AAON Operation & Maintenance Manual

DATE:	**February 14, 2019**
PROJECT:	**Phase II, 6 MGD Expansion Four Mile Creek WQRF City of Wichita**
PREPARED BY:	**Ariel Davis**
SUBMITTED BY:	**Dane Pletcher Building Controls & Services, Inc. 1730 East Douglas Wichita, Kansas 67214 Tel: (316) 267-5814 Fax: (316) 267-2988**

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Equipment Submittal

BUILDING CONTROLS AND SERVICES, INC.
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SUBMITTAL REVIEW RESPONSE

PROJECT NAME: COW PN 468-84961 PHASE II, 6 MGD EXPANSION FOUR MILE CREEK WQRF
CH2M Project No: 496312
UCI Project No: 117104

SUBMITTAL NUMBER:	23 77 00-01 Rev2
DESCRIPTION:	Air Handling Units Product Data
SPEC SECTION (S):	23 77 00

TO BE COMPLETED BY PRIMARY REVIEWER:	
☐ **Approved**	☒ **Approved As Noted**
☐ **Partial Approval, Resubmit as Noted**	☐ **Revise and Resubmit**
Engineer's review and acceptance of this submittal are expressly limited as provided in the Contract Documents and are only to determine conformance with information given in the Contract documents and compatibility with the design concept for the completed project as a functioning whole as indicated in the Contract Documents. Contractor is, and Engineer is NOT, responsible for all matters relating to fabrication, shipping, handling, storage, assembly, installation, construction (including all safety aspects of performing the Work), and for coordinating the Work.	
As the primary reviewer of this submittal, I have coordinated my review comments with the comments of the secondary reviewer(s), Alexander Sutherland, Jim Landman	
Scott Hoffman	12/18/17
CH2M HILL	Date

Comments:

General

Unit heights shall be conformed to NEC and OSHA to ensure no disconnect is above 78" above grade for safety shutdown of power.

All curbs and Pads shall be coordinated with General Contractor to ensure that curb size and location is relocated due to change in unit size from design drawings.

110-AHU-001 shall be moved back from return duct riser to allow for clearance to condenser coil for cleaning.

110-MAU-001 heating CFM operation shall be 7100 CFM not 8,000 CFM.

210-AHU-001 shall be moved back from return duct riser to allow for clearance to condenser coil for cleaning.

Single Point power connection for all units shall be coordinated with electrical contractor

350-MAU-001 shall be located with clearances verified with existing retaining wall. Drawings markups shows no interference.

Corrosive resistant paint appears to be "Direct to Metal" additional touch up paint shall be supplied to prevent scratches upon delivery of equipment to site, corrosion while equipment is awaiting installation, and after installation.

UCI

1930 S. Hoover, Suite 100 - Wichita, Kansas 67277-0592 - P.O. Box 9592 - (316) 265-9506

11/22/2017

Transmitted To:
Estell Johnson
CH2M
245 N Waco St Suite 240
Wichita, KS 67202

Subject: Air Handling Units Product Data Resubmittal

Job Number: 117104.
Job Name: Four Mile Creek WQRF Plant 4 Phase 2 6 MGD Expansion

Owner Project Number: 468-84961
Engineer Project Number: 496312

Notes:

Please find Submittal 237700-01 Rev2 Air Handling Units Product Data for Review and Approval. If there are any questions regarding this submittal please contact Steve Hermes at 316.239.7769 or shermes@ucict.com.

Document Type	***Document***	***Copies Sent***	***Status***	***Remarks / Comments***
	:Air Handling Units Product Data Resubmittal	1	Open	Please Review and Approve.

From:

Carbon Copied:

Steve Hermes

Steve Hermes
UCI

Submittal Number: 237700-01 Rev. 2

Project:	**117104.**
Project Name:	**Four Mile Creek WQRF Plant 4 Phase 2 6 MGD Expansion**
Owner Project #:	**468-84961**
Engineer Project #:	**496312**

To:	**From:**
Estell Johnson	Steve Hermes
CH2M	UCI
245 N Waco St Suite 240	1930 S Hoover, Suite 100 PO Box 9592
Wichita, KS 67202	Wichita, KS 67277-0592

Submittal Item	**Status**	**Submitted Date**	**Copies**	**Date Due**
1 : Air Handling Units Product Data	Open	11/22/2017	1	12/13/2017

Comments:
UCI apologizes. The wrong submittal package was submitted in Revision 1. Please see attached submittal package for the correct information.

CONTRACTOR'S REVIEW: This submittal has been reviewed for general compliance with the plans and specifications.

By: ______Steve Hermes______________
Steve Hermes, UCI

Date:___11/22/2017_________________

3636 N. Topeka
Wichita, KS 67219
Ph : 3168387885

Submittal

Job: A-02480-00
4 Mile Creek Wichita WWPT

Spec Section No: 23 77 00
Submittal No: 1
Revision No: 1
Sent Date: 11/13/2017

Spec Section Title: Air Handling Units
Submittal Title: HVAC Equipment

Contractor:
Kruse Corporation

Contractor's Stamp

CONTRACTOR'S REVIEW

THIS SUBMITTAL HAS BEEN REVIEWED FOR GENERAL COMPLIANCE WITH THE PLANS AND SPECIFICATIONS

BY: Jason McCartney DATE: 11/13/2017

PM: Jason McCartney DATE: 11/13/2017

Other:
UCI
Steve Hermes

Architect's Stamp

Engineer's Stamp

AAON MAKE-UP AIR UNIT & AIR HANDLING UNIT SUBMITTAL

SPEC SECTION: 23 77 00 – "AIR HANDLING UNITS"

DATE:	**November 10, 2017**
PROJECT:	**Phase II, 6 MGD Expansion** **Four Mile Creek WQRF** **City of Wichita**
PREPARED BY:	**Amanda Roodhouse**
SUBMITTED BY:	**Dane Pletcher** **Building Controls & Services, Inc.** **1730 East Douglas** **Wichita, Kansas 67214** **Tel: (316) 267-5814** **Fax: (316) 267-2988**

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Equipment Summary

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<u>AAON "RN" Series Packaged Units</u>

Qty (5)   Plan Marks: ***110, 210 & 350-MAU-001; 110 & 210-AHU/AC-001***

- **Integral AHU and AC Units Require No Field Refrigerant Piping**
- Double-Wall R-13 Foam Panel Construction
- 2500 Hour Salt Spray Tested Exterior Paint
- Hinged Access Doors
- 460V/3Ø Single Point Voltage Connection
- Factory Installed Unit Disconnect Switch
- 115V GFCI Convenience Receptacle, Factory Wired
- 2" Pleated, MERV-8 Filters (One spare set included)
- Interior Corrosion Protection
- Modulating Gas Heat (MAUs Only)
- Stainless Steel Heat Exchanger w/25-year Non-Prorated Warranty (MAUs Only)
- 2-Stage Cooling (110-AHU/AC-001 Only)
- Modulating Cooling (210-AHU/AC-001 Only)
- Scroll Compressor w/ 5-year Non-Prorated Warranty (AHU/ACs Only)
- DX Coil with Stainless Steel Drain Pan (AHU/ACs Only)
- Polymer E-Coated Evaporator Coil w/ 5-year Warranty (AHU/ACs Only)
- 0° Low Ambient Cooling (AHU/ACs Only)
- Polymer E-Coated Microchannel Condenser Coil w/ 5-year Warranty (AHU/ACs Only)
- Direct Drive Plenum Supply Fan w/ Premium Efficiency Motor and VFD
- Shaft Grounding Rings for VFDs
- Spark Resistant Supply Fans w/ Aluminum Wheel Construction
- Factory Controls
    - BACnet Interface
    - Explosion Proof Space Temperature Sensor
- Factory Installed Hail Guards (AHU/ACs Only)
- Insulated Ground Mounted Curbs
    - Horizontal Discharge/Intake
- Factory Authorized Startup Labor Included
- Standard One (1) Year Parts Only Warranty except where noted otherwise
- **<u>By Others</u>**
    - Smoke Detectors
    - Thermostat Rough-In / Explosion Proof Conduit
    - High Voltage / Low Voltage / Control Wiring
    - Sensor Installation (Space Temp, Supply Temp)
    - Gas Pressure Regulators as Required (Inlet Pressure Must Be 6 to 10.5" W.C.)

BUILDING CONTROLS AND SERVICES, INC. 1730 E. DOUGLAS WICHITA, KS 67214
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Unit Ratings

Unit Rating

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3E9:K000-00B-DDF-000-000AH0F-00-0000000VB

Tag: 110-MAU-001

Job Information

Job Name:	*Phase II Mile Creek WQRF COW*
Job Number:	*Submittal 4.27.17*
Site Altitude:	*1300 ft*

Unit Information

Approx. Op./Ship Weights:	*2949 / 2949 lbs. (±5%)*
Supply CFM/ESP:	*7100 / 1.25 in. wg.*
Final Filter FV / Qty:	*221.88 fpm / 8*
Outside CFM:	*8000*
Ambient Temperature:	*95 ºF DB / 75 ºF WB*

Static Pressure

External:	*1.25 in. wg.*	Economizer:	*0.00 in. wg.*
Evaporator:	*0.00 in. wg.*	Heating:	*0.05 in. wg.*
Filters Clean:	*0.08 in. wg.*	Cabinet:	*0.11 in. wg.*
Dirt Allowance	*0 in. wg.*	Total:	*1.49 in. wg.*

Cooling Section

No Cooling is Selected

Supply Air Fan:	*1 x 245D @ 3.09 BHP*
SA Fan RPM / Width:	*1308 / 5.480"*

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*Nat. Gas Heat*
Heating CFM:	*8000*
Total Capacity:	*864.0 MBH*
OA Temp:	*-2.0 ºF DB / -2.0 ºF WB*
RA Temp:	*75.0 ºF DB / 62.0 ºF WB*
Entering Air Temp:	*-2.0 ºF DB / -2.0 ºF WB*
Leaving Air Temp:	*97.8 ºF DB / 57.0 ºF WB*
Input:	*1080.0 MBH*
Heater Qty:	*1*
Consumption:	*1080.0 MBH*

Electrical Data

Rating:	*460/3/60*	Minimum Circuit Amp:	*13*
Unit FLA:	*11*	Maximum Overcurrent:	*20*

	Qty	HP	VAC	Phase	RPM	FLA	RLA
Supply Fan:	1	5.00	460	3	1760	7.6	
Combustion:	4	0.25	460	1	3210	0.9	

Cabinet Sound Power Levels*

Octave Bands:	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Discharge LW(dB):	87	86	89	92	87	83	78	74
Return LW(dB):	85	79	74	70	73	71	64	63

**Sound power levels are given for informational purposes only. The sound levels are not guaranteed.*

24.5" STAR Plenum

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

JOB INFORMATION:

Job Name:	*Phase II Mile Creek WQRF*
Job Tag:	*COW*
Rep Firm:	*110-MAU-001*
Date:	
	04/27/2017

WHEEL SPECIFICATION:

Max RPM:	*1,800*
Diameter x Qty:	
CFM:	*24.5 in. x 1*
Tip Speed:	*7100*
Inertia:	*8,390 FPM*
	10 WR²

OPERATING CONDITIONS:

Air Flow:	*7,100 CFM*
Static Pressure:	*1.49 in. Wg.*
Relief Dampers DP:	*0.00 in. Wg.*
TSP:	*1.49 in. Wg.*
Site Altitude:	*1300.00 Ft*
TSP @ Sea Level:	*1.56 in. Wg.*

MOTOR SELECTION:

Rated HP / Bypass:	*5 / No*
Frame Size:	*184T*
Nominal RPM:	*1760*
VAC/PH/HZ:	*460/3/60*
Efficiency	*Premium / 0.895*
Enclosure Type:	*ODP*
Max Inertial Load:	*52 WR²*

FAN PERFORMANCE:

RPM:	*1308*
BHP:	*3.09*
Efficiency:	*53.9%*
In/Out Velocity:	*2171/2391 FPM*
Plenum Out Velocity:	*80 FPM*

Max Duct SP with Blocked Airway: **3.4 in. Wg. @ 1308 rpm**

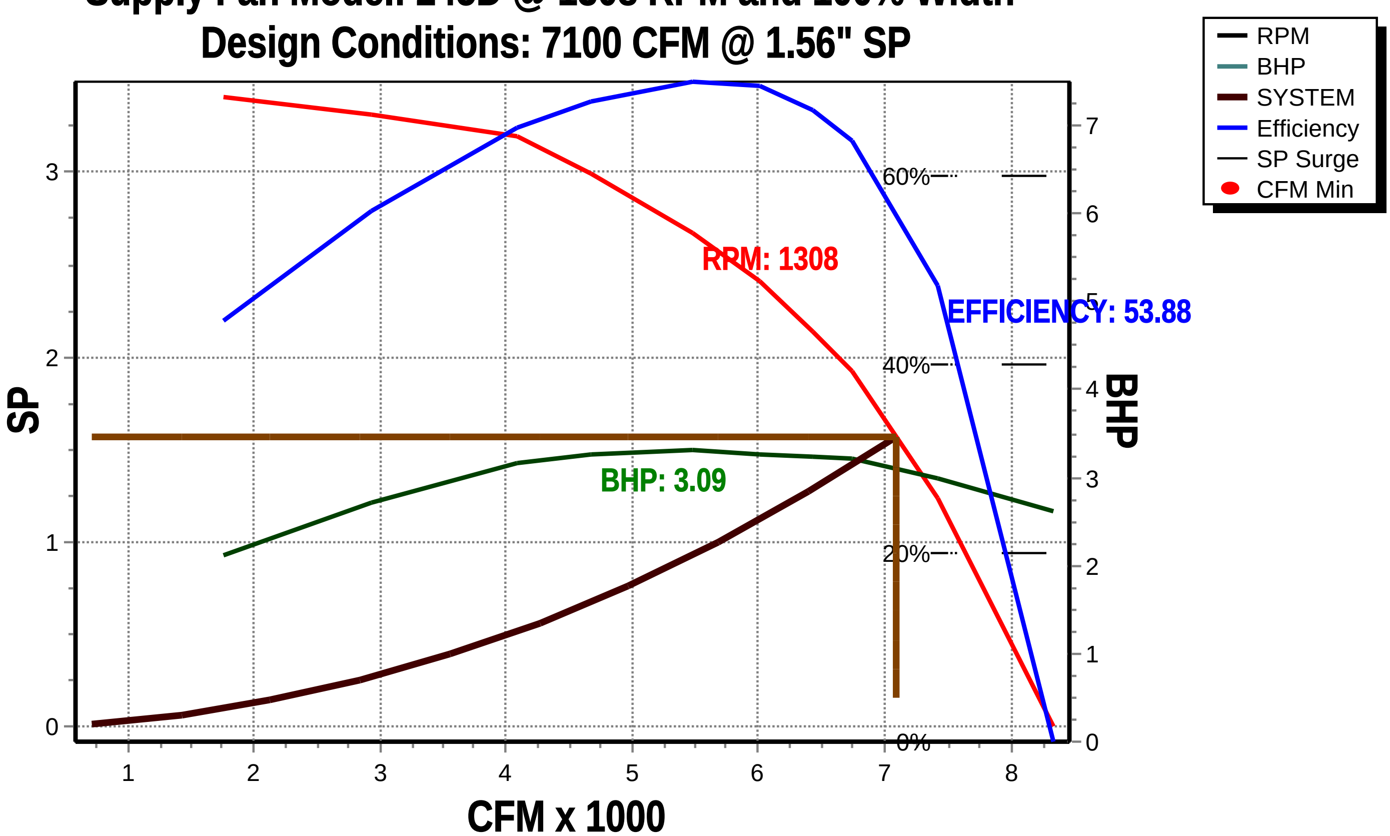
FAN SOUND POWER (Inlet/Outlet):

Octave Band: **(Re 10^-12 watts)**

1	2	3	4	5	6	7	8
85	*84*	*83*	*83*	*82*	*80*	*78*	*77*
87	*86*	*89*	*93*	*90*	*86*	*82*	*78*

SOUND POWER A-Weighted: 89 / 93 dB

Supply Fan Model: 245D @ 1308 RPM and 100% Width
Design Conditions: 7100 CFM @ 1.56" SP



Unit Rating

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-006-3-A-0000-3L9:K000-00B-DBC-000-000AH0F-00-0000000VB

Tag: 210-MAU-001

Job Information

Job Name:	*Phase II Mile Creek WQRF COW*
Job Number:	*Submittal 4.27.17*
Site Altitude:	*1300 ft*

Unit Information

Approx. Op./Ship Weights:	*678 / 678 lbs. (±5%)*
Supply CFM/ESP:	*1600 / 1.25 in. wg.*
Final Filter FV / Qty:	*180.00 fpm / 4*
Outside CFM:	*1600*
Ambient Temperature:	*95 ºF DB / 75 ºF WB*

Static Pressure

External:	*1.25 in. wg.*	Economizer:	*0.00 in. wg.*
Evaporator:	*0.00 in. wg.*	Heating:	*0.02 in. wg.*
Filters Clean:	*0.07 in. wg.*	Cabinet:	*0.04 in. wg.*
Dirt Allowance	*0 in. wg.*	Total:	*1.37 in. wg.*

Cooling Section

No Cooling is Selected

Supply Air Fan:	*1 x RN150 @ 0.53 BHP*
SA Fan RPM / Width:	*1537 / 3.326"*

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*Nat. Gas Heat*
Heating CFM:	*1600*
Total Capacity:	*168.0 MBH*
OA Temp:	*-2.0 ºF DB / -2.0 ºF WB*
RA Temp:	*75.0 ºF DB / 62.0 ºF WB*
Entering Air Temp:	*-2.0 ºF DB / -2.0 ºF WB*
Leaving Air Temp:	*95.1 ºF DB / 56.0 ºF WB*
Input:	*210.0 MBH*
Heater Qty:	*1*
Consumption:	*210.0 MBH*

Electrical Data

Rating:	*460/3/60*	Minimum Circuit Amp:	*3*
Unit FLA:	*3*	Maximum Overcurrent:	*15*

	Qty	HP	VAC	Phase	RPM	FLA	RLA
Supply Fan:	1	1.00	460	3	1760	2.1	
Combustion:	1	0.09	460	1	3010	0.7	

Cabinet Sound Power Levels*

Octave Bands:	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Discharge LW(dB):	76	74	77	72	66	64	60	54
Return LW(dB):	76	73	67	60	59	57	50	44

**Sound power levels are given for informational purposes only. The sound levels are not guaranteed.*

15.0" STAR Plenum

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

JOB INFORMATION:

Job Name:	*Phase II Mile Creek WQRF*
Job Tag:	*COW*
Rep Firm:	*210-MAU-001*
Date:	
	04/27/2017

WHEEL SPECIFICATION:

Max RPM:	*2,200*
Diameter x Qty:	
CFM:	*15.0 in. x 1*
Tip Speed:	*1600*
Inertia:	*6,036 FPM*
	3 WR²

OPERATING CONDITIONS:

Air Flow:	*1,600 CFM*
Static Pressure:	*1.37 in. Wg.*
Relief Dampers DP:	*0.00 in. Wg.*
TSP:	*1.37 in. Wg.*
Site Altitude:	*1300.00 Ft*
TSP @ Sea Level:	*1.44 in. Wg.*

MOTOR SELECTION:

Rated HP / Bypass:	*1 / No*
Frame Size:	*143T*
Nominal RPM:	*1760*
VAC/PH/HZ:	*460/3/60*
Efficiency	*Premium / 0.855*
Enclosure Type:	*ODP*
Max Inertial Load:	*15 WR²*

FAN PERFORMANCE:

RPM:	*1537*
BHP:	*0.53*
Efficiency:	*65.8%*
In/Out Velocity:	*1391/1455 FPM*
Plenum Out Velocity:	*27 FPM*

Max Duct SP with Blocked Airway: **1.7 in. Wg. @ 1537 rpm**

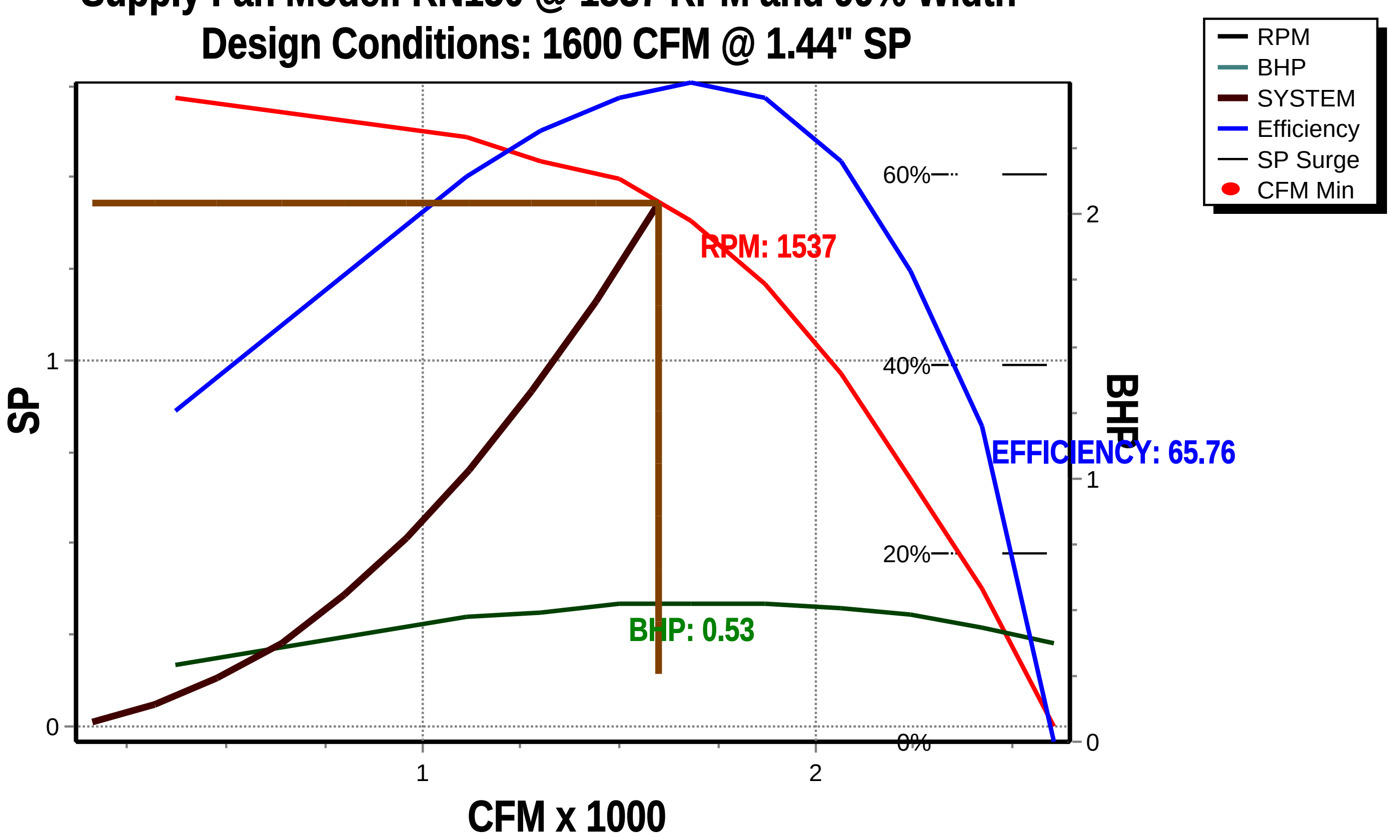
FAN SOUND POWER (Inlet/Outlet):

Octave Band: **(Re 10^-12 watts)**

1	2	3	4	5	6	7	8
76	74	77	74	69	67	64	58
76	74	77	74	69	67	64	58

SOUND POWER A-Weighted: 78 / 78 dB

Supply Fan Model: RN150 @ 1537 RPM and 99% Width
Design Conditions: 1600 CFM @ 1.44" SP



Unit Rating

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3D9:K000-00B-DDQ-000-000AH0F-00-0000000VB

Tag: 350-MAU-001

Job Information

Job Name:	*Phase II Mile Creek WQRF COW*
Job Number:	*Submittal 4.27.17*
Site Altitude:	*1300 ft*

Unit Information

Approx. Op./Ship Weights:	*2839 / 2839 lbs. (±5%)*
Supply CFM/ESP:	*6000 / 1.25 in. wg.*
Final Filter FV / Qty:	*187.50 fpm / 8*
Outside CFM:	*6000*
Ambient Temperature:	*95 ºF DB / 75 ºF WB*

Static Pressure

External:	*1.25 in. wg.*	Economizer:	*0.00 in. wg.*
Evaporator:	*0.00 in. wg.*	Heating:	*0.03 in. wg.*
Filters Clean:	*0.07 in. wg.*	Cabinet:	*0.06 in. wg.*
Dirt Allowance	*0 in. wg.*	Total:	*1.41 in. wg.*

Cooling Section

No Cooling is Selected

Supply Air Fan:	*1 x 245D @ 2.22 BHP*
SA Fan RPM / Width:	*1158 / 5.480"*

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*Nat. Gas Heat*
Heating CFM:	*6000*
Total Capacity:	*648.0 MBH*
OA Temp:	*-2.0 ºF DB / -2.0 ºF WB*
RA Temp:	*75.0 ºF DB / 62.0 ºF WB*
Entering Air Temp:	*-2.0 ºF DB / -2.0 ºF WB*
Leaving Air Temp:	*97.8 ºF DB / 57.0 ºF WB*
Input:	*810.0 MBH*
Heater Qty:	*1*
Consumption:	*810.0 MBH*

Electrical Data

Rating:	*460/3/60*	Minimum Circuit Amp:	*9*
Unit FLA:	*8*	Maximum Overcurrent:	*15*

	Qty	HP	VAC	Phase	RPM	FLA	RLA
Supply Fan:	1	3.00	460	3	1170	4.8	
Combustion:	3	0.25	460	1	3210	0.9	

Cabinet Sound Power Levels*

Octave Bands:	63	125	250	500	1000	2000	4000	8000
Discharge LW(dB):	84	83	88	89	85	81	76	71
Return LW(dB):	83	77	73	68	71	69	62	60

Sound power levels are given for informational purposes only. The sound levels are not guaranteed.

24.5" STAR Plenum

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

JOB INFORMATION:

Job Name:	*Phase II Mile Creek WQRF*
Job Tag:	*COW*
Rep Firm:	*350-MAU-001*
Date:	
	04/27/2017

WHEEL SPECIFICATION:

Max RPM:	*1,800*
Diameter x Qty:	
CFM:	*24.5 in. x 1*
Tip Speed:	*6000*
Inertia:	*7,428 FPM*
	10 WR²

OPERATING CONDITIONS:

Air Flow:	*6,000 CFM*
Static Pressure:	*1.41 in. Wg.*
Relief Dampers DP:	*0.00 in. Wg.*
TSP:	*1.41 in. Wg.*
Site Altitude:	*1300.00 Ft*
TSP @ Sea Level:	*1.48 in. Wg.*

MOTOR SELECTION:

Rated HP / Bypass:	*3 / No*
Frame Size:	*213T*
Nominal RPM:	*1170*
VAC/PH/HZ:	*460/3/60*
Efficiency	*Premium / 0.885*
Enclosure Type:	*ODP*
Max Inertial Load:	*85 WR²*

FAN PERFORMANCE:

RPM:	*1158*
BHP:	*2.22*
Efficiency:	*60.1%*
In/Out Velocity:	*1835/2020 FPM*
Plenum Out Velocity:	*68 FPM*

Max Duct SP with Blocked Airway: **2.7 in. Wg. @ 1158 rpm**

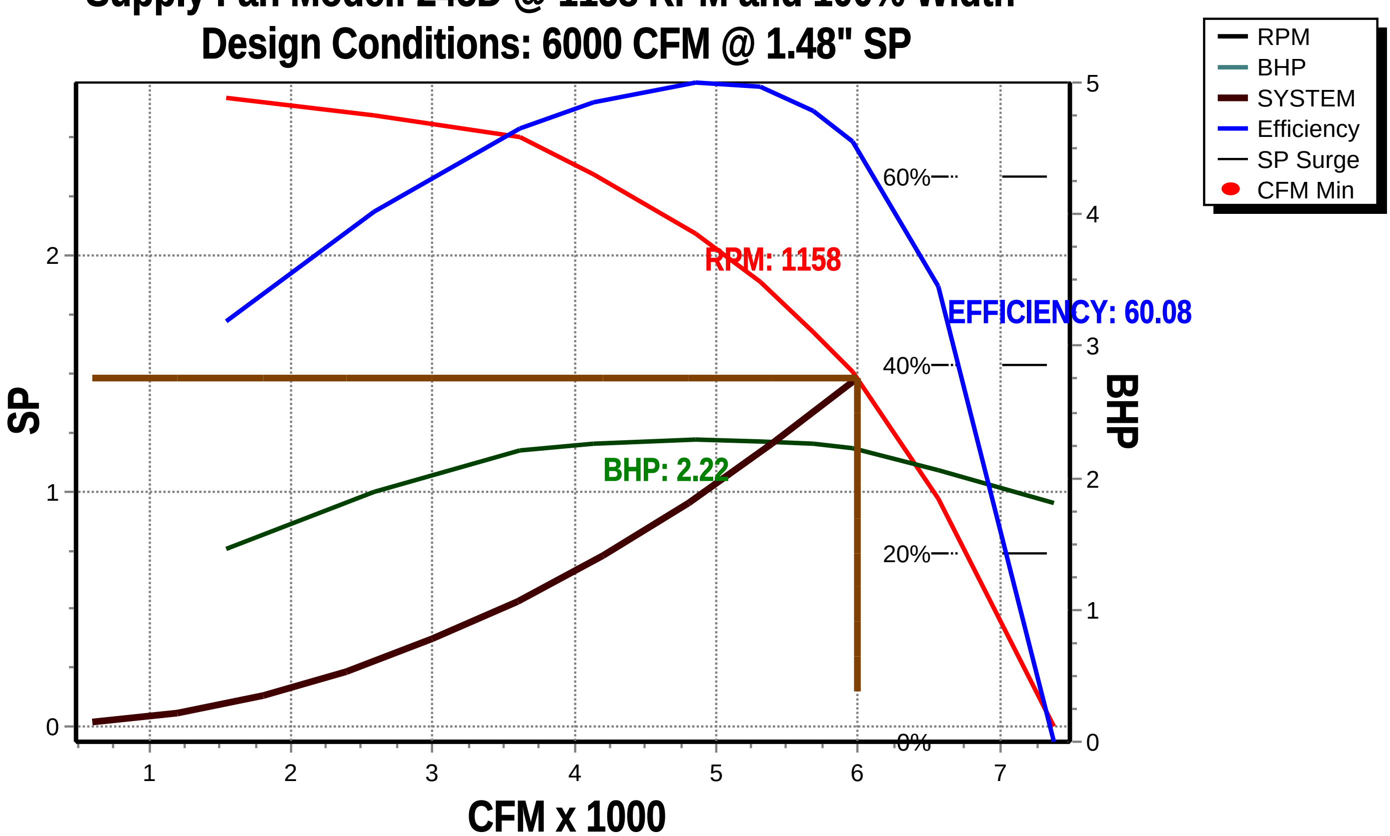
FAN SOUND POWER (Inlet/Outlet):

Octave Band: **(Re 10^-12 watts)**

1	2	3	4	5	6	7	8
83	*82*	*82*	*81*	*80*	*78*	*76*	*74*
84	*83*	*88*	*90*	*88*	*84*	*80*	*75*

SOUND POWER A-Weighted: 86 / 91 dB

Supply Fan Model: 245D @ 1158 RPM and 100% Width
Design Conditions: 6000 CFM @ 1.48" SP



Unit Rating

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-013-3-A-CA12-000:5000-00B-DBD-000-CECAH0E-00-00C0000TB

Tag: 110-AHU/AC-001

Job Information

Job Name:	*Phase II Mile Creek WQRF COW*
Job Number:	*Submittal 4.27.17*
Site Altitude:	*1300 ft*
Refrigerant	*R-410A*

Unit Information

Approx. Op./Ship Weights:	*1554 / 1554 lbs. (±5%)*
Supply CFM/ESP:	*3000 / 1.3 in. wg.*
Final Filter FV / Qty:	*216.00 fpm / 4*
Ambient Temperature:	*100 ºF DB / 75 ºF WB*
Return Temperature:	*75 ºF DB / 62 ºF WB*

Static Pressure

External:	*1.30 in. wg.*	Economizer:	*0.00 in. wg.*
Evaporator:	*0.12 in. wg.*	Heating:	*0.00 in. wg.*
Filters Clean:	*0.08 in. wg.*	Cabinet:	*0.06 in. wg.*
Dirt Allowance	*0 in. wg.*	Total:	*1.56 in. wg.*

Cooling Section

	Gross	Net
Total Capacity:	*140.36*	*136.31 MBH*
Sensible Capacity:	*98.42*	*94.38 MBH*
Latent Capacity:	*41.93 MBH*	
Mixed Air Temp:	*85.00 ºF DB*	*68.00 ºF WB*
Entering Air Temp:	*85.00 ºF DB*	*68.00 ºF WB*
Lv Air Temp (Coil):	*52.19 ºF DB*	*51.48 ºF WB*
Lv Air Temp (Unit)	*53.48 ºF DB*	*52.02 ºF WB*
Supply Air Fan:	*1 x RN150 @ 1.37 BHP*	
SA Fan RPM / Width:	*2153 / 3.360"*	
Evaporator Coil:	*14.6 ft² / 3 Rows / 14 FPI*	
Evaporator Face Velocity:	*205.7 fpm*	

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*No Heat*

Rating Information

Cooling Capacity (MBH):	*146.0*
Cooling EER:	*11.6*
Cooling IEER:	*12.6*

Rated in accordance with AHRI 340/360

Application EER @ Op. Conditions: *9.8*

Electrical Data

Rating:	*460/3/60*	Minimum Circuit Amp:	*32*
Unit FLA:	*29*	Maximum Overcurrent:	*40*

	Qty	HP	VAC	Phase	RPM	FLA	RLA
Compressor 1:	2		460	3			10.6
Condenser Fans:	2	0.75	460	1	1080	2.3	
Supply Fan:	1	2.00	460	3	1760	3.4	

Cabinet Sound Power Levels*

Octave Bands:	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Discharge LW(dB):	85	84	87	85	79	75	72	66
Return LW(dB):	80	74	75	70	68	63	58	49

**Sound power levels are given for informational purposes only. The sound levels are not guaranteed.*

15.0" STAR Plenum

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

JOB INFORMATION:

Job Name:	*Phase II Mile Creek WQRF*
Job Tag:	*COW*
Rep Firm:	*110-AHU/AC-001*
Date:	
	04/27/2017

WHEEL SPECIFICATION:

Max RPM:	*2,200*
Diameter x Qty:	
CFM:	*15.0 in. x 1*
Tip Speed:	*3000*
Inertia:	*8,455 FPM*
	3 WR²

OPERATING CONDITIONS:

Air Flow:	*3,000 CFM*
Static Pressure:	*1.56 in. Wg.*
Relief Dampers DP:	*0.00 in. Wg.*
TSP:	*1.56 in. Wg.*
Site Altitude:	*1300.00 Ft*
TSP @ Sea Level:	*1.64 in. Wg.*

MOTOR SELECTION:

Rated HP / Bypass:	*2 / No*
Frame Size:	*145T*
Nominal RPM:	*1760*
VAC/PH/HZ:	*460/3/60*
Efficiency	*Premium / 0.865*
Enclosure Type:	*ODP*
Max Inertial Load:	*27 WR²*

FAN PERFORMANCE:

RPM:	*2153*
BHP:	*1.37*
Efficiency:	*53.7%*
In/Out Velocity:	*2609/2727 FPM*
Plenum Out Velocity:	*50 FPM*

