



NuClimate

zehnder

always the
best climate

Robert Button

National Sales Manager NuClimate Product Line

INDUCTION & CHILLED BEAM TECHNOLOGY

Made in America for the American Market

Overview

General Knowledge

How Induction works

Operation, History & Evolution

Sensible only Designs

Fully Condensing Designs

Challenges

System Design

Installations

Benefits

Software & Support Documentation



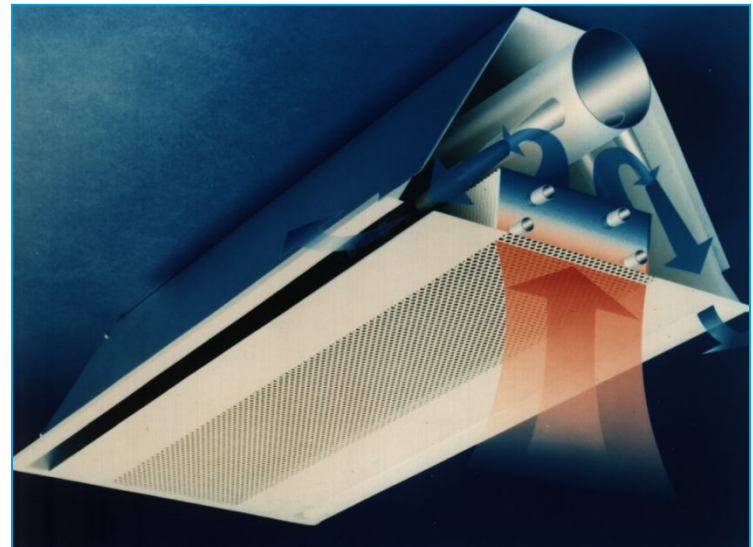
Evolution

Rebirth in Europe in 1990's

Europe is a Hydronic heating market – 78DB/67WB in Cooling mode

Europe designs based on low cooling load requirements

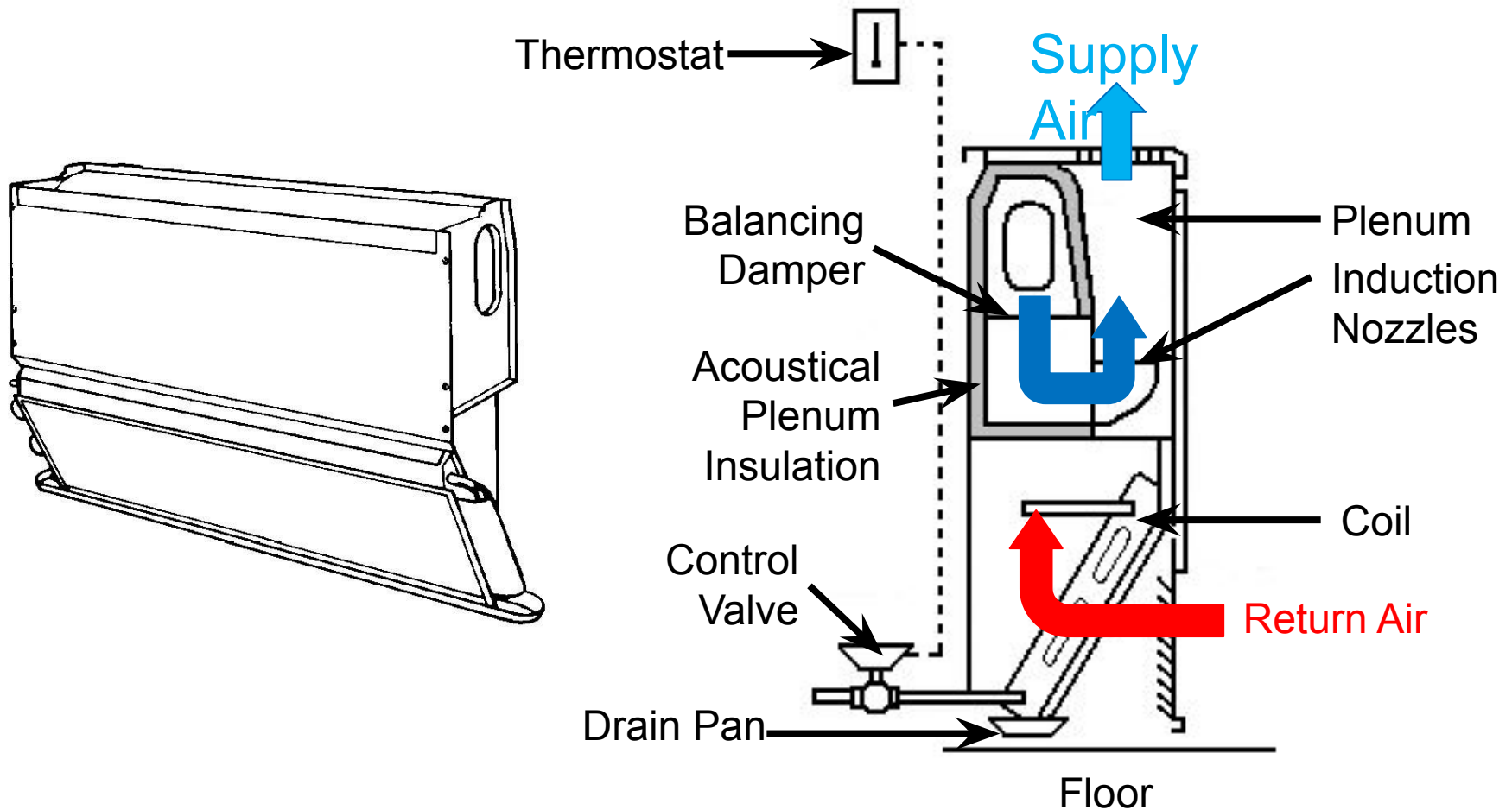
Similar spaces in Europe are less square feet than in the US



History

Began with Carrier 36S Series Induction Unit

Units require higher static pressure to work, up to 2"

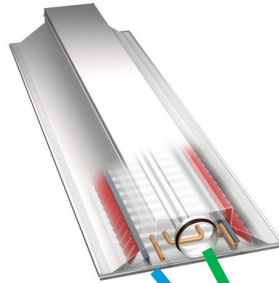


Operation

Sensible Only Chilled Beams (no drain pans)

58 to 62°F Chilled water

120 to 180°F Hot water

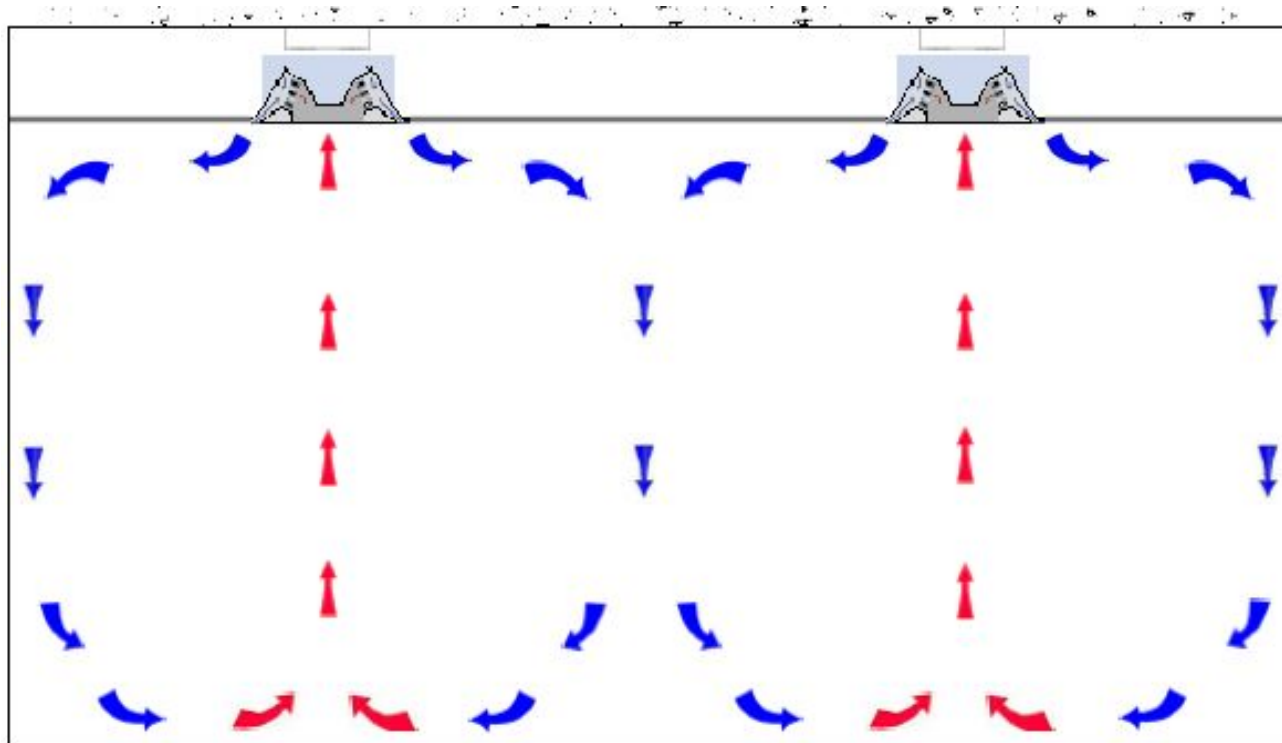


Primary Ventilation Air:

