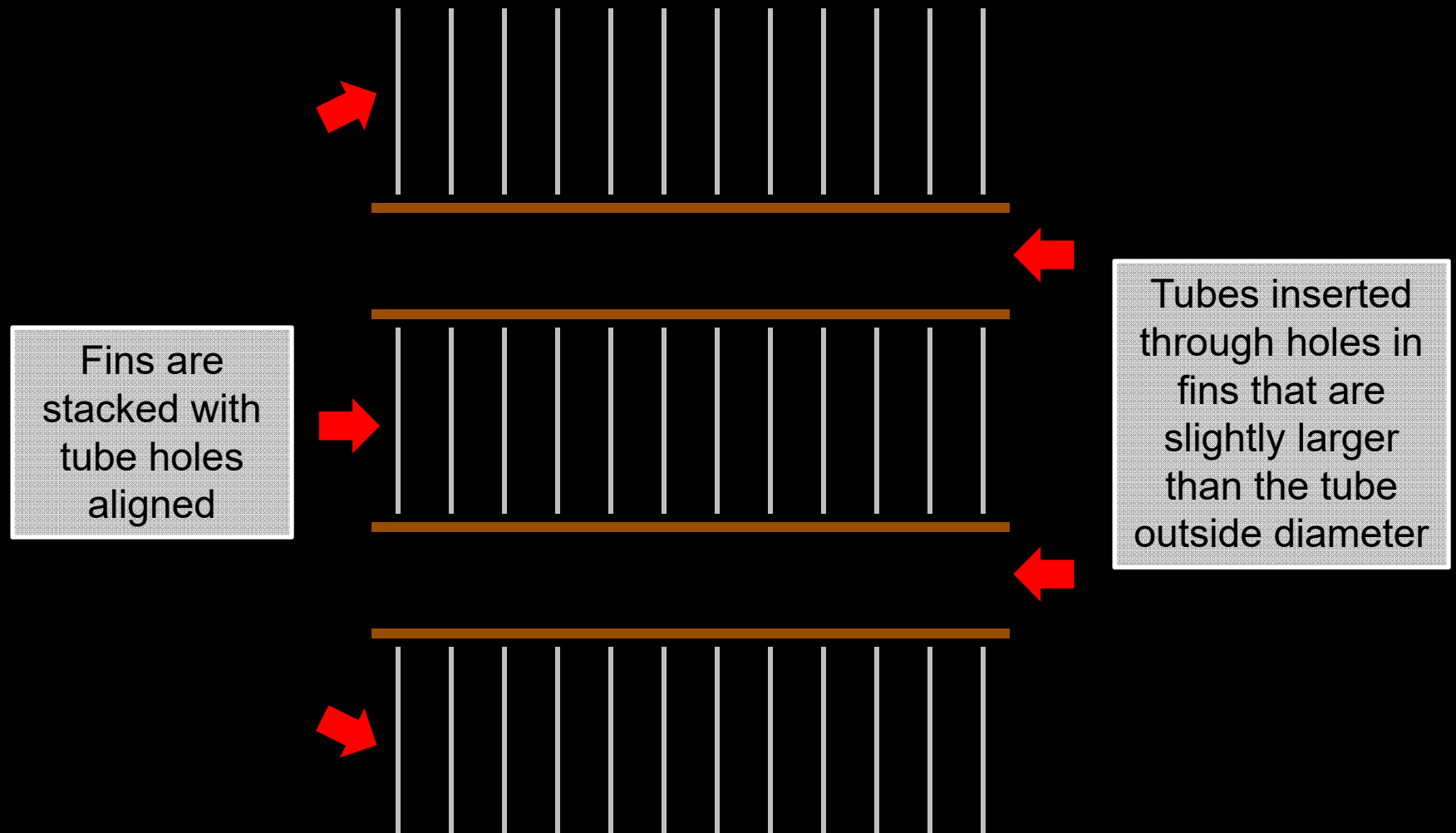
Draining Condensate

UNIT RUNNING

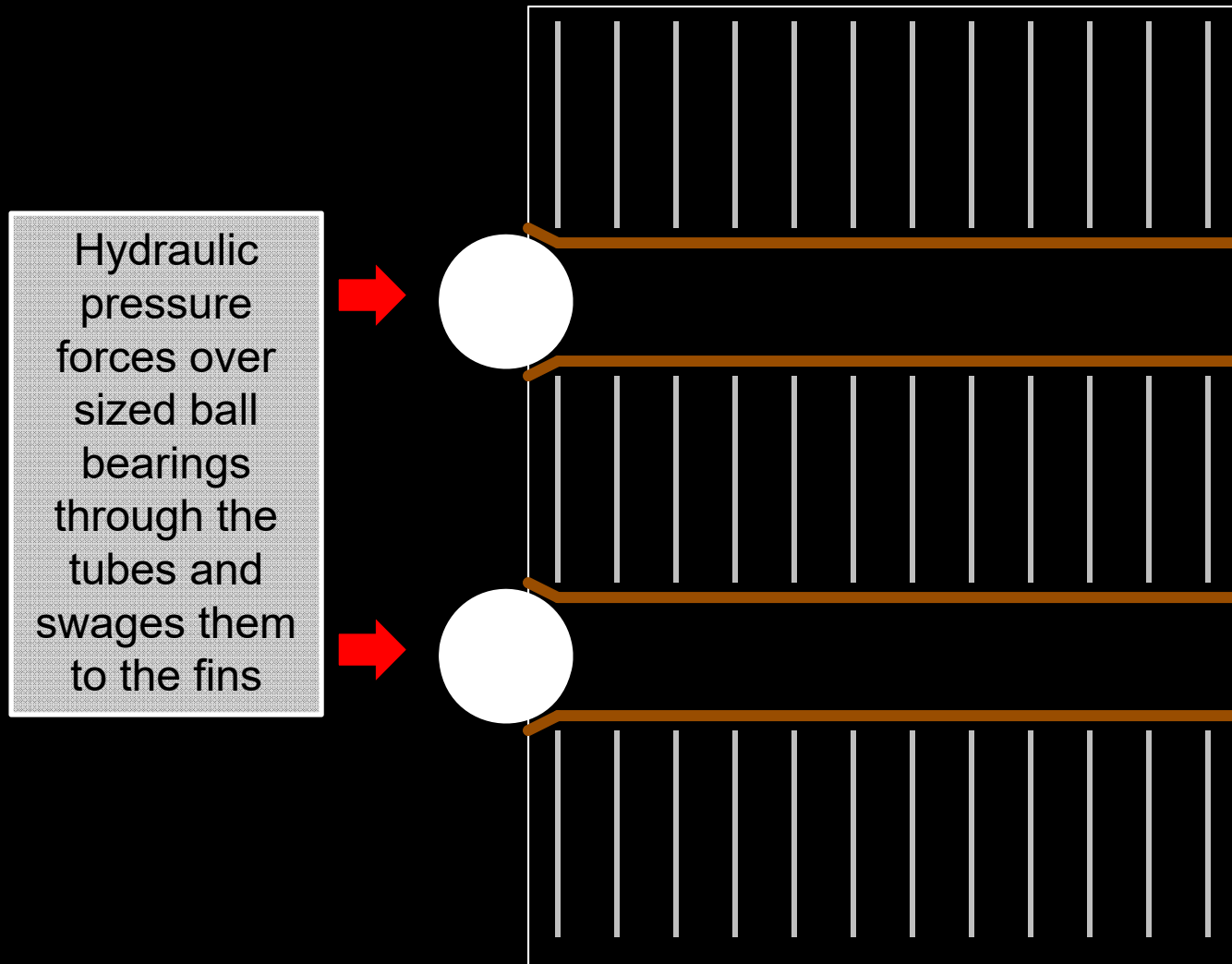
Additional condensate accumulates in the drain line, raising the level on both sides until the level on the leaving side reaches the discharge line. The condensate can now drain from the unit through the seal created by the trap.



