Condensing Rooftop Unit Training with BOMA Oregon

Presenters

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neea


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CHELAN COUNTY
Clark
Public
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EnergyTrust
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NorthWestern
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NW Natural
PACIFIC POWER
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City Light
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PUBLIC UTILITY DISTRICT NO. 1
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TACOMA PUBLIC UTILITIES

Agenda

- Objectives
- What is a Condensing RTU?
- Where should a Condensing RTU be installed?
- Case Studies
- Financial Considerations
- O&M Considerations
- Next Steps

Objectives

- Walk away with knowledge and familiarity of Condensing RTUs
- Debunk common myths about the technology
- Understand the financial business cases for considering Condensing RTUs
- Identify potential pilot sites

Pop Quiz

Of all of natural gas used in the U.S. in 2016, how much was used in the commercial sector?

A. 34%

B. 20%

C. 11%

D. 3%

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What is a Condensing RTU (C-RTU)?

What is a Rooftop Unit (RTU)?

- RTUs are HVAC equipment option used to heat/cool a commercial building
- They are packaged heating and cooling units located outdoors
- Generally the building is max 3 stories tall because the unit pushes conditioned air down into the building

Acronyms to Know

- RTU = Rooftop Unit
- C-RTU = Condensing Rooftop Unit
- DOAS = Dedicated Outside Air System
- MUA = Make Up Air
- OA = Outside Air
- EFLH = Equivalent Full-Load Hours (runtime)
- AFUE = Annual Fuel Utilization Efficiency
- TE = Thermal Efficiency
- CFM = Cubic Feet per Minute (air volume)
- kWh = Kilowatt Hours (electricity)
- BTU = British Thermal Units (gas)

What is a Condensing RTU?

We're all familiar with a condensing furnace in our residential homes

This is a condensing rooftop unit for our commercial buildings

What is a Condensing RTU?

- Packaged unit used for space heating, space cooling and ventilation
- Adds a secondary heat exchanger
- Requires condensate management

This is a condensing rooftop unit for our commercial buildings

Why do we care about C-RTUs?

How much of a building's gas usage is tied to space heating?

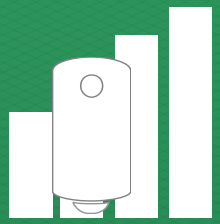
60%

of natural gas usage goes to space heating on average in U.S. commercial buildings

Current Market Strategy

Emerging Technologies

- Product development
- **Lab and field testing**
- Product feasibility and validation
- **Manufacturer engagement**



Market Development

- **Technical training**
- Sales training
- **Marketing support**
- **Incentives**

Research & Evaluation

- Market characterization
- Data acquisition

Codes & Standards

- **Eliminate barriers to installation found in local codes**

C-RTU Pictionary

How are your C-RTU drawing skills?

- Split into groups of 4 people each
- Your task? Draw the best condensing gas rooftop unit of your life
- After 2 minutes, we will compare drawings
- Winning team gets bragging rights for eternity