41 to 48 grains

50-70°F EAT

0.2"-0.8" Inlet Pressure

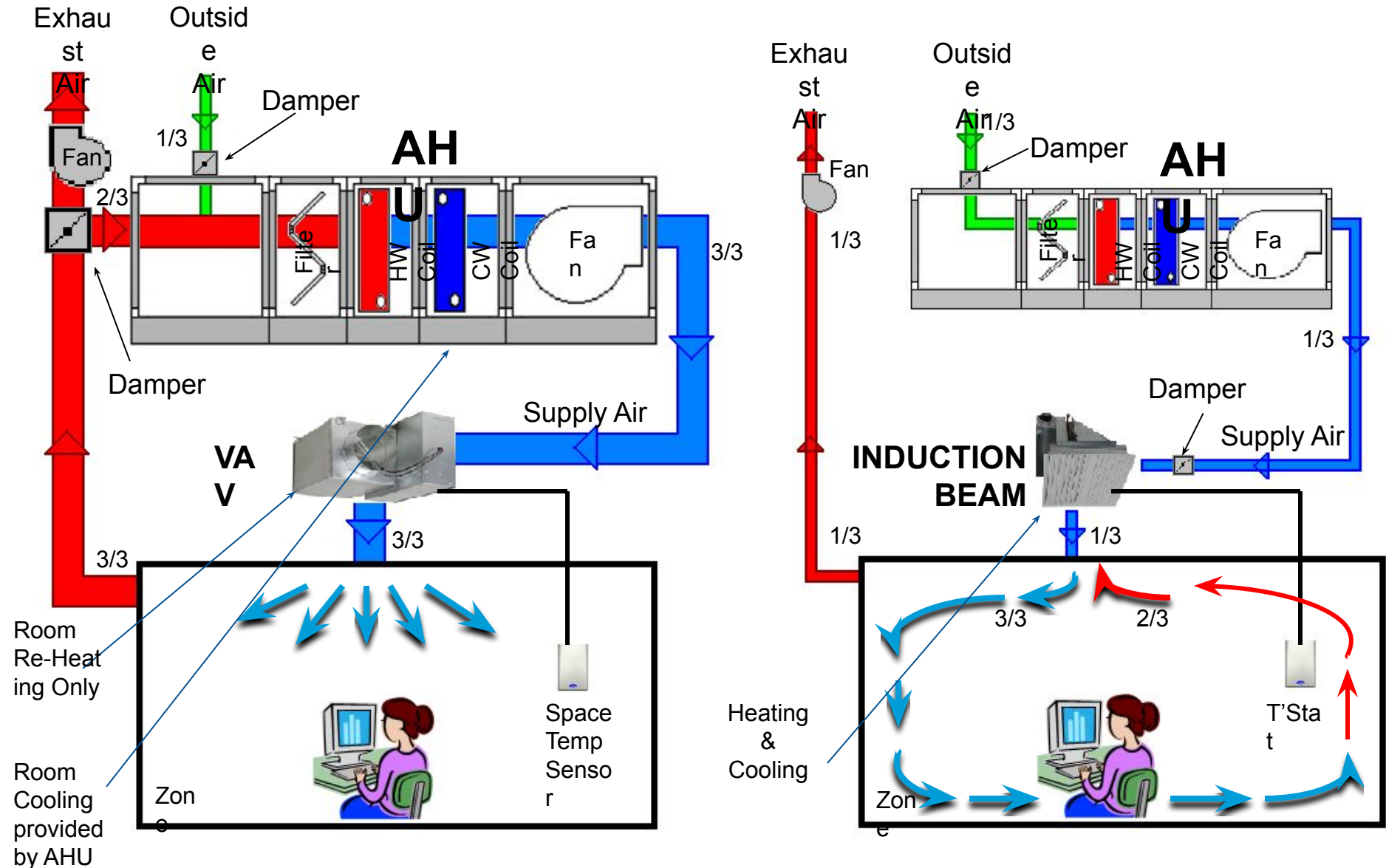


Room Conditions
75DB/50RH

50% RH design
or lower helps
reduce the
condensation
risk

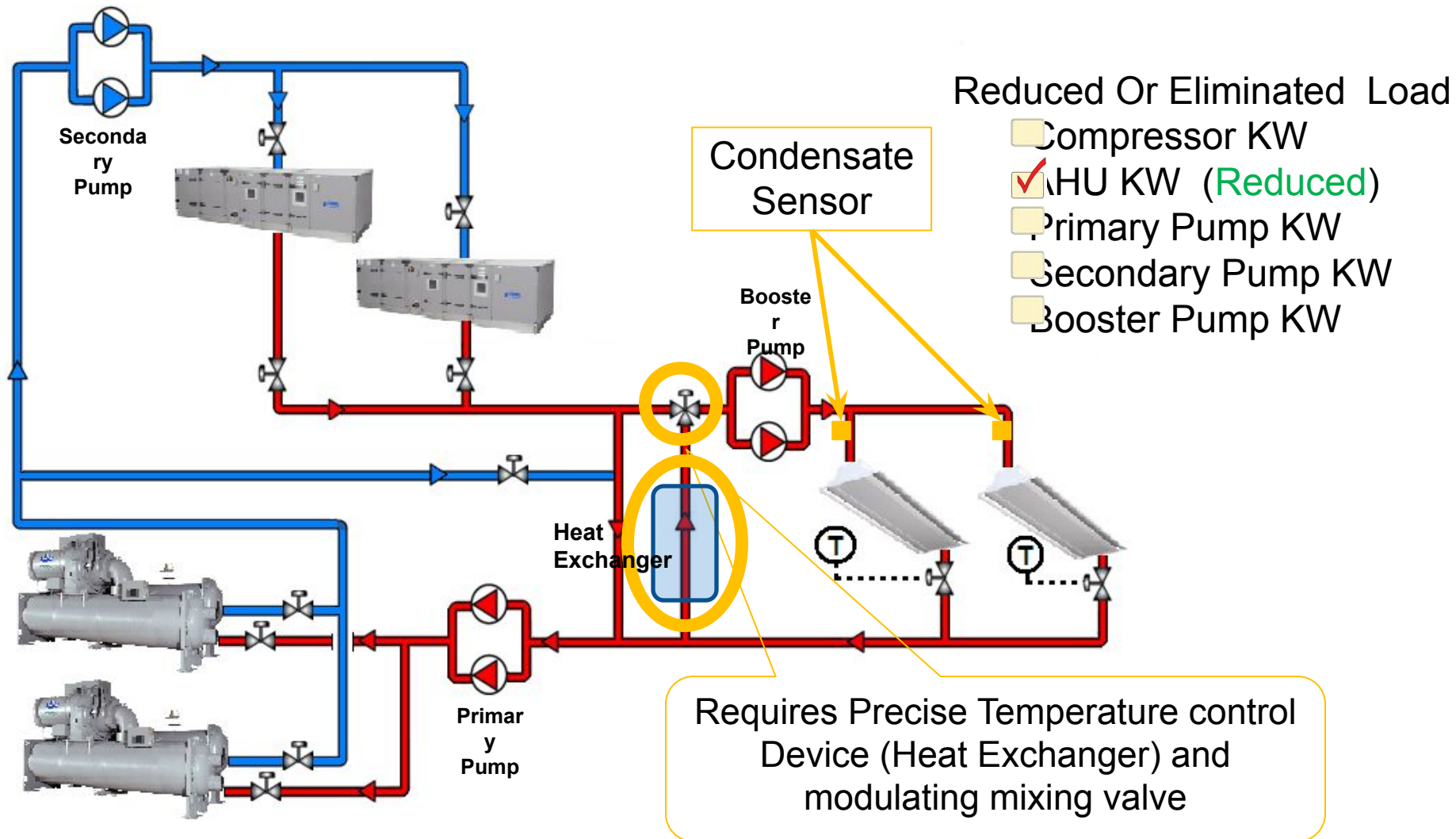
Fan Energy Savings!

Traditional VAV vs. Induction/Chilled Beam



System Design

Primary – Secondary Loop System. Sensible Only Chilled Beams



Most building are designed for 75db/62wb/50%RH or 75db/61wb/45%RH

TRADITIONAL

Building Design Conditions

Building Design Temp
Relative Humidity

Condition # 1

75° F

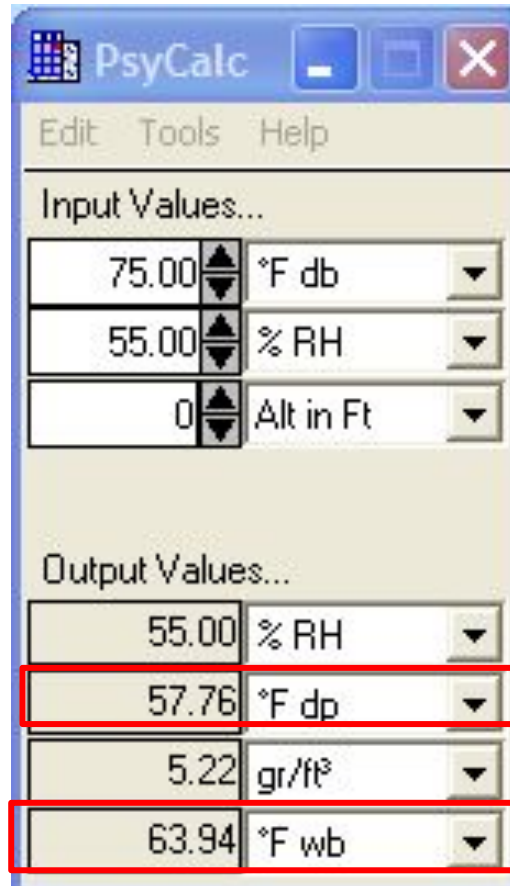
55 %

Condition # 2

75° F

50 %

**Dew
Points
Wet Bulb
Temp**



PsyCalc

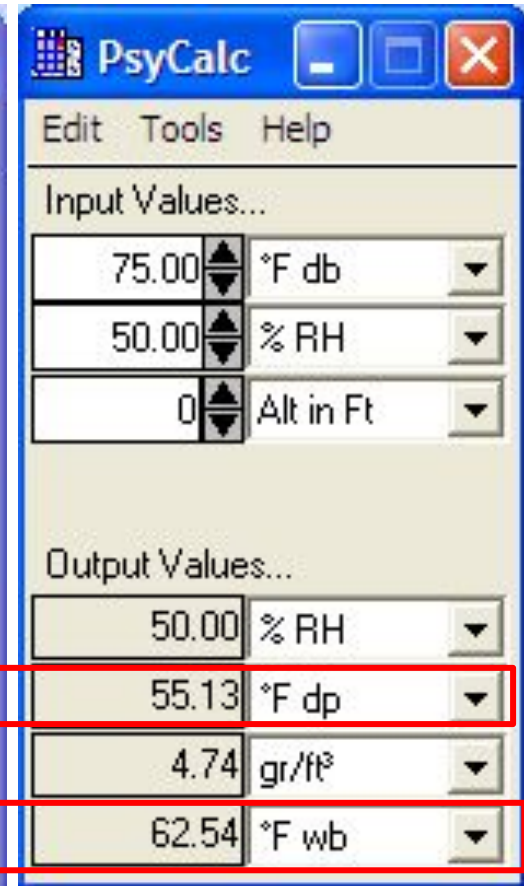
Edit Tools Help

Input Values...