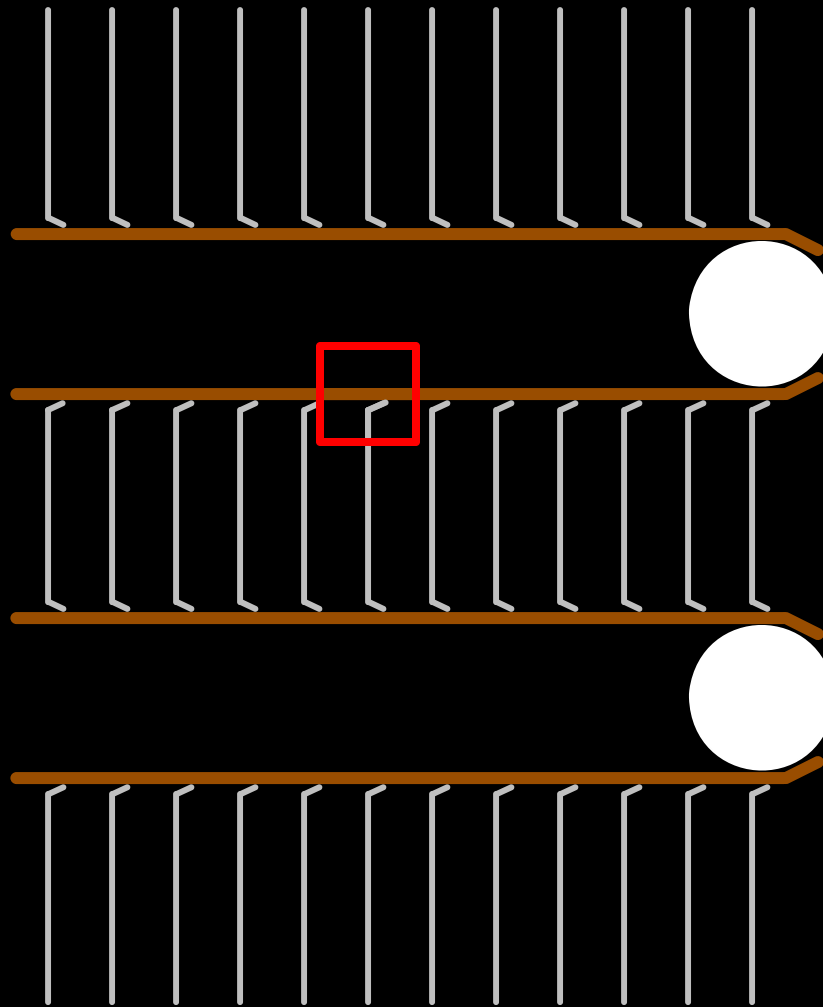
Typical Coil Fabrication



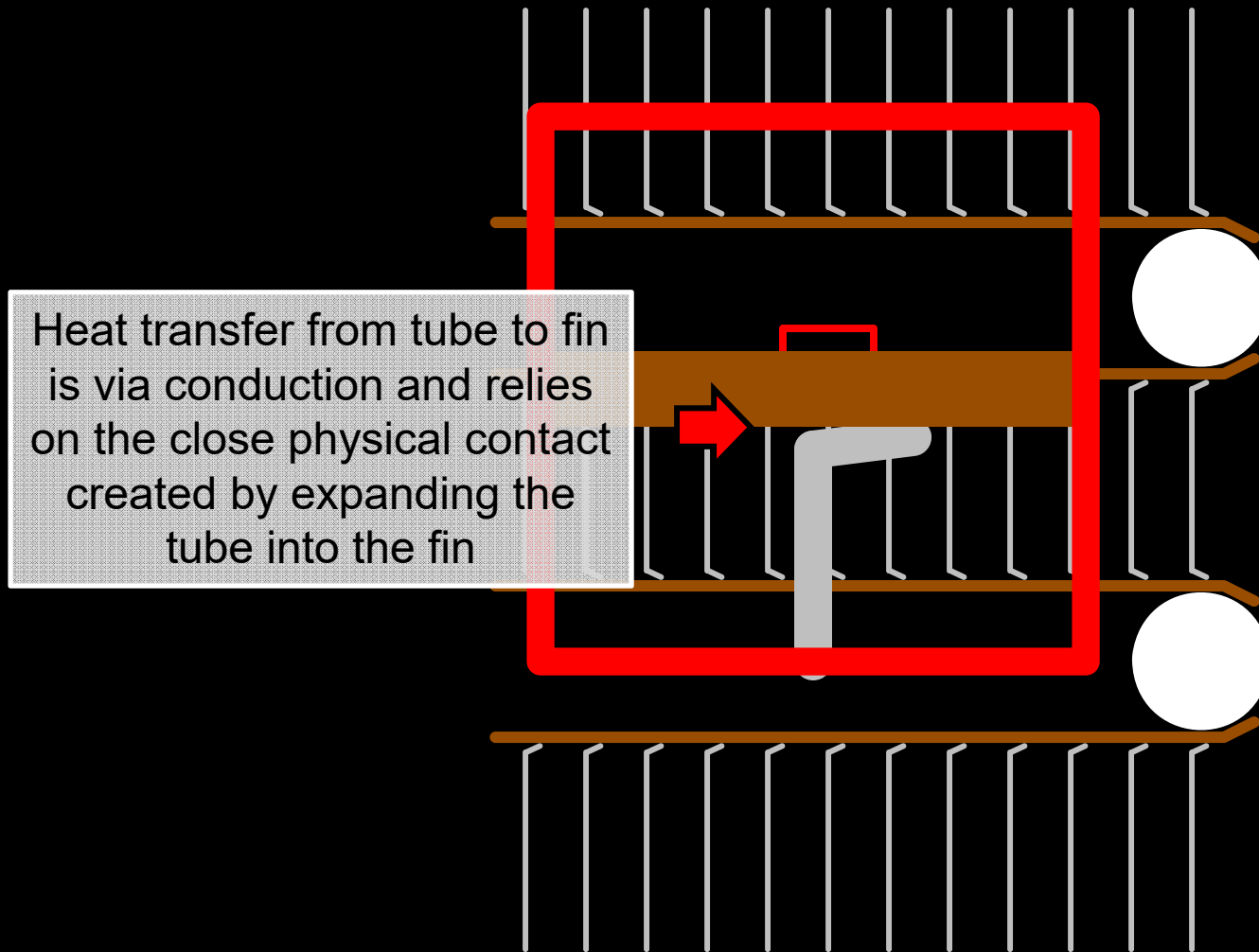
Typical Coil Fabrication



Typical Coil Fabrication



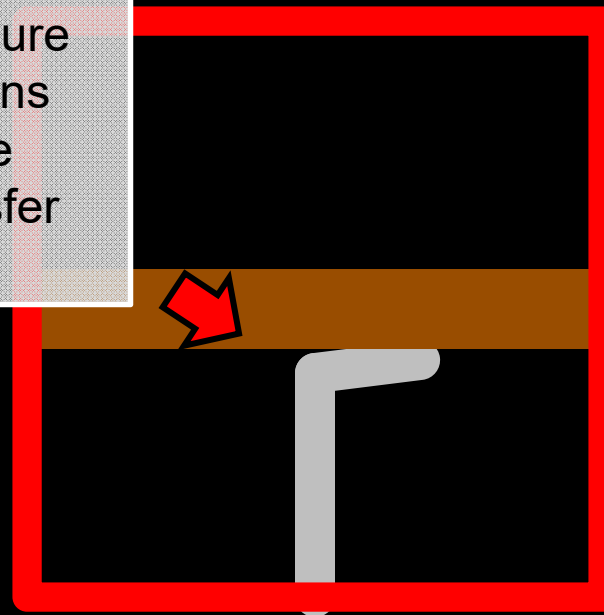
Typical Coil Fabrication



Typical Coil Fabrication



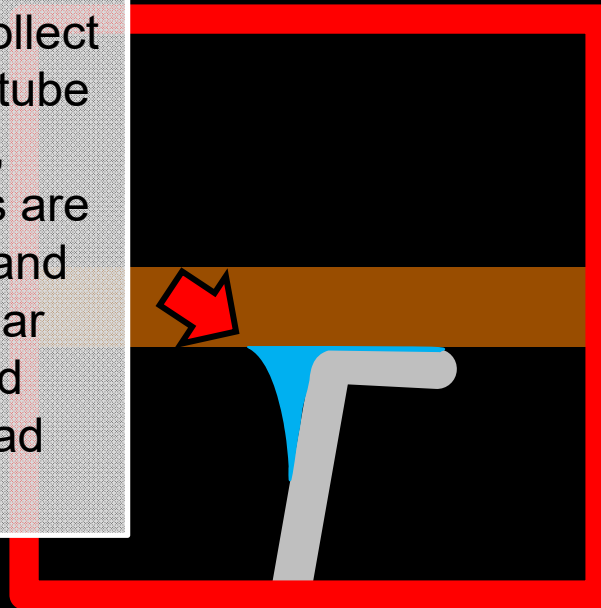
Force from high pressure washers can knock fins loose and break the conduction heat transfer path



Typical Coil Fabrication



Cleaning solutions can collect in gaps between fin and tube and cause corrosion, especially if the solutions are corrosive to begin with and especially with dissimilar metals like copper and aluminum, making a bad situation worse



Coil Cleaning Resources

Coil cleaning approaches and equipment

- <http://www.goodway.com/coil-cleaning.htm>
- http://www.bbjenviro.com/news_articles_031098.asp

Ultra-violet light is an lesser known technology targeted at disinfecting coils and eliminating biological fouling

The best approach for cleaning coils ...