Here's one for comparison…

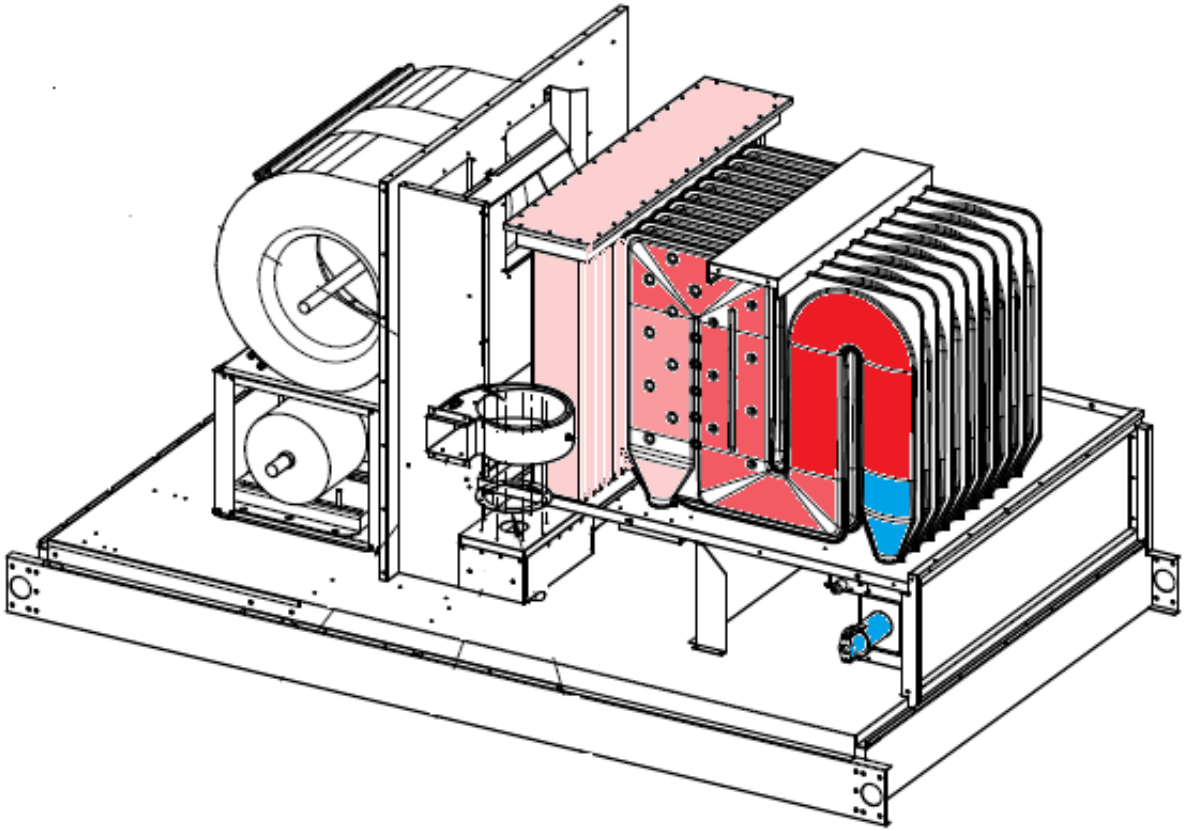


Image Credit: John McKissack, Nortek Reznor RHH Model C-RTU

Where Should a C-RTU be Installed?

What do these buildings have in common?