75.00	°F db
55.00	% RH
0	Alt in Ft

Output Values...

55.00	% RH
57.76	°F dp
5.22	gr/ft³
63.94	°F wb



PsyCalc

Edit Tools Help

Input Values...

75.00	°F db
50.00	% RH
0	Alt in Ft

Output Values...

50.00	% RH
55.13	°F dp
4.74	gr/ft³
62.54	°F wb

TRADITIONAL CHILLED BEAM LIMITATIONS

The image displays two side-by-side screenshots of the 'Chilled Water Coil' software interface, comparing results for two different wet bulb temperature inputs. The left screenshot shows a wet bulb temperature of 64°F, while the right screenshot shows 65°F. Both screenshots include a 'PsyCalc' window showing calculated psychrometric values.

Chilled Water Coil Software Data:

Parameter	Left Screenshot (64°F WB)	Right Screenshot (65°F WB)
Customer ID	[Blank]	[Blank]
Date	6/15/2012	6/15/2012
Fin Height	5	5
Tubes High	4	4
Fin Length	42	42
FPI	8	8
Rows Deep	2	2
Tube Wall	.016	.016
Fin Mat'l	Aluminum	Aluminum
Tube Fouling	0	0
Fin Fouling	0	0
#Circuits	1	1
Face Area Ft²	1.46	1.46
Face Vel FPM	82.29	82.29
SCFM	119	119
APD	0.006	0.009
Leaving Air °F (DB)	63.23	63.1
Leaving Air °F (WB)	0	60.65
Leaving Fluid °F	60.04	60.29
GPM	1.5	1.5
Connection Size	0.5	0.5
Coil Model	W4- 4x42.0-2-8	W4- 4x42.0-2-8
Rated and Certified In Accordance With	The Current Edition Of ARI Std. 410	The Current Edition Of ARI Std. 410
Total BtuH	1531	1716
Sensible BtuH	1531	1550
Fluid Vel FPS	2.55	2.55
FPD	4.18	4.18
Entering Air °F (DB)	75	75
Entering Air °F (WB)	64	65
ACFM	120	120
Entering Fluid °F	58	58
Altitude (FT)	0	0
Fluid Rise °F	[Blank]	[Blank]
GPM	1.5	1.5
Fluid Type	Water	Water
Gly %	[Blank]	[Blank]

PsyCalc Window Data:

Parameter	Left Screenshot (64°F WB)	Right Screenshot (65°F WB)
Input Values...		
75.00 °F db	75.00 °F db	75.00 °F db
64.00 °F wb	64.00 °F wb	65.00 °F wb
Alt in Ft	[Blank]	[Blank]
Output Values...		
55.22 % RH	55.22 % RH	58.88 % RH
57.87 °F dp	57.87 °F dp	59.66 °F dp
5.24 gr/ft³	5.24 gr/ft³	5.59 gr/ft³
64.00 °F wb	64.00 °F wb	65.00 °F wb

Wet Bulb Temp

Dew Points

Chilled Water Coil Rating - Program Version 2.0

Date: 01-14-2013

Customer ID:

CoilModel: W4- 4x42.0-2-8

Coil Construction:

Fin Height: 5"

Fin Length: 42"

Fin Thickness: .0075"

Tube Wall: .016"

Circuits: 1

Rows Deep: 2

FPI: 8

Fin Material: Aluminum

Tube Material: Copper

Connection Size: 0.5"

Fin Type: Sine Wave

Tube O.D.: 1/2"

Face Area: 1.46 ft²

1,531 BTUH

Rating Conditions:

Entering DB: 75° f

CFM: 120

Fluid Temp In: 58° f

Fluid: Water

Entering WB: 64° f

Altitude: 0 ft

GPM: 1.5

% Glycol:

1.5 GPM

SCFM: 119

Performance:

Total btuh: 1,531

Leaving DB: 63.2° f

Face Velocity: 82 fpm

Fluid Temp Out: 60.° f

Sensible btuh: 1,531

Leaving WB: .° f

Air Press. Drop: .01"

Fluid Velocity: 2.6 fps

Fluid Pressure Drop: 4.2'

Challenges in USA

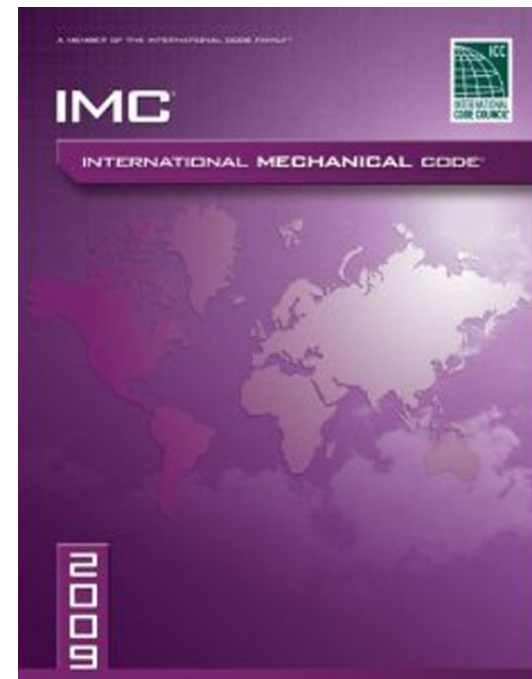
- Higher Sensible and Latent Load Densities
- Higher Outside Air Latent Loads
- Code compliant drain pans required. (Sen. only exception)
- Spaces maintained to 75DB/64WB/55RH or Lower
- Requires tight control of space to avoid condensation
- Must apply necessary protection – dew point control, condensation sensors, mixing valves, booster pumps, piping loops, controls.

Challenges & Requirements to Control Liability

Requirements in US Market

Requires drain pan to eliminate liability concerns.

307.2 Evaporators and cooling coils. Condensate drain systems shall be provided for equipment and appliances containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with Sections 307.2.1 through 307.2.4



Challenges & Requirements

Requirements (cont..)

“...cast iron, galvanized steel, copper, cross-linked polyethylene, polybutylene, polyethylene, ABS, CPVC or PVC pipe or tubing...size shall be not less than ¾-inch...”

307.2.2 Drain pipe materials and sizes. Components of the condensate disposal system shall be cast iron, galvanized steel, copper, cross-linked polyethylene, polybutylene, polyethylene, ABS, CPVC or PVC pipe or tubing. All components shall be selected for the pressure and temperature rating of the installation. Condensate waste and drain line size shall be not less than ¾-inch (19 mm) internal diameter and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method. All horizontal sections of drain piping shall be installed in uniform alignment at a uniform slope.

“An auxiliary drain pan...”

307.2.3 Auxiliary and secondary drain systems. In addition to the requirements of Section 307.2.1, a secondary drain or auxiliary drain pan shall be required for each cooling or evaporator coil or fuel-fired appliance that produces condensate, where damage to any building components will occur as a result of overflow from the equipment drain pan or stoppage in the condensate drain piping. One of the following methods shall be used:

“A separate overflow drain line shall be connected to the drain pan provided with the equipment.”

“An auxiliary drain pan without a separate drain...”

“A water level detection device conforming to UL 508...The device shall be installed in the primary drain line, the overflow drain line, or in the equipment-supplied drain pan, located at a point higher than the primary...”

1. An auxiliary drain pan with a separate drain shall be provided under the coils on which condensation will occur. The auxiliary pan drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The pan shall have a minimum depth of 1.5 inches (38 mm), shall not be less than 3 inches (76 mm) larger than the unit or the coil dimensions in width and length and shall be constructed of corrosion-resistant material. Metallic pans shall have a minimum thickness of not less than 0.0276-inch (0.7 mm) galvanized sheet metal. Non-metallic pans shall have a minimum thickness of not less than 0.0625 inch (1.6 mm).
2. A separate overflow drain line shall be connected to the drain pan provided with the equipment. Such overflow drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The overflow drain line shall connect to the drain pan at a higher level than the primary drain connection.
3. An auxiliary drain pan without a separate drain line shall be provided under the coils on which condensate will occur. Such pan shall be equipped with a water-level detection device conforming to UL 508 that will shut off the equipment served prior to overflow of the pan. The auxiliary drain pan shall be constructed in accordance with Item 1 of this section.
4. A water level detection device conforming to UL 508 shall be provided that will shut off the equipment served in the event that the primary drain is blocked. The device shall be installed in the primary drain line, the overflow drain line, or in the equipment-supplied drain pan, located at a point higher than the primary

Sensible & Latent Induction Beams w/Drain Pans Fan Coils w/out Fans?