Max Duct SP with Blocked Airway: **3.4 in. Wg. @ 2153 rpm**

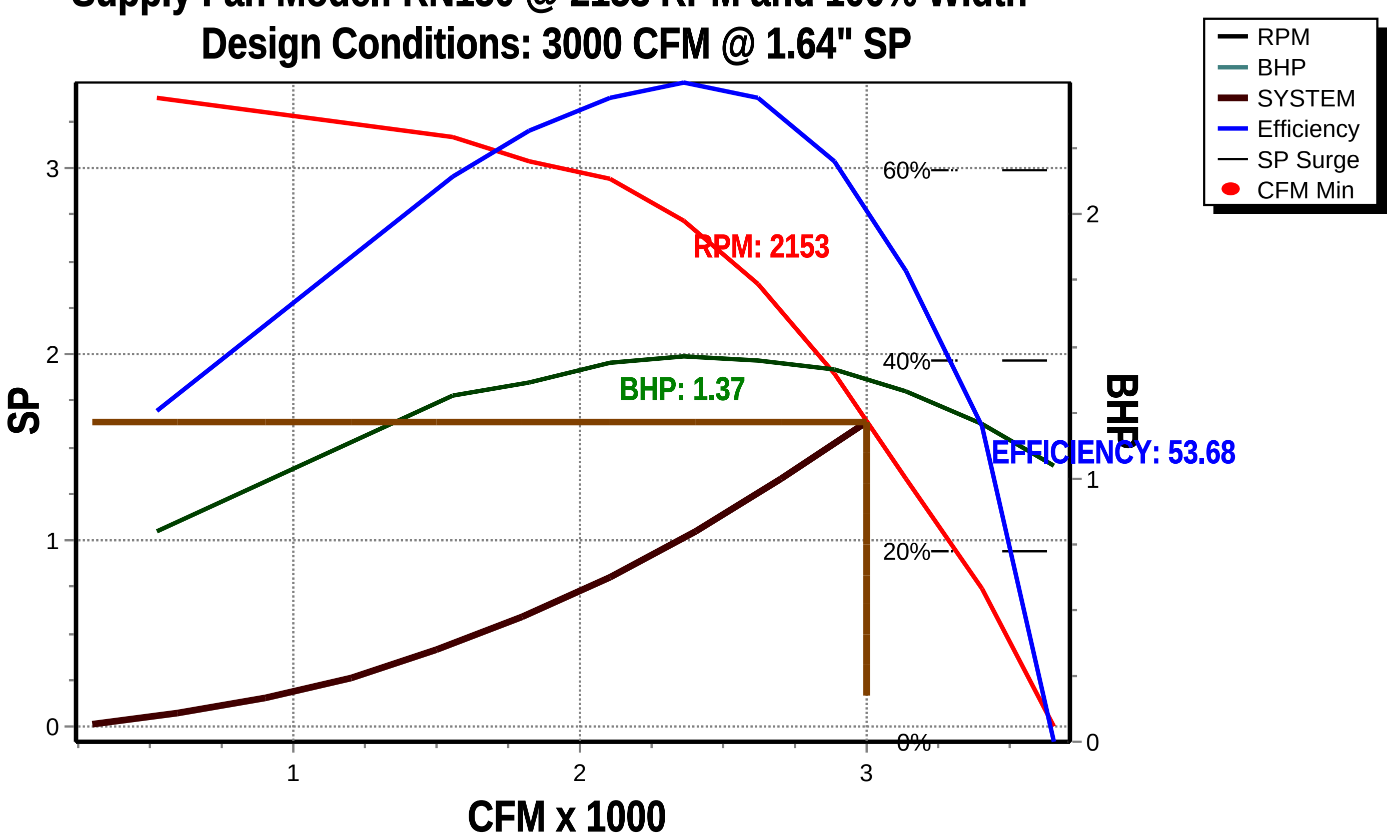
FAN SOUND POWER (Inlet/Outlet):

Octave Band: **(Re 10^-12 watts)**

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
85	*84*	*87*	*87*	*82*	*78*	*76*	*70*
85	*84*	*87*	*87*	*82*	*78*	*76*	*70*

SOUND POWER A-Weighted: 88 / 88 dB

Supply Fan Model: RN150 @ 2153 RPM and 100% Width
Design Conditions: 3000 CFM @ 1.64" SP



Unit Rating

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AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-007-3-A-FA19-000:5000-00B-DMC-000-CECAH0E-00-00C0000TB

Tag: 210-AHU/AC-001

Job Information

Job Name:	*Phase II Mile Creek WQRF COW*
Job Number:	*Submittal 4.27.17*
Site Altitude:	*1300 ft*
Refrigerant	*R-410A*

Unit Information

Approx. Op./Ship Weights:	*956 / 956 lbs. (±5%)*
Supply CFM/ESP:	*1200 / 1.3 in. wg.*
Final Filter FV / Qty:	*135.00 fpm / 4*
Ambient Temperature:	*100 ºF DB / 75 ºF WB*
Return Temperature:	*75 ºF DB / 62 ºF WB*

Static Pressure

External:	*1.30 in. wg.*	Economizer:	*0.00 in. wg.*
Evaporator:	*0.04 in. wg.*	Heating:	*0.00 in. wg.*
Filters Clean:	*0.06 in. wg.*	Cabinet:	*0.02 in. wg.*
Dirt Allowance	*0 in. wg.*	Total:	*1.43 in. wg.*

Cooling Section

	Gross	Net
Total Capacity:	*59.54*	*58.04 MBH*
Sensible Capacity:	*40.12*	*38.61 MBH*
Latent Capacity:	*19.42 MBH*	
Mixed Air Temp:	*85.00 ºF DB*	*68.00 ºF WB*
Entering Air Temp:	*85.00 ºF DB*	*68.00 ºF WB*
Lv Air Temp (Coil):	*51.55 ºF DB*	*50.31 ºF WB*
Lv Air Temp (Unit)	*52.76 ºF DB*	*50.83 ºF WB*
Digital Comp. Capacity Ratio:	*100%*	
Supply Air Fan:	*1 x RN135 @ 0.51 BHP*	
SA Fan RPM / Width:	*1876 / 3.012"*	
Evaporator Coil:	*8.5 ft² / 2 Rows / 14 FPI*	
Evaporator Face Velocity:	*141.1 fpm*	

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*No Heat*

Rating Information

Cooling Capacity (MBH):	*66.0*
Cooling EER:	*11.7*
Cooling IEER:	*13.6*

Rated in accordance with AHRI 340/360

Application EER @ Op. Conditions: *9.6*

Electrical Data

Rating:	*460/3/60*	Minimum Circuit Amp:	*15*
Unit FLA:	*13*	Maximum Overcurrent:	*25*

	Qty	HP	VAC	Phase	RPM	FLA	RLA
Compressor 1:	1		460	3			9.7
Condenser Fans:	1	0.33	460	1	1080	1.1	
Supply Fan:	1	1.00	460	3	1760	2.1	

Cabinet Sound Power Levels*

Octave Bands:	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Discharge LW(dB):	75	73	75	72	65	63	61	55
Return LW(dB):	71	69	63	57	55	52	47	39

**Sound power levels are given for informational purposes only. The sound levels are not guaranteed.*

13.5" STAR Plenum

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

JOB INFORMATION:

Job Name:	*Phase II Mile Creek WQRF*
Job Tag:	*COW*
Rep Firm:	*210-AHU/AC-001*
Date:	
	04/27/2017

WHEEL SPECIFICATION:

Max RPM:	*3,200*
Diameter x Qty:	
CFM:	*13.5 in. x 1*
Tip Speed:	*1200*
Inertia:	*6,630 FPM*
	3 WR²

OPERATING CONDITIONS:

Air Flow:	*1,200 CFM*
Static Pressure:	*1.43 in. Wg.*
Relief Dampers DP:	*0.00 in. Wg.*
TSP:	*1.43 in. Wg.*
Site Altitude:	*1300.00 Ft*
TSP @ Sea Level:	*1.50 in. Wg.*

MOTOR SELECTION:

Rated HP / Bypass:	*1 / No*
Frame Size:	*143T*
Nominal RPM:	*1760*
VAC/PH/HZ:	*460/3/60*
Efficiency	*Premium / 0.855*
Enclosure Type:	*ODP*
Max Inertial Load:	*15 WR²*

FAN PERFORMANCE:

RPM:	*1876*
BHP:	*0.51*
Efficiency:	*53.4%*
In/Out Velocity:	*1290/1348 FPM*
Plenum Out Velocity:	*20 FPM*

Max Duct SP with Blocked Airway: **1.9 in. Wg. @ 1876 rpm**

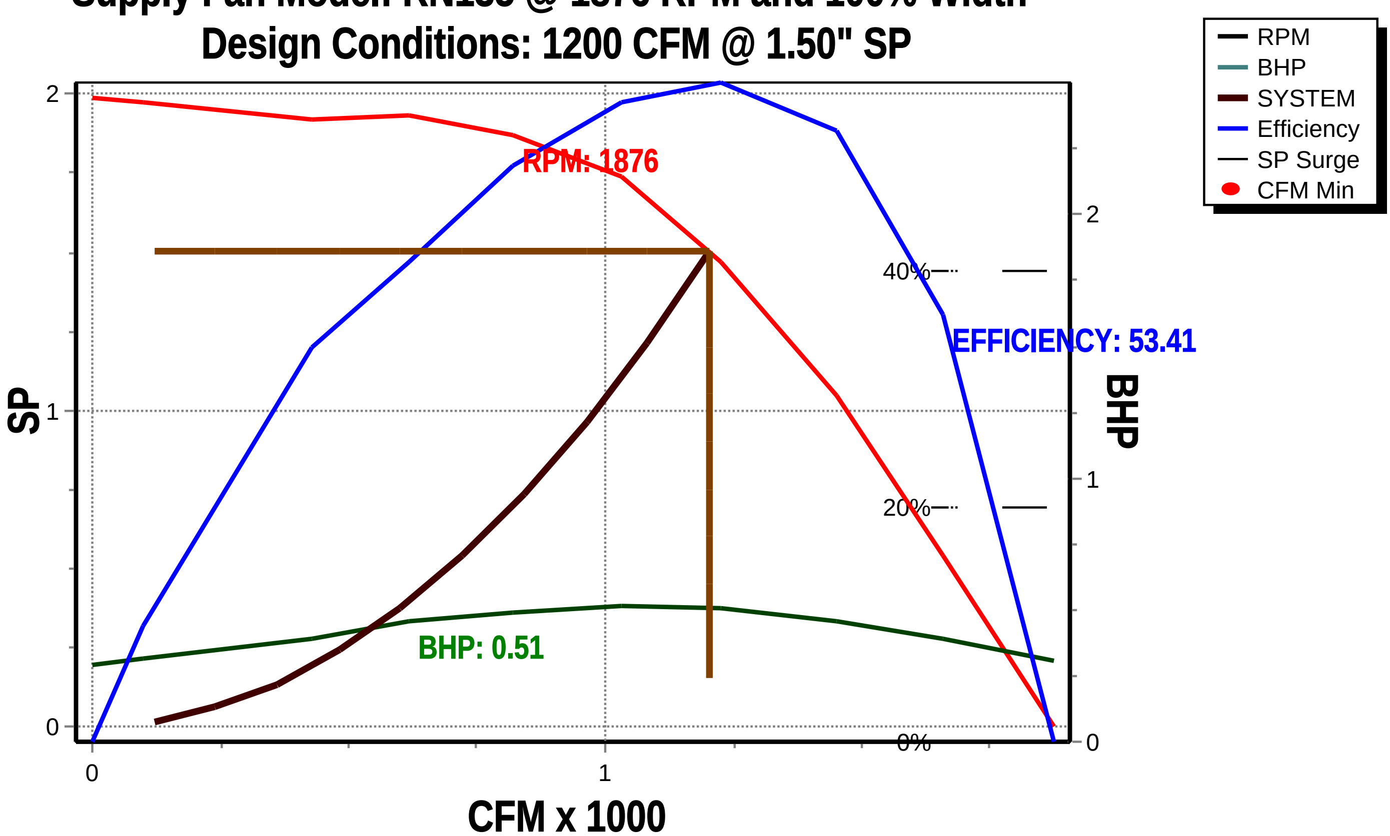
FAN SOUND POWER (Inlet/Outlet):

Octave Band: **(Re 10^-12 watts)**

1	2	3	4	5	6	7	8
75	*73*	*75*	*73*	*68*	*66*	*64*	*58*
75	*73*	*75*	*73*	*68*	*66*	*64*	*58*

SOUND POWER A-Weighted: 77 / 77 dB

Supply Fan Model: RN135 @ 1876 RPM and 100% Width
Design Conditions: 1200 CFM @ 1.50" SP



Unit Submittal

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

Unit Submittal

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3E9:K000-00B-DDF-000-000AH0F-00-0000000VB

Tag: 110-MAU-001

Job Name:	*Phase II Mile Creek WQRF COW*	**Unit Submittal For:**	
Job Number:	*Submittal 4.27.17*	**Unit Submittal Date:**	*April 27, 2017*

	Base Option	Description
R	Series	Roof Top Unit
N	Generation	Ninth Generation
026	Unit Size	Twenty Six
3	Voltage	460V/3Ø/60Hz
A	Interior Protection	Interior Corrosion Protection
0	Refrigerant Style	Air Handling Unit
0	Unit Configuration	No Cooling
0	Coil Coating	Standard
0	Cooling/Heat Pump Staging	No Cooling
3	Heating Type	Natural Gas Stainless Steel
E	Heating Designation	Heat E - 1080 MBtuh
9	Heating Staging	Modulating Gas - Temperature Control

	Feature Option	Description
K	**1A.** RA/OA Section	100% Outside Air - No RA Opening
0	**1B.** RA/EA Blower Configuration	Standard - None
0	**1C.** RA/EA Blower	Standard - None
0	**1D.** RA/EA Blower Motor	Standard - None
0	**2.** OA Control	Standard - None
0	**3.** Heat Options	Standard
B	**4.** Maintenance Options	115V Convenience Outlet - Factory Wired
D	**5A.** SA Blower Configuration	1 Blower + Premium Efficiency Motor + 1 VFD
D	**5B.** SA Blower	24" Direct Drive Backward Curved Plenum
F	**5C.** SA Motor	5.0 hp - 1760 rpm
0	**6A.** Pre Filter Type	Standard - None
0	**6B.** Unit Filter Type	2" Pleated - 30% Eff
0	**6C.** Filter Options	Standard
0	**7.** Refrigeration Control	Standard
0	**8.** Refrigeration Options	Standard
0	**9.** Refrigeration Accessories	Standard
A	**10.** Power Options	Non-fused Disconnect Power Switch - 100 Amps
H	**11.** Safety Options	Remote Safety Shutdown Terminals
0	**12.** Controls	Standard
F	**13.** Special Controls	Make Up Air Unit Controller - CV Cool + CV Heat
0	**14A.** Preheat Configuration	Standard - None
0	**14B.** Preheat Sizing	Standard - None
0	**15.** Glycol Percent	Water or No WSHP
0	**16.** Interior Cabinet Options	Standard - Double Wall + R-13 Foam Insulation
0	**17.** Exterior Cabinet Options	Standard
0	**18.** Customer Code	Standard
0	**19.** Code Options	Standard - ETL U.S.A. Listing
0	**20.** Crating	Standard
0	**21.** Water-Cooled Cond.	Standard - None
V	**22.** Control Vendors	WattMaster VCC-X Controls + Integrated BACnet MSTP
B	**23.** Type	Standard - Includes AAON Gray Paint

AAON®

Unit Submittal

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-006-3-A-0000-3L9:K000-00B-DBC-000-000AH0F-00-0000000VB

Tag: 210-MAU-001

Job Name:	*Phase II Mile Creek WQRF COW*	**Unit Submittal For:**	
Job Number:	*Submittal 4.27.17*	**Unit Submittal Date:**	*April 27, 2017*

	Base Option	Description
R	Series	Roof Top Unit
N	Generation	Ninth Generation
006	Unit Size	Six
3	Voltage	460V/3Ø/60Hz
A	Interior Protection	Interior Corrosion Protection
0	Refrigerant Style	Air Handling Unit
0	Unit Configuration	No Cooling
0	Coil Coating	Standard
0	Cooling/Heat Pump Staging	No Cooling
3	Heating Type	Natural Gas Stainless Steel
L	Heating Designation	Heat L - 210 MBtuh
9	Heating Staging	Modulating Gas - Temperature Control

	Feature Option	Description
K	**1A.** RA/OA Section	100% Outside Air - No RA Opening
0	**1B.** RA/EA Blower Configuration	Standard - None
0	**1C.** RA/EA Blower	Standard - None
0	**1D.** RA/EA Blower Motor	Standard - None
0	**2.** OA Control	Standard - None
0	**3.** Heat Options	Standard
B	**4.** Maintenance Options	115V Convenience Outlet - Factory Wired
D	**5A.** SA Blower Configuration	1 Blower + Premium Efficiency Motor + 1 VFD
B	**5B.** SA Blower	15" Direct Drive Backward Curved Plenum
C	**5C.** SA Motor	1.0 hp - 1760 rpm
0	**6A.** Pre Filter Type	Standard - None
0	**6B.** Unit Filter Type	2" Pleated - 30% Eff
0	**6C.** Filter Options	Standard
0	**7.** Refrigeration Control	Standard
0	**8.** Refrigeration Options	Standard
0	**9.** Refrigeration Accessories	Standard
A	**10.** Power Options	Non-fused Disconnect Power Switch - 100 Amps
H	**11.** Safety Options	Remote Safety Shutdown Terminals
0	**12.** Controls	Standard
F	**13.** Special Controls	Make Up Air Unit Controller - CV Cool + CV Heat
0	**14A.** Preheat Configuration	Standard - None
0	**14B.** Preheat Sizing	Standard - None
0	**15.** Glycol Percent	Water or No WSHP
0	**16.** Interior Cabinet Options	Standard - Double Wall + R-13 Foam Insulation
0	**17.** Exterior Cabinet Options	Standard
0	**18.** Customer Code	Standard
0	**19.** Code Options	Standard - ETL U.S.A. Listing
0	**20.** Crating	Standard
0	**21.** Water-Cooled Cond.	Standard - None
V	**22.** Control Vendors	WattMaster VCC-X Controls + Integrated BACnet MSTP
B	**23.** Type	Standard - Includes AAON Gray Paint

Unit Submittal

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3D9:K000-00B-DDQ-000-000AH0F-00-0000000VB

Tag: 350-MAU-001

Job Name: *Phase II Mile Creek WQRF COW*
Job Number: *Submittal 4.27.17*
Unit Submittal For:
Unit Submittal Date: *April 27, 2017*

	Base Option	Description
R	Series	Roof Top Unit
N	Generation	Ninth Generation
026	Unit Size	Twenty Six
3	Voltage	460V/3Ø/60Hz
A	Interior Protection	Interior Corrosion Protection
0	Refrigerant Style	Air Handling Unit
0	Unit Configuration	No Cooling
0	Coil Coating	Standard
0	Cooling/Heat Pump Staging	No Cooling
3	Heating Type	Natural Gas Stainless Steel
D	Heating Designation	Heat D - 810 MBtuh
9	Heating Staging	Modulating Gas - Temperature Control

	Feature Option	Description
K	**1A.** RA/OA Section	100% Outside Air - No RA Opening
0	**1B.** RA/EA Blower Configuration	Standard - None
0	**1C.** RA/EA Blower	Standard - None
0	**1D.** RA/EA Blower Motor	Standard - None
0	**2.** OA Control	Standard - None
0	**3.** Heat Options	Standard
B	**4.** Maintenance Options	115V Convenience Outlet - Factory Wired
D	**5A.** SA Blower Configuration	1 Blower + Premium Efficiency Motor + 1 VFD
D	**5B.** SA Blower	24" Direct Drive Backward Curved Plenum
Q	**5C.** SA Motor	3.0 hp - 1170 rpm
0	**6A.** Pre Filter Type	Standard - None
0	**6B.** Unit Filter Type	2" Pleated - 30% Eff
0	**6C.** Filter Options	Standard
0	**7.** Refrigeration Control	Standard
0	**8.** Refrigeration Options	Standard
0	**9.** Refrigeration Accessories	Standard
A	**10.** Power Options	Non-fused Disconnect Power Switch - 100 Amps
H	**11.** Safety Options	Remote Safety Shutdown Terminals
0	**12.** Controls	Standard
F	**13.** Special Controls	Make Up Air Unit Controller - CV Cool + CV Heat
0	**14A.** Preheat Configuration	Standard - None
0	**14B.** Preheat Sizing	Standard - None
0	**15.** Glycol Percent	Water or No WSHP
0	**16.** Interior Cabinet Options	Standard - Double Wall + R-13 Foam Insulation
0	**17.** Exterior Cabinet Options	Standard
0	**18.** Customer Code	Standard
0	**19.** Code Options	Standard - ETL U.S.A. Listing
0	**20.** Crating	Standard
0	**21.** Water-Cooled Cond.	Standard - None
V	**22.** Control Vendors	WattMaster VCC-X Controls + Integrated BACnet MSTP
B	**23.** Type	Standard - Includes AAON Gray Paint

Unit Submittal

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-013-3-A-CA12-000:5000-00B-DBD-000-CECAH0E-00-00C0000TB

Tag: 110-AHU/AC-001

Job Name:	*Phase II Mile Creek WQRF COW*	**Unit Submittal For:**	
Job Number:	*Submittal 4.27.17*	**Unit Submittal Date:**	*April 27, 2017*

	Base Option	Description
R	Series	Roof Top Unit
N	Generation	Ninth Generation
013	Unit Size	Thirteen
3	Voltage	460V/3Ø/60Hz
A	Interior Protection	Interior Corrosion Protection
C	Refrigerant Style	R-410A - Standard Efficiency
A	Unit Configuration	Air-Cooled Cond. + Std Evap. Coil
1	Coil Coating	Polymer E-Coated Evap. and Cond. Coils
2	Cooling/Heat Pump Staging	2 Stage
0	Heating Type	No Heating
0	Heating Designation	No Heating
0	Heating Staging	No Heating

	Feature Option	Description
5	**1A.** RA/OA Section	100% Return Air (No O/A Opening)
0	**1B.** RA/EA Blower Configuration	Standard - None
0	**1C.** RA/EA Blower	Standard - None
0	**1D.** RA/EA Blower Motor	Standard - None
0	**2.** OA Control	Standard - None
0	**3.** Heat Options	Standard
B	**4.** Maintenance Options	115V Convenience Outlet - Factory Wired
D	**5A.** SA Blower Configuration	1 Blower + Premium Efficiency Motor + 1 VFD
B	**5B.** SA Blower	15" Direct Drive Backward Curved Plenum
D	**5C.** SA Motor	2.0 hp - 1760 rpm
0	**6A.** Pre Filter Type	Standard - None
0	**6B.** Unit Filter Type	2" Pleated - 30% Eff
0	**6C.** Filter Options	Standard
C	**7.** Refrigeration Control	Adjustable Fan Cycling
E	**8.** Refrigeration Options	0°F Low Ambient Lead Stage
C	**9.** Refrigeration Accessories	Sight Glass + Compressor Isolation Valves
A	**10.** Power Options	Non-fused Disconnect Power Switch - 100 Amps
H	**11.** Safety Options	Remote Safety Shutdown Terminals
0	**12.** Controls	Standard
E	**13.** Special Controls	Constant Volume (CV) Unit Controller - CV Cool + CV Heat
0	**14A.** Preheat Configuration	Standard - None
0	**14B.** Preheat Sizing	Standard - None
0	**15.** Glycol Percent	Water or No WSHP
0	**16.** Interior Cabinet Options	Standard - Double Wall + R-13 Foam Insulation + Stainless Steel Drain Pan
C	**17.** Exterior Cabinet Options	Cond. Coil Guards
0	**18.** Customer Code	Standard
0	**19.** Code Options	Standard - ETL U.S.A. Listing
0	**20.** Crating	Standard
0	**21.** Water-Cooled Cond.	Standard - None
T	**22.** Control Vendors	WattMaster VCB-X Controls + Integrated BACnet MSTP
B	**23.** Type	Standard - Includes AAON Gray Paint

Unit Submittal

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-007-3-A-FA19-000:5000-00B-DMC-000-CECAH0E-00-00C0000TB

Tag: 210-AHU/AC-001

Job Name:	*Phase II Mile Creek WQRF COW*	**Unit Submittal For:**	
Job Number:	*Submittal 4.27.17*	**Unit Submittal Date:**	*April 27, 2017*

	Base Option	Description
R	Series	Roof Top Unit
N	Generation	Ninth Generation
007	Unit Size	Seven
3	Voltage	460V/3Ø/60Hz
A	Interior Protection	Interior Corrosion Protection
F	Refrigerant Style	R-410A VCC - Standard Efficiency
A	Unit Configuration	Air-Cooled Cond. + Std Evap. Coil
1	Coil Coating	Polymer E-Coated Evap. and Cond. Coils
9	Cooling/Heat Pump Staging	Modulating - 1 Variable Capacity Compressor
0	Heating Type	No Heating
0	Heating Designation	No Heating
0	Heating Staging	No Heating

	Feature Option	Description
5	**1A.** RA/OA Section	100% Return Air (No O/A Opening)
0	**1B.** RA/EA Blower Configuration	Standard - None
0	**1C.** RA/EA Blower	Standard - None
0	**1D.** RA/EA Blower Motor	Standard - None
0	**2.** OA Control	Standard - None
0	**3.** Heat Options	Standard
B	**4.** Maintenance Options	115V Convenience Outlet - Factory Wired
D	**5A.** SA Blower Configuration	1 Blower + Premium Efficiency Motor + 1 VFD
M	**5B.** SA Blower	13.5" Direct Drive Backward Curved Plenum
C	**5C.** SA Motor	1.0 hp - 1760 rpm
0	**6A.** Pre Filter Type	Standard - None
0	**6B.** Unit Filter Type	2" Pleated - 30% Eff
0	**6C.** Filter Options	Standard
C	**7.** Refrigeration Control	Adjustable Fan Cycling
E	**8.** Refrigeration Options	0°F Low Ambient Lead Stage
C	**9.** Refrigeration Accessories	Sight Glass + Compressor Isolation Valves
A	**10.** Power Options	Non-fused Disconnect Power Switch - 100 Amps
H	**11.** Safety Options	Remote Safety Shutdown Terminals
0	**12.** Controls	Standard
E	**13.** Special Controls	Constant Volume (CV) Unit Controller - CV Cool + CV Heat
0	**14A.** Preheat Configuration	Standard - None
0	**14B.** Preheat Sizing	Standard - None
0	**15.** Glycol Percent	Water or No WSHP
0	**16.** Interior Cabinet Options	Standard - Double Wall + R-13 Foam Insulation + Stainless Steel Drain Pan
C	**17.** Exterior Cabinet Options	Cond. Coil Guards
0	**18.** Customer Code	Standard
0	**19.** Code Options	Standard - ETL U.S.A. Listing
0	**20.** Crating	Standard
0	**21.** Water-Cooled Cond.	Standard - None
T	**22.** Control Vendors	WattMaster VCB-X Controls + Integrated BACnet MSTP
B	**23.** Type	Standard - Includes AAON Gray Paint

Control Details

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

110,210-AHU/AC-001; 110,210,350-MAU-001

Room Air Temperature Sensors

***Space sensor only. Explosion proof conduit, wiring and installation by others

Compact Wall-mount
Dimensions:
W 3.12" (79 mm)
H 2.09" (54 mm)
D 1.80" (46 mm)

Full Size Wall-mount
Dimensions:
W 2.75" (70 mm)
H 4.50" (114 mm)
D 1.56" (40 mm)

Explosionproof Wall-mount
Dimensions:
W 1.60" (41 mm)
H 5.55" (141 mm)
D 2.05" (52 mm)

Flush Wall-mount
Dimensions:
W 2.75" (70 mm)
H 4.50" (114 mm)
D 0.18" (5 mm)

Overview

Minco's room air sensors are available with a variety of enclosures that meet most standard and explosionproof HVAC/R installations. The sensors can be match calibrated with a Minco Temptran™ (temperature transmitter) for increased accuracy and reliability.

Room air sensors are designed for wall mounting. Choose from two plastic enclosure styles with brushed aluminum faceplates or a flushmount stainless steel model.

The full-size enclosure and flushmount fit over standard junction boxes. The full size enclosure has optional knockouts for Wiremold raceway surface wiring. Just remove knockouts with pliers. This enclosure may also include a 4-20 mA temperature transmitter; specify model AS200655.

The compact room air sensor mounts directly on drywall.

The explosionproof sensor housing is UL listed and CSA approved for Class I, Groups C and D; Class II, Groups E, F, and G; and Class III. Download Application Aid #19 for more hazardous area information and the various standards and agencies (including FM, CSA, CENELEC and ATEX) at www.minco.com/sensoraid/.

Specifications

Temperature range:
-45.5 to 100°C (-50 to 212°F)

Temperature range (with TT115 transmitter):
Zero: -40 to 10°C (-40 to 50°F)
Span: 25 to 100°C (45 to 180°F)
Max upper temperature: 85°C (185°F)

Leadwires:
Full size and compact: AWG 22, PTFE insulated, 4" (100 mm) long.
Explosionproof and flush mount: AWG 26, PTFE insulated, 6" (150 mm) inside cover.

Moisture resistance: Meets MIL-STD-202, Method 104, Test Condition B.

Transmitters: Full size sensors with 2 leads can use Temptran™ transmitter model TT115 installed within the sensor enclosure. A variety of transmitters are available for all other sensor models. Transmitters must be installed in a separate enclosure from the sensor.

Specification and order options:

Compact and full size

S472PB	Model number from table
Y	Number of leads: Y = 2 leads Z = 3 leads
4	Lead length in inches: (stocked only in 4")
K0	Knockouts (full size only): K0= No knockouts K1= Knockouts for wiremold raceway
S472PBY4K0 = Sample part number	

Note: For replacement cover only, order part AC692KO or AC692K1 for full size, AC551 for compact.

Explosionproof and flush-mount

S100147PD	Model number from table
Y	Number of leads: Y = 2 leads Z = 3 leads
S100147PDY = Sample part number	

STOCKED PARTS

Sensing Element	# of Leadwires	Lead Length	Lead Covering	Stock Part #
PF	2	6"	PTFE	S101456PFY

Note: Available up to 10 pieces or contact Minco Customer Service

Element	TCR Ω /Ω/°C	Compact room air sensors	Full size room air sensors	Explosion-proof wall-mount sensors	Flush mount room air sensors
RTDs					
Platinum 100 Ω ±0.1% at 0°C	0.00391	S405PB	S472PB		
Platinum 100 Ω±0.1% at 0°C (Meets EN60751, Class B)	0.00385	S448PD	S473PD	S100147PD	S101456PD
Platinum 1000 Ω ±0.1% at 0°C	0.00385	S449PF	S474PF	S100148PF	S101456PF
Platinum 1000 Ω ±0.1% at 0°C	0.00375	S483PW	S489PW	S101608PW	S101456PW
Nickel-iron 1000 Ω ±0.12% at 70°F	0.00527	S403FB	S470FB		
Nickel-iron 2000 Ω ±0.12% at 70°F	0.00527	S404FC	S471FC		
HW 3000 Ω at -30.2°C	0.00262	S1000064PX	S1000063PX		
Thermistors	R_{25}/R_{125}				
Thermistor 2,252 Ω ±1% at 25°C	29.2	TS426TA	TS424TA	TS100149TA	TS101769TA
Thermistor 10,000 Ω ±1% at 25°C	23.5	TS427TB	TS425TB	TS100150TB	TS101769TB

VCCX Components

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3E9:K000-00B-DDF-000-000AH0F-00-0000000VB

Tag: 110-MAU-001

Job Name:	***Phase II Mile Creek WQRF COW***	**VCCX For:**	
Job Number:	***Submittal 4.27.17***	**VCCX Date:**	***April 27, 2017***

Hardware Included For VCCX Controller

Part #	Included Parts	Assigned Channel	BACnet Point
V87900	VCCX CONTROLLER		
R82890	Supply Temp Sensor - Field Installed	VCCX control point AI 3	AI:9
R81550	Outside Temp Sensor	VCCX control point AI 7	AI:16
	Supply Fan Control Signal 0-10VDC	VCCX control point AO 1	AI:22
R62330	Proof of Air Flow	VCCX control point BI 1	BI:6
	Safety Shut Down	VCCX control point BI 8	BI:26
	Supply Fan	Configured Relay point	BI:63
V12090	MODULATING GAS MODULE		
	ModGas Gas Valve Signal	MODGAS-X	
	ModGas High Speed Enable	MODGAS-X	AI:43
	ModGas Low Speed Enable	MODGAS-X	
	ModGas Aux Heat Valve Enable 1	MODGAS-X	

VCCX Components

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-006-3-A-0000-3L9:K000-00B-DBC-000-000AH0F-00-0000000VB

Tag: 210-MAU-001

Job Name:	***Phase II Mile Creek WQRF COW***	**VCCX For:**	
Job Number:	***Submittal 4.27.17***	**VCCX Date:**	***April 27, 2017***

Hardware Included For VCCX Controller

Part #	Included Parts	Assigned Channel	BACnet Point
V87900	VCCX CONTROLLER		
R82890	Supply Temp Sensor - Field Installed	VCCX control point AI 3	AI:9
R81550	Outside Temp Sensor	VCCX control point AI 7	AI:16
	Supply Fan Control Signal 0-10VDC	VCCX control point AO 1	AI:22
R62330	Proof of Air Flow	VCCX control point BI 1	BI:6
	Safety Shut Down	VCCX control point BI 8	BI:26
	Supply Fan	Configured Relay point	BI:63

VCCX Components

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-026-3-A-0000-3D9:K000-00B-DDQ-000-000AH0F-00-0000000VB

Tag: 350-MAU-001

Job Name:	***Phase II Mile Creek WQRF COW***	**VCCX For:**	
Job Number:	***Submittal 4.27.17***	**VCCX Date:**	***April 27, 2017***

Hardware Included For VCCX Controller

Part #	Included Parts	Assigned Channel	BACnet Point
V87900	VCCX CONTROLLER		
R82890	Supply Temp Sensor - Field Installed	VCCX control point AI 3	AI:9
R81550	Outside Temp Sensor	VCCX control point AI 7	AI:16
	Supply Fan Control Signal 0-10VDC	VCCX control point AO 1	AI:22
R62330	Proof of Air Flow	VCCX control point BI 1	BI:6
	Safety Shut Down	VCCX control point BI 8	BI:26
	Supply Fan	Configured Relay point	BI:63
V12090	MODULATING GAS MODULE		
	ModGas Gas Valve Signal	MODGAS-X	
	ModGas High Speed Enable	MODGAS-X	AI:43
	ModGas Low Speed Enable	MODGAS-X	
	ModGas Aux Heat Valve Enable 1	MODGAS-X	

VCBX Components

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-013-3-A-CA12-000:5000-00B-DBD-000-CECAH0E-00-00C0000TB

Tag: 110-AHU/AC-001

Job Name:	***Phase II Mile Creek WQRF COW***	**VCBX For:**	
Job Number:	***Submittal 4.27.17***	**VCBX Date:**	***April 27, 2017***

Hardware Included For VCBX Controller

Part #	Included Parts	Assigned Channel	BACnet Point
V28940	VCBX Controller		
P94320	Space Temp Sensor	VCBX control point AI1	AI:6
R82890	Supply Temp Sensor	VCBX control point AI2	AI:7
R81550	Outside Temp Sensor	VCBX control point AI3	AI:10
	Supply Fan 0-10VDC	VCBX control point AO1	AI:33
	Safety Shut Down	VCBX control point BI1	BI:25
R62330	Proof Of Flow	VCBX control point BI2	BI:23
	Supply Fan	Configured Relay point	BI:37
	Cooling 1	Configured Relay Point	BI:38
	Cooling 2	Configured Relay Point	BI:39

VCBX Components

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.256 (SN: 7366656-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN-007-3-A-FA19-000:5000-00B-DMC-000-CECAH0E-00-00C0000TB

Tag: 210-AHU/AC-001

Job Name:	***Phase II Mile Creek WQRF COW***	**VCBX For:**	
Job Number:	***Submittal 4.27.17***	**VCBX Date:**	***April 27, 2017***

Hardware Included For VCBX Controller

Part #	Included Parts	Assigned Channel	BACnet Point
V28940	VCBX Controller		
P94320	Space Temp Sensor	VCBX control point AI1	AI:6
R82890	Supply Temp Sensor	VCBX control point AI2	AI:7
R81550	Outside Temp Sensor	VCBX control point AI3	AI:10
	Supply Fan 0-10VDC	VCBX control point AO1	AI:33
	Safety Shut Down	VCBX control point BI1	BI:25
R62330	Proof Of Flow	VCBX control point BI2	BI:23
	Supply Fan	Configured Relay point	BI:37
	Cooling 1	Configured Relay Point	BI:38

Unit Drawings

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

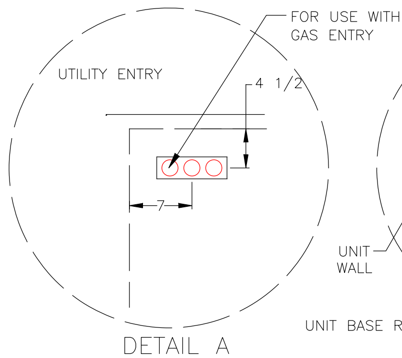
110,350-MAU-001

RN UNITS 26-70 TON AIR HANDLER

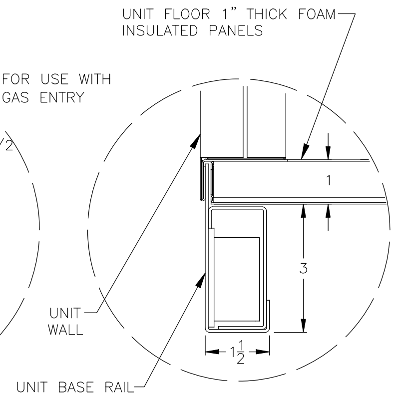
AAON®

CLEARANCES	
LOCATION	UNIT SIZE 26–70 TON
RETURN AIR BACK	48
VENT SIDE FRONT	48
LEFT SIDE	48
RIGHT SIDE	70
TOP	UNOBSTRUCTED

NOTE: RIGHT AND LEFT SIDE UNIT CLEARANCES ARE INTERCHANGEABLE ON UNITS THAT DO NOT HAVE THE HYDRONIC HEATING OPTION. (UNITS WITH HYDRONIC HEAT MUST HAVE 70" RIGHT SIDE ACCESS FOR SERVICE.)