Retail

Medical / Healthcare

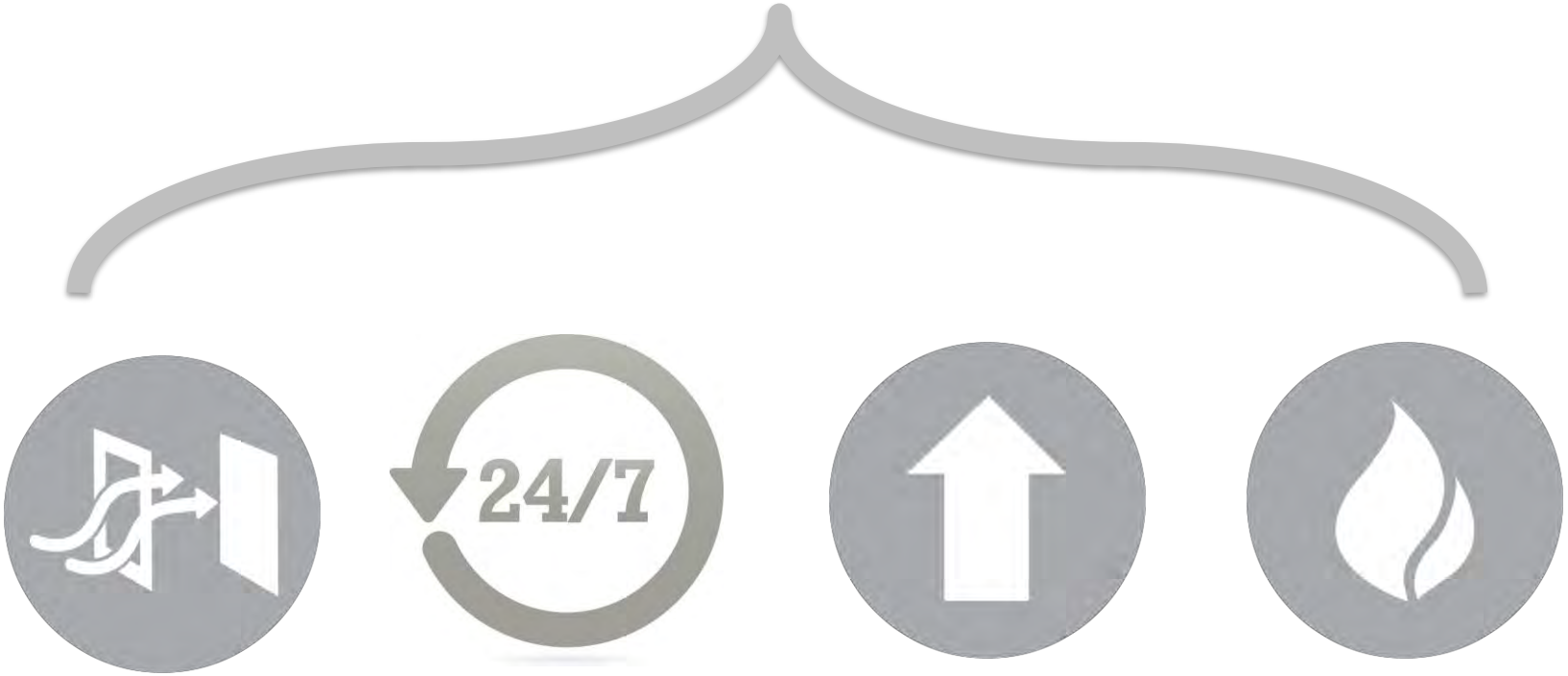
Gyms

Commercial Kitchens

Hotels

Schools / Child Care

Ideal Building Candidates for C-RTUs



Lots of ventilation

Long runtimes

High heating loads

Building has gas

Pop Quiz

A retail store brings in 100% outdoor air for ventilation and utilizes an old gas unit to heat its space 6 months out of the year for its 24/7 operations.

Is this building a good candidate for a C-RTU?

A. Yes!

B. Maybe?

C. No.

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Lots of ventilation

Building has gas

Lots of heating

24/7

Long runtimes

Pop Quiz

An office building brings in 10% outdoor air for ventilation and uses heating 2 months out of the year for half the day.

Is this building a good candidate for a C-RTU?