Higher Capacity

Provides Sensible and Latent Cooling

Occupant Comfort – No drafts

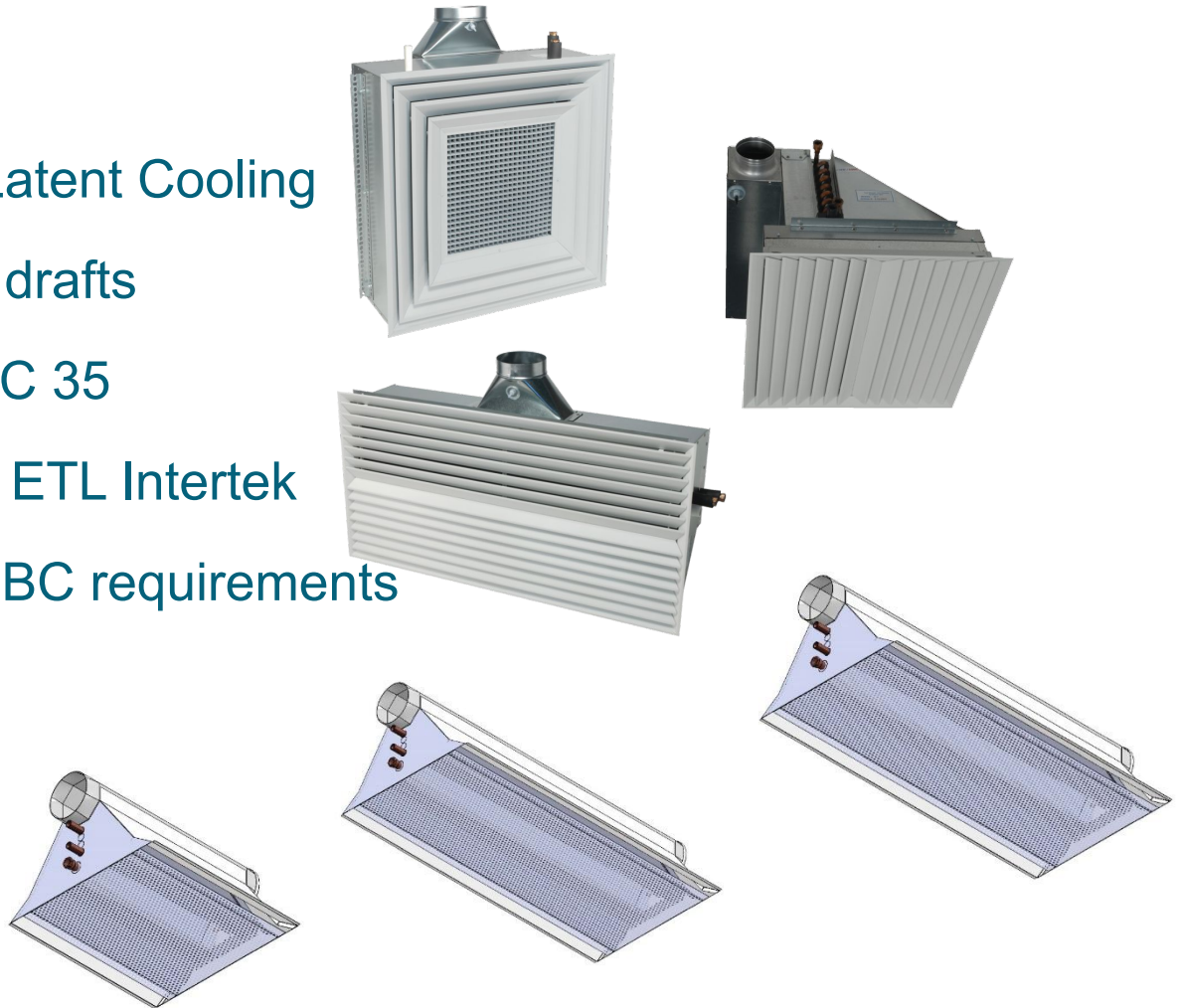
Noise Levels NC14 to NC 35

Independently tested by ETL Intertek

All Drain Pans meeting IBC requirements

No Filters Required

AHRI Certified Coils



Solution

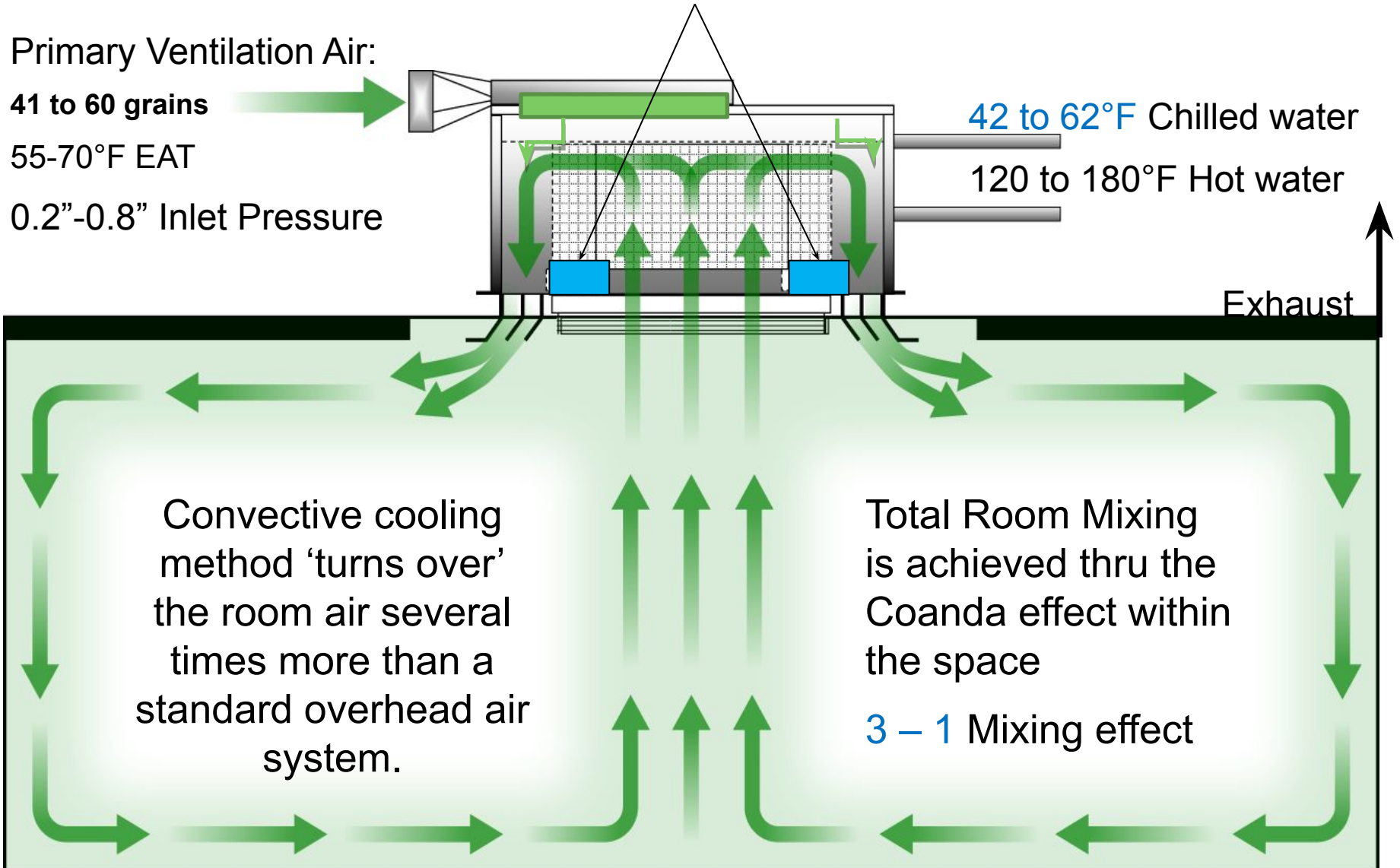
Induction Beam with Drain Pans

Primary Ventilation Air:

41 to 60 grains

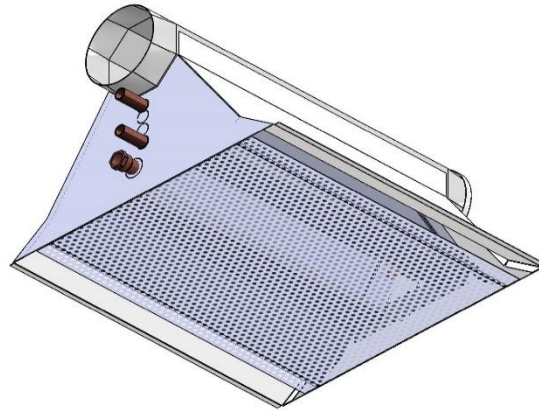
55-70°F EAT

0.2"-0.8" Inlet Pressure

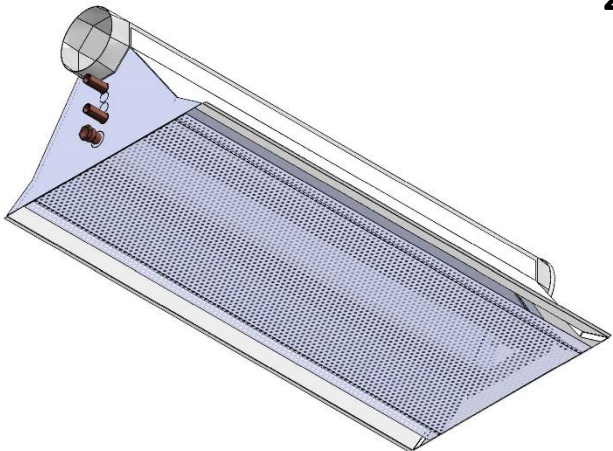


INDUCTION BEAMS WITH DRAIN PANS

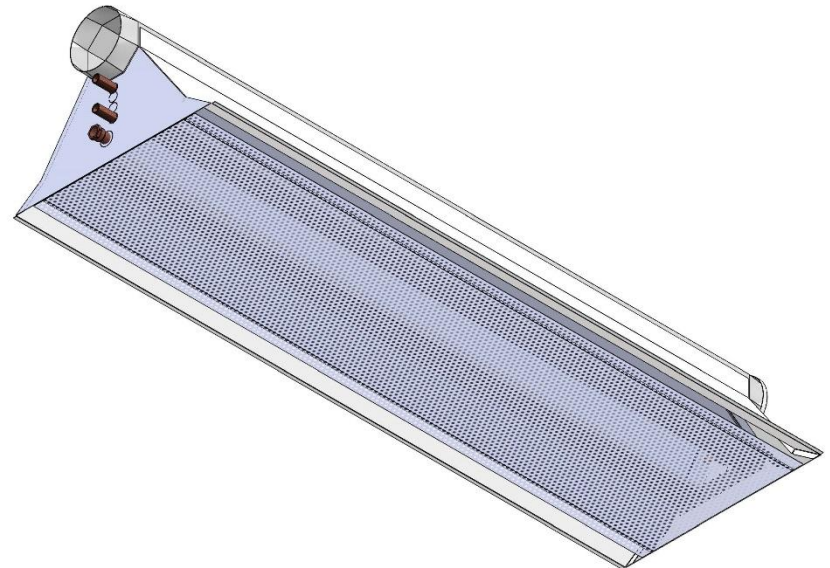
1-Way, 2-Way Blow & All Way - Induction Rates from 3 to 1 thru 7 – 1
0.2"-0.8" Inlet Pressure



24" X 24"



48" X 24"



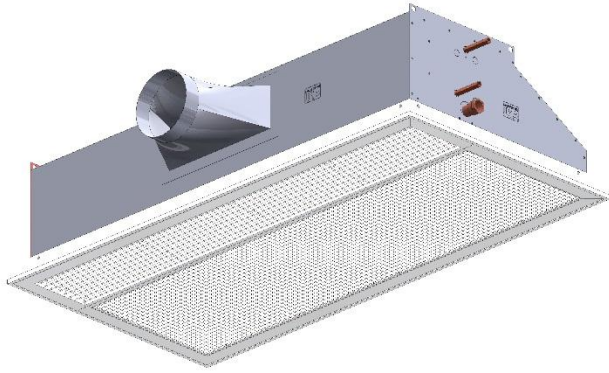
72" X 24"



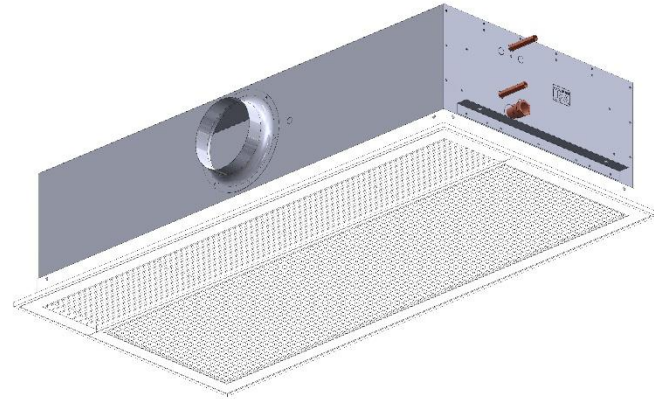


L-285-W
Rev. 8
P.O. # 3402887
JAN No. 87111-08

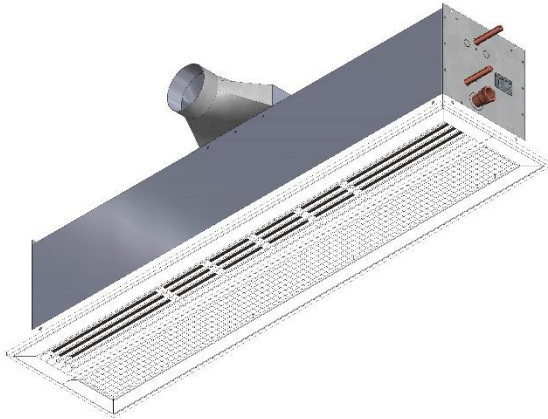
INDUCTION BEAMS WITH DRAIN PANS



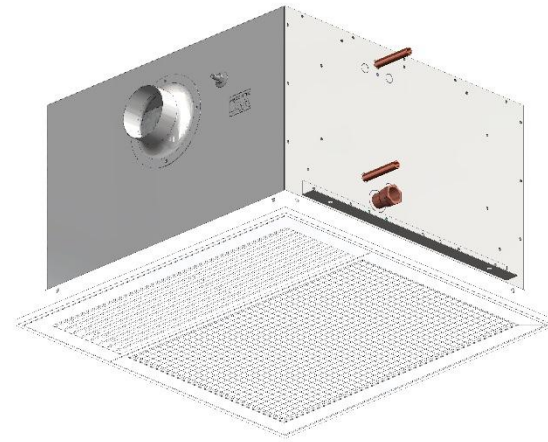
24" X 48"



24" X 48"

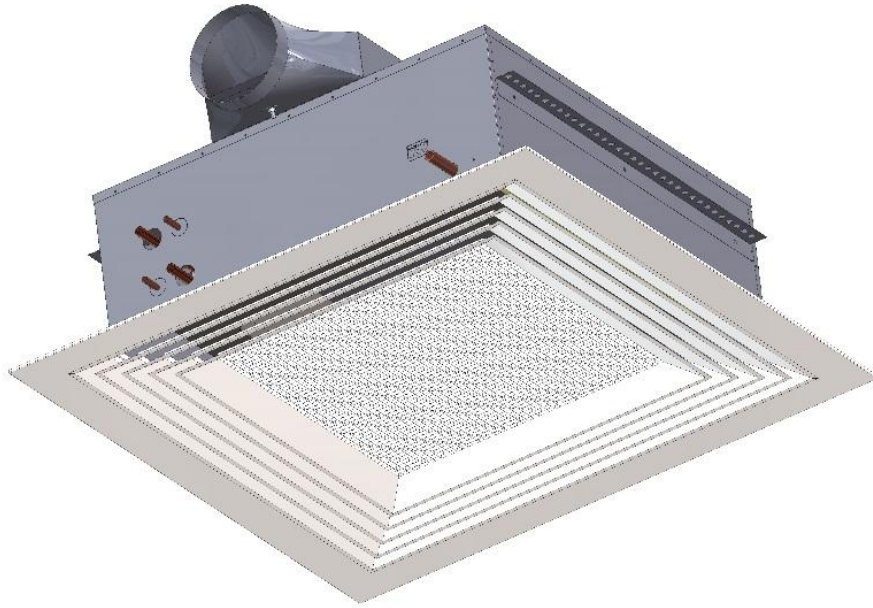


12" X 48"

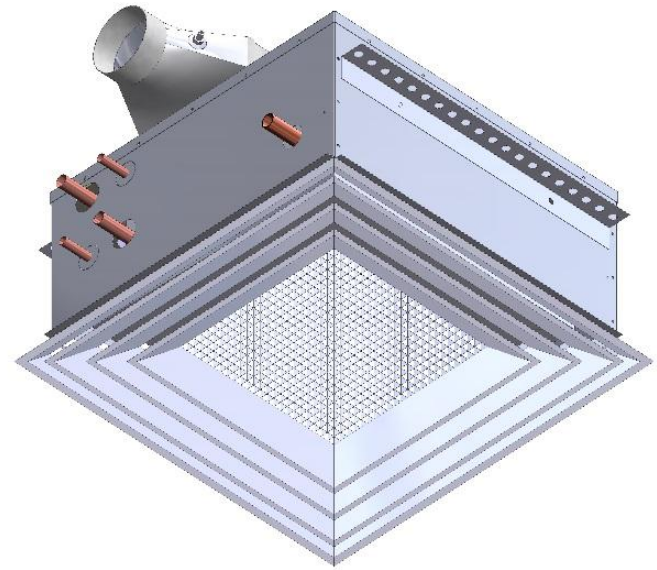


24" X 24"

INDUCTION BEAMS WITH DRAIN PANS



48" X 48"



24" X 24"

Soffit / Bulkhead Induction Unit



Chilled Water Coil Rating - Program Version 2.0

Date: 01-14-2013

Customer ID:

CoilModel: W4- 4x42.0-2-8

Coil Construction:

Fin Height: 5"

Fin Length: 42"

Fin Thickness: .0075"

Tube Wall: .016"

Circuits: 1

Rows Deep: 2

FPI: 8

Fin Material: Aluminum

Tube Material: Copper

Connection Size: 0.5"

Fin Type: Sine Wave

Tube O.D.: 1/2"

Face Area: 1.46 ft²

Rating Conditions:

Entering DB: 75° f

CFM: 120

Fluid Temp In: 58° f

Fluid: Water

Entering WB: 64° f

Altitude: 0 ft

GPM: 1.5

% Glycol:

1.5 GPM

SCFM: 119

Performance:

Total btuh: 1,531

Leaving DB: 63.2° f

Face Velocity: 82 fpm

Fluid Temp Out: 60.° f

Sensible btuh: 1,531

Leaving WB: .° f

Air Press. Drop: .01"

Fluid Velocity: 2.6 fps

Fluid Pressure Drop: 4.2'

*** Rated and Certified In Accordance With The Current Edition Of ARI Std. 410 ***

Chilled Water Coil Rating - Program Version 2.0

Date: 01-14-2013
Customer ID:
CoilModel: W4- 4x42.0-2-8

**At 42°@ 1.5 GPM
4,965 BTUH vs 1,531 BTUH
324% more capacity (same coil)**

Coil Construction:

Fin Height: 5"	Rows Deep: 2	
Fin Length: 42"	FPI: 8	
Fin Thickness: .0075"	Fin Material: Aluminum	Fin Type: Sine Wave
Tube Wall: .016"	Tube Material: Copper	Tube O.D.: 1/2"
# Circuits: 1	Connection Size: 0.5"	Face Area: 1.46 ft²