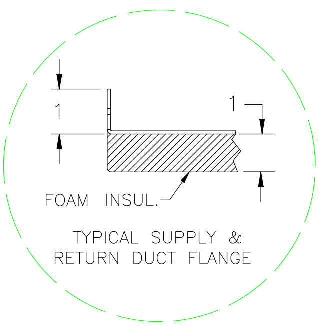


DETAIL A

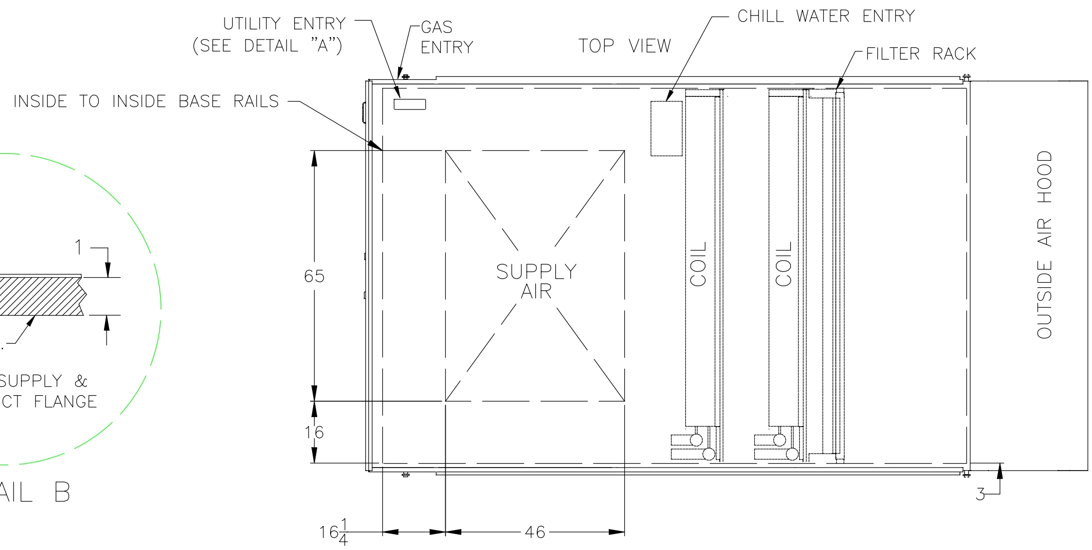


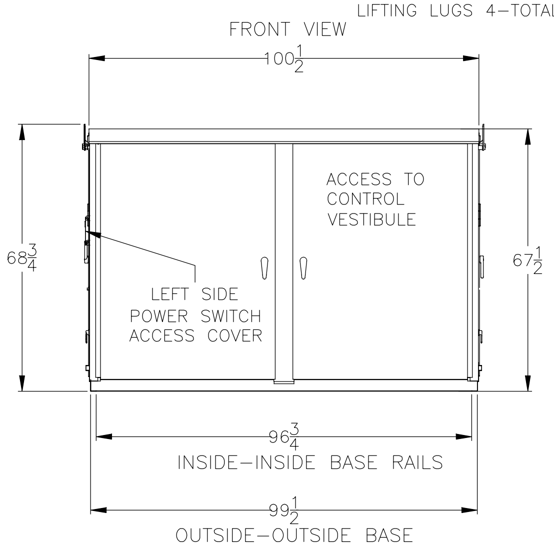
BASE RAIL CLEARANCE

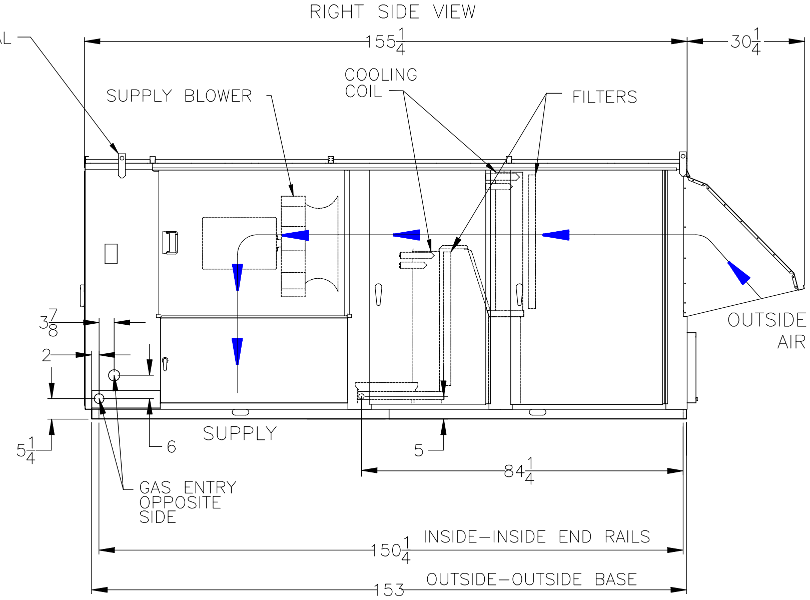
NOTE: 26–40 TON UNITS INCLUDES A SINGLE COOLING COIL. 50–70 TON UNIT INCLUDE TWO COOLING COILS.



DETAIL B



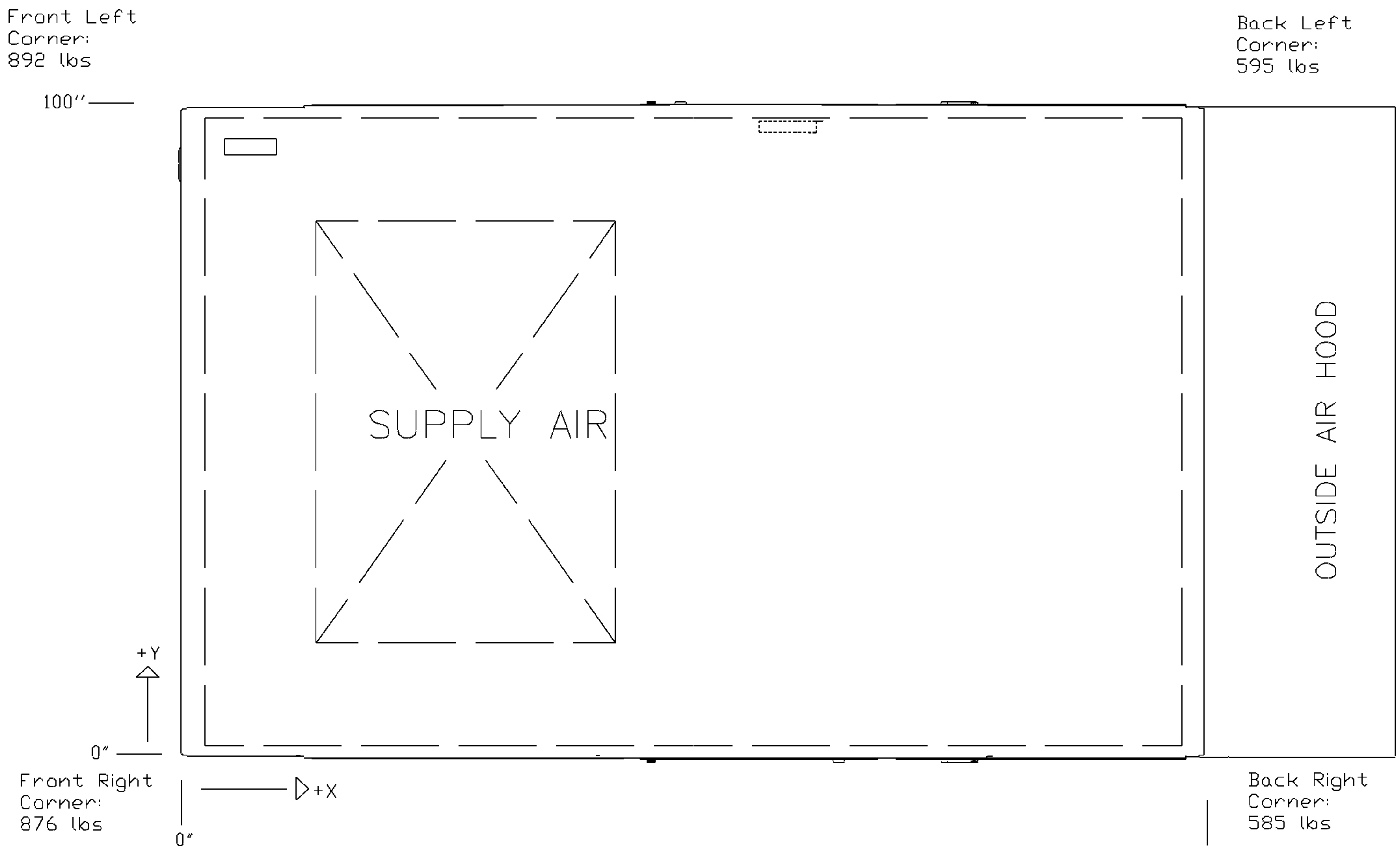




RND CABINET
NO COOLING UNIT

110-MAU-001

RN-026-3-A-0000-3E9:K000-00B-DDF-000-000AH0F-00-0000000VB



CGx: 61.2"
CGy: 50.2"

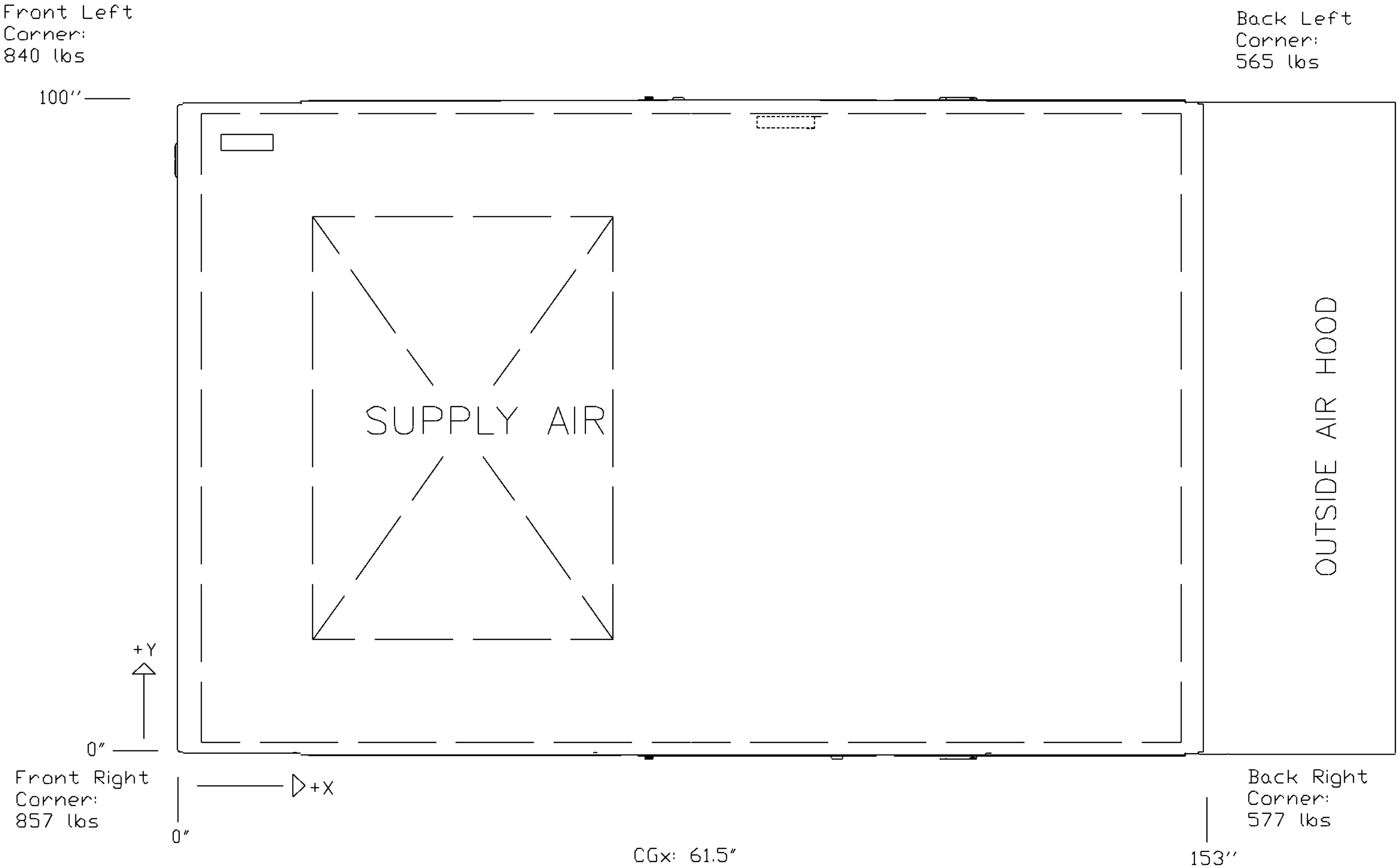
Total Weight:
2949 lbs (±5%)

Disclaimer:
This weight estimate does not account for any SPAs.

RND CABINET
NO COOLING UNIT

350-MAU-001

RN-026-3-A-0000-3D9:K000-00B-DDQ-000-000AH0F-00-0000000VB



CGx: 61.5"
CGy: 49.3"

Total Weight:
2839 lbs (±5%)

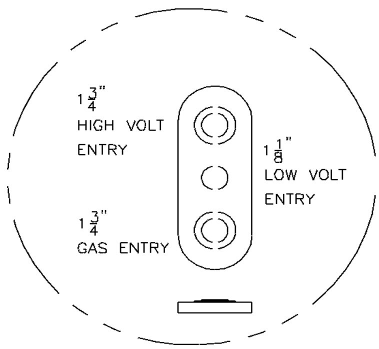
Disclaimer:
This weight estimate does not account for any SPAs.

RN SERIES
A - CABINET DX AIR HANDLER OR NO COOLING
STANDARD ~ 6-10 TON

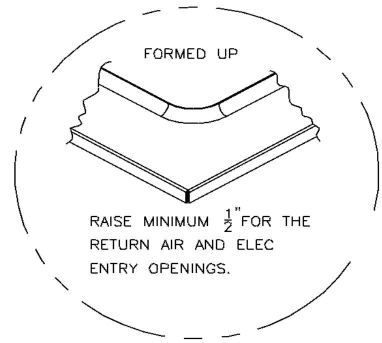
CLEARANCES

LOCATION	• UNIT SIZE • 6 - 10 TON
OUTSIDE AIR (BACK)	36
CONTROLS SIDE (FRONT)	48
LEFT SIDE	6
RIGHT SIDE	48
TOP	UNOBSTRUCTED

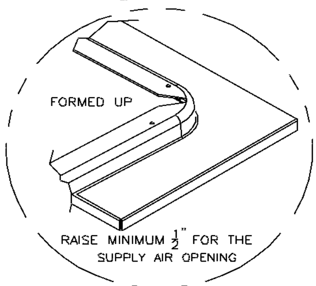
NOTE: THE RNA UNIT IS NOT COMPATIBLE WITH PREVIOUS GENERATIONS OF AAON CURBS. AN ADAPTER CURB IS AVAILABLE IN ECAT.



DETAIL A

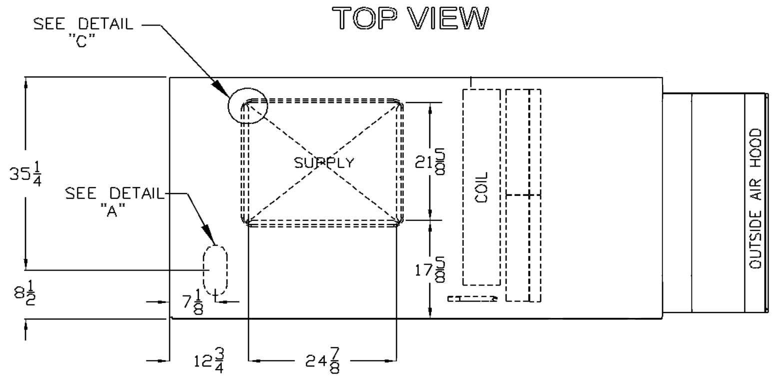


DETAIL B

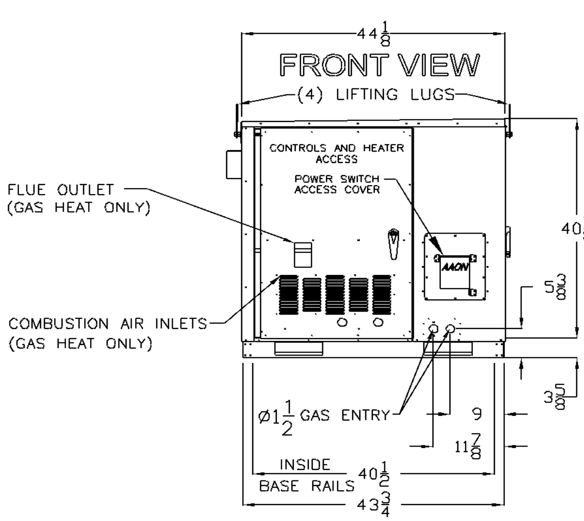


DETAIL C

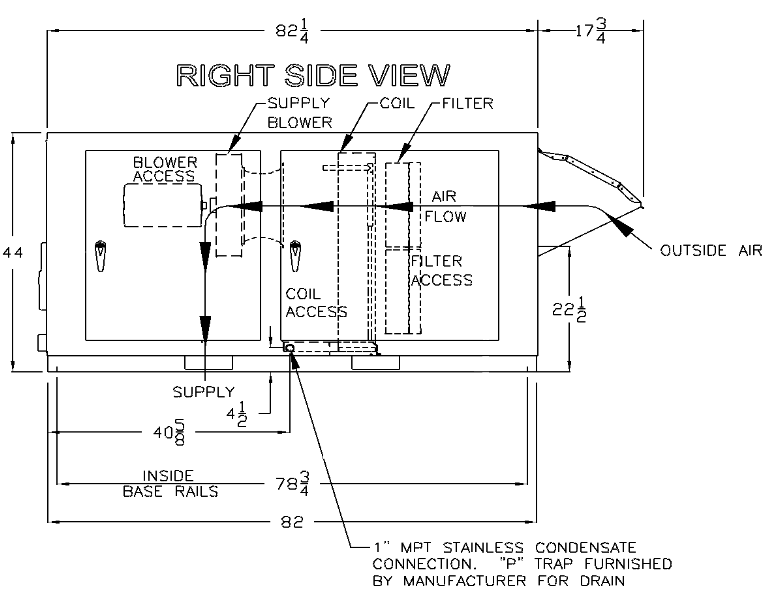
TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW



RNA-00022 NEW 10/16/09 JRL

NOTE: ALL DIMENSIONS ARE IN INCHES

RNA CABINET
NO COOLING UNIT

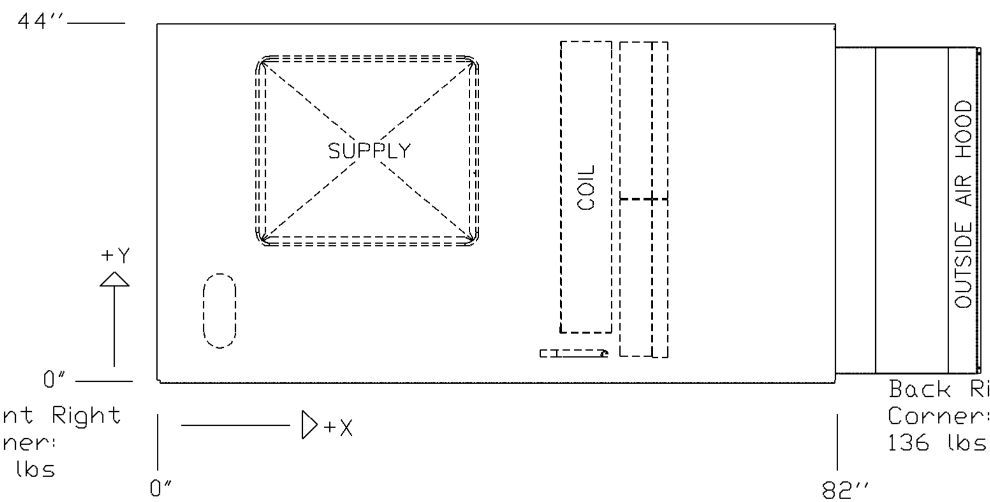
AAON®

210-MAU-001

RN-006-3-A-0000-3L9:K000-00B-DBC-000-000AH0F-00-0000000VB

Front Left
Corner:
203 lbs

Back Left
Corner:
135 lbs



Front Right
Corner:
204 lbs

Back Right
Corner:
136 lbs

CGx: 32.8"
CGy: 21.8"

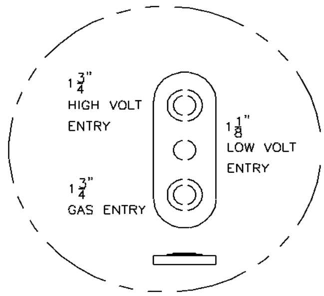
Total Weight:
678 lbs (±5%)

Disclaimer:
This weight estimate does not account for any SPAs.

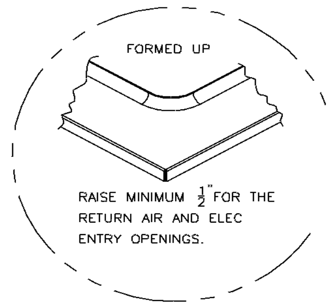
RN SERIES
B - CABINET STANDARD WITH 100% RETURN AIR ~ 9-15 TON

CLEARANCES

LOCATION	• UNIT SIZE • 9 - 15 TON
OUTSIDE AIR (BACK)	48
CONTROLS SIDE (FRONT)	48
LEFT SIDE	6
RIGHT SIDE	48
TOP	UNOBSTRUCTED



DETAIL A

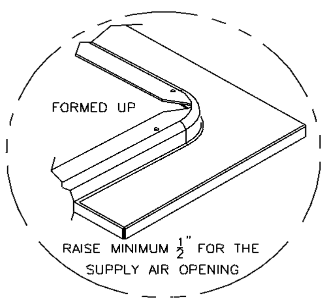


DETAIL B

NUMBER OF CONDENSER FANS

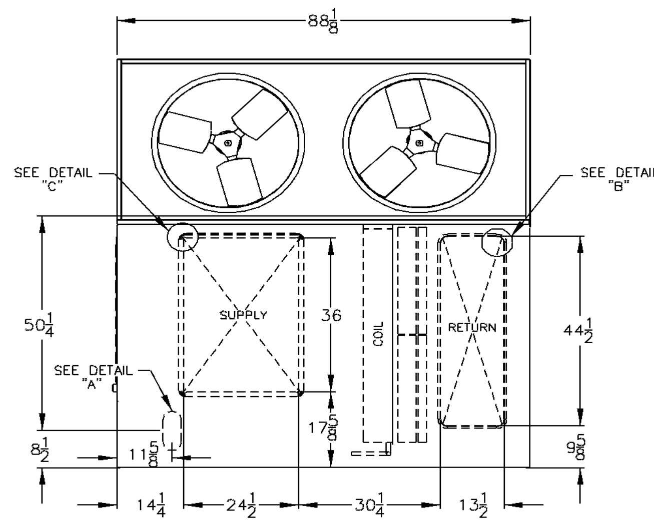
9 & 11 TON - 1 FAN

13 & 15 TON - 2 FANS

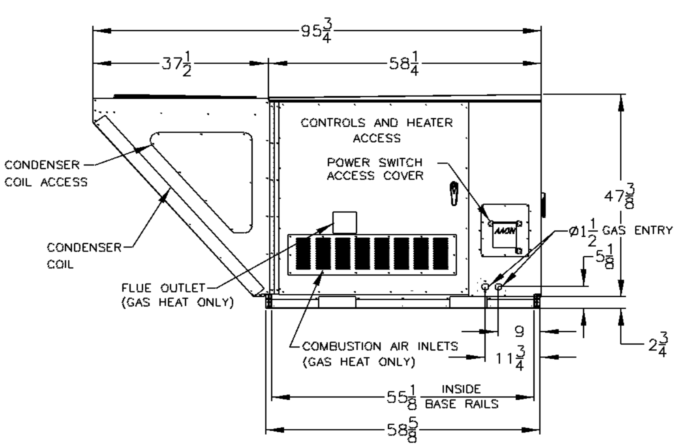


DETAIL C

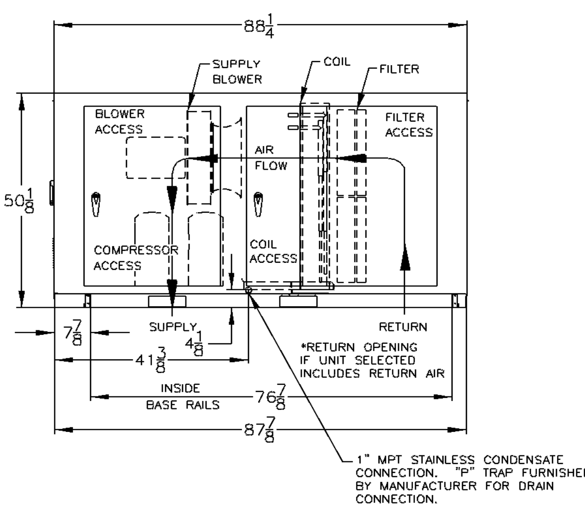
TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW



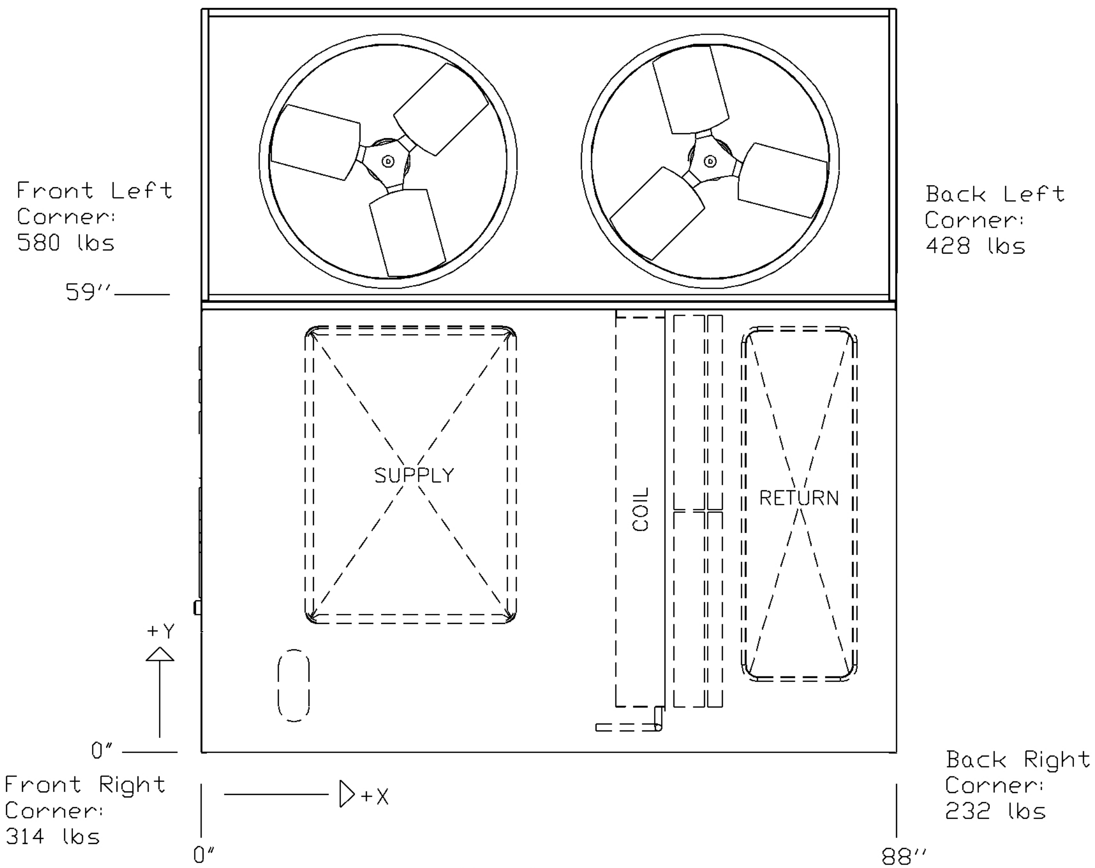
RNB-00097 REV:A 08/30/11 JRL

NOTE: ALL DIMENSIONS ARE IN INCHES

RNB CABINET
AIR COOLED CONDENSING UNIT

110-AHU/AC-001

RN-013-3-A-CA12-000:5000-00B-DBD-000-CECAH0E-00-00C0000TB



CGx: 37.4"
CGy: 38.1"

Total Weight:
1554 lbs (±5%)

Disclaimer:
This weight estimate does not account for any SPAs.

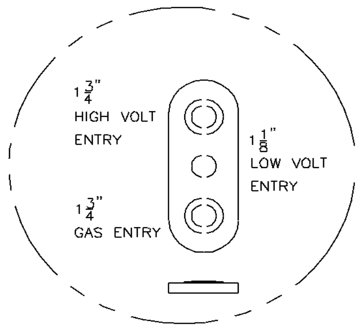
210-AHU/AC-001

RN SERIES
A - CABINET STANDARD WITH 100% RETURN AIR ~ 6-10 TON

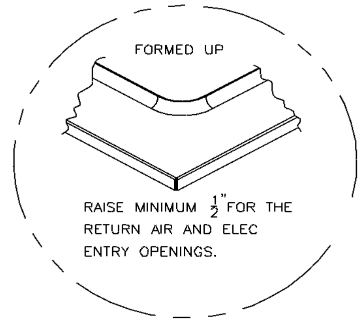
CLEARANCES

LOCATION	• UNIT SIZE • 6 - 10 TON
OUTSIDE AIR (BACK)	36
CONTROLS SIDE (FRONT)	48
LEFT SIDE	6
RIGHT SIDE	48
TOP	UNOBSTRUCTED

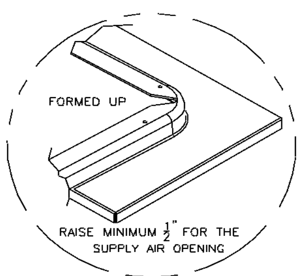
NOTE: THE RNA UNIT IS NOT COMPATIBLE WITH PREVIOUS GENERATIONS OF AAON CURBS. AN ADAPTER CURB IS AVAILABLE IN ECAT.