... don't let them get dirty in the first place

Learning More about Coils

- USA Coil Website
 - www.usacoil.com/
 - Coil modeling program
 - Newsletters discussing coil construction and application details
- Keeprite Coil Website
 - <http://www.keepriterefrigeration.com/>
 - Selection tables
- Super Radiator Coil Company
 - <http://www.srcoils.com/>
 - Application bulletins discussing coil construction and operation

Learning by Experimenting

http://www.usacoil.com/cd.cfm



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FREE COIL SELECTION/ CALCULATION PROGRAM (CD-ROM)

USA Coil & Air has long been a leading manufacturer of coils, fan/coil units, and air handlers for the commercial and industrial HVAC market. Recognized as the leading retrofit and replacement specialists in the industry, USA products are backed by a long history of service and integrity.

USA offers you our "Windows" based coil selection program that can be used for free-standing coils, or coils installed in fan/coils or air handlers. This program is the finest and easiest to use of all the coil programs in HVAC industry.

Please complete the [Request Form](#) for more information.

Helpful Information For The Coil Selection Program

[Input Screens](#)
[Output Screens](#)
[Booster Coil Selection Module](#)
[Important Coil Selection Formulas](#)
[Conversion Factors](#)



Please note: These files require
Adobe Acrobat Reader 6.0, or higher.
[Click here to download.](#)



[En Español](#)

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Learning by Experimenting

http://www.greenheck.com/content/view/software_selection?ref=software

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Model Lookup:

CAPS

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CAPS FAQs

PSYCHROMETRIC
CALCULATOR

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SELECTION PROGRAM

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PROGRAM

Software » Coil Software Selection Program

Coil Software Selection Program

Release 3.4 Now Available!

Greenheck is happy to announce the latest release (Release 3.4) of our new coil selection and pricing software. Already popular among our current customers, the program now includes some great enhanced features. *Scroll down the page for the download link.*

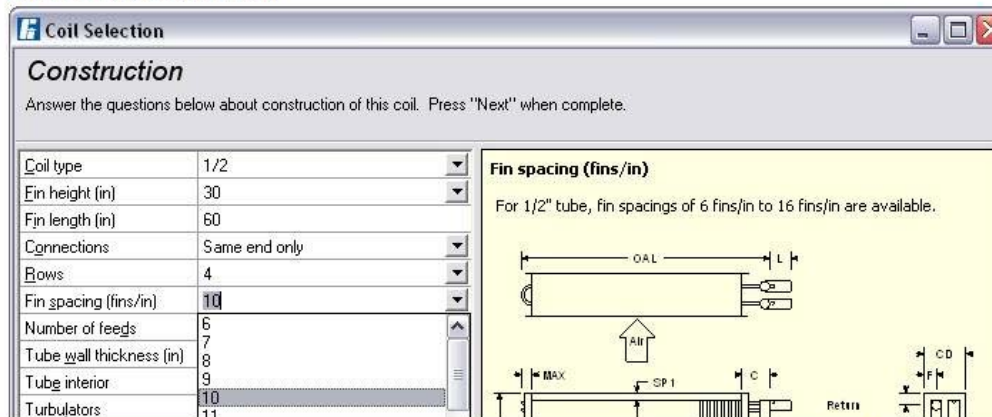
Before you install the program, you will need to obtain an activation code. [Click here to request your activation code.](#)

NOTE: If you have an older version of the software on your computer, the new version will override it. You will not need a new activation code. Simply scroll down to the bottom of this page and click on "Download Selection Program" and "Run."

Notable Features

Expanded 1/2" Coil Capabilities. We have expanded our product offerings for 1/2" coils. Check out these new options:

New Fin Spacing Range: 6 to 16 fpi



Coil Selection

Construction

Answer the questions below about construction of this coil. Press "Next" when complete.

Coil type	1/2
Fin height (in)	30
Fin length (in)	60
Connections	Same end only
Rows	4
Fin spacing (fins/in)	10
Number of feeds	6
Tube wall thickness (in)	7
Tube interior	9
Turbulators	11

Fin spacing (fins/in)

For 1/2" tube, fin spacings of 6 fins/in to 16 fins/in are available.