Rating Conditions:

Entering DB: 75° f	Entering WB: 64° f	1.5 GPM
CFM: 120	Altitude: 0 ft	SCFM: 119
Fluid Temp In: 42° f	GPM: 1.5	
Fluid: Water	% Glycol:	

Performance:

4,965 BTUH

Total btuh: 4,965	6.6F Delta T	Sensible btuh: 3,030
Leaving DB: 51.7° f		Leaving WB: 49.7° f
Face Velocity: 82 fpm		Air Press. Drop: .01"
Fluid Temp Out: 48.6° f		Fluid Velocity: 2.6 fps
		Fluid Pressure Drop: 4.4'

Chilled Water Coil Rating - Program Version 2.0

Date: 01-14-2013

Customer ID:

CoilModel: W4- 4x42.0-2-8

**At .5 GPM or 1/3 the total flow we
still Produce 3,490 BTUH vs 1,531
BTUH or 228% Greater Capacity**

Coil Construction:

Fin Height: 5"

Fin Length: 42"

Fin Thickness: .0075"

Tube Wall: .016"

Circuits: 1

Rows Deep: 2

FPI: 8

Fin Material: Aluminum

Tube Material: Copper

Connection Size: 0.5"

Fin Type: Sine Wave

Tube O.D.: 1/2"

Face Area: 1.46 ft²

Rating Conditions:

Entering DB: 75° f

CFM: 120

Fluid Temp In: 42° f

Fluid: Water

Entering WB: 64° f

Altitude: 0 ft

GPM: .5

% Glycol:

.5 GPM

SCFM: 119

3,490 BTUH

Performance:

Total btuh: 3,490

Leaving DB: 56.8° f

Face Velocity: 82 fpm

Fluid Temp Out: 55.9° f

13.9 DEGREE DELTA T

Sensible btuh: 2,365

Leaving WB: 54.4° f

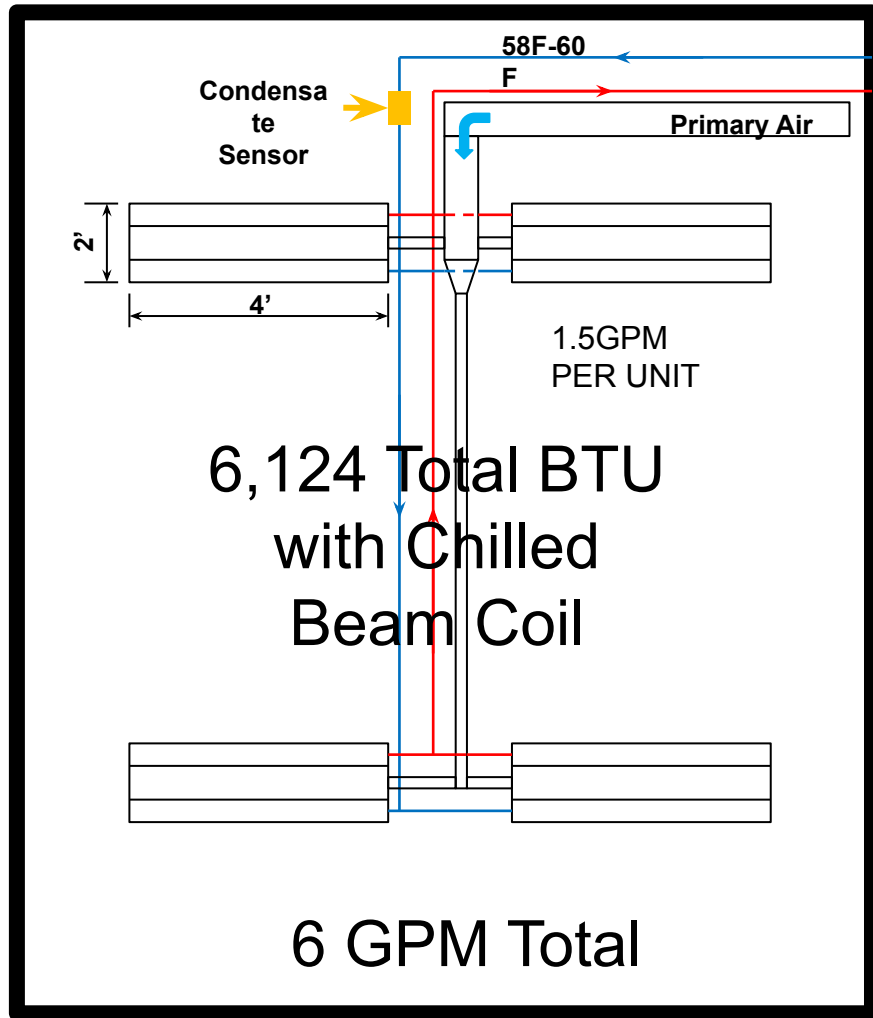
Air Press. Drop: .01"

Fluid Velocity: .9 fps

Fluid Pressure Drop: .5'