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Pop Quiz

An **office building** brings in

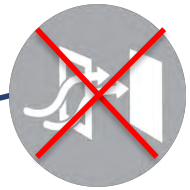
10% outdoor air for ventilation

and uses heating

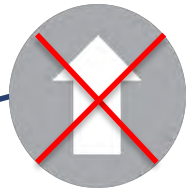
2 months out of the year

for **half the day.**

Not listed in ideal building type



Low % OA



Low amount of heating

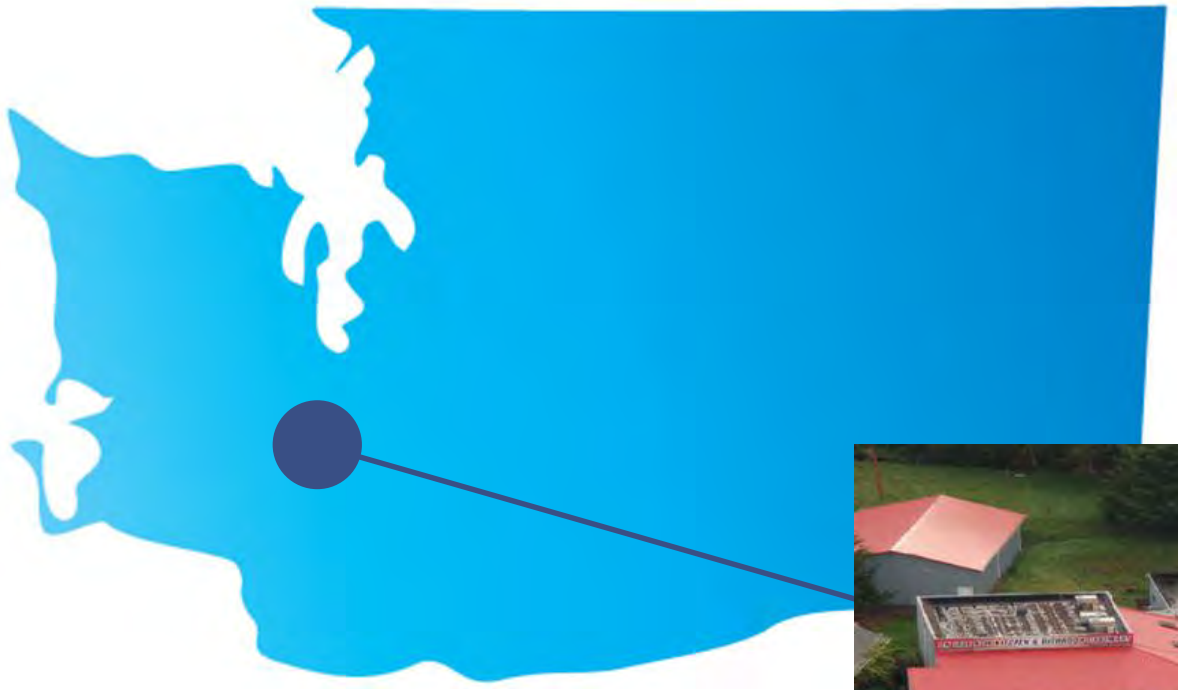
Low EFLH operating hours

Case Studies

Case Study 1

Retail Showroom in Chehalis, WA

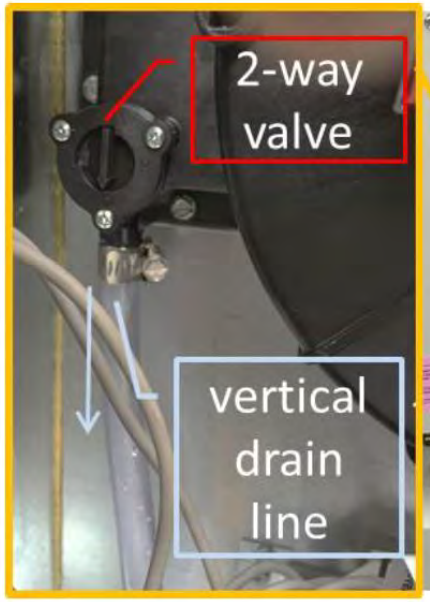
30% Outside Air



Case Study 1

Retail Showroom in Chehalis, WA

30% Outside Air



Condensing Gas RTU

Vertical Condensate System Drain (clear flexible tube with 2-way value in vertical vs horizontal drain position)

Horizontal Flue (white PVC)

Case Study 1

Retail Showroom in Chehalis, WA

30% Outside Air

23%

annual gas savings

2.2 years

simple payback

$392

annual gas savings

Case Study 1

Retail Showroom in Chehalis, WA

30% Outside Air

"Well, we no longer see our owner Jon running around the showroom spraying Febreze everywhere." – Elena Payne, Accountant at Home Carpet Warehouse, Inc.

"As if lower utility bills haven't been enough, our staff has experienced significantly less headaches from the fumes and I no longer hear customers walk into the store and claim that 'it smells like carpet in here' instantly." – Jon Vigre, Owner of Home Carpet Warehouse, Inc.

Case Study 1

Retail Showroom in Chehalis, WA

30% Outside Air

C-RTU Costs and Paybacks	Full 2015/2016 Heating Season
Annual Gas Savings (therms)	462
Annual Gas Cost Savings ($)	$392
Annual Electric Savings (kWh)	4,654
Annual Electric Cost Savings ($)	$423
Net Energy Cost Savings ($)	$815
Total Equipment Cost ($)	$4,665
Total Installation Cost ($)	$10,835
Total Incremental Installed Cost ($)	$1,787
Payback of Incremental Cost (years)	**2.2**

Case Study 2

Restaurant in Spokane, WA

100% Makeup Air

Case Study 2

Restaurant in Spokane, WA

100% Makeup Air

Condensing
Gas RTU

Condensate System
Drain in RTU

Case Study 2

Restaurant in Spokane, WA

100% Makeup Air

26%

annual gas savings

1.3 years

simple payback

$1,617

annual gas savings

Case Study 2

Restaurant in Spokane, WA

100% Makeup Air

"We are very satisfied with the new rooftop unit. I personally spend 30+ hours a week in the kitchen and over the past year we noticed cooler summers and more comfortable w inters with the fresh air coming in. For the first time since I've been here, we were even able to shut off the swa mp cooler we purc hased a few ye ars ago enti rely." – Daniel, Kitchen Manager at The Onion Bar & Grill.