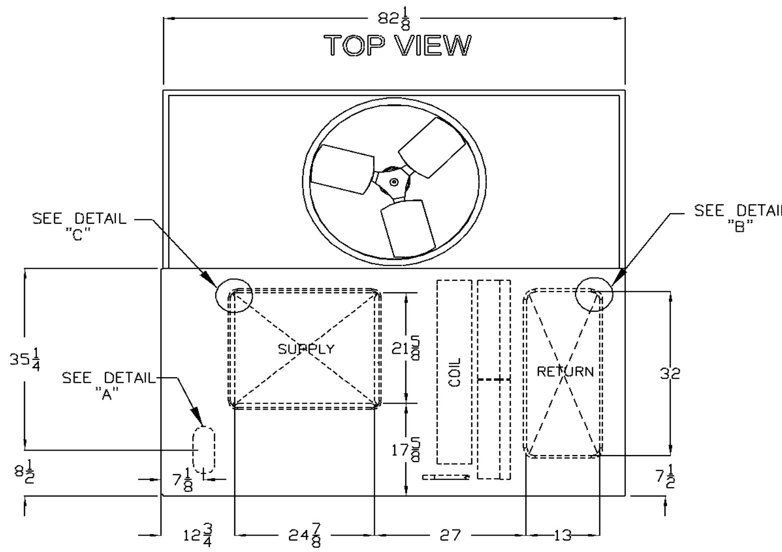
DETAIL A

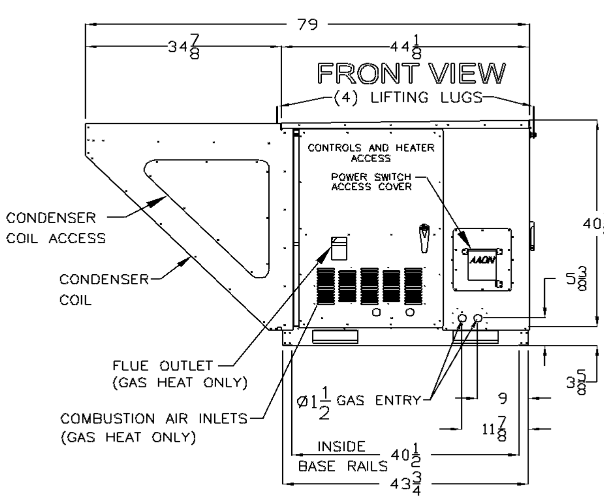


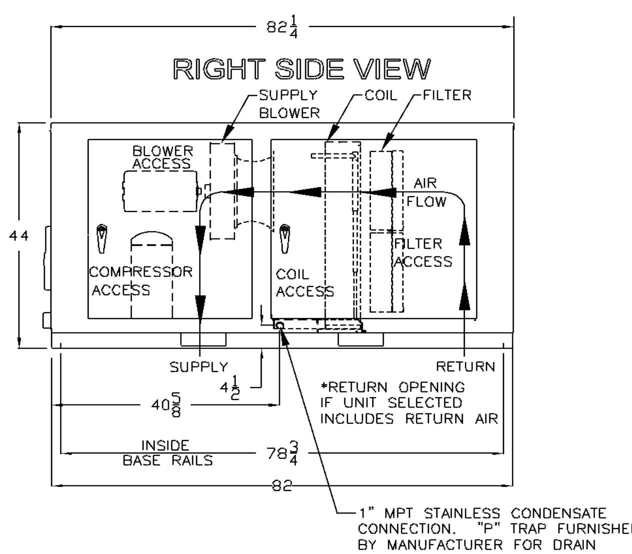
DETAIL B



DETAIL C







RNA-00079 NEW 12/03/10 JRL

NOTE: ALL DIMENSIONS ARE IN INCHES

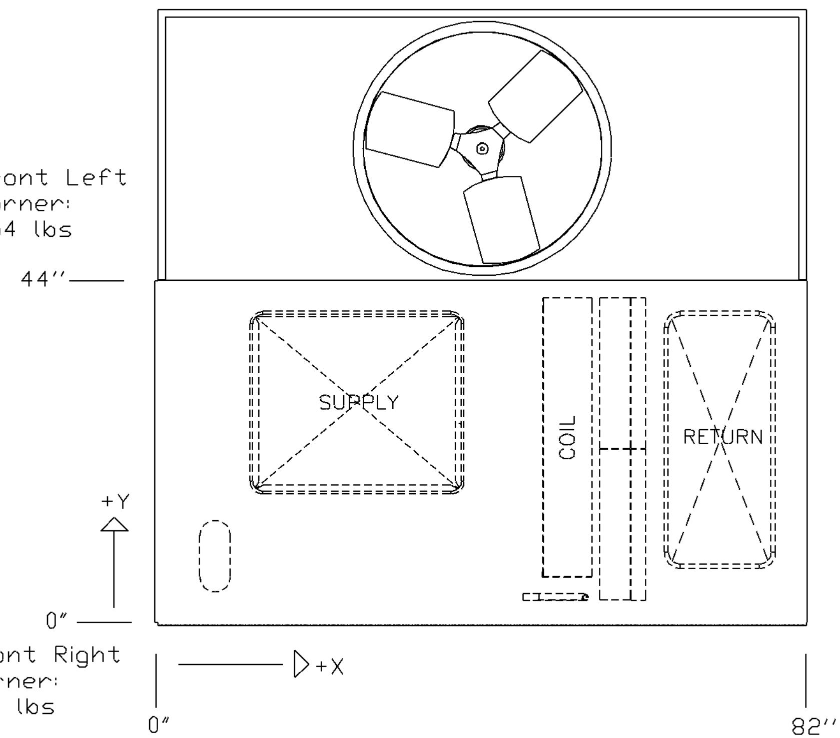
RNA CABINET
AIR COOLED CONDENSING UNIT

210-AHU/AC-001

RN-007-3-A-FA19-000:5000-00B-DMC-000-CECAH0E-00-00C0000TB

Front Left Corner: 354 lbs

Back Left Corner: 282 lbs



Front Right Corner: 179 lbs

Back Right Corner: 142 lbs

CGx: 36.4"
CGy: 29.1"

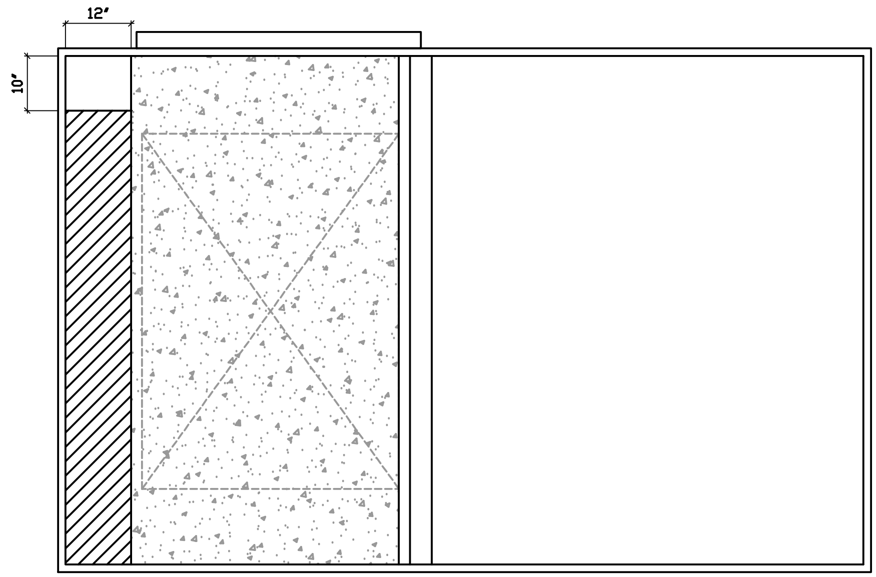
Total Weight:
956 lbs (±5%)

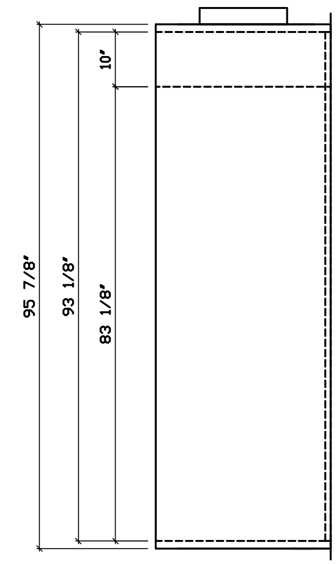
Disclaimer:
This weight estimate does not account for any SPAs.

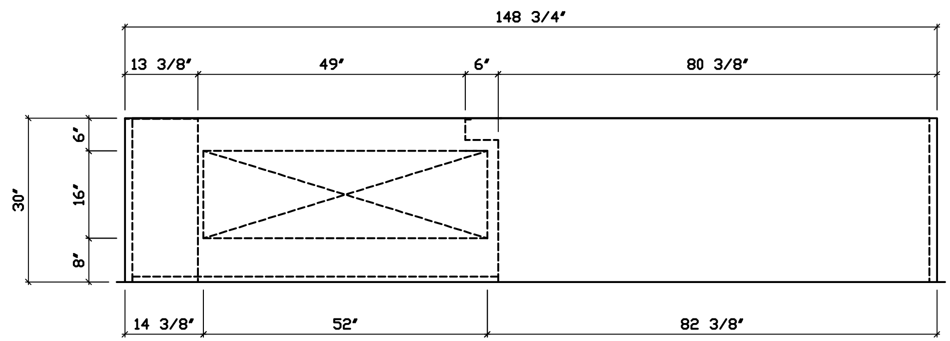
Curb Drawings

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

Curbs will be attached to the equipment pad using 3/8" Hilti Kwik-Bolt-TZ(4" embedment and 1/2" drilled holes) concrete anchors at the curb flange. Locations for the concrete anchors will be at the 4 corners and then additonal anchors centered on the long runs. Equipment pads will be built IAW with detail 0330-056(type H) and the plans.



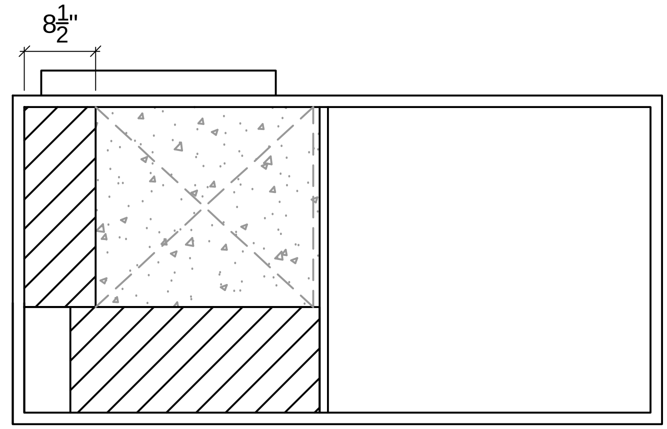


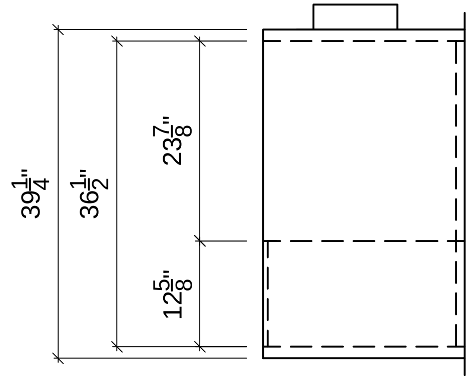


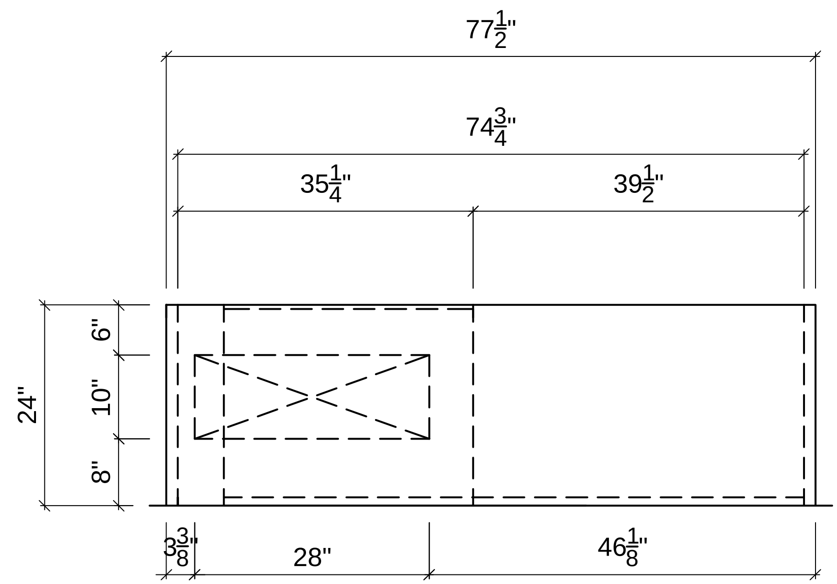
Notes:
1. AAON RN-D, Std Cabinet
2. 14 Gauge, Galvanized Construction
3. Walls Insulated w/ 1 ½", 3 Lb Density Insulation; Floor Insulated w/ 1" Black Insulation
4. Turning Vanes in S/A Section
5. Pad Mount
6. Openings As Specified

Units: Four Mile Creek	
DWG#: 110–MAU–001	
Qty: 1	TECO METAL PRODUCTS
Job#:	
Ship Date:	
Drawn by: TWL	
Shop Use Only:	
Date:	Welded By:
Start Time:	Finish Time:

Curbs will be attached to the equipment pad using 3/8" Hilti Kwik-Bolt-TZ(4" embedment and 1/2" drilled holes) concrete anchors at the curb flange. Locations for the concrete anchors will be at the 4 corners and then additonal anchors centered on the long runs. Equipment pads will be built IAW with detail 0330-056(type H) and the plans.



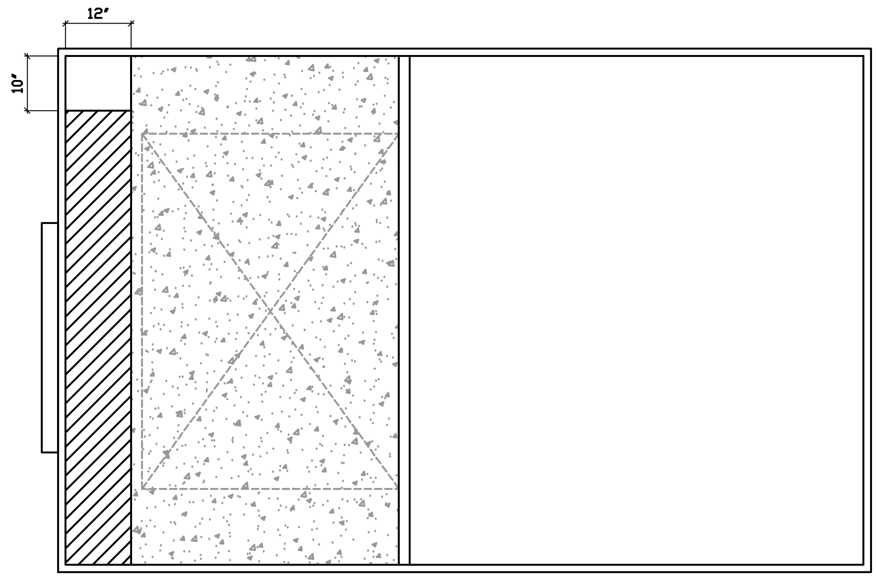


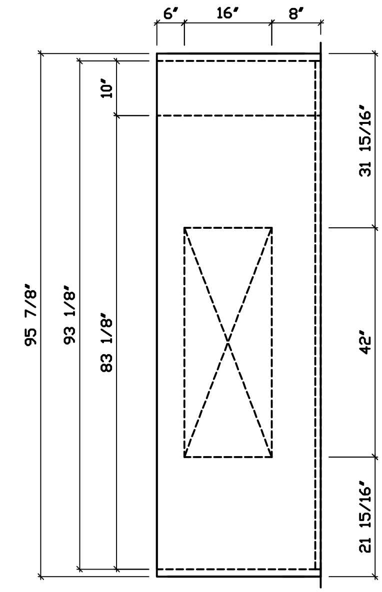


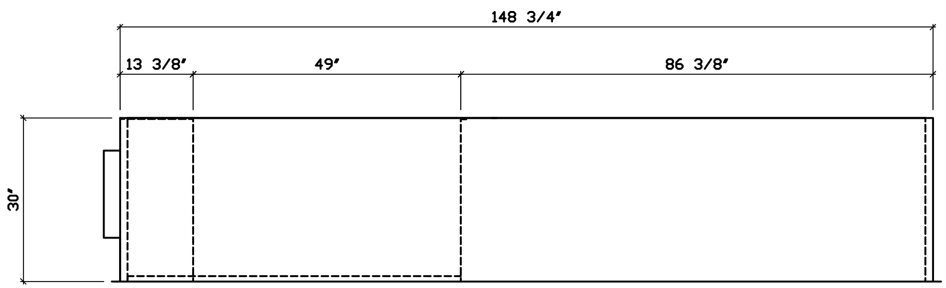
1. AAON RN-A, Std Cabinet
2. 14 Gauge, Galvanized Construction
3. Walls Insulated w/ 1 ½", 3 Lb Density Insulation; Floor/ Channel Insulated w/ 1" Black Insulation
4. Turning Vanes in S/A Section
5. Pad Mounted
6. Openings As Specified

Units: Four Mile Creek	
DWG#: 210-MAU-001	
Qty: 1	
Job#:	
Ship Date:	
Drawn by: TWL	

Curbs will be attached to the equipment pad using 3/8" Hilti Kwik-Bolt-TZ(4" embedment and 1/2" drilled holes) concrete anchors at the curb flange. Locations for the concrete anchors will be at the 4 corners and then additonal anchors centered on the long runs. Equipment pads will be built IAW with detail 0330-056(type H) and the plans.





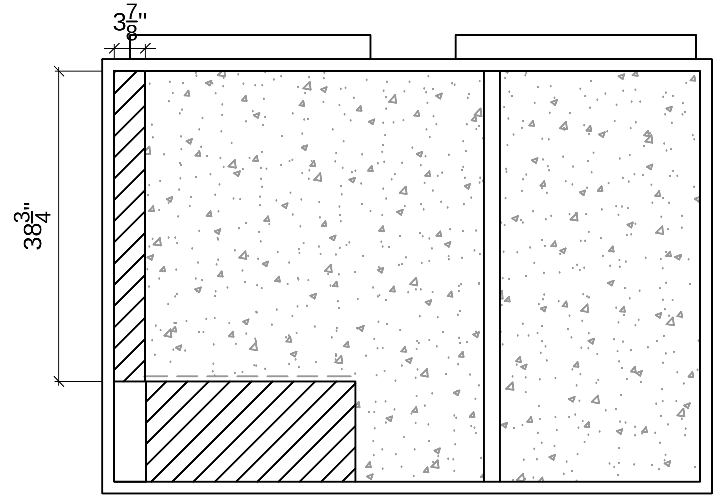


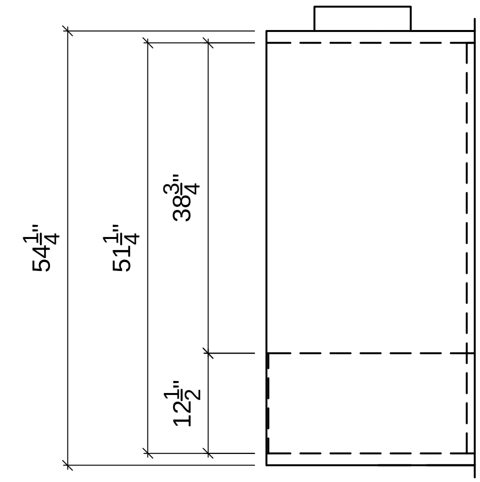
Notes:

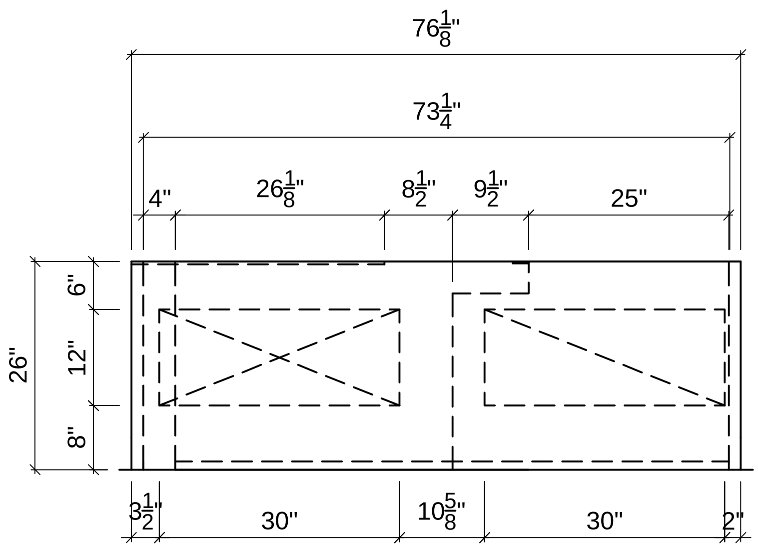
1. AAON RN-D, Std Cabinet
2. 14 Gauge, Galvanized Construction
3. Walls Insulated w/ 1 ½", 3 Lb Density Insulation; Floor Insulated w/ 1" Black Insulation
4. Turning Vanes in S/A Section
5. Pad Mount
6. Openings As Specified

Units: Four Mile Creek	
DWG#: 350-MAU-001	
Qty: 1	TECO METAL PRODUCTS
Job#:	
Ship Date:	
Drawn by: TWL	
Shop Use Only:	
Date:	Welded By:
Start Time:	Finish Time:

Curbs will be attached to the equipment pad using 3/8" Hilti Kwik-Bolt-TZ(4" embedment and 1/2" drilled holes) concrete anchors at the curb flange. Locations for the concrete anchors will be at the 4 corners and then additonal anchors centered on the long runs. Equipment pads will be built IAW with detail 0330-056(type H) and the plans.



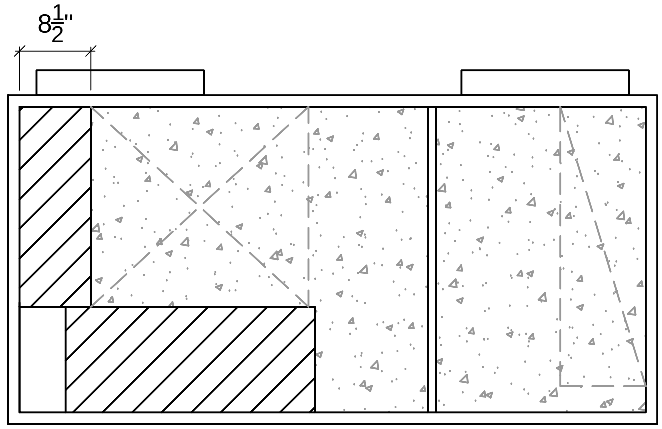


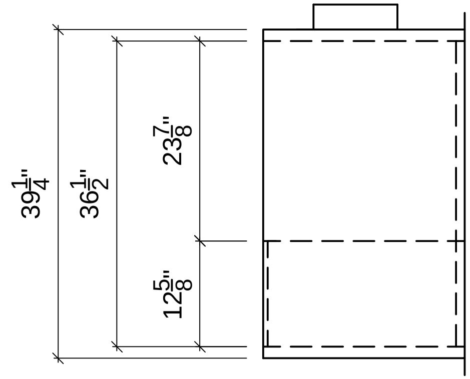


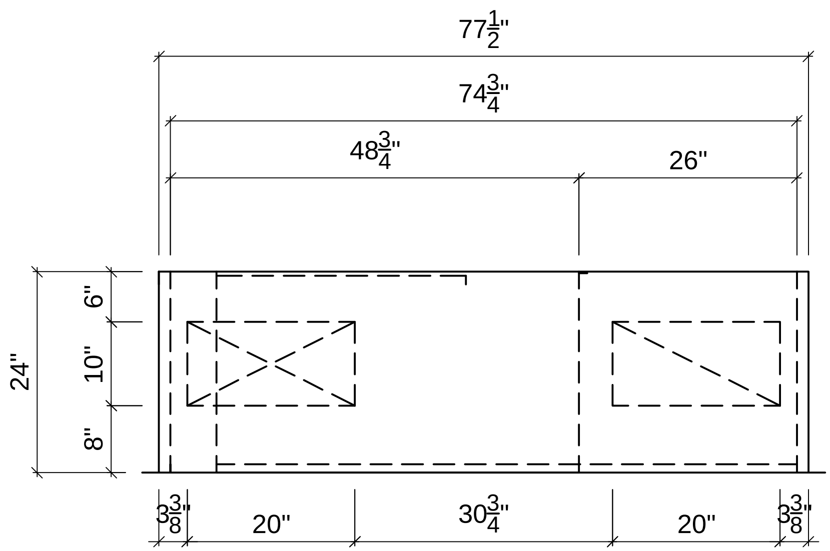
RN–B, Std
14 Gauge Galvanized Steel
1.5” Insulation on Walls
1” Insulation on Floor
Turning Vanes in Supply Section
Pad Mount

Units: Four Mile Creek	
DWG#: 110 AHU–AC–001	
Qty: 1	TECO METAL PRODUCTS
Job#:	
Ship Date:	
Drawn by: TWL	
Shop Use Only:	
Date:	Welded By:
Start Time:	Finish Time:

Curbs will be attached to the equipment pad using 3/8" Hilti Kwik-Bolt-TZ(4" embedment and 1/2" drilled holes) concrete anchors at the curb flange. Locations for the concrete anchors will be at the 4 corners and then additonal anchors centered on the long runs. Equipment pads will be built IAW with detail 0330-056(type H) and the plans.







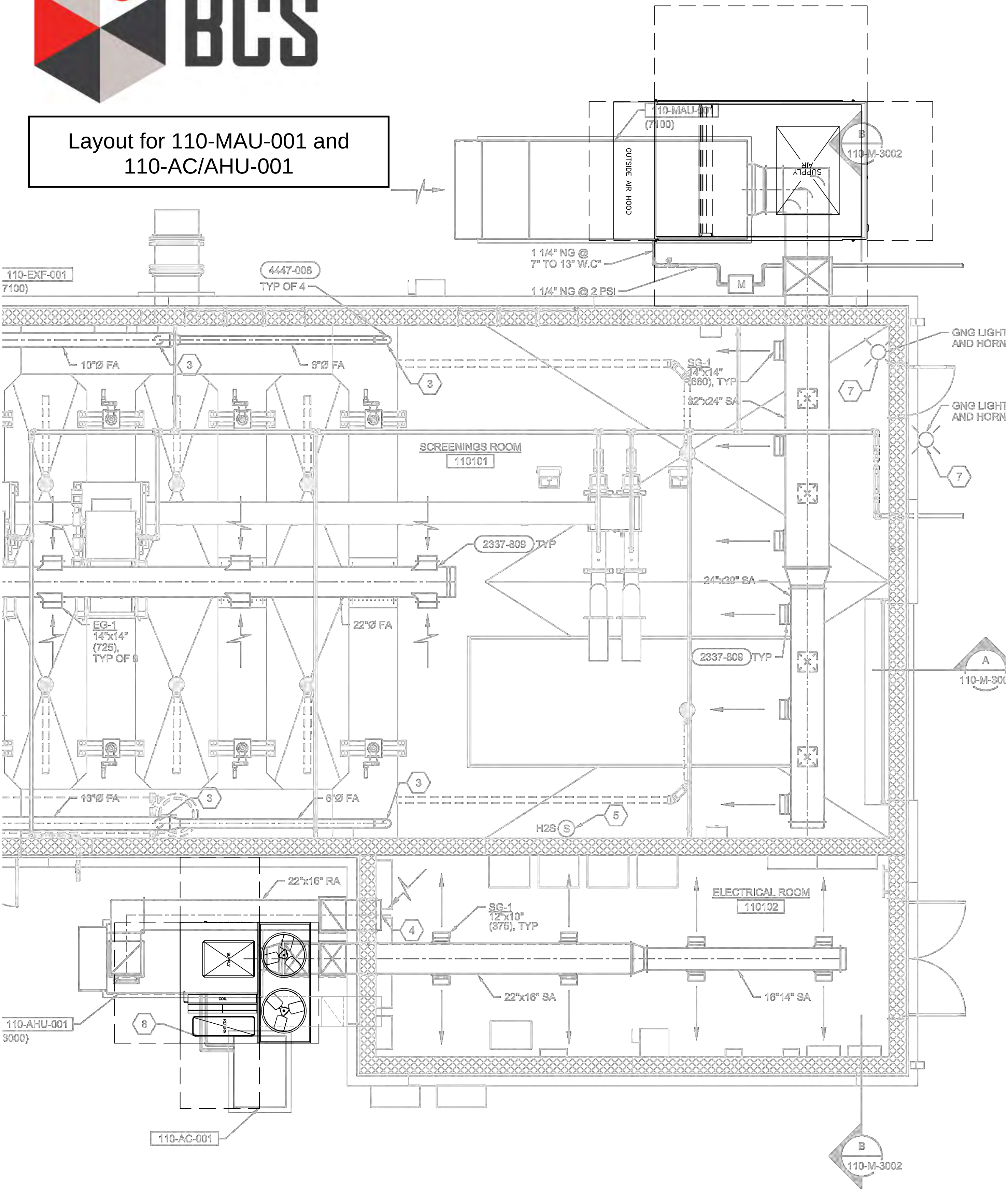
1. AAON RN-A, Std Cabinet
2. 14 Gauge, Galvanized Construction
3. Walls Insulated w/ 1 ½", 3 Lb Density Insulation; Floor/ Channel Insulated w/ 1" Black Insulation
4. Turning Vanes in S/A Section
5. Pad Mounted
6. Openings As Specified

Units: Four Mile Creek
DWG#: 210-AHU/AC-001
Qty: 1
Job#:
Ship Date:
Drawn by: TWL

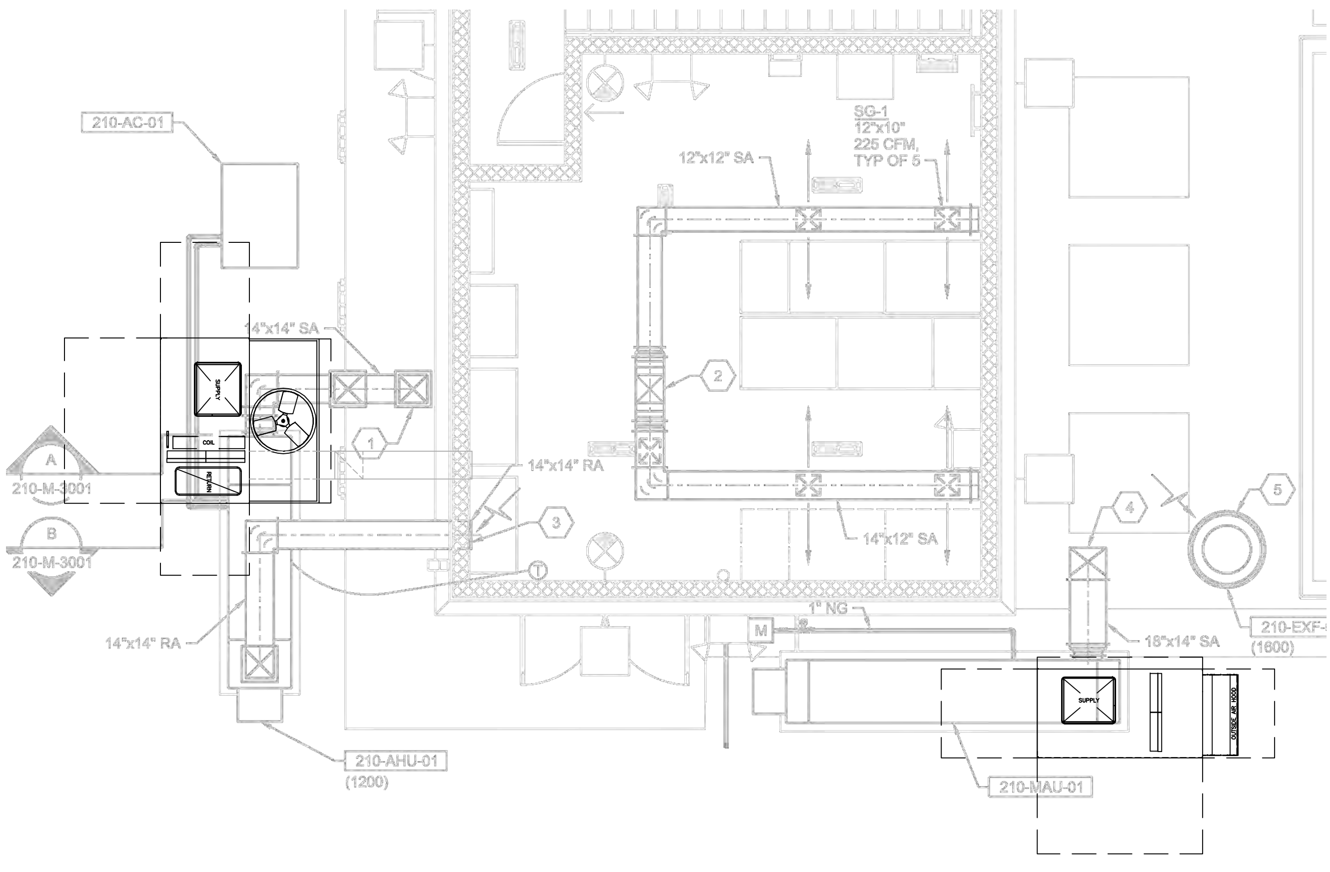
TECO METAL PRODUCTS

Proposed Equipment Layout

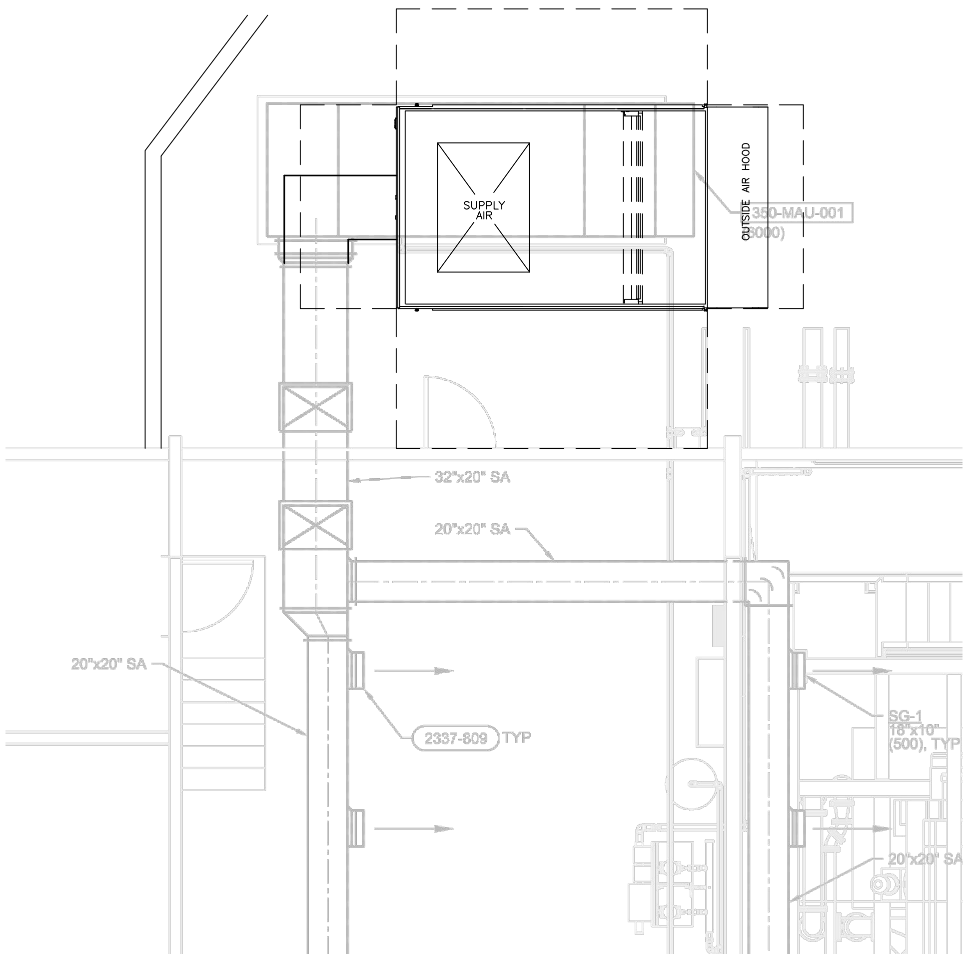
Layout for 110-MAU-001 and 110-AC/AHU-001



Layout for 210-MAU-001 and 210-AC/AHU-001



Layout for 350-MAU-001



Unit Coatings Information

AAON

5% SALT SPRAY (FOG) CORROSION RESISTANCE TEST REPORT

Sherry Laboratories

Comments on Sherry Laboratories Test Report

HVAC equipment installed on the exterior or rooftop of a building can be exposed to extreme ambient conditions. Depending on the location the installed equipment, it can experience everything from hot and humid periods to cold and dry periods. AAON recognized there is a need to provide an attractive, corrosion resistant paint that will last the lifetime of the equipment.

Typically the industry acceptability for HVAC equipment paint has been to surpass a 500 hour salt spray corrosion resistance test.

The ASTM B 117-95 testing procedure is the HVAC industry standard method of testing the acceptability and longevity of a paint For the test, panels are placed in a 5% salt spray and fog atmosphere for measured periods of time. The test is usually terminated, and the hours recorded, when the surface of the sample has been penetrated by the corrosive effects of the salt environment.

After extensive testing and research, AAON made the change in 1996 to a new paint system, with polyurethane paint and a catalytic dryer, which surpasses a 2,500 hour salt spray corrosion resistance test. This is applied to the G90 galvanized steel exterior of AAON equipment. As an option, the paint can be applied to interior of AAON equipment to provide corrosion protection to the complete unit.

The following pages of this document are a reproduction of the entire report received from an independent testing laboratory of the current paint applied to AAON equipment. Notice that paint bond galvanized panels were included in the test. Photos were taken at the start of the test, every 500 hours and at the termination of the test.

Results:

-
- Panels retained their color and gloss throughout the entire 2,696 hours of the salt spray test exposure.
- The galvanized panels performed as well as the paint bond galvanized panels.

6825 East 38th Street
Tulsa, OK 74145-3241
Telephone 918-664-7767

SHERRY LABORATORIES
INDIANA LOUISIANA OKLAHOMA
Metlab Testing Services, Inc.

Fax 918-627-3062
800-324-8378

LABORATORY REPORT

Attn: Richard Davis
AAON, Inc.
2425 S. Yukon
Tulsa, OK 74107

Report No: **1998070126-1**
Date Received: **07/09/98**
Date Reported: **11/12/98**

P.O. No: **Verbal**

Sample description: S/N-1, Galvanized panels (set of 3);
S/N-2, Paint bond panels w/ clipped corner (set of 3).

5% SALT SPRAY (FOG) CORROSION RESISTANCE TEST REPORT

Test Method: ASTM B 117-95

Tested for Conformance to: Internal requiremnets

Number of specimens tested: 2 sets (3 each)

Exposure in Salt Spray Cabinet, Hours: 2696

Evaluation Requirements: Observe and photograph at 500 hour intervals.