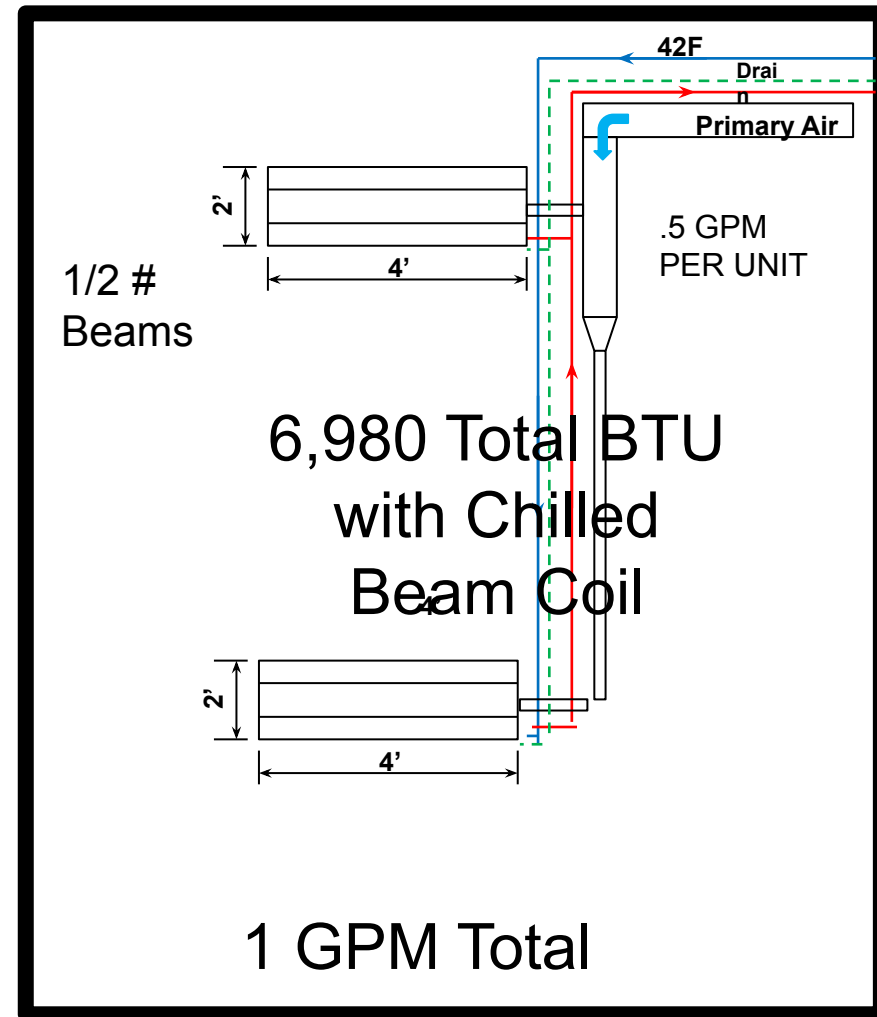
Applications

Zone Layout – Chilled Beam



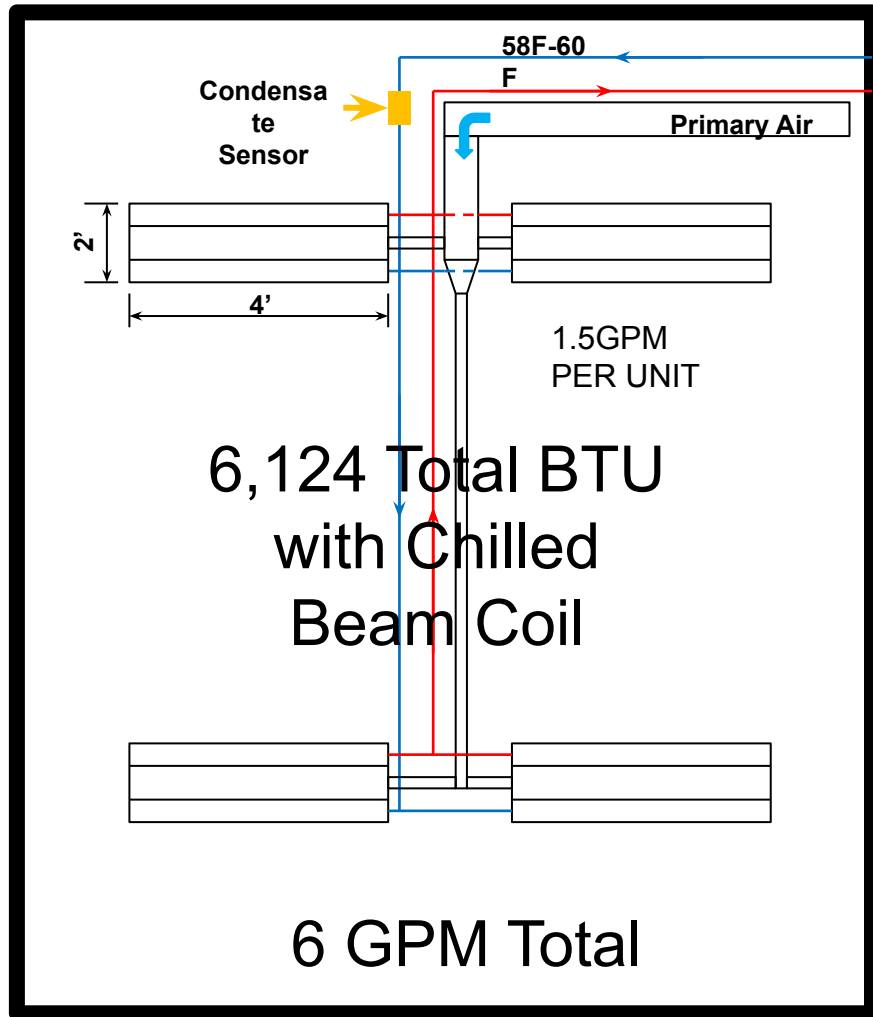
Applications

Zone Layout – Induction Beam

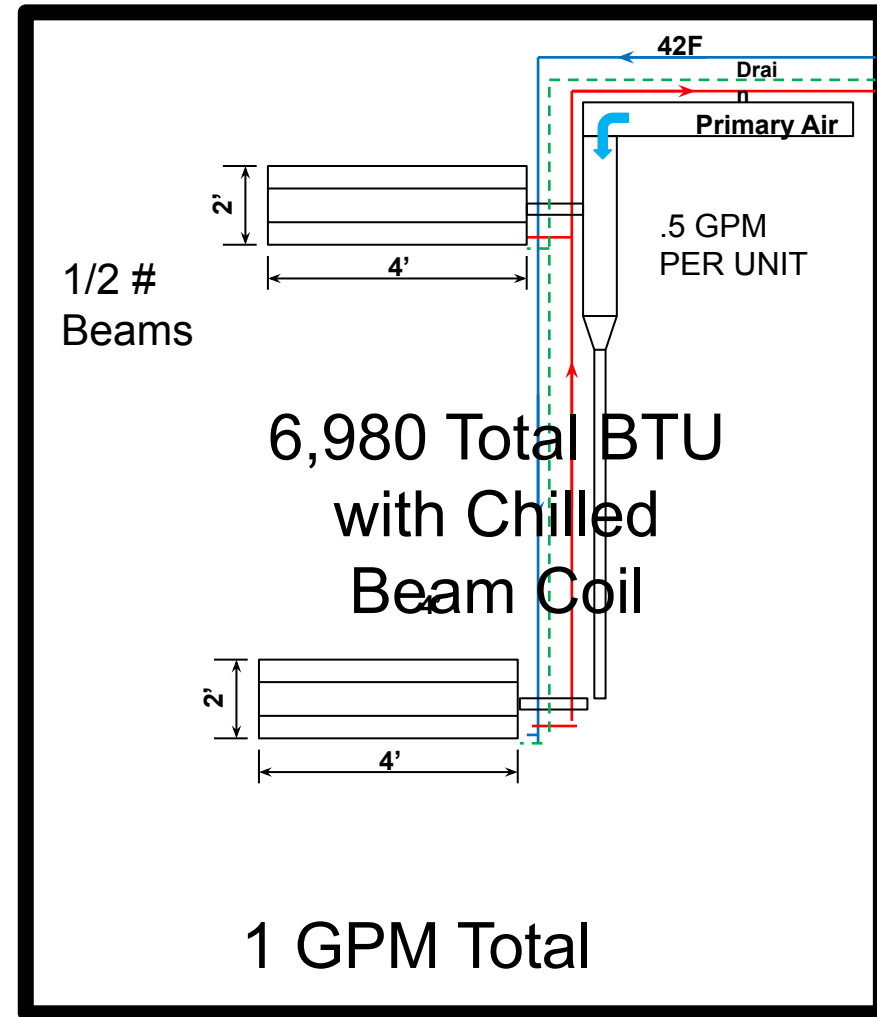


Applications

Zone Layout – Chilled Beam

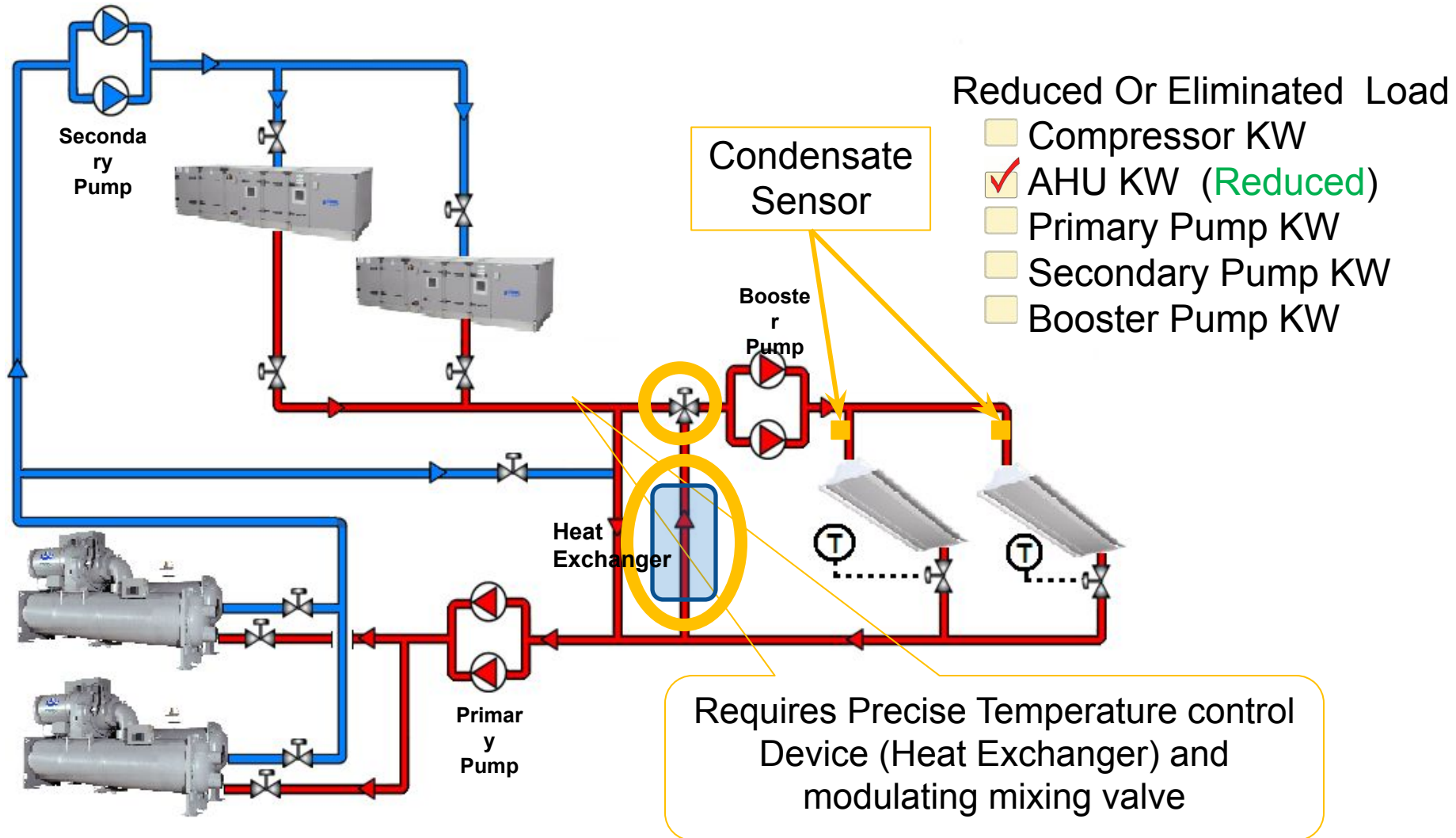


Zone Layout – Induction Beam



System Design

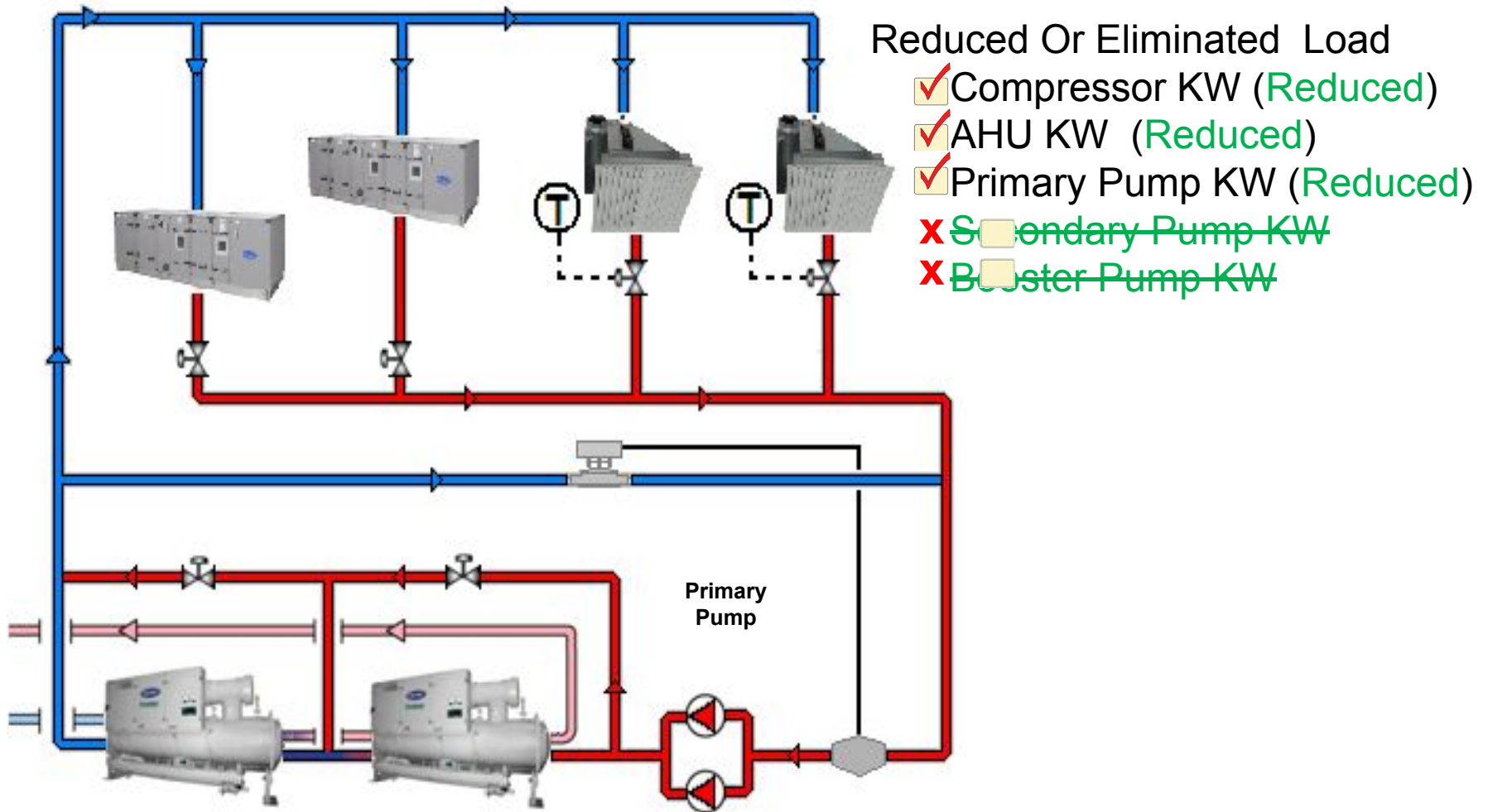
Primary – Secondary Loop System With Traditional Chilled Beams



Most building are designed for **75db/62wb/50%RH** or **75db/61wb/45%RH**

System Design

Primary Variable Loop System With Induction Beams



Most building are designed for 75db/64wb/55%RH or 75db/62wb/50%RH

Applications

- Educational
- Office
- University
- Health Care
- Laboratories
- Government
- Nursing Homes
- Public Library
- Police Stations
- Fire Stations
- Court House

Emerging Technologies

The following article was published in ASHRAE Journal, September 2007. ©Copyright 2007 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. It is presented for educational purposes only. The article may not be copied and/or distributed electronically or in paper form without permission of ASHRAE.

Chilled Beam Cooling

John Dieckmann, Member ASHRAE
Ph.D., Member ASHRAE

by different chilled beams primarily a chilled beam in the space and infiltration are the main source of humidity. Consequently, chilled beam systems in most climates usually require dedicated outdoor air systems (DOAS) and tight building envelopes to manage humidity. The DOAS handles the OA humidity loads prior to introduction to the space, with enough additional humidity removed to cover internal moisture generation.

Chilled beams are often well-suited for laboratories in applications where heat removed by laboratory and process

low levels. In most loads can vary and where safety is, however, rarely chilled high indoor heaters.^{1,2}

n. First, they require existing ventilation systems to satisfy OA requirements [62 Pa to 124 Pa] for central and DOAS units with heat of the DOAS rejects and to the quantity consumed to use higher conditioning 59°F to 45°F cooling loads 20% higher cooling loads reduction of 6 feet as in air greatly using exhaust

ber: 2007



Photo 1: The Tahoe Center for Environmental Sciences in a chilled beam to eliminate reheat.

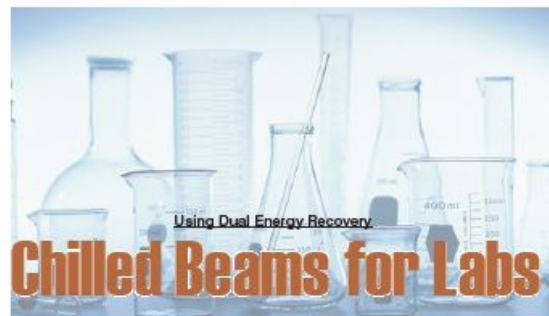
Chilled Beams Eliminating Reheat & S

By Peter Rumsey, P.E., Member ASHRAE; and Jo

In laboratories, the use of active chilled beam induction diffusers, allows designers to decouple requirements from sensible heating and cooling carefully and thoughtfully, this strategy can dramatically reduce reheat energy and air-handling system size. In project where active chilled beams were used, air handlers and ductwork was reduced by 40% eliminated completely.

18 ASHRAE Journal as

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By Barry M. Barnet, P.E.

This article illustrates the potential energy savings for cooling and heating laboratories by using a design that combines active chilled beams with a ventilation system that uses dual energy recovery. Energy simulations were conducted through an hourly analysis program, using as a model the New Jersey Economic Development Authority (NJEDA) Tech IV building in New Brunswick, N.J. This facility is one in a series of flexible open laboratories conceived to provide state-of-the-art, affordable laboratory, office, and production facilities for emerging and established technology companies. NJEDA Tech IV comprises about 20,000 m² (1858 m²) of laboratory, office, and associated support space.