"Those second ary heat exchangers really ma ke these units head-and-shoulders abo ve noncondens ing units in terms of efficiency . While they require more work on our part with regard to condensate piping and freeze protection, the customer gets a lot more out of the unit. From a strictly energy efficiency standpoint, the potential is there." – Chris, Project Manager at Holliday Heating

Case Study 2

Restaurant in Spokane, WA

100% Makeup Air

C-RTU Costs and Paybacks	Full 2015/2016 Heating Season
Annual Gas Savings (therms)	1,902
Annual Gas Cost Savings ($)	$1,617
Annual Electric Savings (kWh)	3,003
Annual Electric Cost Savings ($)	$273
Net Energy Cost Savings ($)	$1,890
Total Equipment Cost ($)	$32,726
Total Installation Cost ($)	$22,329
Total Incremental Installed Cost ($)	$2,529
Payback of Incremental Cost (years)	**1.3**

C-RTU
Financial Comparisons

Variables that play into C-RTU Costs and Savings Calculations

- Percent of outside air (OA) the unit is bringing into the building generally 100% or <30% - the more OA, the better the business case
- Geographic climate in terms of the number of heating degree days – the cooler the climate, the better the business case
- Runtime amount of Large Equivalent Full Operating Hours (EFLH) – the more hours of runtime, the better the business case
- Volume amount of air coming in – more air coming in (CFM), better business case

…NOT the size of the unit (tonnage, BTU/h)

Pop Quiz

What variable doesn't impact the energy savings of a C-RTU?

A. Outside Air Intake
B. Equivalent Full Load Hours (EFLHs)
C. Outdoor Air Temperature
D. Inside Temperature Setpoints
E. Unit Size (Tonnage)
F. Supply CFM

Pop Quiz

What variable doesn't impact the energy savings of a C-RTU?

A. Outside Air Intake
B. Equivalent Full Load Hours (EFLHs)
C. Outdoor Air Temperature
D. Inside Temperature Setpoints
E. Unit Size (Tonnage)
F. Supply CFM

Who Manufactures C-RTUs?

C-RTU
O&M Considerations

Pop Quiz

Why does a Condensing Gas RTU save more energy than a Conventional Gas RTU?

A. Faster Air Flow

B. Lower Heat Gas Flame

C. Heat Exchanger

Pop Quiz

Why does a Condensing Gas RTU save more energy than a Conventional Gas RTU?

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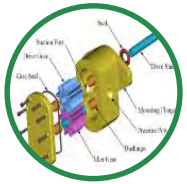
Condensate Management



- Get the piping right
- Install condensate pump for drainage
- Neutralize the condensate before disposing
- Plan for freezing temps and freeze protection
- Organize proper proactive maintenance

Code Variations & Interpretations

Code varies by state/city/locality for plumbing, mechanical, wastewater and building code requirements for condensate management (disposal and neutralization)

- International Association of Plumbing and Mechanical Officials (IAMPO) – International Plumbing Code & Uniform Plumbing Code
- International Mechanical Code (IMC) Uniform Mechanical Code
- International Code Council (ICC) International Fuel and Gas Code (IFGC)
- Original equipment manufacturer (OEM) recommendations for installation and training

The City of Portland Commercial Building Code Guides does not have a specific section to address condensate drains on fuel-burning appliances, though an inspector indicated that neutralizers are required for approval in Portland as a requirement of the Portland Office of Environmental Services

The City of Seattle's 2015 Fuel Gas Code specifically adopts the IFGC Section 307.1 through 307.5, verbatim, with regards to condensate disposal, and also included a Section 307.6 regarding condensate pumps. If a unit is installed in an uninhabitable space (i.e. attic), the unit must be configured to cease operation if the condensate pump stops operation

Organize Proper Proactive Maintenance

Scheduled preventative maintenance is critical. Failure to regularly service neutralizers, pumps, and drain lines can lead to system failure and building damage.

Replace neutralization media annually to avoid blockage from build-up of dissolved media in piping.