CORROSION RESISTANCE TEST RESULTS

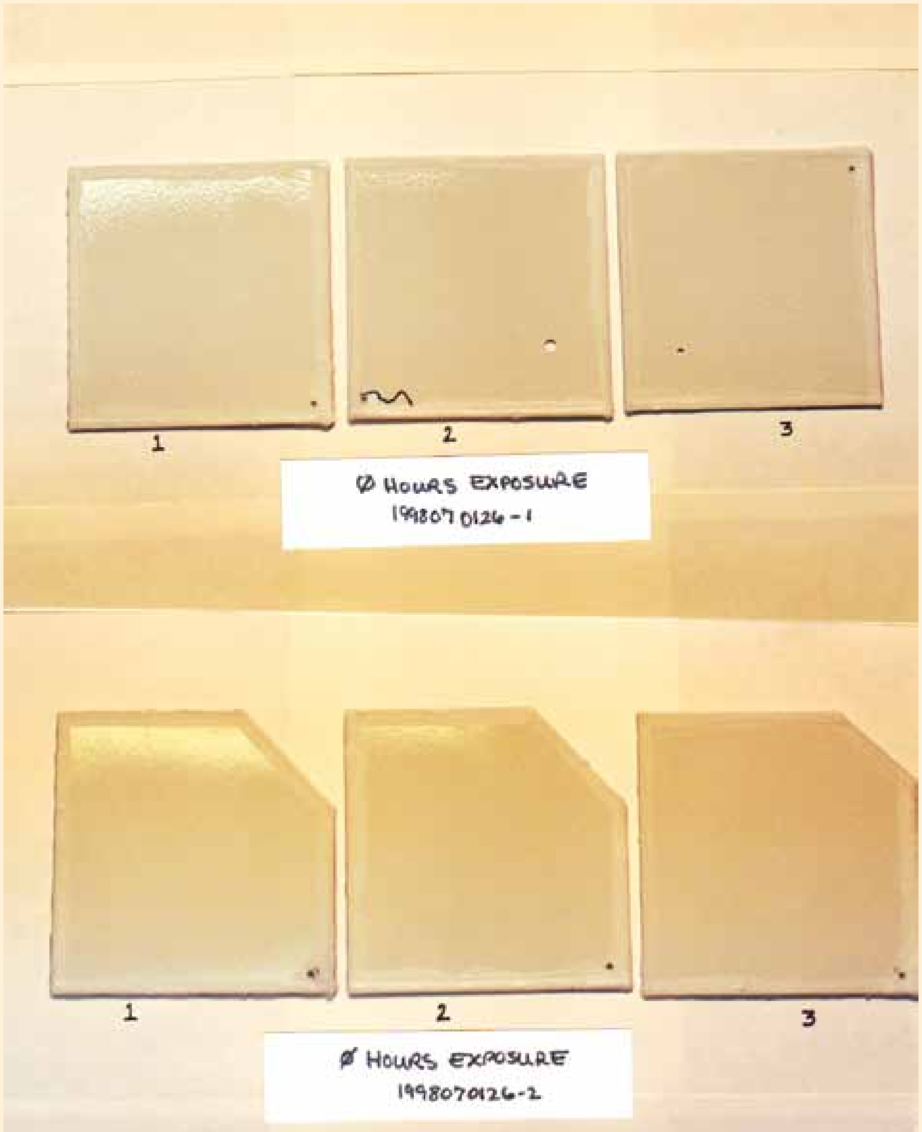
S/N-1, Galvanized	
HOURS	**OBSERVATIONS / TEST NOTES**
0	Panels submitted for testing with edges waxed.
500	No visible effects.
1000	No visible effects.
1500	No visible effects.
2000	No visible effects. Continued salt spray with two panels.
2512	Panel #1 exhibited 2 small red rust spots <.025” diameter. Panel #3 exhibited blistering around a hole in the panel.
2696	Test ended per custoner request. Panel #1 exhibited 2 small red rust spots <.030” diameter. Panel #3 exhibited blistering around a hole in the panel and 5 to 7 red rust spots barely visible to the naked eye.

AAON, Inc. **Report No: 1998070126-1**

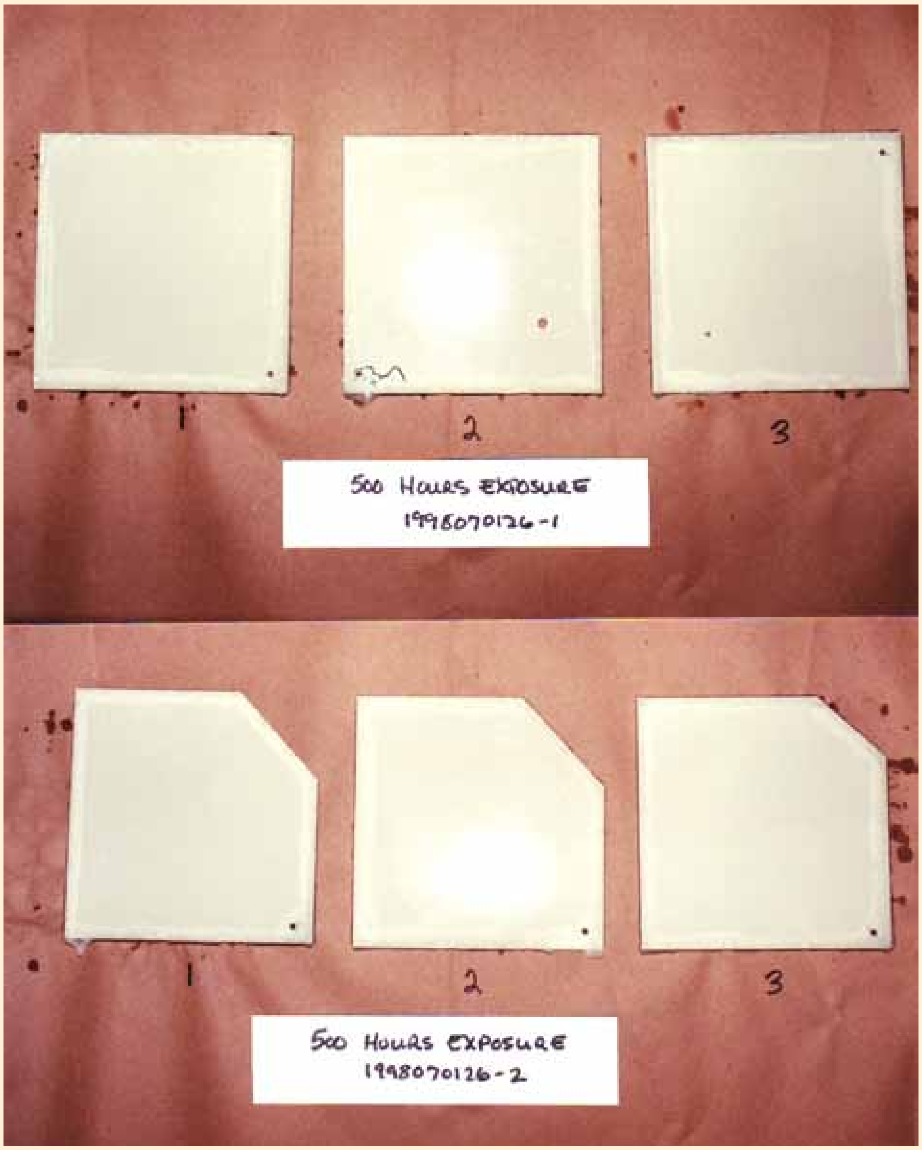
S/N-2, Paint bond	
HOURS	**OBSERVATIONS / TEST NOTES**
0	Panels submitted for testing with edges waxed.
500	No visible effects.
1000	No visible effects.
1500	No visible effects.
2000	No visible effects. Continued salt spray with two panels.
2512	Panel #1 exhibited small blisters, some in clusters, throughout the panel (<.05" dia.). Panel #2 exhibited blisters around a hole near a corner in the panel, which was not considered a significant evaluation area.
2696	Test ended per custoner request. Panel #1 exhibited small blisters, with many in clusters. Panel #2 exhibited blisters around a hole in the panel.

Approved By: Dan M Lawson

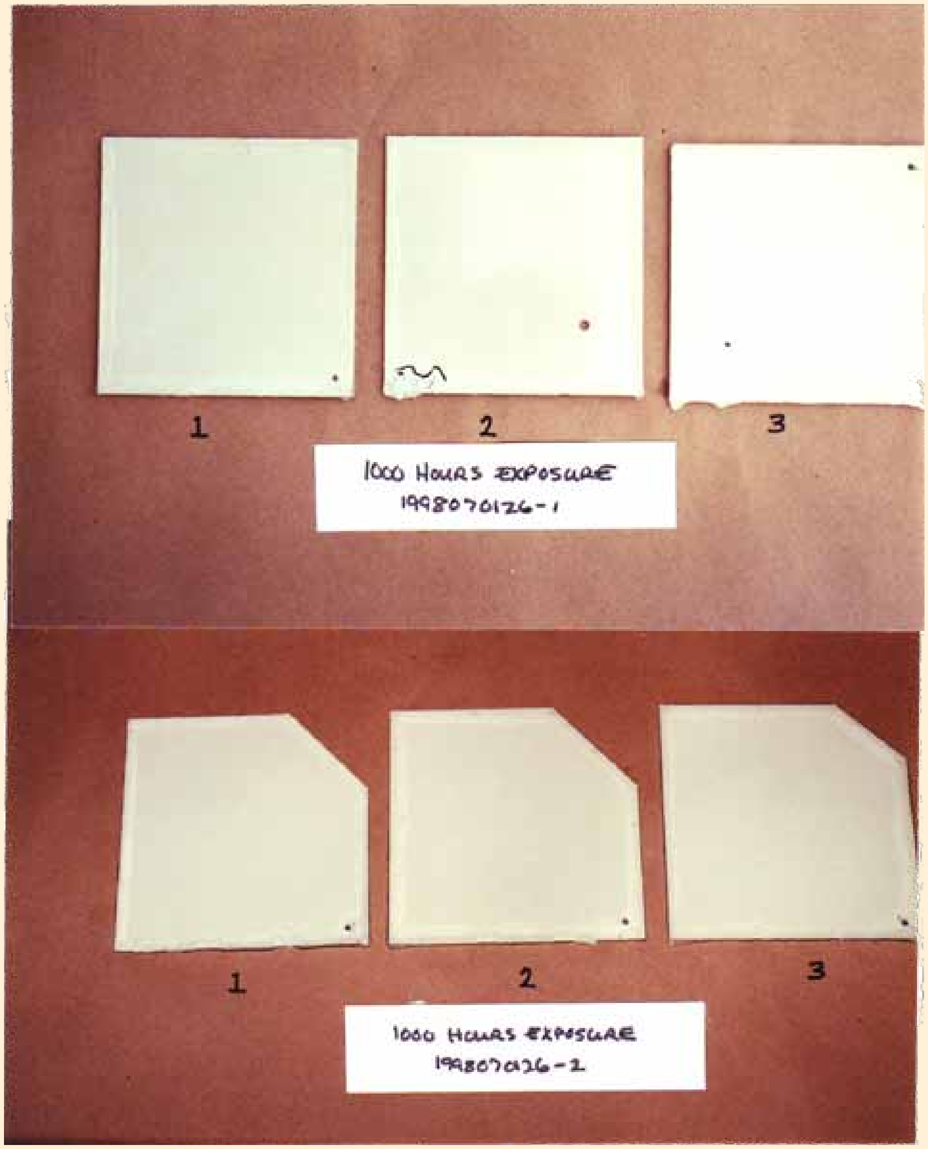
Dan M. Lawson, President
Sherry Laboratories/OK



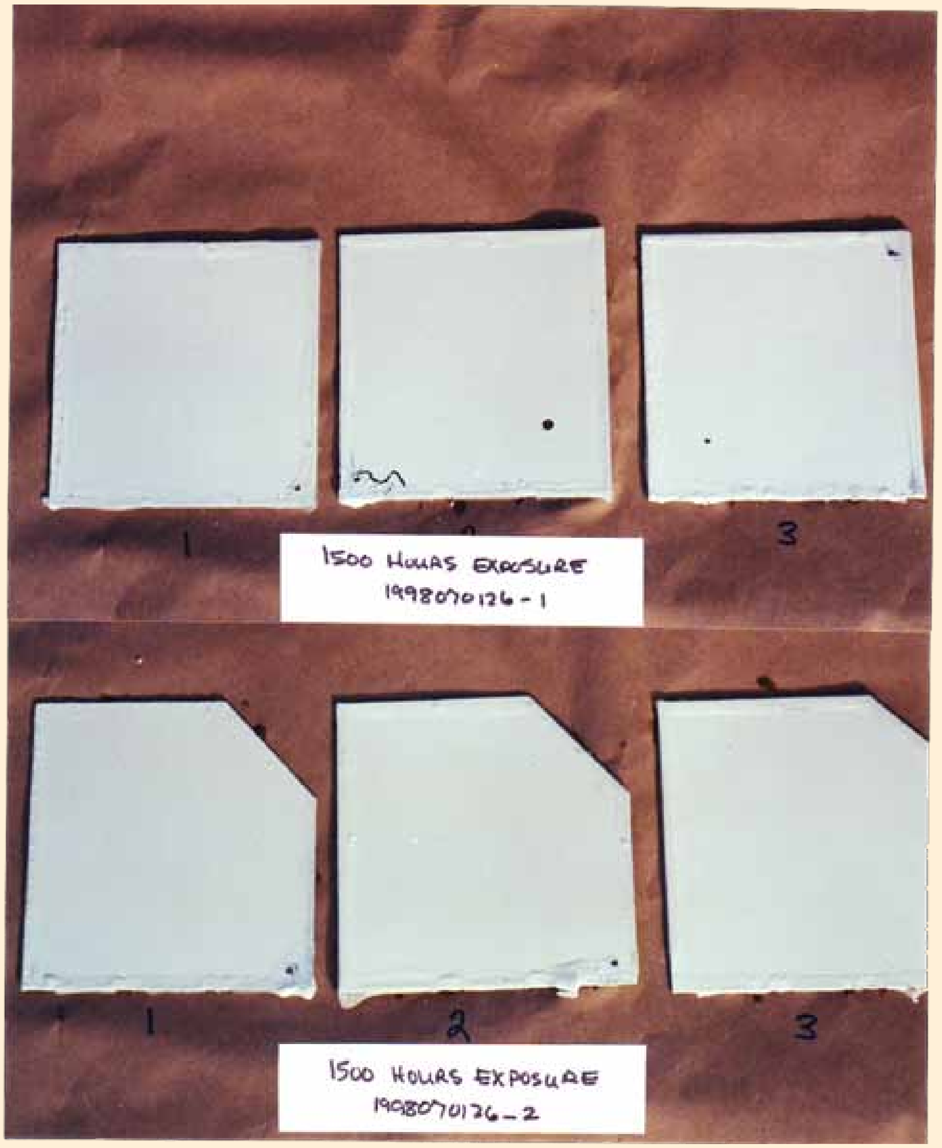
Top: S/N - 1 Bottom: S/N - 2



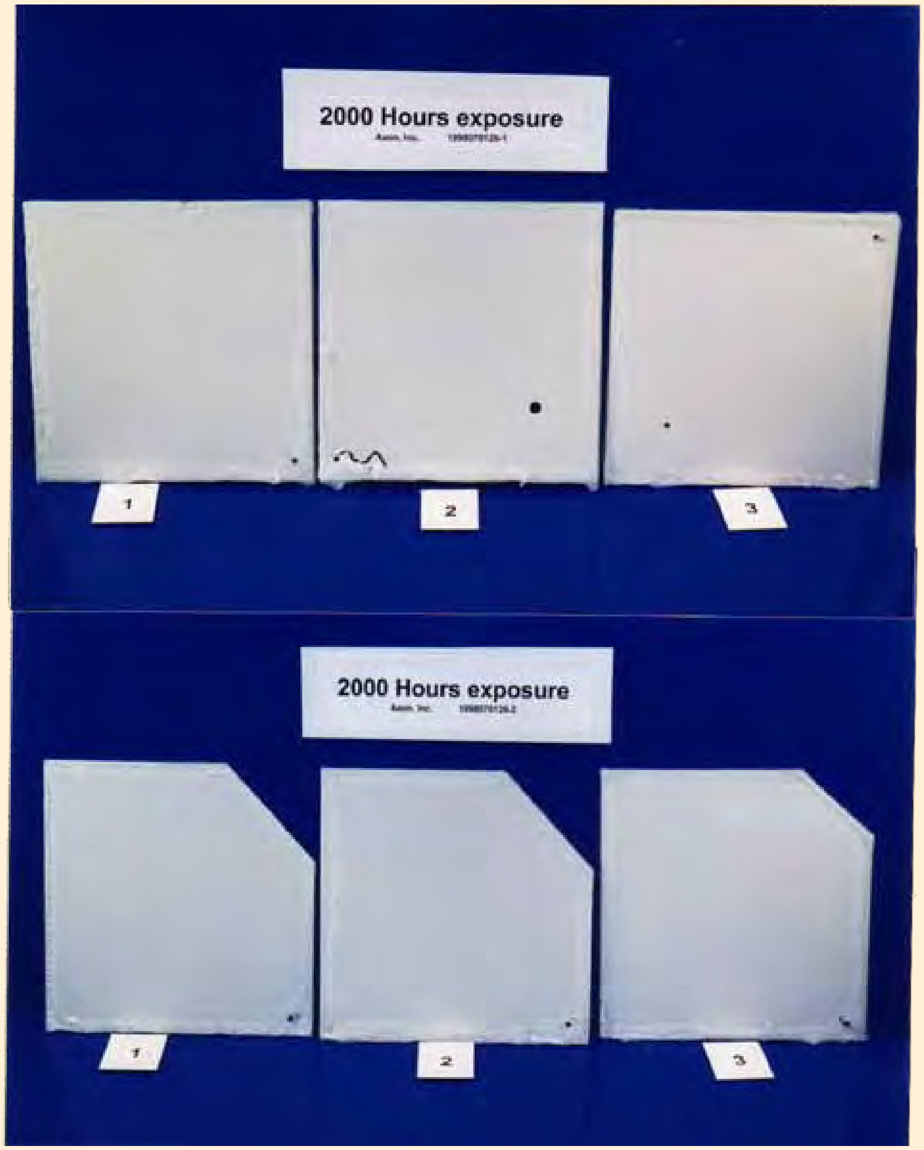
Top: S/N - 1 Bottom: S/N - 2



Top: S/N - 1 Bottom: S/N - 2



Top: S/N - 1 Bottom: S/N - 2



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Top: S/N - 1

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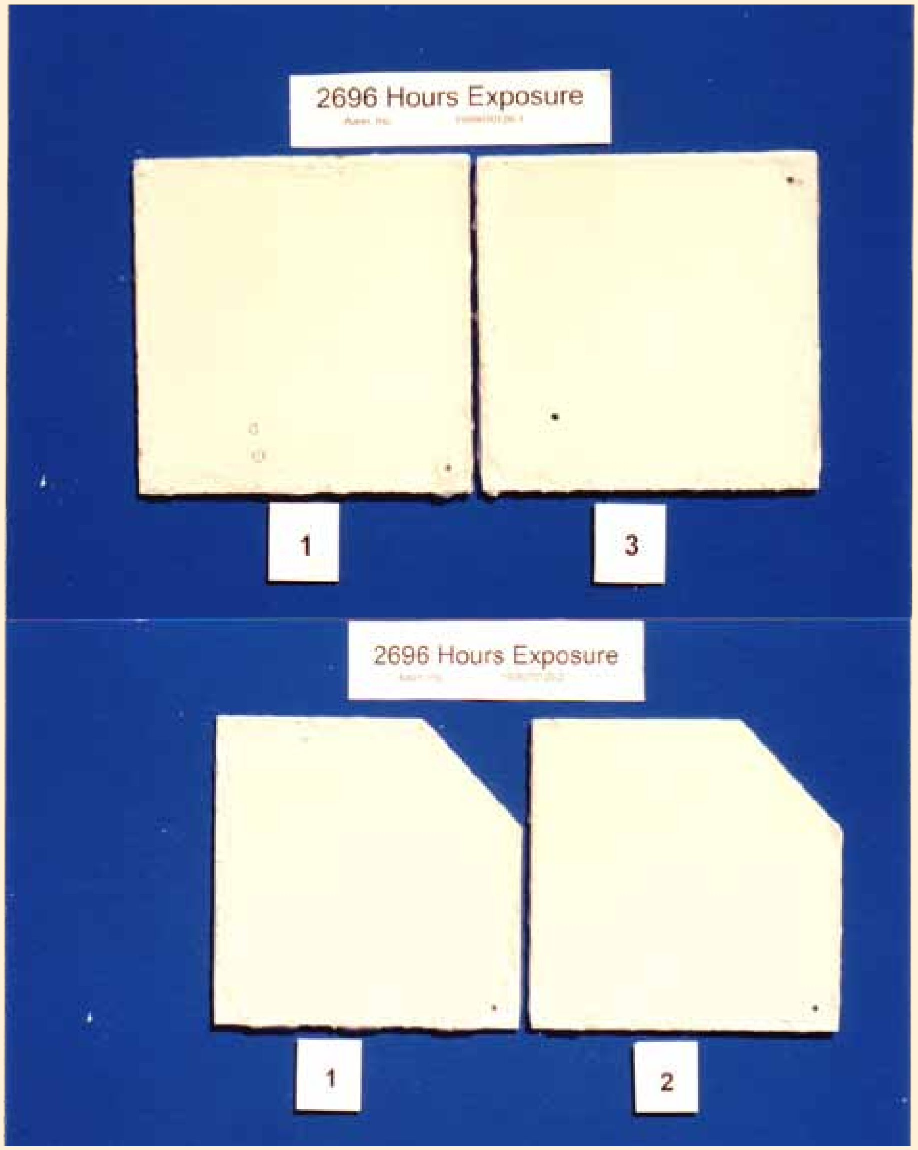

Top: S/N - 1 Bottom: S/N - 2

SaltTest • R55580 • 130531

Specifications

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

Part 1 - General

1.01 Warranty

A. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

Part 2 - Products

2.01 Rooftop Units

A. General Description

1. [110,210-AHU/AC-001] Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, and unit controls.
2. [110,210,350-MAU-001] Outdoor air handling unit shall include filters, supply fans, dampers, gas heaters, and unit controls.
3. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
4. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
5. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
6. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
7. Installation, Operation, and Maintenance manual shall be supplied within the unit.
8. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
9. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall,

impact resistant, rigid polyurethane foam panels.

2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 210/240. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

6. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

7. Access to filters, dampers, cooling coils, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

8. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

9. Units with cooling coils shall include double sloped 304 stainless steel drain pans.

10. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch

in height around the opening.

11. Unit shall include lifting lugs on the top of the unit.

12. Unit shall include interior corrosion protection which shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Air tunnel, fans and dampers shall all include the corrosion protection.

13. [110,350-MAU-001] Unit base shall be fabricated of 1 inch thick double wall, impact resistant, rigid polyurethane foam panels.

14. [110,210-AHU/AC-001] Unit shall include factory installed, painted galvanized steel condenser coil guards on the face of the condenser coil.

C. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

2. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.

D. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

E. [110,210-AHU/AC-001] Cooling Coils

1. Evaporator Coils

a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

b. Coils shall be standard capacity.

c. Coils shall have interlaced circuitry and shall be standard capacity.

d. Coils shall be hydrogen or helium leak tested.

e. Coils shall be furnished with factory installed expansion valves.

f. Coils shall have a flexible, dip applied epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Luvata Electrofin. The Luvata Electrofin written instructions for installation, operation, coil cleaning, maintenance, and recording keeping must be followed. Refer to the Luvata Electrofin Terms and Conditions of Sale.

F. [110,210-AHU/AC-001] Refrigeration System

1. Unit shall be factory charged with R-410A refrigerant.

2. Compressors shall be scroll type with thermal overload protection and carry a 5-year non-prorated warranty, from the date of original equipment shipment from the factory.

3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

5. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.

7. [110-AHU/AC-001] Unit shall include 2 stages of capacity control.

8. [210-AHU/AC-001] Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.

9. Refrigeration circuit shall be equipped with a liquid line sight glass.

10. Each refrigeration circuit shall be equipped with a liquid line sight glass.

11. Refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

12. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

13. First capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F.

14. [210-AHU/AC-001] Refrigeration circuit shall be equipped with flooded condenser low ambient head pressure control to allow operation down to 0°F. Option includes adjustable compressor lockout.

15. [110-AHU/AC-001] Lead refrigeration circuit shall be equipped with flooded condenser low ambient head pressure control to allow operation down to 0°F. Option includes adjustable compressor lockout.

G. [110,210-AHU/AC-001] Condensers

1. Air-Cooled Condenser

   a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.

   b. Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.

   c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

   d. Coils shall be hydrogen or helium leak tested.

   e. Coils shall have a flexible, dip applied epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Luvata Electrofin. The Luvata Electrofin written instructions for installation, operation, coil cleaning, maintenance, and recording keeping must be followed. Refer to the Luvata Electrofin Terms and Conditions of Sale.

H. [110,210,350-MAU-001] Gas Heating

1. Stainless steel heat exchanger furnace shall carry a 25-year non-prorated warranty, from the date of original equipment shipment from the factory.

2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

4. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

5. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature set point shall be adjustable on the electronic controller within the controls compartment.210 MBH gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.810 MBH gas heating assemblies shall be capable of operating at any firing rate between 100% and 20% of their rated capacity.1080 MBH gas heating assembly shall be capable of operating at any firing rate between 100% and 15% of its rated capacity.

I. Filters

1. Unit shall include 2-inch-thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.

2. [110,210,350-MAU-001] Unit shall include 100% outside air opening, without a damper assembly, with bird screen, and outside air hood.

3. [110,210-AHU/AC-001] Unit shall be 100% return air with no outside air opening, only a return air connection.

J. Controls

1. Factory Installed and Factory Provided Controller

   a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, set point adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

d. [110,210-AHU/AC-001] Constant Volume Controller

1. Unit shall modulate cooling with constant airflow to meet space temperature cooling loads.

e. [110,210,350-MAU-001] Makeup Air Controller

1. Unit shall modulate heating with constant airflow to meet ventilation outside air loads. Heating capacity shall modulate based on supply air temperature.

K. Accessories

1. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

Equipment O&M's

RN Series

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

RN SERIES

Packaged Rooftop Units, Heat Pumps,
& Outdoor Air Handling Units

Installation, Operation,
& Maintenance

WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in serious injury, death or property damage.

Be sure to read and understand the installation, operation, and service instructions in this manual.

Improper installation, adjustment, alteration, service, or maintenance can cause serious injury, death, or property damage.

A copy of this IOM should be kept with the unit.

WARNING

- Do not store gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance

- WHAT TO DO IF YOU SMELL GAS
  - Do not try to light any appliance.
  - Do not touch any electrical switch; do not use any phone in your building.
  - Leave the building immediately.
  - Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.

- Startup and service must be performed by a Factory Trained Service Technician.

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- Factory Installed AAONAIRE Energy Recovery Wheels
- Mixed/Return Air Bypass
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- 15 Year Aluminized Steel Heat Exchanger Warranty
- 25 Year Stainless Steel Heat Exchanger Warranty
- Condenser Coil Guards
- Interior Corrosion Protection
- Polymer E-Coated Coils - 5 Year Warranty
- Stainless Steel Coil Casing
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Safety

Attention should be paid to the following statements:

NOTE - Notes are intended to clarify the unit installation, operation, and maintenance.

CAUTION - Caution statements are given to prevent actions that may result in equipment damage, property damage, or personal injury.

WARNING - Warning statements are given to prevent actions that could result in equipment damage, property damage, personal injury or death.

DANGER - Danger statements are given to prevent actions that will result in equipment damage, property damage, severe personal injury or death.

WARNING

ELECTRIC SHOCK, FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death, or property damage.

- Before servicing, disconnect all electrical power to the furnace. More than one disconnect may be provided.
- When servicing controls, label all wires prior to disconnecting. Reconnect wires correctly.
- Verify proper operation after servicing. Secure all doors with key-lock or nut and bolt.

CAUTION

WHAT TO DO IF YOU SMELL GAS

- Do not try to turn on unit.
- Shut off main gas supply.
- Do not touch any electric switch.
- Do not use any phone in the building.
- Never test for gas leaks with an open flame.
- Use a gas detection soap solution and check all gas connections and shut off valves.

WARNING

Electric shock hazard. Before servicing, shut off all electrical power to the unit, including remote disconnects, to avoid shock hazard or injury from rotating parts. Follow proper Lockout-Tagout procedures.

WARNING

FIRE, EXPLOSION OR CARBON MONOXIDE POISONING HAZARD

Failure to replace proper controls could result in fire, explosion, or carbon monoxide poisoning. Failure to follow safety warnings exactly could result in serious injury, death or property damage. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this appliance.

WARNING

During installation, testing, servicing, and troubleshooting of the equipment it may be necessary to work with live electrical components. Only a qualified licensed electrician or individual properly trained in handling live electrical components shall perform these tasks.

Standard NFPA-70E, an OSHA regulation requiring an Arc Flash Boundary to be field established and marked for identification of where appropriate Personal Protective Equipment (PPE) be worn, should be followed.

CAUTION

Unit power supply wire should be only copper or aluminum.

WARNING

ROTATING COMPONENTS

Unit contains fans with moving parts that can cause serious injury. Do not open door containing fans until the power to the unit has been disconnected and fan wheel has stopped rotating.

WARNING

GROUNDING REQUIRED

All field installed wiring must be completed by qualified personnel. Field installed wiring must comply with NEC/CEC, local and state electrical code requirements. Failure to follow code requirements could result in serious injury or death. Provide proper unit ground in accordance with these code requirements.

WARNING

VARIABLE FREQUENCY DRIVES

Do not leave VFDs unattended in hand mode or manual bypass. Damage to personnel or equipment can occur if left unattended. When in hand mode or manual bypass mode VFDs will not respond to controls or alarms.

CAUTION

Electric motor over-current protection and overload protection may be a function of the Variable Frequency Drive to which the motors are wired. Never defeat the VFD motor overload feature. The overload ampere setting must not exceed 115% of the electric motor's FLA rating as shown on the motor nameplate.

WARNING

UNIT HANDLING

To prevent injury or death lifting equipment capacity shall exceed unit weight by an adequate safety factor. Always test-lift unit not more than 24 inches high to verify proper center of gravity lift point to avoid unit damage, injury or death.

CAUTION

Failure to properly drain and vent coils when not in use during freezing temperature may result in coil and equipment damage.

CAUTION

Rotation must be checked on all MOTORS AND COMPRESSORS of 3 phase units at startup by a qualified service technician. Scroll compressors are directional and can be damaged if rotated in the wrong direction. Compressor rotation must be checked using suction and discharge gauges. Fan motor rotation should be checked for proper operation. Alterations should only be made at the unit power connection

WARNING

Do not use oxygen, acetylene or air in place of refrigerant and dry nitrogen for leak testing. A violent explosion may result causing injury or death.

WARNING

WATER PRESSURE

Prior to connection of condensing water supply, verify water pressure is less than maximum pressure shown on unit nameplate. To prevent injury or death due to instantaneous release of high pressure water, relief valves should be field supplied on system water piping.

⚠ WARNING

Always use a pressure regulator, valves and gauges to control incoming pressures when pressure testing a system. Excessive pressure may cause line ruptures, equipment damage or an explosion which may result in injury or death.

⚠ CAUTION

To prevent damage to the unit, do not use acidic chemical coil cleaners. Do not use alkaline chemical coil cleaners with a pH value greater than 8.5, after mixing, without first using an aluminum corrosion inhibitor in the cleaning solution.

⚠ WARNING

Some chemical coil cleaning compounds are caustic or toxic. Use these substances only in accordance with the manufacturer's usage instructions. Failure to follow instructions may result in equipment damage, injury or death.

⚠ CAUTION

Do not clean DX refrigerant coils with hot water or steam. The use of hot water or steam on refrigerant coils will cause high pressure inside the coil tubing and damage to the coil.

⚠ CAUTION

Door compartments containing hazardous voltage or rotating parts are equipped with door latches to allow locks. Door latch are shipped with nut and bolts requiring tooled access. If you do not replace the shipping hardware with a pad lock always re-install the nut & bolt after closing the door.

⚠ CAUTION

Cleaning the cooling tower or condenser water loop with harsh chemicals such as hydrochloric acid (muriatic acid), chlorine or other chlorides, can damage the refrigerant-to-water heat exchanger. Care should be taken to avoid allowing chemicals to enter the refrigerant-to-water heat exchanger. See Appendix A - Heat Exchanger Corrosion Resistance for more information.

⚠ WARNING

OPEN LOOP APPLICATIONS

Failure of the condenser as a result of chemical corrosion is excluded from coverage under AAON Inc. warranties and the heat exchanger manufacturer's warranties.

⚠ WARNING

WATER FREEZING

Failure of the condenser due to freezing will allow water to enter the refrigerant circuit and will cause extensive damage to the refrigerant circuit components. Any damage to the equipment as a result of water freezing in the condenser is excluded from coverage under AAON warranties and the heat exchanger manufacturer warranties.

⚠ WARNING

COMPRESSOR CYCLING

5 MINUTE MINIMUM OFF TIME
To prevent motor overheating compressors must cycle off for a minimum of 5 minutes.

5 MINUTE MINIMUM ON TIME
To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 6 starts per hour.

1. Startup and service must be performed by a Factory Trained Service Technician.

2. Use only with type of the gas approved for the furnace. Refer to the furnace rating plate.

3. The unit is for outdoor use only. See General Information section for more information.

4. Provide adequate combustion ventilation air to the furnace. If a vent duct extension is used, a class III approved vent is required. See the Locating Units and Gas Heating sections of the Installation section of the manual.

5. Always install and operate furnace within the intended temperature rise range and duct system external static pressure (ESP) as specified on the unit nameplate.

6. The supply and return air ducts must be derived from the same space. It is recommended ducts be provided with access panels to allow inspection for duct tightness. When a down flow duct is used with electric heat, the exhaust duct should be an L shaped duct.

7. Clean furnace, duct and components upon completion of the construction setup. Verify furnace operating conditions including input rate, temperature rise and ESP.

8. Every unit has a unique equipment nameplate with electrical, operational, and unit clearance specifications. Always refer to the unit nameplate for specific ratings unique to the model you have purchased.

9. READ THE ENTIRE INSTALLATION, OPERATION AND MAINTENANCE MANUAL. OTHER IMPORTANT SAFETY PRECAUTIONS ARE PROVIDED THROUGHOUT THIS MANUAL.