According to the U.S. Green Building Council, commercial buildings account for approximately 60% of the electric power and more than 30% of the fossil fuel energy used in the United States. Laboratory buildings typically consume up to 10 times the energy of office buildings.¹ The amount of energy needed in laboratory buildings for HVAC typically ranges from 50% to 80% of the total energy used by the building. The HVAC

consumption is partially attributable to the high equipment and lighting loads typical for laboratories, resulting in a much greater requirement for cooling energy. However, another key factor is the greater amount of outside air usually required in laboratory applications. The air-handling units for laboratory buildings are typically 100% outside air without recirculation. The amount of outside air required is determined by three basic factors which,

on a room-by-room basis, determine the overall size of the 100% outside air-handling unit. The first factor is the minimum required for an acceptable air change rate per hour (ACH). This is generally in the range of 6 to 10 ACH minimum.² The rooms for which this is the determining factor are described as "air-change driven." The second factor is the amount of air required to make up for air exhausted outside through hoods and other devices. These rooms are referred to as "exhaust-driven." The third factor is determined through a traditional design approach, which calculates the amount of air required to cool the room with air supply of about 55°F (13°C). These rooms are called "load-driven." In a given room, any one of these three considerations can be the determining factor in the amount of supply air required.

If a central system is supplying air to various spaces at a constant discharge temperature of 55°F (13°C), the rooms in which the amount of air supply was

About the Author

Barry M. Barnet, P.E., is senior associate and senior project engineer at HCR/CLAS in Princeton, NJ.

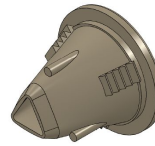
PRODUCT FEATURES

Nozzle Options

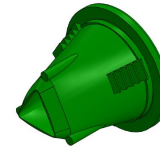
24



31

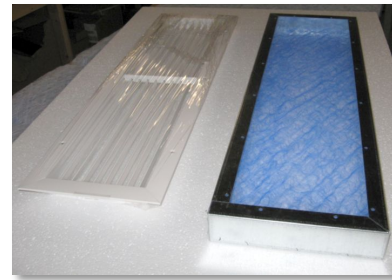
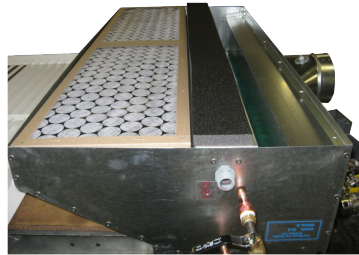


38



Filter Options

Throwaway
Washable
Special



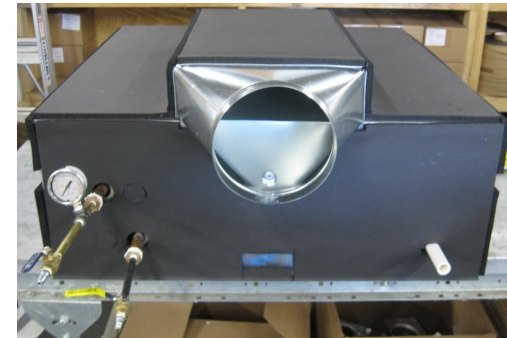
Other Special Features like

Variety Of Grille Style & Finish

Exterior Insulation

SS Drain Pan

Copper Connection Drain Pan



SENSIBLE ONLY CHILLED BEAM SYSTEMS (no drain pans)

When does it make sense?


- When energy efficiency is a driving factor, not first cost.
- When a dedicated chiller can produce 58° water or higher.
- When cooling requirements are low enough that minimum ventilation from the outside air can meet the sensible and latent space loads.
- When infiltration and other latent space loads can easily be controlled by the Air Handler.
- When ceiling space is very limited and running condensate lines is not possible.
- When facility staff is capable of handling more complex DOAS unit and controls.

SUMMARY

INDUCTION BEAM SYSTEMS WITH DRAIN PANS

1940's to present day

- Proven sustainability & flexibility of Induction Technology.
- 50 + Year Hydronic Systems. Carrier 36S IU's (1940-Present)
- Lower first cost / greater capacity / less equipment & controls
- Central plants producing 45° water
- Single cold water loop, as few as ½ the # of terminal units.
- Often cooling requirements are greater than the capacity of sensible only Chilled beams at “minimum ventilation”.
- Design days or above: Hybrid IB system can have up to a 250% increase in cooling capacity. Capacity “at the ready”.
- Densely populated spaces with high latent loads: Schools, labs, dorms, universities & hospitals.
- Standard 100% O.A. AHU's with simple controls vs Custom DOAS



Q & A
Thank You