Inspect and clean condensate pumps. Ensure that all calcium deposits are removed.

Curbs & Adapters

- Each brand of RTU has a different style/version of curbs. When a new RTU is installed, a curb “adapter” is sometimes needed so the unit fits on the building.
- KEY POINT TO REMEMBER – The condensate piping has to route properly through the curb otherwise it can freeze and the unit will break.
- Make sure the installer routes condensate drain lines inside curbs and inside the building when possible.

*The edge at the bottom of RTUs? That’s a **curb**.*

Pop Quiz

How do you make sure the condensate in your C-RTU doesn't freeze?

A. Get the piping right

B. Install condensate pump for drainage

C. Neutralize the condensate before disposing

D. Plan for freezing temps and freeze protection

E. Organize proper proactive maintenance

Pop Quiz

How do you make sure the condensate in your C-RTU doesn't freeze?

A. Get the piping right
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C. Neutralize the condensate before disposing
D. Plan for freezing temps and freeze protection
E. Organize proper proactive maintenance

Next Steps

Next Steps

- Pilot a C-RTU with us!
- Contact Christine Riegler with questions or feedback
- Download and share resources from the BetterBricks C-RTU site
- Ask your contractor and engineer teams about C-RTUs for commercial projects

https://betterbricks.com/solutions/hvac/gas-condensing-roof-top-units-c-rtus

Contact Information

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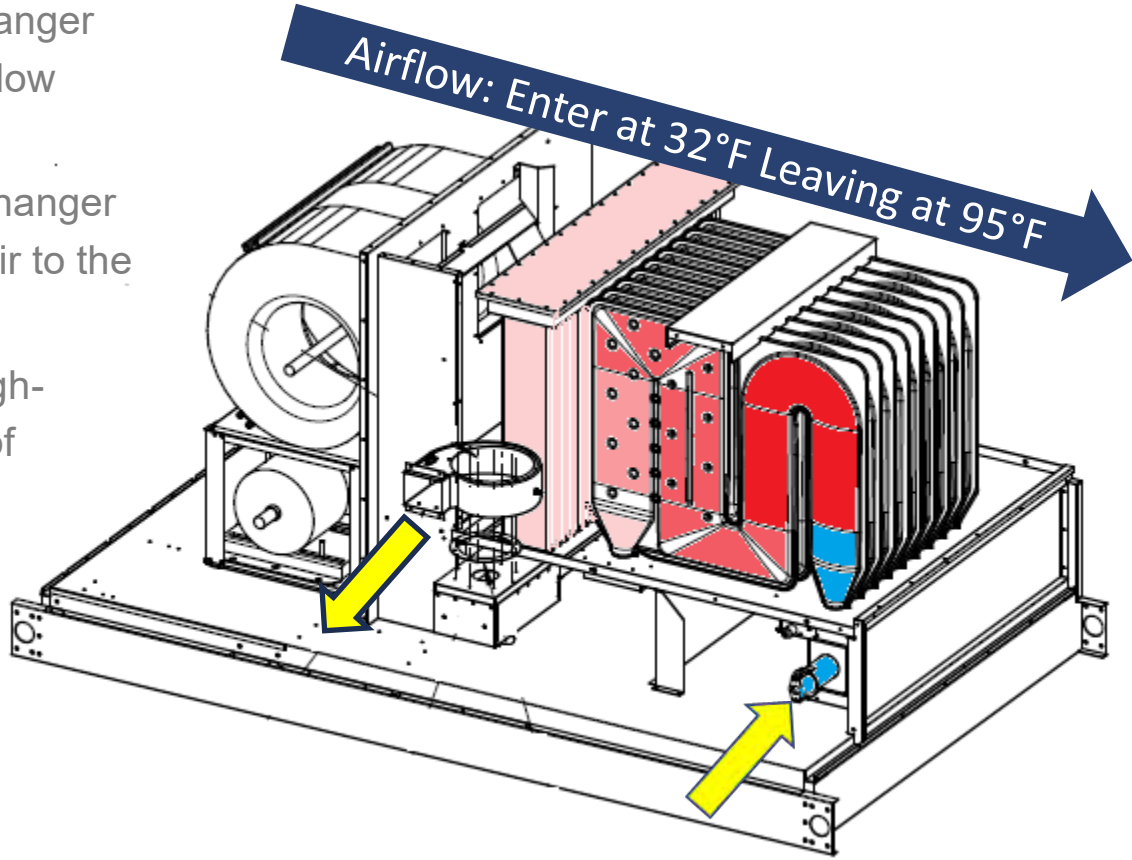
Thank you!