10. Keep this manual and all literature safeguarded near or on the unit.

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A 0 0 0 – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 B

BASE MODEL

SERIES AND GENERATION

RN

UNIT SIZE

006 = 6 ton Capacity
007 = 7 ton Capacity
008 = 8 ton Capacity
009 = 9 ton Capacity
010 = 10 ton Capacity
011 = 11 ton Capacity
013 = 13 ton Capacity
014 = 14 ton Capacity
015 = 15 ton Capacity
016 = 16 ton Capacity
018 = 18 ton Capacity
020 = 20 ton Capacity
025 = 25 ton Capacity
026 = 26 ton Capacity
030 = 30 ton Capacity
031 = 31 ton Capacity
040 = 40 ton Capacity
050 = 50 ton Capacity
055 = 55 ton Capacity
060 = 60 ton Capacity
065 = 65 ton Capacity
070 = 70 ton Capacity
075 = 75 ton Capacity
090 = 90 ton Capacity
105 = 105 ton Capacity
120 = 120 ton Capacity
130 = 130 ton Capacity
140 = 140 ton Capacity

VOLTAGE

1 = 230V/1Φ/60Hz
2 = 230V/3Φ/60Hz
3 = 460V/3Φ/60Hz
4 = 575V/3Φ/60Hz
6 = 380V/3Φ/50Hz
8 = 208V/3Φ/60Hz
9 = 208V/1Φ/60Hz

INTERIOR PROTECTION

0 = Standard - Vertical Discharge and Return
A = Interior Corrosion Protection - Vertical Discharge and Return

Model Option A: COOLING/HEAT PUMP

A1: REFRIGERANT STYLE

0 = Air Handling Unit
B = R-410A - High Efficiency
C = R-410A - Standard Efficiency
E = R-410A Variable Capacity Scroll Compressor - High Efficiency
F = R-410A Variable Capacity Scroll Compressor - Standard Efficiency
G = R-410A Two-Step Compressor - High Efficiency
H = R-410A Two-Step Compressor - Standard Efficiency
K = R-410A VFD Compatible Scroll Compressor + Microchannel Condenser
L= R-410A VFD Compatible Tandem Compressors + Microchannel Condenser

A2: UNIT CONFIGURATION

0 = No Cooling
A = Air-Cooled Cond. + Std Evap. Coil
B = Air-Cooled Cond. + 6 Row Evap. Coil
J = Water-Cooled Cond. + Std Evap. Coil
K = Water-Cooled Cond. + 6 Row Evap. Coil
P = Air-Cooled Cond. + 6 Row Evap. Coil + Mixed Air Bypass
Q = Air-Cooled Cond. + 6 Row Evap. Coil + Return Air Bypass
R = Water-Cooled Cond. + 6 Row Evap. Coil + Return Air Bypass
T = Water-Cooled Cond. + 6 Row Evap. Coil + Mixed Air Bypass
U = Chilled Water Coil - 4 Row
W = Chilled Water Coil - 6 Row
2 = Non-Compressorized + Std Evap. Coil
4 = Non-Compressorized + 6 Row Evap. Coil
6 = Air-Source Heat Pump
7 = Water-Source/Geothermal Heat Pump

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 **A3 A4** **B1** B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B **0 2 – 3** 8 4 : A 0 0 0 – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 B

Model Option A: COOLING/HEAT PUMP

A3: COIL COATING

0 = Standard
1 = Polymer E-Coated Evap. and Cond.
8 = Polymer E-Coated Cond.
9 = Polymer E-Coated Cooling Coil
A = Stainless Steel Evap. Coil Casing + Polymer E-Coated Cond. Coil
D = Stainless Steel Cooling Coil Casing

A4: COOLING/HEAT PUMP STAGING

0 = No Cooling
1 = 1 Stage
2 = 2 Stage
4 = 4 Stage
5 = 5 Stage
9 = Modulating - Lead VCC
A = Modulating - All VCC
B = 1 Stage + 1 Stage Auxiliary Heat
C = 2 Stage + 1 Stage Auxiliary Heat
D = 4 Stage + 1 Stage Auxiliary Heat
E = Modulating - Lead VCC + 1 Stage Aux. Heat
F = Modulating - All VCC + 1 Stage Aux. Heat
H = Single Serpentine 8 fpi
J = Half Serpentine 8 fpi
K = Single Serpentine 10 fpi
L = Half Serpentine 10 fpi
M = Single Serpentine 12 fpi
N = Half Serpentine 12 fpi
P = 1 Stage + 2 Stage Auxiliary Heat
Q = 2 Stage + 2 Stage Auxiliary Heat
R = 4 Stage + 2 Stage Auxiliary Heat
S = Modulating - Lead VCC + 2 Stage Aux. Heat
T = Modulating - All VCC + 2 Stage Aux. Heat
U = 1 Stage + 4 Stage Auxiliary Heat
V = 2 Stage + 4 Stage Auxiliary Heat
W = 4 Stage + 4 Stage Auxiliary Heat
Y = Modulating - Lead VCC + 4 Stage Aux. Heat
Z = Modulating - All VCC + 4 Stage Aux. Heat

Model Option B: HEATING

B1: HEATING TYPE

0 = No Heating
1 = Electric Heat
2 = Natural Gas Aluminized
3 = Natural Gas Stainless Steel
4 = High Altitude Natural Gas Aluminized
5 = High Altitude Natural Gas Stainless Steel
6 = LP Gas Aluminized
7 = LP Gas Stainless Steel
8 = High Altitude LP Gas Aluminized
9 = High Altitude LP Gas Stainless Steel
C = Steam Distributing Standard
D = Steam Distributing Polymer E-Coated
E = Hot Water Standard
F = Hot Water Polymer E-Coated

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 **B2** **B3** **1A** 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 **8** **4** **:** **A** 0 0 0 – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 0 B

B2: HEATING DESIGNATION

0 = No Heating
1 = Heat 1
2 = Heat 2
3 = Heat 3
4 = Heat 4
6 = Heat 6
7 = Heat 7
8 = Heat 8
9 = Heat 9
A = Heat A
B = Heat B
C = Heat C
D = Heat D
E = Heat E
F = Heat F
G = Heat G
H = 1 Row Coil
J = 2 Row Coil
K = Heat K
L = Heat L
M = Heat M
N = Heat N
P = Heat P

Model Option B: HEATING

B3: HEATING STAGING

0 = No Heating
1 = 1 Stage
2 = 2 Stage
3 = 3 Stage
4 = 4 Stage
5 = 5 Stage
6 = 6 Stage
7 = 7 Stage
8 = 8 Stage
9 = Modulating Gas/SCR Electric
A = Modulating/SCR Electric, 0-10V Control Signal
B = High Turndown Modulating Gas
H = Single Serpentine 8 fpi
J = Half Serpentine 8 fpi
K = Single Serpentine 10 fpi
L = Half Serpentine 10 fpi
M = Single Serpentine 12 fpi
N = Half Serpentine 12 fpi

Feature 1: RETURN/OUTSIDE AIR

1A: RETURN/OUTSIDE AIR SECTION

0 = Manually Adjustable OA Opening + RA Opening
A = Economizer
B = Econ + Power Exhaust
C = Econ + Power Return
D = Econ + PE - Discharge Damper Volume Control
E = Econ + PE - Discharge Damper Volume Control + 0-10V External Control
F = Low cfm Total Energy Recovery Wheel
G = Low cfm Total ERW + Bypass
H = Low cfm Sensible ERW
J = Low cfm Sensible ERW + Bypass
K = 100% Outside Air - No Return Air
L = Motorized Outside Air Damper + RA Opening
M = Motorized Outside Air Damper - No Return Air
N = Empty ERW Option Box - No Power Exhaust
P = Empty ERW Option Box + Power Exhaust
Q = 1% Purge Low cfm Total ERW
R = 1% Purge Low cfm Total ERW + Bypass
S = 1% Purge Low cfm Sensible ERW
T = 1% Purge Low cfm Sensible ERW + Bypass
U = High cfm Total ERW
V = High cfm Total ERW + Bypass
W = High cfm Sensible ERW
Y = High cfm Sensible ERW + Bypass
Z = 1% Purge High cfm Total ERW
1 = 1% Purge High cfm Total ERW + Bypass
2 = 1% Purge High cfm Sensible ERW
3 = 1% Purge High cfm Sensible ERW + Bypass
4 = Single Total Energy Recovery Wheel + Bypass
5 = 100% Return Air

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A **1B 1C 1D** 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A **0 0 0** – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 B

Feature 1: RETURN/OUTSIDE AIR

1B: RETURN/EXHAUST AIR BLOWER CONFIGURATION

A = 1 Blower + Standard Efficiency Motor
B = 2 Blowers + Standard Efficiency Motor
C = 1 Blower + Premium Efficiency Motor
D = 2 Blowers + Premium Efficiency Motors
E = 1 Blower + Premium Efficiency Motor + 1 VFD
F = 2 Blowers + Premium Efficiency Motors + 2 Motors on 1 VFD
G = 2 Blowers + Premium Efficiency Motors + 2 Motors on 2 VFDs
H = 1 Blower + Premium Efficiency TEFC Motor
J = 2 Blowers + Premium Efficiency TEFC Motors
K = 1 Blower + Premium Efficiency TEFC Motor + 1 VFD
L = 2 Blowers + Premium Efficiency TEFC Motors + 2 Motors on 1 VFD
M = 2 Blowers + Premium Efficiency TEFC Motors + 2 Motors on 2 VFDs
N = Option E + Shaft Grounding
P = Option F + Shaft Grounding
Q = Option G + Shaft Grounding
R = Option K + Shaft Grounding
S = Option L + Shaft Grounding
T = Option M + Shaft Grounding

1C: RETURN/EXHAUST AIR BLOWER

0 = Standard - None
A = 12”x9” Forward Curved
B = 15” Backward Curved Plenum
C = 18.5” Backward Curved Plenum
D = 22” Backward Curved Plenum
F = 27” Backward Curved Plenum
G = 22” Direct Drive Axial Flow
H = 35.5” Direct Drive Axial Flow
J = 15” BC Plenum - 50% Width with Banding
K = 18.5” BC Plenum - 70% Width with Banding
L = 22” BC Plenum - 70% Width with Banding
M = 27” BC Plenum - 70% Width with Banding
N = 30” Backward Curved Plenum
P = 42” 9 Blade Direct Drive Axial Flow
Q = 42” 12 Blade Direct Drive Axial Flow
R = 24” Backward Curved Plenum
S = 33” Backward Curved Plenum

1D: RETURN/EXHAUST AIR BLOWER MOTOR

0 = Standard - None
C = 1 hp - 1760 rpm
D = 2 hp - 1760 rpm
E = 3 hp - 1760 rpm
F = 5 hp - 1760 rpm
G = 7.5 hp - 1760 rpm
H = 10 hp - 1760 rpm
L = 15 hp - 1760 rpm
M = 20 hp - 1760 rpm
N = 1 hp - 1170 rpm
P = 2 hp - 1170 rpm
Q = 3 hp - 1170 rpm
R = 5 hp - 1170 rpm
S = 7.5 hp - 1170 rpm
T = 10 hp - 1170 rpm
U = 15 hp - 1170 rpm
V = 20 hp - 1170 rpm
W = 25 hp - 1170 rpm
Y = 30 hp - 1170 rpm
3 = 25 hp - 1760 rpm
4 = 30 hp - 1760 rpm
5 = 40 hp - 1760 rpm
6 = 50 hp - 1760 rpm

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN		SIZE		VLT		CONFIG		A1	A2	A3	A4		B1	B2	B3		1A	1B	1C	1D		**2**	**3**	**4**		5A	5B	5C		6A	6B	6C		7	8	9	10	11	12	13		14A	14B		15	16	17	18	19	20	21	22	23
RN	–	0 2 5	–	3	–	0	–	B	B	0	2	–	3	8	4	:	A	0	0	0	–	**D**	**0**	**B**	–	D	E	H	–	0	B	A	–	0	D	0	0	0	0	L	–	0	0	–	0	0	B	0	0	0	0	0	B

Feature 2: OUTSIDE AIR CONTROL

0 = Standard - None
A = 3 Position Actuator - Sensible Limit
B = 3 Position Actuator - Enthalpy Limit
C = Fully Modulating Actuator - Sensible Limit
D = Fully Modulating Actuator - Enthalpy Limit
E = DDC Actuator
F = Constant Volume Outside Air
G = Options A + F
H = Options B + F
J = Options C + F
K = Options D + F
L = Options E + F
M = 3 Pos. Act. - Sensible Limit + CO_2 Override
N = 3 Pos. Act. - Enthalpy Limit + CO_2 Override
P = Fully Mod. Act. - Sensible + CO_2 Override
Q = Fully Mod. Act. - Enthalpy + CO_2 Override
R = DDC Actuator + CO_2 Override
S = Dual Minimum Position Potentiometers + Fully Mod. Act. - Sensible Limit
T = Dual Minimum Position Potentiometers + Fully Mod. Act. - Enthalpy Limit
U = 2 Position Actuator
Y = Fault Detection and Diagnostics Controller (FDD) Sensible Limit
Z = FDD Enthalpy Limit
1 = FDD Sensible Limit + CO_2 Override
2 = FDD Enthalpy Limit + CO_2 Override

Feature 3: HEAT OPTIONS

0 = Standard - None
E = Discharge Air Override
K = Auxiliary Heat K
L = Auxiliary Heat L
M = Auxiliary Heat M
N = Auxiliary Heat N
P = Auxiliary Heat P
Q = Auxiliary Heat Q
R = Auxiliary Heat R
S = Auxiliary Heat S
T = Auxiliary Heat T
U = Auxiliary Heat U
V = Auxiliary Heat V
W = Auxiliary Heat W

Feature 4: MAINTENANCE OPTIONS

0 = Standard - None
A = Field Wired 115V Outlet
B = Factory Wired 115V Outlet
C = Blower Aux. Contact
D = Remote Start/Stop Terminals
E = Options A + C
F = Options A + D
G = Options B + C
H = Options B + D
J = Options A + C + D
K = Options B + C + D
L = Options C + D

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 **5A 5B** 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A 0 0 0 – D 0 B – **D E** H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 B

Feature 5: SUPPLY AIR OPTIONS

5A: SUPPLY AIR BLOWER CONFIGURATION

0 = 1 Blower + Standard Efficiency Motor
A = 2 Blowers + Standard Efficiency Motor
B = 1 Blower + Premium Efficiency Motor
C = 2 Blowers + Premium Efficiency Motor
D = 1 Blower + Premium Efficiency Motor + 1 VFD
F = 2 Blowers + Premium Efficiency Motors + 2 Motors on 1 VFD
G = 2 Blowers + Premium Efficiency Motors + 2 Motors on 2 VFDs
H = 1 Blower + Premium Efficiency TEFC Motor
J = 2 Blowers + Premium Efficiency TEFC Motors
K = 1 Blower + Premium Efficiency TEFC Motor + 1 VFD
L = 2 Blowers + Premium Efficiency TEFC Motors + 2 Motors on 1 VFD
M = 2 Blowers + Premium Efficiency TEFC Motors + 2 Motors on 2 VFDs
N = Option D + Shaft Grounding
P = Option F + Shaft Grounding
Q = Option G + Shaft Grounding
R = Option K + Shaft Grounding
S = Option L + Shaft Grounding
T = Option M + Shaft Grounding

5B: SUPPLY AIR BLOWER

B = 15” Backward Curved Plenum
C = 18.5” Backward Curved Plenum
D = 24” Backward Curved Plenum
E = 27” Backward Curved Plenum
F = 30” BC Plenum - 90% Width + 1750 rpm Max - Aluminum Wheel
G = 15” BC Plenum - 70% Width
H = 18.5” BC Plenum - 70% Width
J = 18.5” Backward Curved Plenum
K = 18.5” BC Plenum - 60% Width
L = 30” BC Plenum - 1600 rpm Max - Aluminum Wheel
M = 13.5” Backward Curved Plenum
N = 13.5” BC Plenum - 70% Width
P = 24” BC Plenum - 60% Width
Q = 27” BC Plenum - 60% Width
R = 22” Backward Curved Plenum
S = 22” BC Plenum - 70% Width
T = 17” Backward Curved Plenum
U = 17” BC Plenum - 70% Width
V = 33” Backward Curved Plenum
W = 36.5” Backward Curved Plenum
Y = 42.5” Backward Curved Plenum

RN Series Feature String Nomenclature

GEN	SIZE	VLT	CONFIG	A1	A2	A3	A4	B1	B2	B3	1A	1B	1C	1D	2	3	4	5A	5B	**5C**	**6A**	**6B**	**6C**	**7**	8	9	10	11	12	13	14A	14B	15	16	17	18	19	20	21	22	23
RN –	025 –	3 –	0 –	B	B	0	2 –	3	8	4 :	A	0	0	0 –	D	0	B –	D	E	**H** –	**0**	B	**A** –	**0**	D	0	0	0	0	L –	0	0 –	0	0	B	0	0	0	0	0	B

5C: SUPPLY AIR BLOWER MOTOR

C = 1 hp - 1760 rpm
D = 2 hp - 1760 rpm
E = 3 hp - 1760 rpm
F = 5 hp - 1760 rpm
G = 7.5 hp - 1760 rpm
H = 10 hp - 1760 rpm
L = 15 hp - 1760 rpm
M = 20 hp - 1760 rpm
N = 1 hp - 1170 rpm
P = 2 hp - 1170 rpm
Q = 3 hp - 1170 rpm
R = 5 hp - 1170 rpm
S = 7.5 hp - 1170 rpm
T = 10 hp - 1170 rpm
U = 15 hp - 1170 rpm
V = 20 hp - 1170 rpm
W = 25 hp - 1170 rpm
Y = 30 hp - 1170 rpm
3 = 25 hp - 1760 rpm
4 = 30 hp - 1760 rpm
5 = 40 hp - 1760 rpm
6 = 50 hp - 1760 rpm

Feature 6: FILTERS

6A: PRE FILTER

0 = Standard - None
A = 2” Pleated - MERV 8
B = Metal Mesh Outside Air Filter
C = Lint Screen Filter
D = Exhaust Air ERW Filter
E = Options A + B
F = Options A + D
G = Options B + D
H = Options A + B + D

6B: UNIT FILTER

0 = 2” Pleated - MERV 8
B = 4” Pleated - MERV 8
C = 2” Permanent Filter + Replaceable Media
F = 4” Pleated - MERV 11
G = 4” Pleated - MERV 13
H = 4” Pleated - MERV 14

6C: FILTER OPTIONS

0 = Standard
A = Clogged Filter Switch
B = Magnehelic Gauge
C = Options A + B

Feature 7: REFRIGERATION CONTROL

0 = Standard
A = 5 Min. Time Delay Relay - Comp. Off
B = 20 Sec. Time Delay Relay - Comp. Staging
D = Adjustable Lockout
E = Freeze Stats - Each Circuit
F = Options A + B
H = Options A + D
J = Options A + E
L = Options B + D
M = Options B + E
N = Adjustable Fan Cycling with Adjustable Compressor Lockout
Q = Options D + E
S = Options A + B + D
T = Options A + B + E
U = Options A + N
W = Options A + D + E
Y = Options B + N
1 = Options B + D + E
2 = Options N + E
3 = Options A + B + N
5 = Options A + B + D + E
6 = Options A + N+ E
7 = Options B + N + E
8 = Options A + B + N + E

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 **8 9 10** 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A 0 0 0 – D 0 B – D E H – 0 B A – 0 **D 0 0** 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 B

Feature 8: REFRIGERATION OPTIONS

0 = Standard
A = Hot Gas Bypass Lead Stage
or Hot Gas Bypass Lag Stage with Lead Variable Capacity Compressor
B = Hot Gas Bypass Lead and Lag Stages
D = Modulating Hot Gas Reheat
E = 0°F Low Ambient Lead Stage
H = Options A + D
J = Options B + D
K = Options A + E
L = Options B + E
N = Polymer E-Coated Modulating Hot Gas Reheat
R = Polymer E-Coated HGB Lead + MHGR
S = Polymer E-Coated HGB Lead + HGB Lag + MHGR
T = Split System HGB Lead Stage
U = Split System HGB Lead + HGB Lag
W = Split System Modulating Hot Gas Reheat
1 = Split System HGB Lead + MHGR
2 = Split System HGB Lead + HGB Lag + MHGR
4 = Split System Polymer E-Coated MHGR
7 = Split System HGB Lead + Coated MHGR
8 = Split System HGB Lead + HGB Lag + Polymer E-Coated MHGR

Feature 9: REFRIGERATION ACCESSORIES

0 = Standard
A = Sight Glass
B = Compressor Isolation Valves
C = Options A + B
D = ECM Condenser Fan - Multiple Speed
E = ECM Condenser Fan - Head Pressure Control
F = VFD Controlled Condenser Fans - Variable Speed
G = Options A + D
H = Options B + D
J = Options A + B + D
K = Options A + E
L = Options B + E
M = Options A + B + E
N = Options A + F
P = Options B + F
Q = Options C + F

Feature 10: POWER OPTIONS

0 = Standard Power Block
A = 100 Amp Power Switch
B = 150 Amp Power Switch
C = 225 Amp Power Switch
D = 400 Amp Power Switch
E = 600 Amp Power Switch
F = 60 Amp Power Switch
5 = 800 Amp Power Switch
6 = 1200 Amp Power Switch
G = 15 Amp Circuit Breaker
H = 20 Amp Circuit Breaker
J = 25 Amp Circuit Breaker
K = 30 Amp Circuit Breaker
L = 35 Amp Circuit Breaker
M = 40 Amp Circuit Breaker
N = 45 Amp Circuit Breaker
P = 50 Amp Circuit Breaker
Q = 60 Amp Circuit Breaker
R = 70 Amp Circuit Breaker
S = 80 Amp Circuit Breaker
T = 90 Amp Circuit Breaker
U = 100 Amp Circuit Breaker
V = 110 Amp Circuit Breaker
W = 125 Amp Circuit Breaker
Y = 150 Amp Circuit Breaker
Z = 175Amp Circuit Breaker
1 = 200 Amp Circuit Breaker
2 = 225 Amp Circuit Breaker
3 = 250 Amp Circuit Breaker

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN	SIZE	VLT	CONFIG	A1 A2 A3 A4	B1 B2 B3	1A 1B 1C 1D	2 3 4	5A 5B 5C	6A 6B 6C	7 8 9 10 **11** **12** 13	14A 14B	15 16 17 18 19 20 21 22 23
RN –	0 2 5 –	3 –	0 –	B B 0 2 –	3 8 4 :	A 0 0 0 –	D 0 B –	D E H –	0 B A –	0 D 0 0 **0** **0** L –	0 0 –	0 0 B 0 0 0 0 0 B

Feature 11: SAFETY OPTIONS

0 = Standard
A = Return and Supply Air Firestat
B = Return Air Smoke Detector
C = Supply Air Smoke Detector
D = Options B + C
E = Options A + B
F = Options A + C
G = Options A + B + C
H = Remote Smoke Detector Terminals
J = Options A + H
K = Options B + H
L = Options C + H
M = Options D + H
N = Options A + B + H
P = Options A + C + H
Q = Options A + B + C + H
R = High Condensate Level Switch
S = Options A + R
T = Options B + R
U = Options C + R
V = Options D + R
W = Options H + R
Y = Options E + R
Z = Options F + R
1 = Options G + R
2 = Options J + R
3 = Options K + R
4 = Options L + R
5 = Options M + R
6 = Options N + R
7 = Options P + R
8 = Options Q + R

Feature 12: CONTROLS

0 = Standard
A = Low Limit Controls
B = Phase and Brown Out Protection
C = Energy Recovery Wheel Defrost
D = Energy Recovery Wheel Rotation Detection
E = Compressor Power Factor Correction
F = Options A + B
G = Options A + C
H = Options A + D
J = Options A + E
K = Options B + C
L = Options B + D
M = Options B + E
N = Options C + D
P = Options C + E
Q = Options D + E
R = Options A + B + C
S = Options A + B + D
T = Options A + B + E
U = Options A + C + D
V = Options A + C + E
W = Options A + D + E
Y = Options B + C + D
Z = Options B + C + E
1 = Options B + D + E
2 = Options C + D + E
3 = Options A + B + C + D
4 = Options A + B + C + E
5 = Options A + B + D + E
6 = Options A + C + D + E
7 = Options B + C + D + E
8 = Options A + B + C + D + E

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 **13** **14A** **14B** **15** **16** 17 18 19 20 21 22 23

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A 0 0 0 – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 **L** – **0 0** – **0 0** B 0 0 0 0 0 B

Feature 13: SPECIAL CONTROLS

0 = Terminal Block for Thermostat Control
D = VAV Unit Controller - VAV Cool + CV Heat
E = Constant Volume Unit Controller - CV Cool + CV Heat
F = Makeup Air Unit Controller - CV Cool + CV Heat
J = Factory Installed DDC Controls Furnished by Others
K = Factory Installed DDC Controls Furnished by Others w/ Isolation relays
L = Terminal Block for Thermostat Control with Isolation Relays
U = Digital Precise Air Controller, D-PAC
V = Precise Air Controller, PAC
Y = Single Zone VAV Heat Pump Unit Controller - VAV Cool + VAV Heat
Z = Constant Volume Heat Pump Unit Controller - CV Cool + CV Heat
1 = Makeup Air Heat Pump Unit Controller - CV Cool + CV Heat
2 = Single Zone VAV Unit Controller VAV Cool + CV Heat
3 = Single Zone VAV Unit Controller VAV Cool + VAV Heat
4 = Field Installed DDC Controls by Others
5 = Field Installed DDC Controls Furnished by Others with Isolation Relays
6 = Factory Installed DDC Controls Furnished by Others with Isolation Relays (SPA)

Feature 14: PREHEAT

14A: PREHEAT CONFIGURATION

0 = Standard - None
A = Steam Distributing Preheat Coil - 1 Row
B = Steam Distributing Preheat Coil - 2 Row
C = Hot Water Preheat Coil - 1 Row
D = Hot Water Preheat Coil - 2 Row
E = Modulating Electric Preheat
F = Outside Airflow Monitoring Size A
G = Outside Airflow Monitoring Size B
H = Outside Airflow Monitoring Size C

14B: PREHEAT SIZING

0 = Standard - None
A = Single Serpentine 8 fpi
B = Half Serpentine 8 fpi
C = Single Serpentine 10 fpi
D = Half Serpentine 10 fpi
E = Single Serpentine 12 fpi
F = Half Serpentine 12 fpi
G = 10 kW (7.5 kW @ 208V)
H = 15 kW (11.3 kW @ 208V)
J = 20 kW (15 kW @208V)
K = 30 kW (22.5 kW @208V)
L = 40 kW (30 kW @208V)
M = 50 kW (37.6 kW @208V)
N = 60 kW (45.1 kW @208V)
P = 70 kW (52.6 kW @208V)
Q = 80 kW (60.1 kW @208V)
R = 90 kW (67.6 kW @208V)
S = 100 kW (75.1 kW @208V)
T = 110 kW (82.6 kW @208V)
U = 120 kW (90.1 kW @208V)

Feature 15: Glycol Percentage

0 = Standard
C = Field Adjustable for Glycol %

Feature 16: INTERIOR CABINET OPTIONS

0 = Standard
B = Control Panel Service Lights
H = UV Lights
J = Compressor Sound Blanket (CSB)
K = Control Panel Service Lights + UV Lights
L = Control Panel Service Lights + CSB
M = UV Lights + CSB
N = Control Panel Service Lights + UV Lights + CSB

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 **17 18 19 20 21** 22 23

RN – 0 2 5 – 3 – 0 – BB 0 2 – 3 8 4 : A 0 0 0 – D 0 B – DEH – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 **B 0 0 0 0** 0 B

Feature 17: EXTERIOR CABINET OPTIONS

0 = Standard
A = Base Insulation
B = Burglar Bars
C = Condenser Coil Guards
D = Options A + B
E = Options A + C
F = Options B + C
G = Options A + B + C

Feature 18: CUSTOMER CODE

0 = Standard

Feature 19: CODE OPTIONS

0 = Standard - ETL U.S.A. Listing
B = Chicago - Cool + Gas
C = Chicago - Cool + Electric Heat
D = Chicago - Cool Only
E = Chicago - Gas Only
F = Chicago - Electric Heat Only
G = Chicago - No Cool + No Heat
H = ETL U.S.A. + Canada Listing
K = California OSHPD Certification
L = Shake Table Cert. (ASCE 7-05/ICC-ES AC 156)
M = Seismic Construction (Non-Certified)
N = California OSHPD Certification + Chicago
P = Shake Table Cert. (ASCE 7-05/ICC-ES AC 156) + Chicago
Q = Seismic Construction (Non-Certified) + Chicago

Feature 20: CRATING

0 = Standard
A = Export Crating
B = Export Crating - No Condenser Section
C = Shrink Wrap
D = Options A + C
E = Options B + C

Feature 21: WATER-COOLED CONDENSER

0 = Standard - None
A = Balancing Valves
B = Water Flow Switch
C = Motorized Shut-off Valve
D = Head Pressure Control
E = Options A + B
F = Options A + C
G = Options A + D
H = Options B + C
J = Options B + D
L = Options A + B + C
M = Options A + B + D
R = SMO 254 Brazed Plate Heat Exchanger
S = Options A + R
T = Options B + R
U = Options C + R
V = Options D + R
W = Options A + B + R
Y = Options A + C + R
Z = Options A + D + R
1 = Options B + C + R
2 = Options B + D + R
3 = Options C + D + R
4 = Options A + B + C + R
5 = Options A + B + D + R

RN Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN SIZE VLT CONFIG A1 A2 A3 A4 B1 B2 B3 1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 **22** **23**

RN – 0 2 5 – 3 – 0 – B B 0 2 – 3 8 4 : A 0 0 0 – D 0 B – D E H – 0 B A – 0 D 0 0 0 0 L – 0 0 – 0 0 B 0 0 0 0 0 **0** **B**

Feature 22: CONTROL VENDORS

0 = None
T = WattMaster Orion VCB-X Controls System + Integrated BACnet MSTP
U = WattMaster Orion VCB-X Controls System + Integrated BACnet MSTP with Specials
V = WattMaster Orion VCC-X Controls System + Integrated BACnet MSTP
W = WattMaster Orion VCC-X Controls System + Integrated BACnet MSTP with Specials
Y = Remote Mounted AAON Touchscreen Controller
Z = VCC-X w/BACnet MSTP & Split System
1 = VCC-X w/BACnet MSTP w/Specials & Split System

Feature 23: TYPE

B = Standard - AAON Gray Paint
U = Special Pricing Authorization + Special Paint
X = Special Pricing Authorization + AAON Gray Paint
1 = Standard Paint + 2 Year Parts Only Warranty
4 = Standard Paint + 5 Year Parts Only Warranty
9 = Standard Paint + 10 Year Parts Only Warranty

General Information

RN Series packaged rooftop units, heat pumps and outdoor air handling units have been designed for outdoor installation only. Units are assembled, wired, charged and run tested at the factory.

Startup and service must be performed by a Factory Trained Service Technician.

⚠ WARNING

Improper installation, adjustment, alteration, service, or maintenance can cause property damage, personal injury or loss of life. Startup and service must be performed by a Factory Trained Service Technician. A copy of this IOM should be kept with the unit.

⚠ CAUTION

These units must not be used for heating or cooling at any time during any phase of construction. Very low return air temperatures, harmful vapors, and misplacement of the filters will damage the unit and its efficiency.

Certification of Gas Heat Models

a. AAON gas heat exchangers have successfully completed 10,000 burner operation cycles and corrosion resistance as specified per test standard ANSI 21.47. All gas heat exchangers used in AAON appliances are certified for use downstream of evaporator or cooling coils.
b. Certified as a Category III forced air furnace with or without cooling.
c. Certified for outdoor installation only.
d. Certified for installation on a combustible roof with a minimum of 12" high curb.

Certification of Steam or Hot Water Heat Models

a. Certified as a forced air heating system with or without cooling.
b. Certified for outdoor installation only.
c. Certified for installation on a combustible roof with a minimum of 12" high curb.

Certification of Electric Heat Models

a. Certified as an electric warm air furnace with or without cooling.
b. Certified for outdoor installation only.
c. Certified for installation on a combustible roof with a minimum of 12" high curb.

Certification of Cooling Models

a. Certified as a commercial central air conditioner with or without electrically operated compressors.
b. Certified for outdoor installation only.
c. Certified for installation on a combustible roof with a minimum of 12" high curb.
d. Certified with refrigerant R-410A coils or with chilled water cooling coils.

Codes and Ordinances

RN Series units have been tested and certified, by ETL, in accordance with UL Safety Standard 1995/CSA C22.2 No. 236, ANSI Safety Standard Z21.47b-2008/CSA 2.3b-2008, and ANSI Safety Standard Z83.8-2006/CSA 2.6-2006.

System should be sized in accordance with the American Society of Heating, Refrigeration and Air Conditioning Engineers Handbook.

Installation of RN Series units must conform to the ICC standards of the International Mechanical Code, the International Building Code, and local building, plumbing and waste water codes. In the absence of local codes installation must conform to the current (United States) National Fuel Gas Code ANSI-Z223.1/NFPA 54 or the current (Canada) National Fuel & Propane Installation Code CSA B149.1 or B149.2, and Mechanical Refrigeration Code CSA B52. All appliances must be electrically grounded in accordance with local codes, or in the absence of local codes, the current National Electric Code, ANSI/NFPA 70 or the current Canadian Electrical Code CSA C22.1.

⚠ CAUTION

The Clean Air Act of 1990 bans the intentional venting of refrigerant as of July 1, 1992. Approved methods of recovery, recycling, or reclaiming must be followed.

⚠ WARNING

Coils and sheet metal surfaces present sharp edges and care must be taken when working with equipment.

⚠ WARNING

Failure to observe the following instructions will result in premature failure of your system and possible voiding of the warranty.

Receiving Unit

When received, the unit should be checked for damage that might have occurred in transit. If damage is found it should be noted on the carrier's freight bill. A request for inspection by carrier's agent should be made in writing at once. Nameplate should be checked to ensure the correct model sizes and voltages have been received to match the job requirements.

If repairs must be made to damaged goods, then the factory should be notified before any repair action is taken in order to protect the warranty. Certain equipment alteration, repair, and manipulation of equipment without the manufacturer's consent may void the product warranty. Contact the AAON Warranty Department for assistance with handling damaged goods, repairs, and freight claims: (918) 382-6450.

Note: Upon receipt check shipment for items that ship loose such as filters and remote sensors. Consult order and shipment documentation to identify potential loose-shipped items. Loose-shipped items may have been placed inside unit cabinet for security. Installers and owners should secure all doors with locks or nuts and bolts to prevent unauthorized access.

Figure 1 - Lockable Handle

Storage

If installation will not occur immediately following delivery, store equipment in a dry protected area away from construction traffic and in the proper orientation as marked on the packaging with all internal packaging in place. Secure all loose-shipped items.

Packaged Direct Expansion (DX) Units

⚠ WARNING

COMPRESSOR CYCLING

5 MINUTE MINIMUM OFF TIME

To prevent motor overheating compressors must cycle off for a minimum of 5 minutes.

5 MINUTE MINIMUM ON TIME

To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 6 starts per hour.

All DX refrigeration systems are factory assembled, leak tested, charged with refrigerant, and run tested.

All refrigerant systems include an evaporator, condenser, liquid line filter driers, expansion valves and scroll compressors.

⚠ CAUTION

CRANKCASE HEATER OPERATION

Some units are equipped with compressor crankcase heaters, which should be energized at least 24 hours prior to cooling operation, to clear any liquid refrigerant from the compressors.

Never cut off the main power supply to the unit, except for servicing, emergency, or complete shutdown of the unit. When power is cut off from the unit crankcase heaters cannot prevent refrigerant migration into the compressors. This means the compressor will cool down and liquid refrigerant may accumulate in the compressor. The compressor is designed to pump refrigerant gas and damage may occur when power is restored.

If power to the unit must be off for more than an hour, turn the thermostat system switch to "OFF", or turn the unit off at the control panel, and leave the unit off until the main power switch has been turned on again for at least 24 hours for units with compressor crankcase heaters. This will give the crankcase heater time to clear any liquid accumulation out of the compressor before it is started.

Always control the unit from the thermostat, or control panel, never at the main power supply, except for servicing, emergency or complete shutdown of the unit.

During the cooling season, if the air flow is reduced due to dirty air filters or any other reason, the cooling coils can get too cold which will cause excessive liquid to return to the compressor. As the liquid concentration builds up, oil is washed out of the compressor, leaving it starved for lubrication.

The compressor life will be seriously shorted by reduced lubrication and the pumping of excessive amounts of liquid oil and refrigerant.

Note: Low Ambient Operation
Air-cooled DX units without a low ambient option, such as condenser fan cycling or the 0°F low ambient option, will not operate in the cooling mode of operation properly when the outdoor temperature is below 55°F. Low ambient and/or economizer options are recommended if cooling operation below 55°F is expected.

⚠ CAUTION

Polyolester (POE) and Polyvinylether (PVE) oils are two types of lubricants used in hydrofluorocarbon (HFC) refrigeration systems. Refer to the compressor label for the proper compressor lubricant type.

Note: Multiple Units with Multiple Thermostats
When several heating and cooling units are used to condition a space all unit thermostat switches must be set in either heating mode, cooling mode or off. Do not leave part of the units switched to the opposite mode. Cooling only units should be switched off at the thermostat during the heating season.

Gas or Electric Heating
The unit is designed to heat a given amount of air while operating. If this amount of air is greatly reduced, approximately 1/3 during the heating season, the gas heat exchanger or electric heating coil may overheat, and may cut the burner or heater off entirely by action of the safety high temperature limit devices which are factory mounted at the heat exchanger and supply fan areas.

Airflow should be adjusted after installation to obtain an air temperature rise within the range specified on the unit rating plate at the required external static pressure.
Should overheating occur with a gas heat exchanger, or the gas supply fail to shut off, shut off the manual gas valve to the furnace before shutting off the electrical supply.

Prolonged overheating of the heat exchanger will shorten its life.
If unit has not been selected as a 100% outside air unit (makeup air unit) the return air duct must be sealed to the unit and the return air temperature must be maintained between 55°F and 80°F.

Table 1 - Electric and Gas Heating Capacities

Model Option B2	Gas Heat Input Capacity	Gas Heat Output Capacity	Electric Heat Capacity	
	MBH	MBH	kW (208V)	kW (230V, 380V 460V, 575V)
1 = *Heat 1*			7.5	10
2 = *Heat 2*	90.0	72.0	15.0	20
3 = *Heat 3*			22.5	30
4 = *Heat 4*	270.0	218.7	30.0	40
5 = *Heat 5*			37.5	50
6 = *Heat 6*	390.0	315.9	45.1	60
7 = *Heat 7*			60.1	80
8 = *Heat 8*	405.0	328.1	75.1	100
9 = *Heat 9*			90.1	120
A = *Heat A*			120.1	160
B = *Heat B*			150.2	200
C = *Heat C*	540.0	432.0	180.2	240
D = *Heat D*	810.0	648.0	210.3	280
E = *Heat E*	1080.0	864.0	240.3	320
F = *Heat F*	195.0	156.0		
G = *Heat G*	292.5	234.0		
K = *Heat K*	150.0	120.0		
L = *Heat L*	210.0	168.0		
M = *Heat M*	800.0	640.0		
N = *Heat N*	1600.0	1280.0		
P = *Heat P*	2400.0	1920.0		

Wiring Diagrams

Unit specific wiring diagrams are laminated and affixed inside the controls compartment door.

Installation

AAON equipment has been designed for quick and easy installation.

Locating Units

The curb should be mounted first and must be located so that duct connections will be clear of structural members of the building.

Verify rooftop or foundation can support the total unit weight, including accessory weights.

WARNING

When locating gas fired units, it is recommended the unit be installed so that the flue discharge vents are located at least 120 inches away from any opening through which combustion products could enter the building.

WARNING

Distances from adjacent public walkways, adjacent buildings, operable windows and building openings, shall conform to local codes and/or the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or the National Gas & Propane Code, CSA B149.1

Do not position flue opening to discharge into a fresh air intake of any other piece of equipment. Unit should also be installed so that the flow of combustion intake air is not obstructed from reaching the furnace.

Vent opening must not be blocked by snow. A minimum 12" curb must be used or the vent outlet shall be greater than 12" off the ground/roof.

Flue gas is dangerously hot and contains containments. The user is responsible for determining if vent gases may degrade building materials.

The National Gas and Propane Installation Code, B149.1 specifies a 6 ft. horizontal vent terminal clearance to gas and electric meters and relief devices.

Local codes may supersede or further place restrictions on vent termination locations.

Table 2 - A Cabinet Unit Clearances

Location	Unit Size
	6-8 and 10 tons
Front - (Controls Side)	48"
Back - (Outside Air)	36"
*Left Side	*6"
Right Side	48"
Top	Unobstructed

*Units with a water-cooled condenser or chilled water coil require 48" of clearance on the left side for service access. DX and no cooling air handling units with an energy recovery wheel require 24" of clearance on the left side for service access.

Table 3 - B Cabinet Unit Clearances

Location	Unit Size
	9 and 11-15 tons
Front - (Controls Side)	48"
Back - (Outside Air)	48"
*Left Side	*6"
Right Side	48"
Top	Unobstructed

*Units with a water-cooled condenser or chilled water coil require 48" of clearance on the left side for service access. DX and no cooling air handling units with an energy recovery wheel require 24" of clearance on the left side for service access.

Table 4 - C Cabinet Unit Clearances

Location	Unit Size
	16-25 and 30 tons
Front - (Controls Side)	48”
Back - (Outside Air)	48”
*Left Side	*6”
Right Side	60”
Top	Unobstructed
*Units with a water-cooled condenser or chilled water coil require 48” of clearance on the left side for service access.	

Figure 2 - RN Series A, B and C Cabinet, 6-25 and 30 tons

Table 5 - D Cabinet Unit Clearances

Location	Unit Size
	26 and 31-70 tons
Front - (Controls Side)	48”
Back - (Outside Air)	48”
*Left Side	*48”
*Right Side	*70”
Top	Unobstructed
*Right and left side unit clearances are interchangeable on units that do not have hydronic heating. Units with hydronic heating require 70” right side access for service.	

Figure 3 - RN Series D Cabinet, 26, 31-50, 60 and 70 tons

Table 6 - E Cabinet Unit Clearances

Location	Unit Size
	55, 65 and 75-140 tons
Front - (Controls Side)	60”
Back - (Outside Air)	100” from end of the unit
Left Side	72”
Right Side	72”
Top	Unobstructed

Figure 4 - RN Series E Cabinet, 55, 65 and 75-140 tons

Setting the Curb

Make openings in roof decking large enough to allow for duct penetration and workspace only. Do not make openings larger than necessary. Set the curb to coincide with the openings. Make sure the curb is level. Unit must be level in both horizontal axes to support the unit and reduce noise and vibration.

⚠ CAUTION

All roofing work should be performed by competent roofing contractors to avoid any possible leakage.

⚠ CAUTION

Where the supply or warm air duct passes through a combustible roof, a clearance of 1 inch must be maintained between the outside edges of the duct and combustible material in accordance with National Fire Protection Association Standard No. 90A. Provide flashings or enclosure between structure and roof and all joints must be sealed with mastic roofing to ensure a watertight seal.

Be careful to install the provided neoprene isolator according to the following figure prior to setting the unit on the curb.

⚠ CAUTION

Neoprene isolator for unit vibration isolation is provided in the cabinet and must be installed according to installation manual.

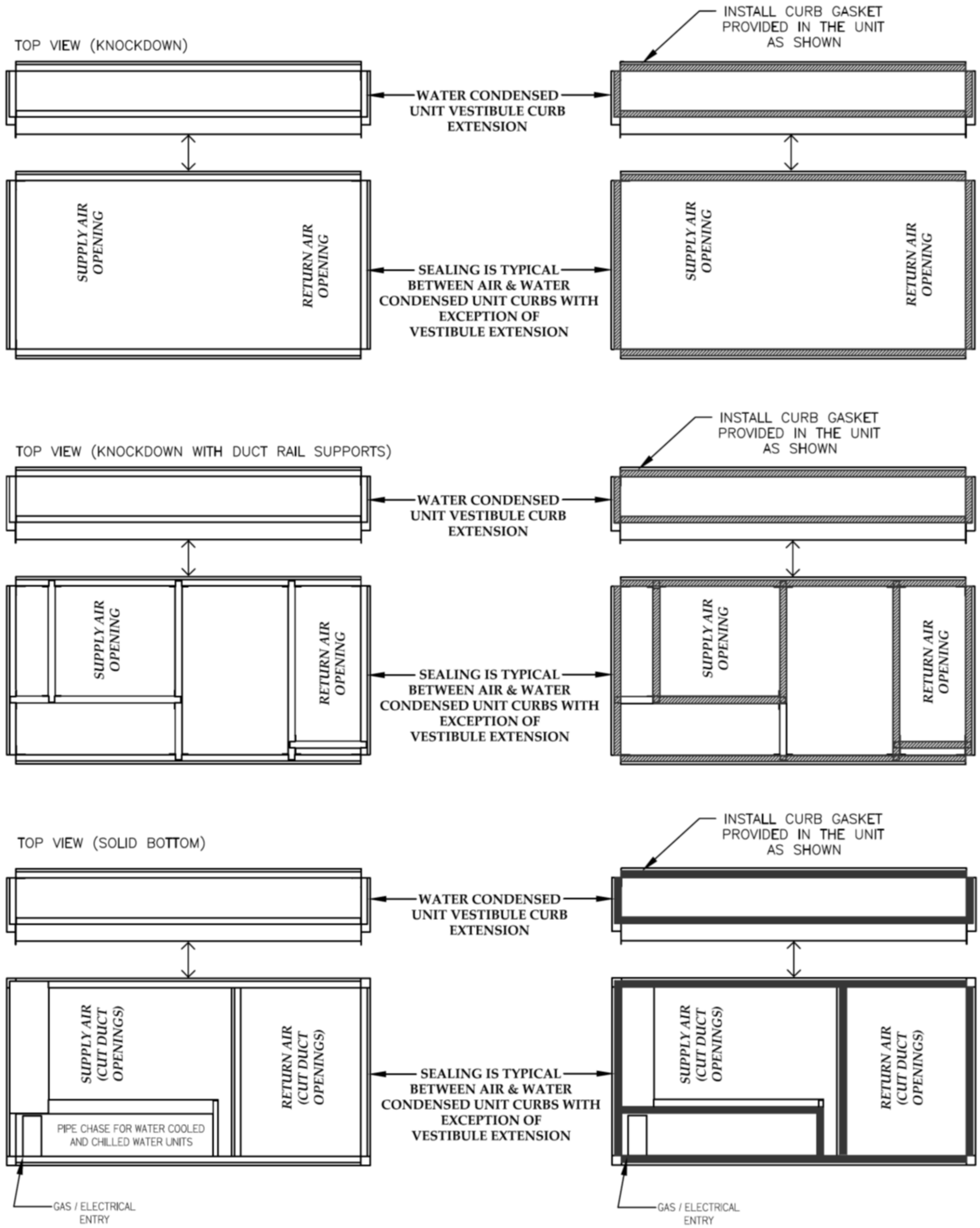


Figure 5 - RN Series 6-8 and 10 ton Unit Isolator Locations

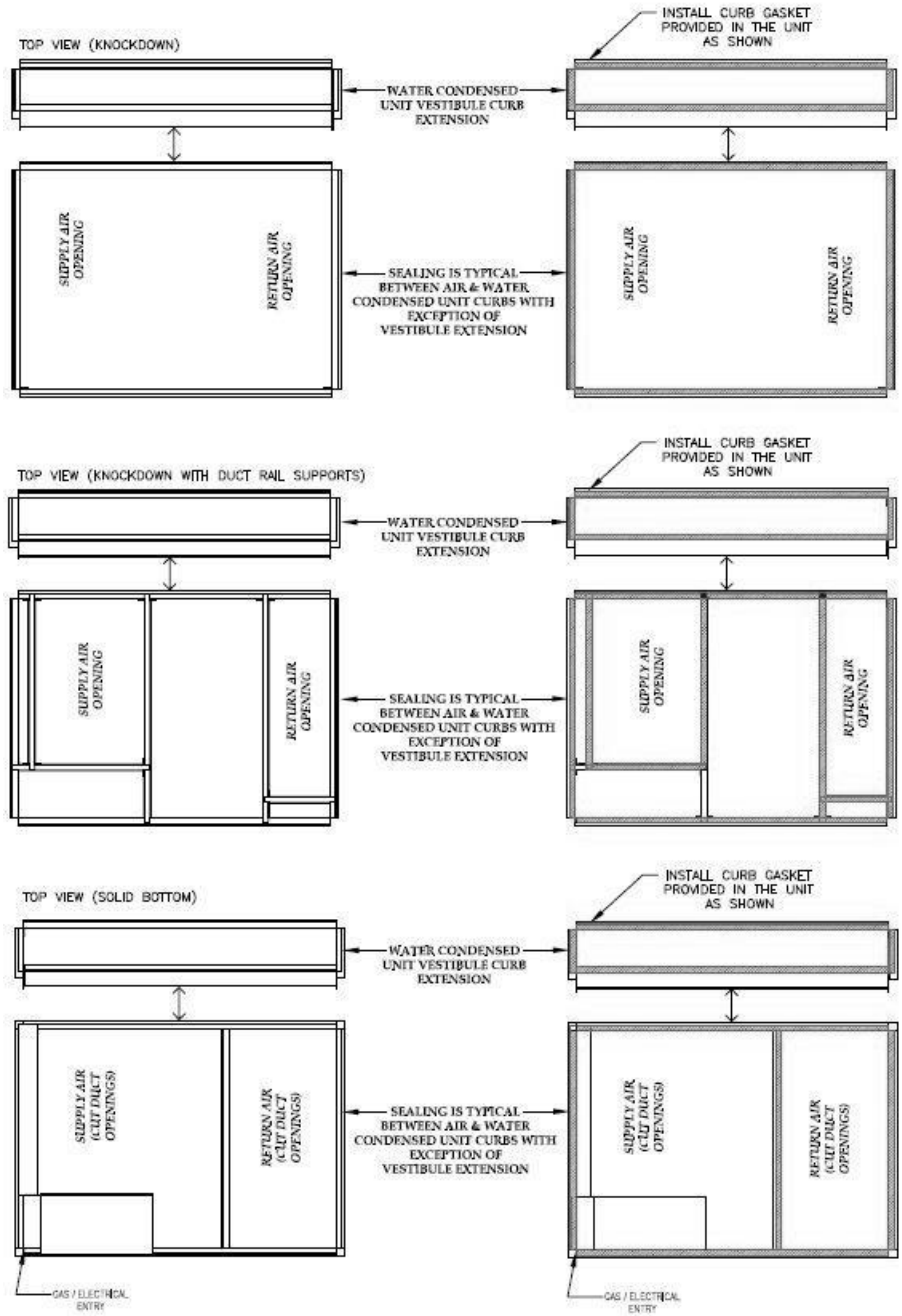


Figure 6 - RN Series 9 and 11-15 ton Unit Isolator Locations

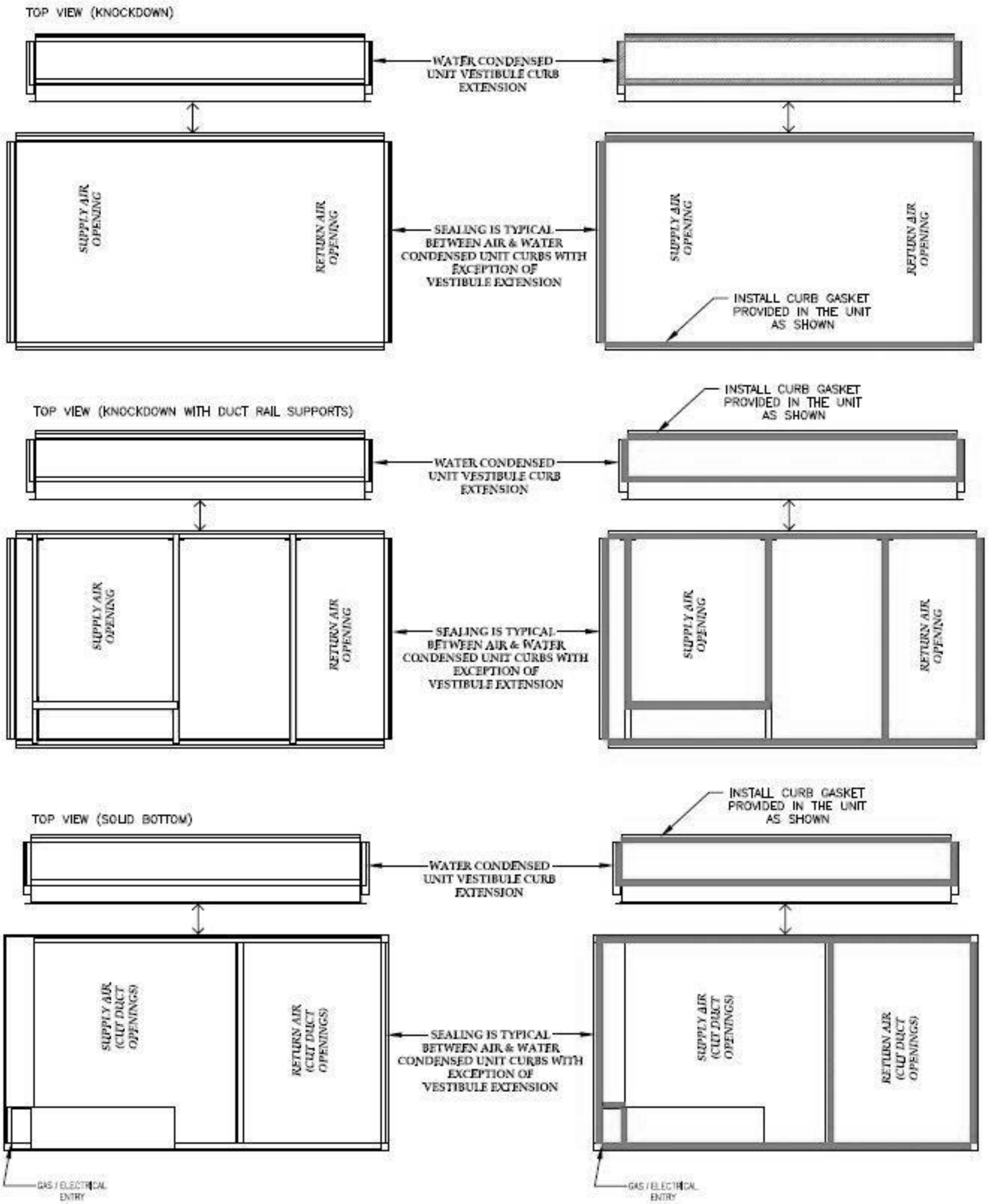


Figure 7 - RN Series 16-25 and 30 ton Unit Isolator Locations

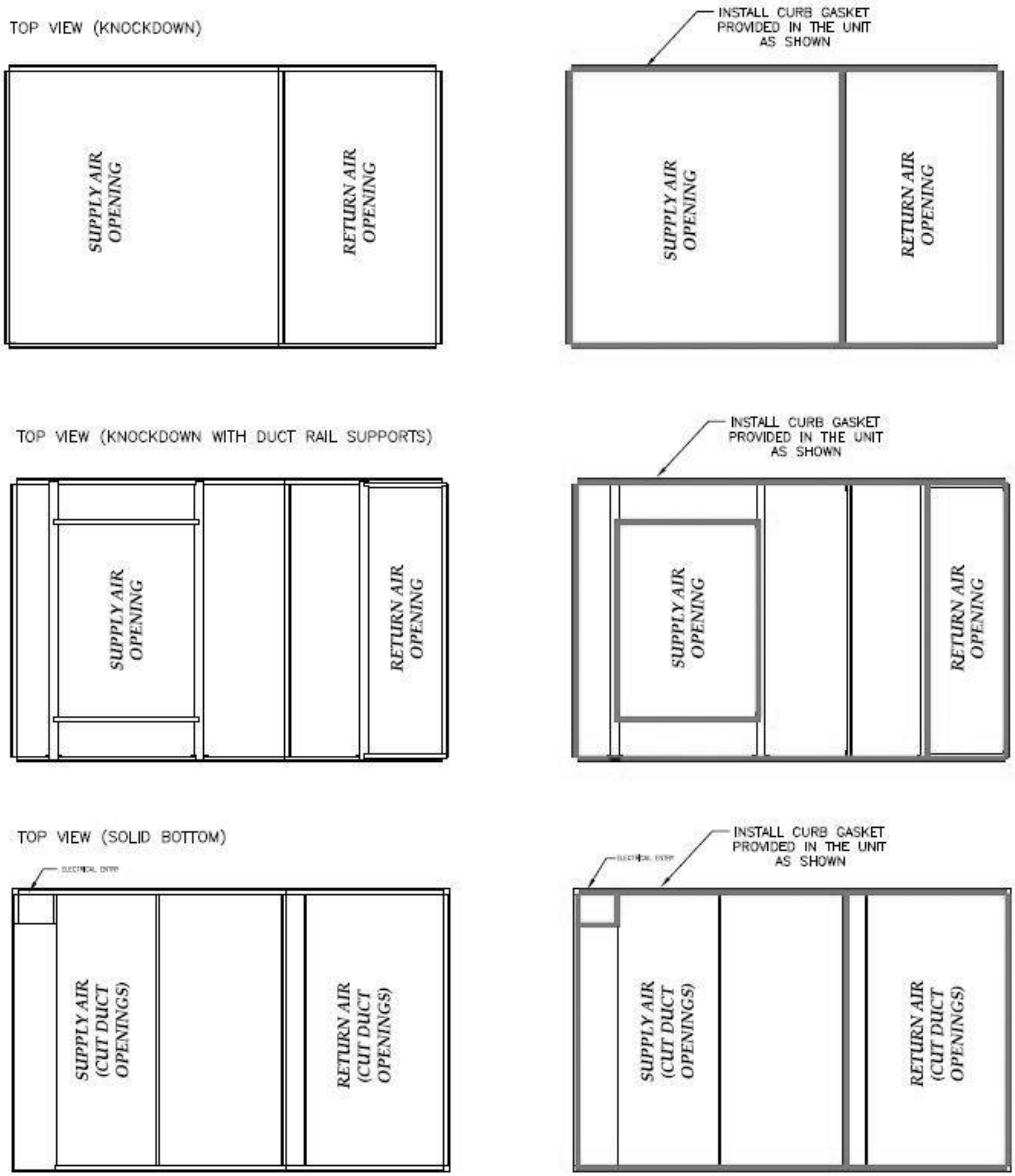


Figure 8 - RN Series 26, 31-50, 60, and 70 ton Unit Isolator Locations

> ⚠ **CAUTION**
>
> Incorrect lifting can cause damage to the unit.

Forklifting the Unit (6-25 and 30 ton)
6-25 and 30 ton units can be lifted using a forklift. 9, 11-25 and 30 ton units must have forks 72" in length or the forks must have 72" fork extensions. 6-8 and 10 ton units must have forks at least 48" in length. Standard units can be lifted from all sides except the condenser side. Units with power exhaust can be lifted from the controls side or the access (right) side. Units with energy recovery wheels or power return can only be fork lifted from the access (right) side.

Forks must be perpendicular to the unit and they must be in far enough that the back of the forks are no more than 6" away from the edge of the unit.

> ⚠ **CAUTION**
>
> FORKLIFTING
> 9, 11-25 AND 30 TON UNITS
>
> Forks or Fork Extensions must be 72" in length.

> ⚠ **CAUTION**
>
> FORKLIFTING
> 6-8 AND 10 TON UNITS
>
> Forks or Fork Extensions must be at least 48" in length.

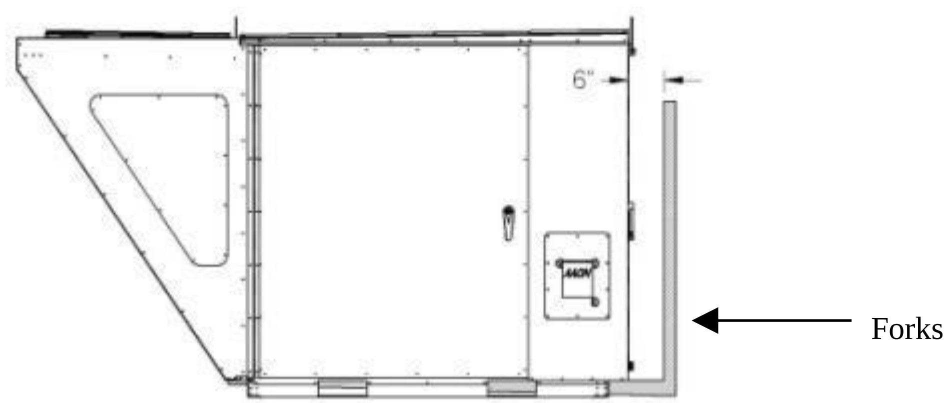


Figure 9 - Forklifting an RN Series A, B and C Cabinet, 6-25 and 30 tons

Lifting the Unit
If cables or chains are used to hoist the unit they must be the same length. Minimum cable length is 99" for 6-25 and 30 ton units and 180" for 26 and 31-50, 60 and 70 ton units. Spreader bars are required for 55, 65 and 75-140 ton units. Care should be taken to prevent damage to the cabinet, coils, and condenser fans.

It is recommended to lift the unit with the outside air hood in the downward shipping position. However, the unit may be lifted with the outside air hood in the open position.

Before lifting unit, be sure that all shipping material has been removed from unit. Secure hooks and cables at all lifting points / lugs provided on the unit.

Hoist unit to a point directly above the curb and duct openings. Be sure that the gasket material has been applied to curb.

Carefully lower and align the unit with utility and duct openings. Lower the unit until the unit skirt fits around the curb. Some units are designed to overhang the curb. Take care that any recessed base rails fit around the curb. Make sure the unit is properly seated on the curb and is level.

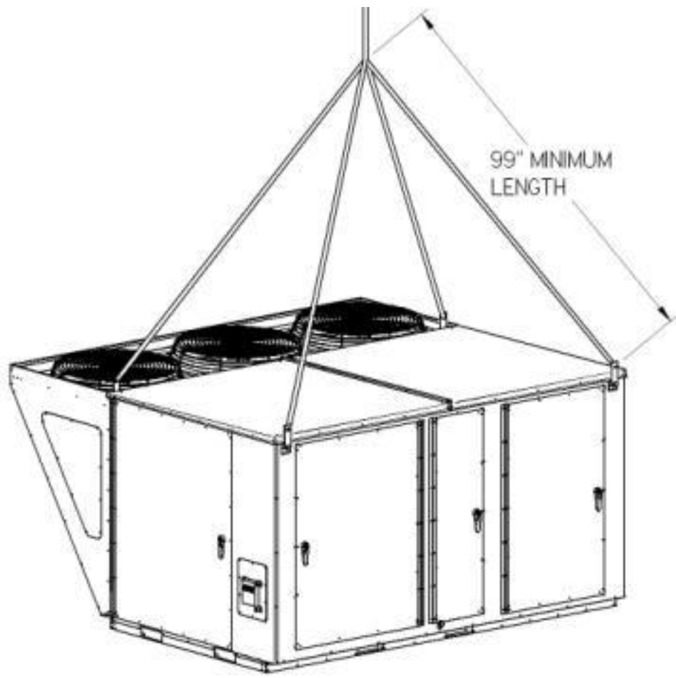


Figure 10 - Lifting Details of a 6-25 and 30 ton Standard or Power Exhaust Unit

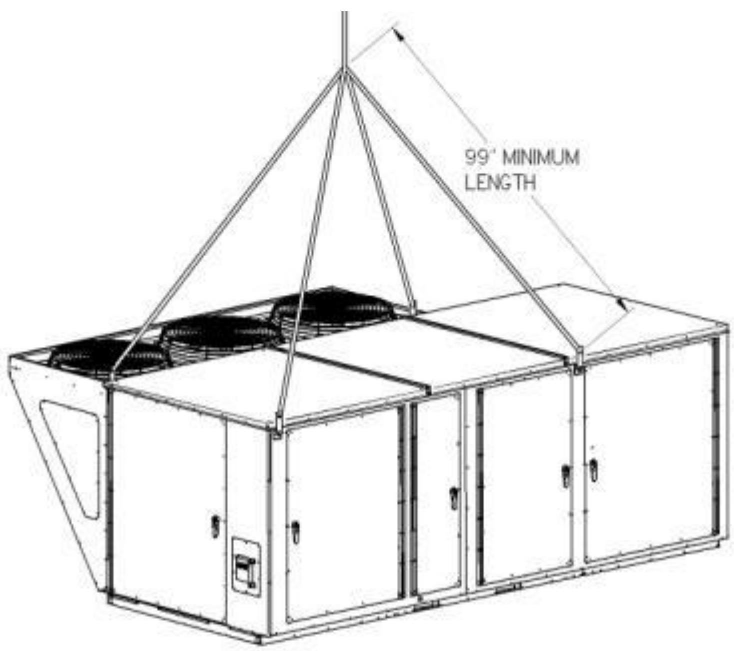


Figure 11 - Lifting Details of a 6-25 and 30 ton Energy Recovery Wheel or Power Return Unit

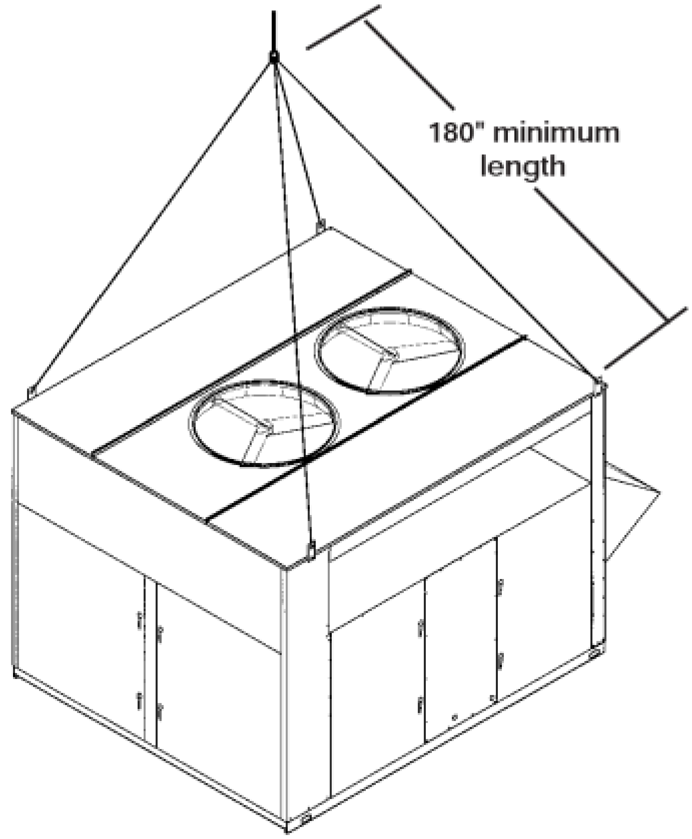


Figure 12 - Lifting Details of a 26, 31-50, 60 and 70 ton Unit

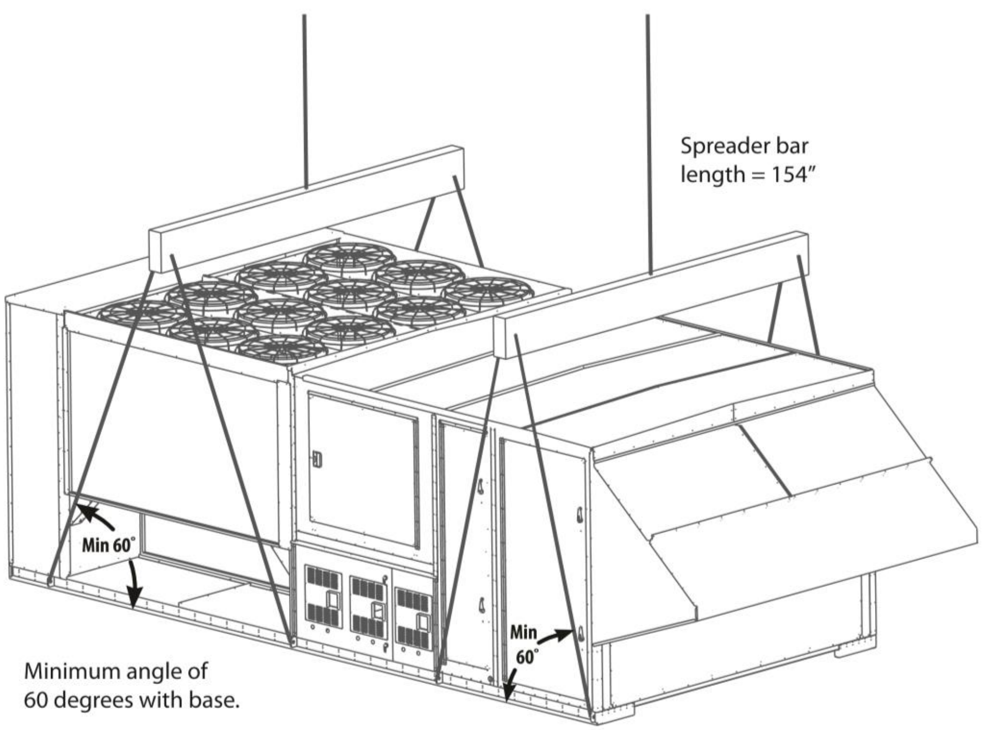


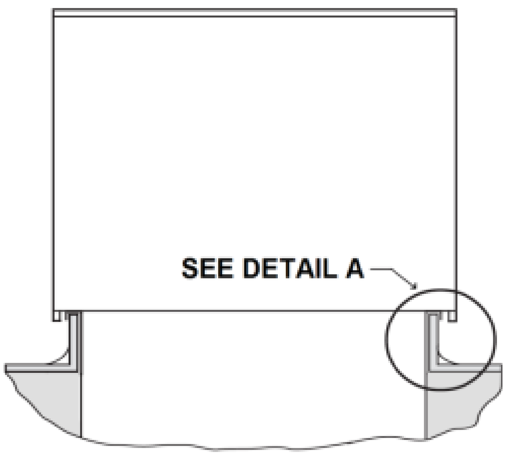
Figure 13 - Lifting Details of a 55, 65 and 75-140 ton Unit

Duct Connection

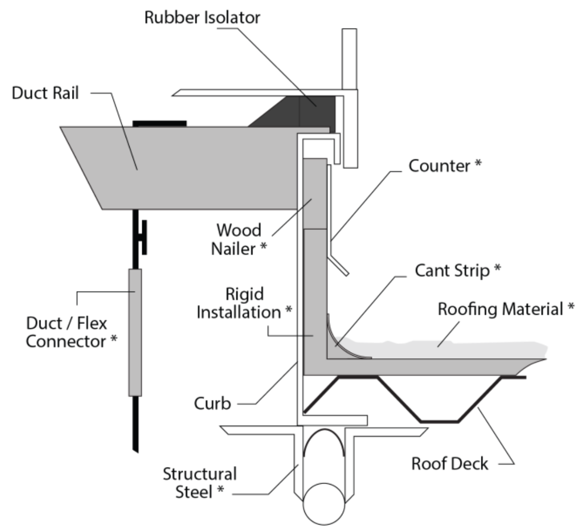
Note: If outside air will be in contact with the air tunnel base of an A, B or C cabinet unit (6-25 and 30 tons), the unit should include the base insulation option or the base must be field insulated. D and E cabinet (26 and 31-140 tons) units include base insulation standard.

CAUTION

Do not drill or punch holes in the base of the unit, from inside the unit or from below the unit to attach ductwork. Leaking may occur if unit base is punctured.

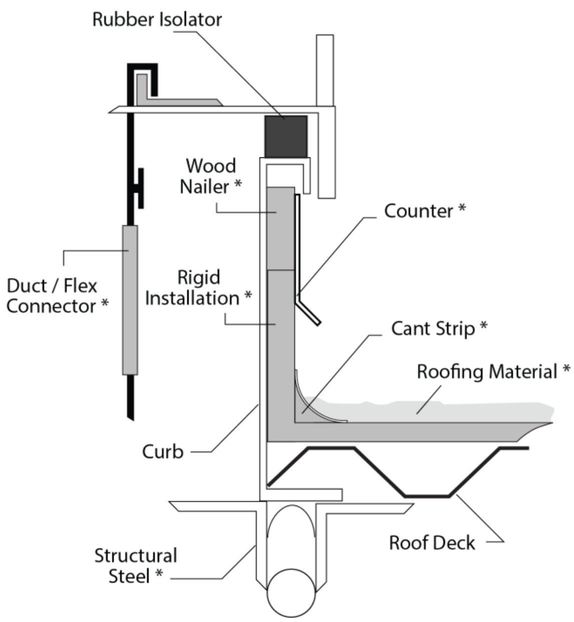


SECTIONAL VIEW OF UNIT ON ROOF CURB



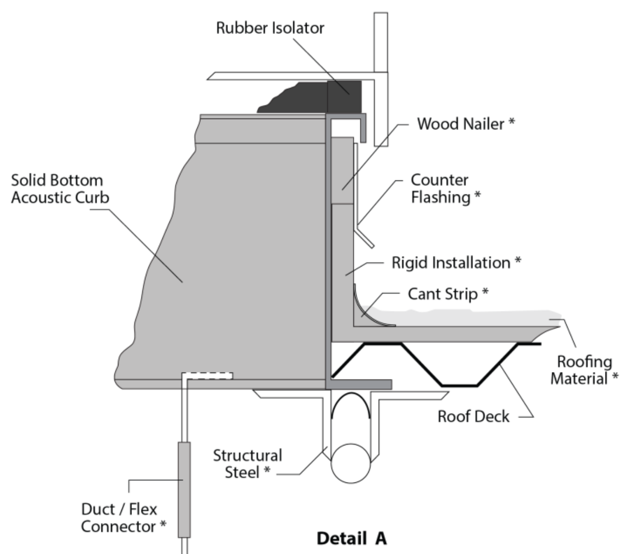
Detail A

Knock Down Curb
Duct Support Rail Connection
***** Field Supplied



Detail A

Unit Base Connection
***** Field Supplied



Detail A

Solid Bottom Acoustic
Curb Duct Connection
* Field Supplied

Figure 14 - Duct Connection

Seismic Curb Installation

Using a standard curb with a seismic unit will void the certification of the unit. All mounting details listed must be followed to achieve seismic certification. The AAON unit must be certified to ICC-ES AC156 when using a seismic curb for seismic certifications to apply. Any deviations or modifications to the unit or curb will void all seismic certification.