BETTERBRICKS

Appendix

Step by Step Operations

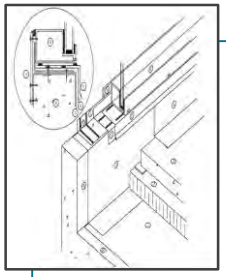
- Flame (blue) runs through heat exchanger (pink) until gas leaves out of flue (yellow arrows)
- Fan sends cold air over hot heat exchanger unit it leaves at 95°F, delivering hot air to the space
- Water management plays into the high-efficiency unit, and the temperature of exhaust fumes varies as well:
  - @ 80% Efficiency:
    Air Temp is > 200°F,
    No Water
  - @ 90% Efficiency:
    Air Temp is < 130°F,
    Lot of Water



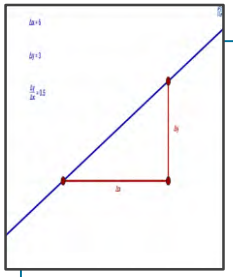
Get the Piping Right

Use PVC/CPVC that meet appropriate ASTM/CSA specifications

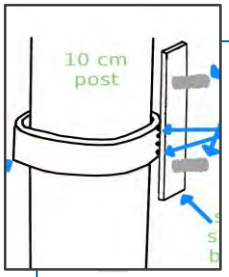
Configure drain lines such that future cleanout and clearing of blockages will not require the drain line to be cut



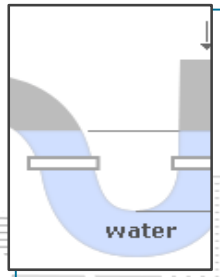
Route drain lines inside curbs and inside the building when possible



Provide a minimum slope of 2% for gravity-driven drainage. This is equal to a slope of ¼” per foot.

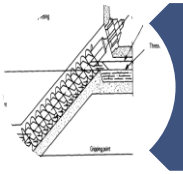


Space support hangers or brackets at a minimum of every three feet along the run of a suspended pipe



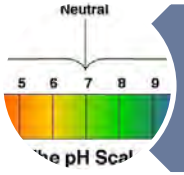
Provide a condensate trap (at least 6” high unless using a waterless trap) directly after the C-RTU drain outlet to prevent air from entering the unit. Ensure the trap is in conditioned space to prevent freezing.

Install Condensate Pump for Drainage

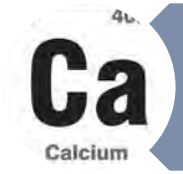


Install a condensate pump where gravity will not sufficiently provide condensate drainage

Ensure that the pump is correctly sized to handle two to three times the volume of condensate that will be produced in order to avoid 100% run times during cold weather



Ensure that the pump is either rated to handle acidic condensate or has integrated neutralization capability



Place the condensate pump up-stream of the neutralizer to avoid calcium deposit build-up in the pump

Install fault detection such that when the pump fails the unit will stop operating

Neutralize the Condensate Before Disposing

Neutralize condensate to a pH of 5 or above before depositing into sanitary or drain lines

Select a neutralizer that is designed to handle the estimated flow rate produced at peak heating conditions

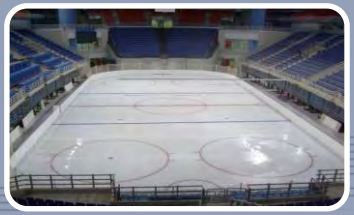
Choose a neutralization media that contains a minimum of 90% calcium carbonate

Plan for Freezing Temps & Freeze Protection

Install outdoor condensing equipment on a curb. Slab mounting is not recommended.

Install frost free traps immediately after the condensing unit drain output.

Install heat trace along the pipe where exposed to outside temperatures. In extremely cold areas install heat trace even when piping is routed inside the curb.



Do not drain the condensate onto the roof area.