Structural engineer of record must approve field provided building anchorage to unit or curb in compliance with OSP-0180-10. Use provided self tapping screws to attach base of unit to seismic curb bracket.

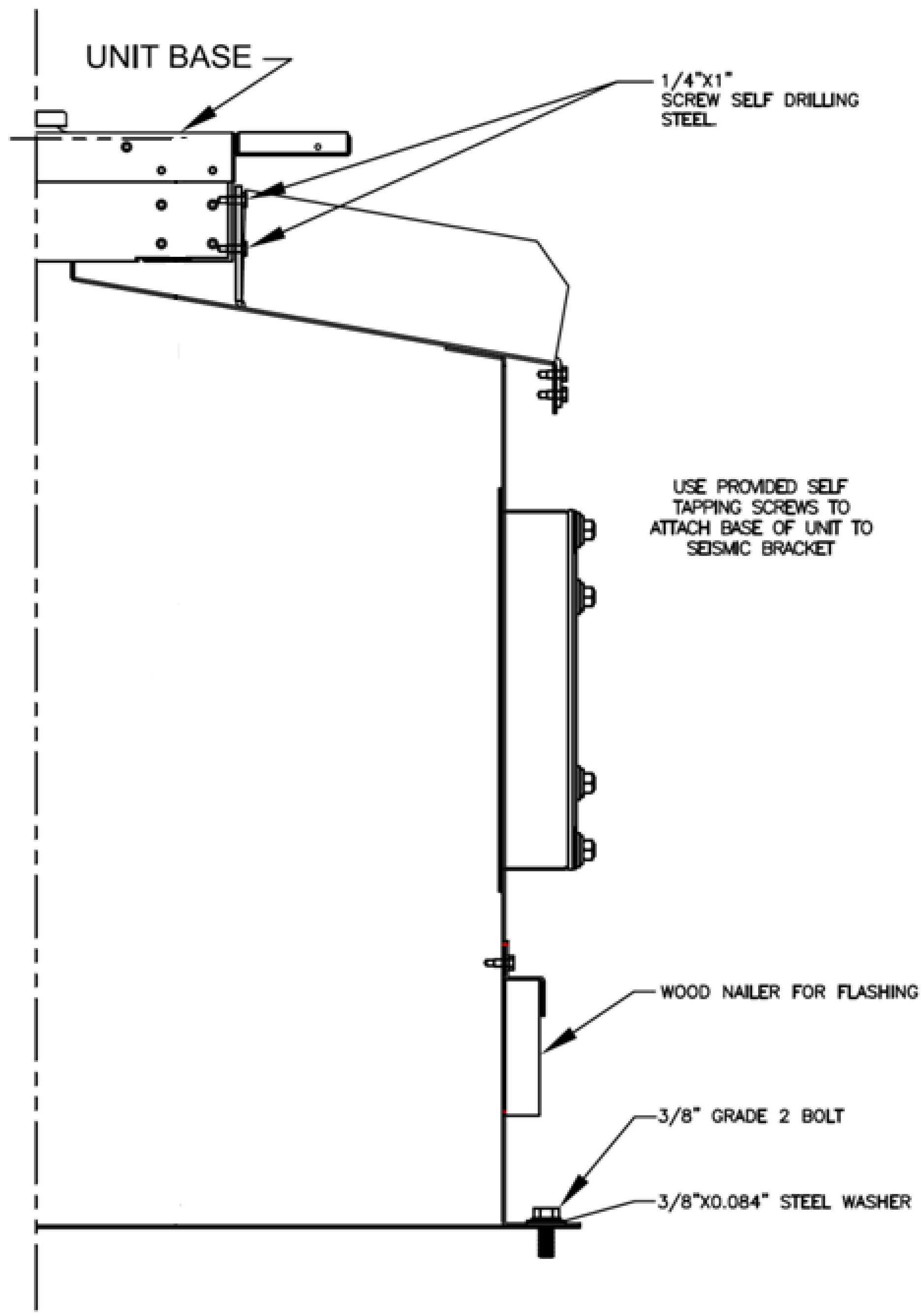


Figure 15 - Solid Bottom Seismic Curb with Filters

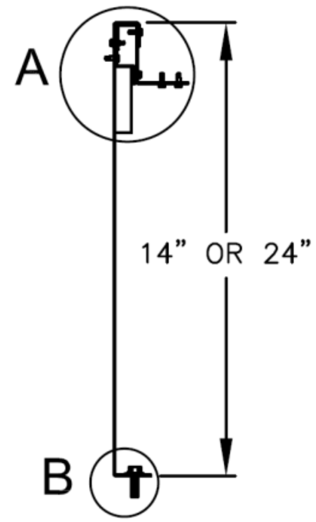


Figure 16 - Seismic Solid Bottom Curb without Filters Cross Section

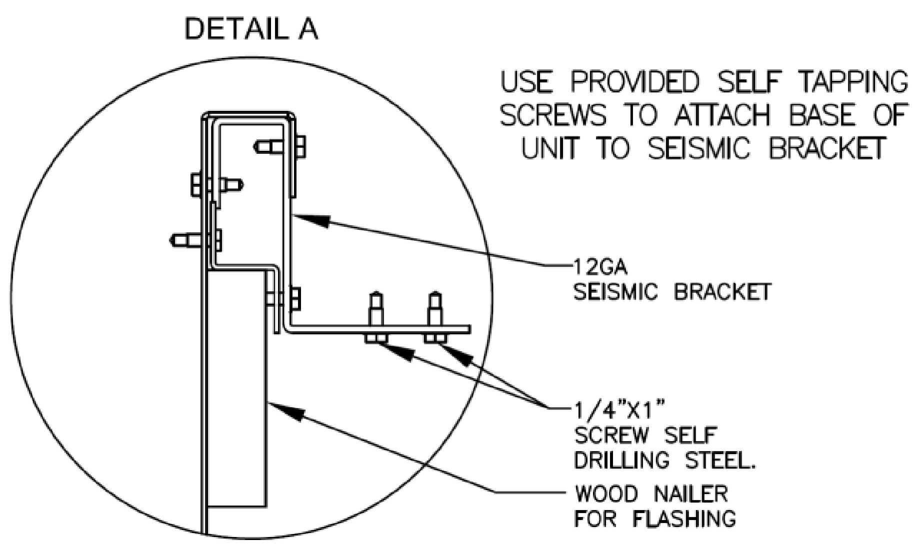


Figure 17 - Seismic Solid Bottom Curb without Filters Detail A

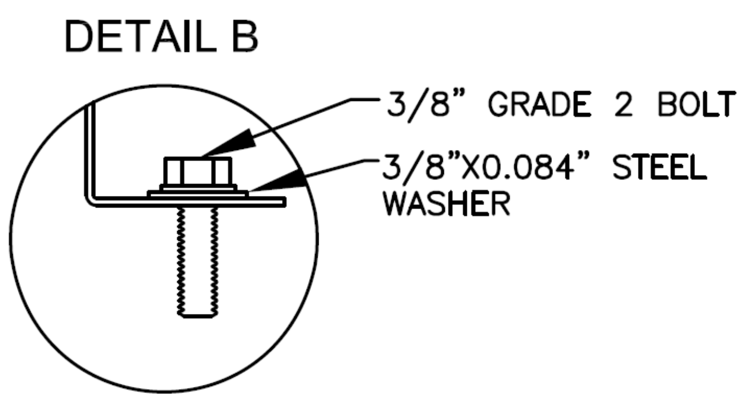


Figure 18 - Seismic Solid Bottom Curb without Filters Detail B

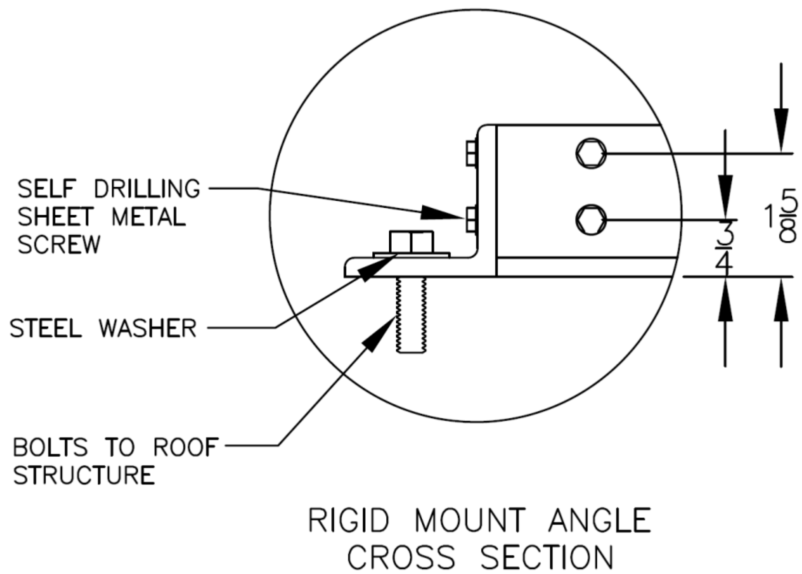


Figure 19 - Seismic Rigid Mount Curb

Condenser Hail Guards

90-140 ton Units

Condenser hail guards fold down and become a condenser coil shipping cover on 90-140 ton RN Series units with copper tube and aluminum fin condenser coils. Condenser hail guards must be opened before startup of the unit.

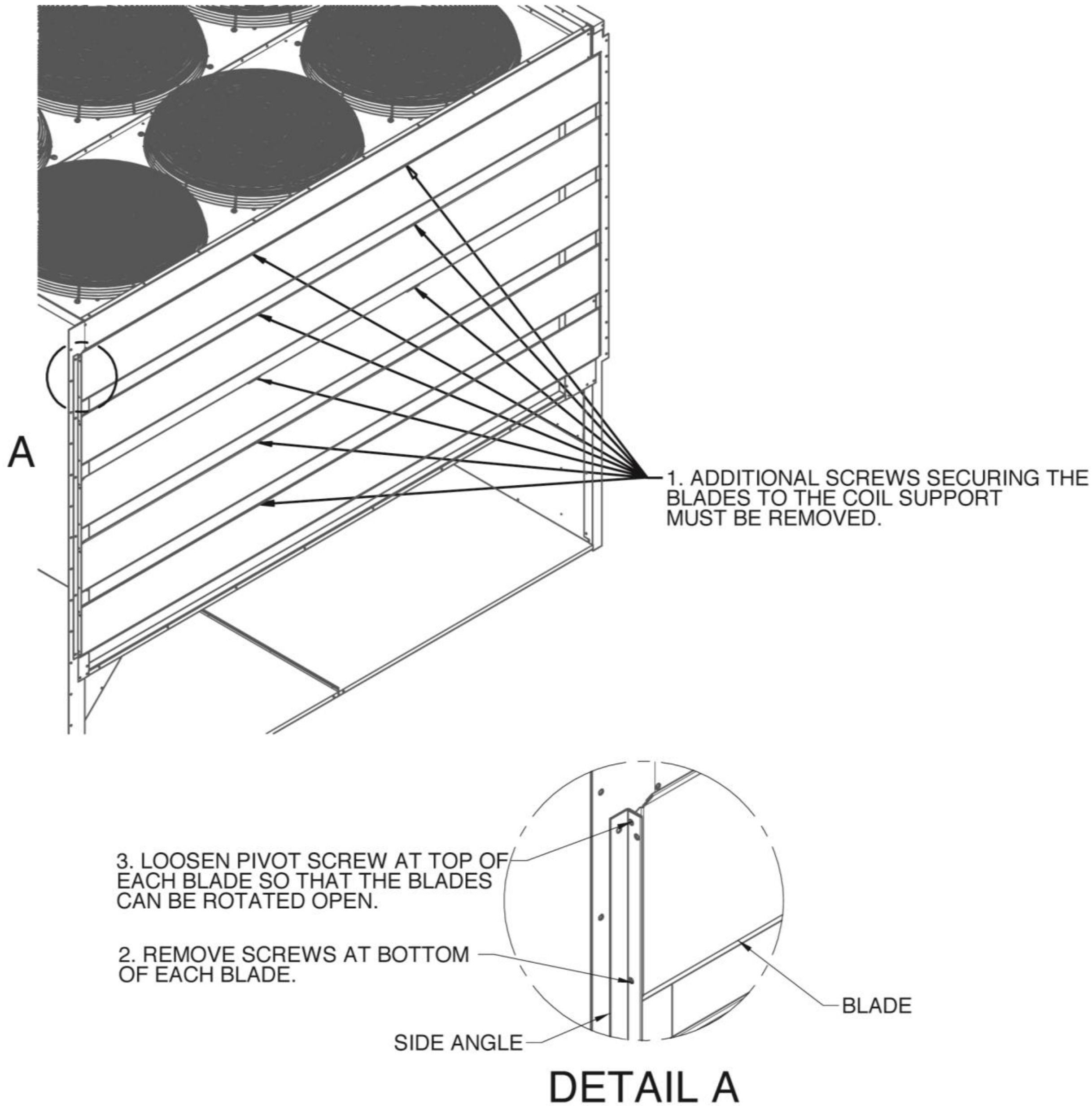


Figure 20 - 90-140 ton Condenser Coil Guard Installation Instructions 1

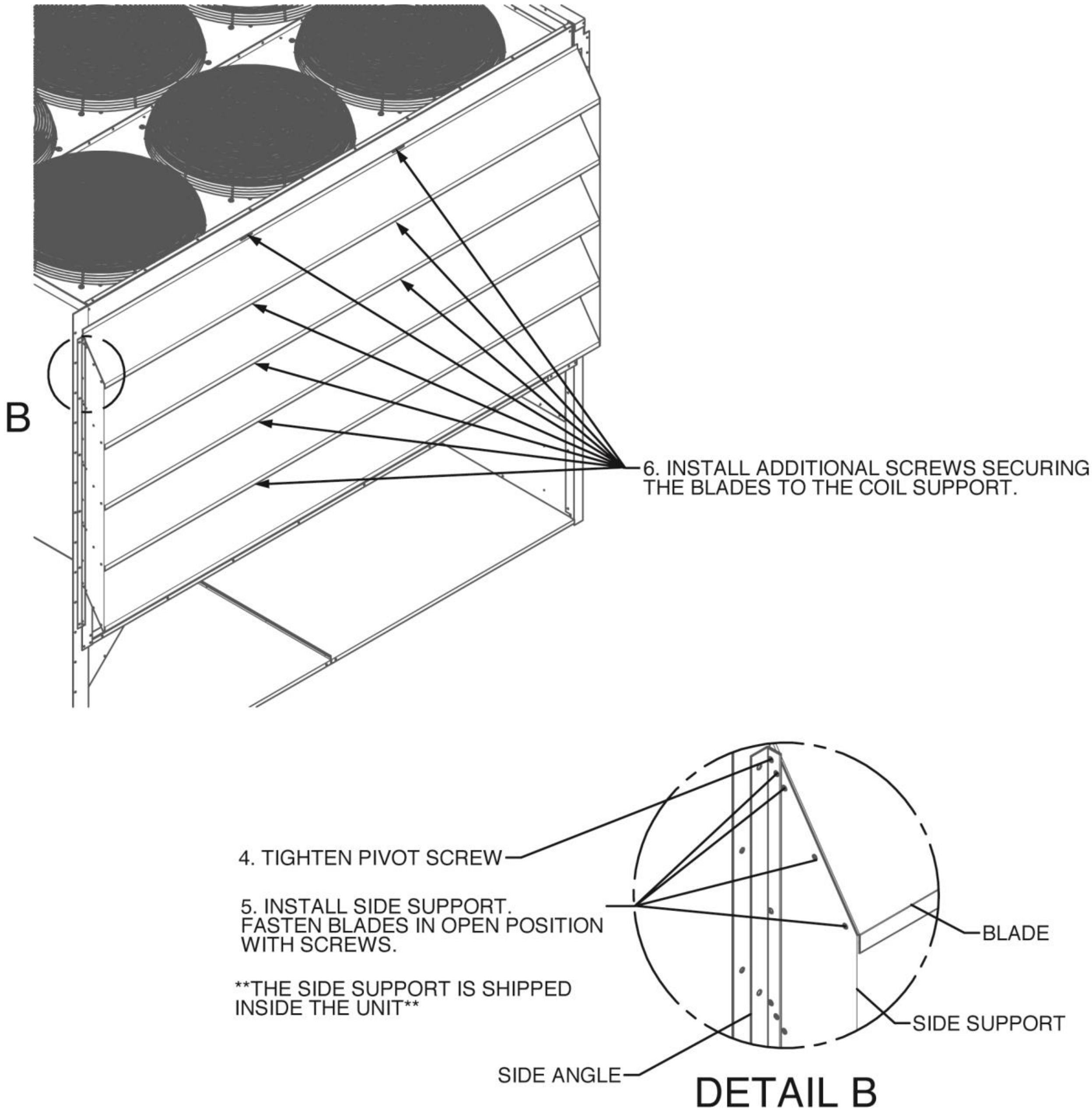


Figure 21 - 90-140 ton Condenser Coil Guard Installation Instructions 2

Outside Air Rain Hood

Rain hood must be opened before startup of the unit. Fresh air intake adjustments should be made according to building ventilation of local code requirements.

6-25 and 30 ton Units

Remove the two screws at the bottom of the rain hood that secure it in the shipping position. Remove the screws that attach the side pieces of the hood to the top of the hood.

Rotate the side pieces so that the holes along one edge line up with the holes on the top piece and the flange is on the inside of the rain hood.

Attach the side pieces to the top of the hood using the provided screws and attached the side pieces to the end of the unit through the flange.

Apply silicon caulking along the top and both sides of the rain hood. Take care to seal the top corners where the rain hood attaches to the unit.

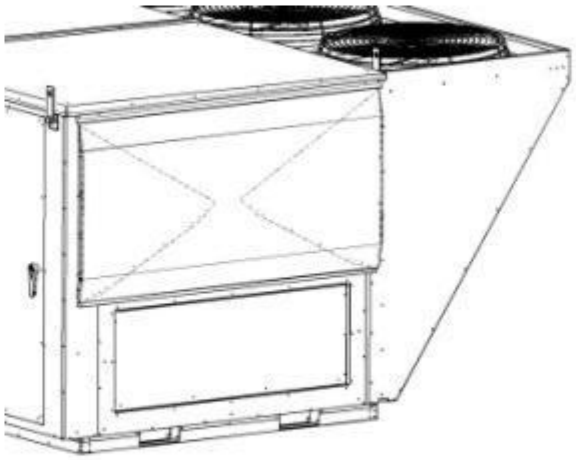


Figure 22 - 6-25 and 30 ton
Closed Rain Hood

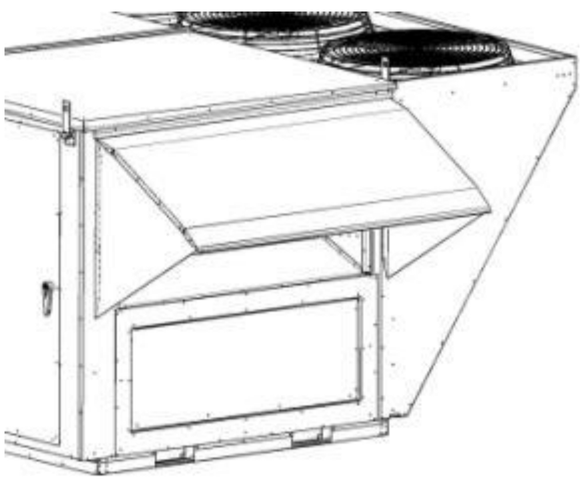


Figure 23 - 6-25 and 30 ton
Open Rain Hood

26 and 31-140 ton Units
Remove the shipping screws from each side of the closed hood.

Lift hood outward and attach the sides of the hood to the side of the unit.

Apply silicon caulking along the top and both sides of the rain hood. Take care to seal the top corners where the rain hood attaches to the unit.

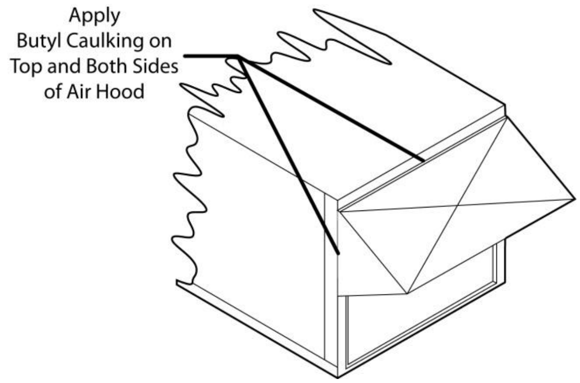


Figure 24 - 26 and 31-140 ton
Open Rain Hood

End Flashing Installation
On RN Series E cabinet units that are 142" wide (RN-55, 65, 75, 90, 105, 120, 130, 140) the cabinet width will overhang the shipping trailer on each side.

In order to secure and protect the unit during transit the sheet metal end flashings have been removed from the unit. The slot created at the base of each end of the unit allows the unit to set firmly on the trailer deck.

Sheet metal flashings are shipped loose with the unit and once the unit is set into place the flashings must be installed on each end of the unit to complete the finished seal at the base. The flashings are unit specific and designed to cover the slot at each end of the unit to prevent water run-off into the curb.

Failure to attach and seal the end of unit with the flashings may result in water leakage into the curb.

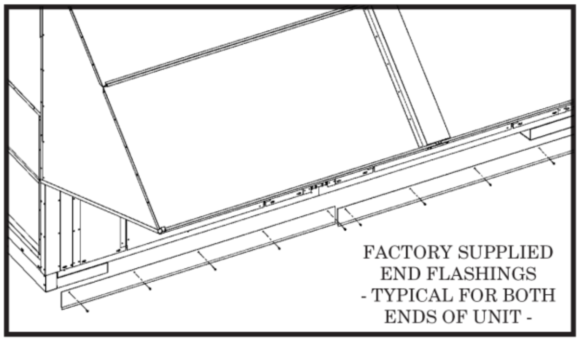


Figure 25 - Factory Supplied End Flashings

CAUTION

In order to prevent water leakage into the roof curb, the factory provided sheet metal flashings MUST BE attached to the unit base to cover the shipping slots at both ends of the unit.

Metal Mesh Filters (6-25 and 30 ton Units)

Metal mesh outside air filters require installation of the filter rack on the intake of the rain hood.

Clips which hold the metal mesh filters in the filter rack should face outward.

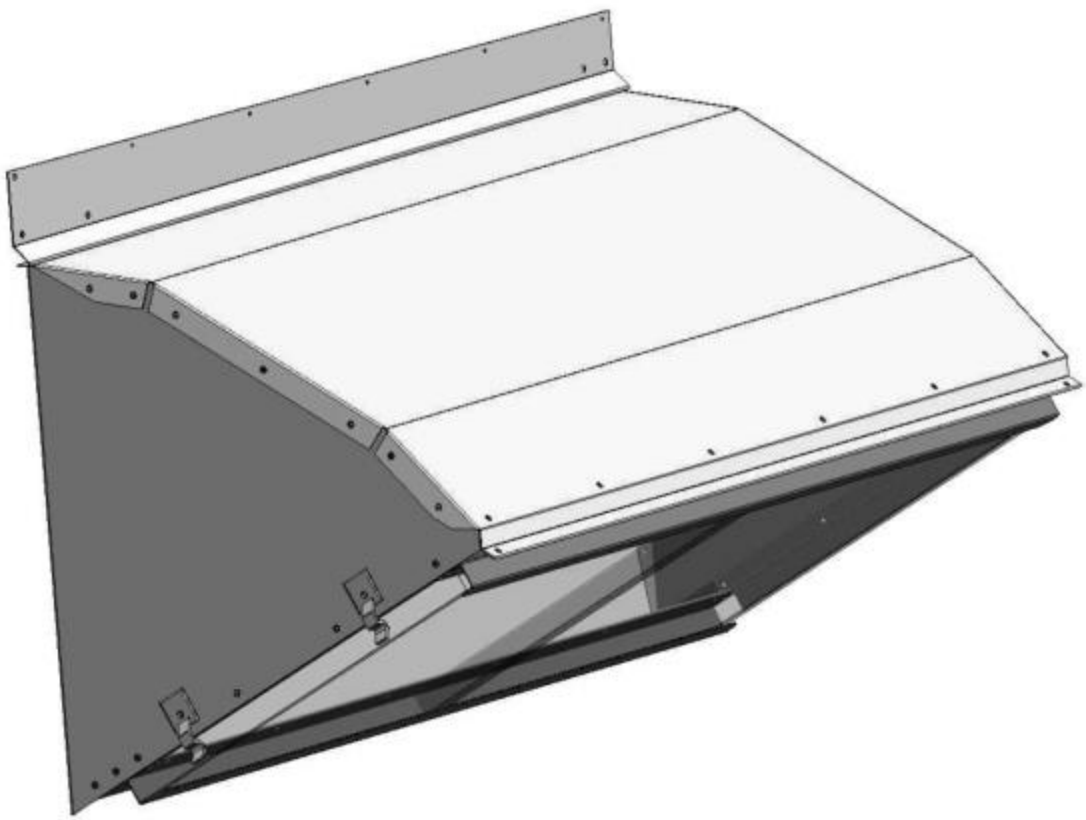


Figure 26 - Rain Hood with Metal Mesh Filter Rack Installation

Electrical

Verify the unit nameplate agrees with power supply. Connect power and control wiring to the unit as shown in Figure I12 and in the unit specific wiring diagram, which shows factory and field wiring and is attached to the inside of the door of the controls compartment.

⚠ WARNING

Electric shock hazard. Before attempting to perform any installation, service, or maintenance, shut off all electrical power to the unit at the disconnect switches. Unit may have multiple power supplies. Failure to disconnect power could result in dangerous operation, serious injury, death, or property damage.

Route power and control wiring, separately, through the utility entry in the base of the unit. Do not run power and control signal wires in the same conduit. The utility entry on 9-25 and 30 ton units is located in the unit base in the front right hand corner of the unit (compressor compartment). The utility entry on 26 and 31-70 ton units is located in the unit base in the front left hand corner in the unit (controls compartment). The utility entry on 55, 65 and 75-140 ton units is located in the center front of the unit. See unit drawing for specific location.

⚠ CAUTION

Installing Contractor is responsible for proper sealing of the electrical and gas entries into the unit Failure to seal the entries may result in damage to the unit and property.

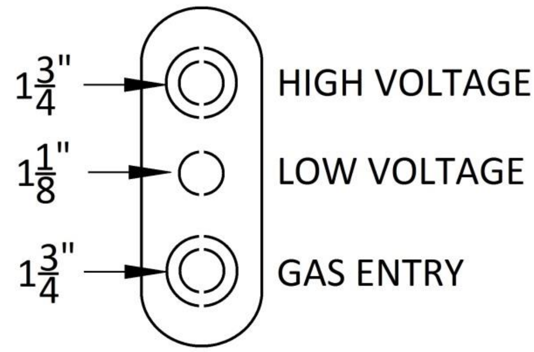


Figure 27 - Unit Utility Entry

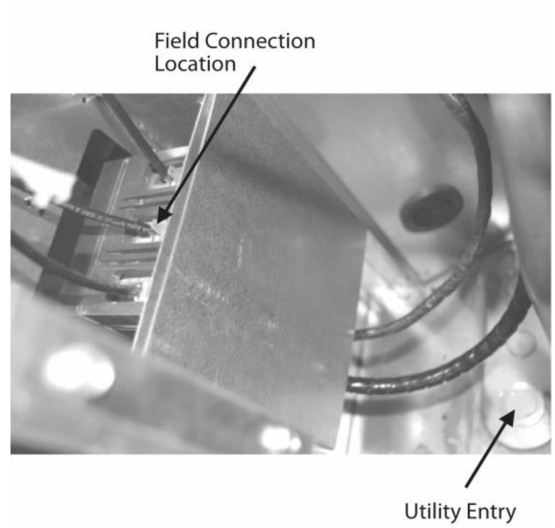


Figure 28 - Back View of Power Switch from Compressor and Control Compartment (6-50, 60, and 70 ton Units)

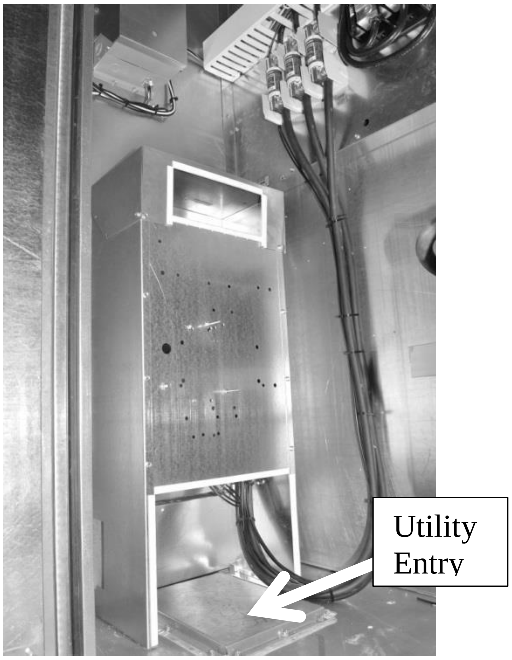


Figure 29 – Back View of Utility Entry and Power Switch from Control Compartment (55, 65 and 75-140 ton Units)

Size supply conductors based on the unit MCA rating. Supply conductors must be rated a minimum of 75°C.

Protect the branch circuit in accordance with code requirements. The unit must be electrically grounded in accordance with local codes, or in the absence of local codes, the current National Electric Code, ANSI/NFPA 70 or the current Canadian Electrical Code CSA C22.1.

Note: All units are factory wired for 208V, 230V, 380V, 460V, or 575V. The transformer configuration must be checked by a qualified technician prior to service, especially if unit is to be connected to a 208V or 230V supply. For 208V service interchange the yellow and red conductor on the low voltage control transformer.

Red-Black for 208V
Yellow-Black for 230V

Wire power leads to the unit's terminal block or main disconnect. All wiring beyond this point has been completed by the manufacturer and cannot be modified without effecting the unit's agency/safety certification.

Supply voltage must be within the min/max range shown on the unit nameplate. Available short circuit current should not exceed the short circuit current rating (SCCR) shown on the unit nameplate.

⚠ CAUTION

Three phase voltage imbalance will cause motor overheating and premature failure.

Three phase voltage imbalance will cause motor overheating and premature failure. The maximum allowable imbalance is 5%.

Voltage imbalance is defined as 100 times the maximum deviation from the average voltage divided by the average voltage.

Example:
(218V+237V+235V)/3 = 230V, then 100*(230V-218V)/230V = 5.2%, which exceeds the allowable imbalance.

Check voltage imbalance at the unit disconnect switch and at the compressor terminal. Contact your local power company for line voltage corrections.

Installing contractor must check for proper motor rotation and check blower motor amperage listed on the motor nameplate is not exceeded. Motor overload protection may be a function of the variable frequency drive and must not be bypassed.

CAUTION

Rotation must be checked on all MOTORS AND COMPRESSORS of three phase units. Supply fan, exhaust fan, return fan, and condenser fan motors should all be checked by a qualified service technician at startup and any wiring alteration should only be made at the unit power connection.

CAUTION

Scroll compressors are directional and will be damaged by operation in the wrong direction. Low pressure switches on compressors have been disconnected after factory testing. Rotation should be checked by a qualified service technician at startup using suction and discharge pressure gauges and any wiring alteration should only be made at the unit power connection.

Wire control signals to the unit's low voltage terminal block located in the controls compartment.

If any factory installed wiring must be replaced, use a minimum 105°C type AWM insulated conductors.

Variable Speed Compressors
Variable speed compressors with VFD speed control are available on 55, 65 and 75-140 ton units. Variable speed compressors should not be operated outside the factory determined frequency range. The factory determined compressor VFD frequency range is given below in Table 7.

Table 7 – Single Circuited Variable Speed Compressor VFD Frequency Range

Model (RN-)	*Compressor VFD Range (Hz)*
208V and 230V Units	
055, 065 & 075-140	35-60 Hz
380V, 460V, and 575V Units	
055, 065, 075, 090, 120, 130	35-75 Hz
105, 140	35-60 Hz

Table 8- Tandem Circuited Variable Speed Compressor VFD Frequency Range

Model (RN-)	*Compressor VFD Range (Hz)*
208V, 230V, 380V, 460V and 575V Units	
055, 065, 075, 090, 105	40-70Hz
120 & 140	35-60 Hz
130	35-65 Hz

CAUTION

No variable speed compressor shall operate below 35 Hz. Operating variable speed compressors outside the frequency range specified in this manual voids all warranties and may result in compressor failure.

Thermostat Control Wiring
If a thermostat is used for unit control, thermostat should be located on an inside wall 4-5 feet above the floor where it will not be subjected to drafts, sun exposure, or heat from electrical fixtures of appliances. Control wiring must deliver adequate voltage to components to assure proper operation. Control voltage returning from controller circuit must be a minimum of 21 VAC. To assure proper wiring use the following chart to determine the allowable wiring distances.

Table 9 - Control Wiring

Wire Size (Stranded) - Copper Conductors Only	Total Wire Distance Allowable
20 AWG	200 ft
18 AWG	350 ft
16 AWG	500 ft
14 AWG	750 ft
12 AWG	1250 ft

Total Wire Distance Allowable =
(Quantity of Control Wires) x
(Control Wire Distance)

Take the total wire distance allowable and divide by the quantity of wires to be connected. This indicates the distance allowable for that size wire. The wiring to the unit must not exceed the total wire distance allowable. If the voltage at the connectors is less than 21 VAC, isolation relays must be installed. If under external control 21 VAC must be field verified.

All external devices must be powered via a separate external power supply.

Example:
A total of 8 wires must be pulled 75ft to a control the unit. What size wire should be used?

According to the Table 9, 16 AWG allows for 63ft (500 ft/8 wires) and 14 AWG allows for 94ft (750 ft/8 wires). Thus, 14 AWG should be used.

Gas Heating

⚠ WARNING

FOR YOUR SAFETY

Read the entire gas heating installation section of this manual before beginning installation of the gas heating section.

If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.

Verify the unit nameplate agrees with the proper gas supply type and amount.

Gas piping must be installed in accordance with local codes, or in the absence of local codes, installation must conform to the current (United States) National Fuel Gas Code ANSI-Z223.1/NFPA 54 or the current (Canada) National Fuel & Propane Installation Code CSA B149.1 or B149.2.

Table 10 - 6-8 and 10 ton Gas Connections

Model Option B2	Input MBH	Connections	
		Quantity	Size
2	90.0	1	1/2” NPT
K	150.0		
L	210.0		3/4” NPT

Table 11 – 9, 11, 13, & 15 ton Gas Connections

Model Option B2	Input MBH	Connections	
		Quantity	Size
F	195.0	1	3/4” NPT
G	292.5		
6	390.0		

Table 12 – 14, 16-25 and 30 ton
Gas Connections

Model Option B2	Input MBH	Connections	
		Quantity	Size
4	270	1	3/4” NPT
8	405		1” NPT
C	540		

Table 13 - 26 and 31-70 ton
Gas Connections

Model Option B2	Input MBH	Connections	
		Quantity	Size
*A	540	2	3/4” NPT
*B	780		
C	540	1	1-1/2” NPT
D	810		
E	1080		

*Obsolete

Table 14 - 55, 65 and 75-140 ton Gas
Connections

Model Option B2	Input MBH	Connections	
		Quantity	Size
M	800	2	1” NPT
N	1600	2	1-1/2” NPT
P	2400		

After verifying gas inlet pressure and manifold pressure the service technician must time the gas flow rate through the gas meter with a stopwatch to verify the gas input rate.

Unit nameplate input rate value has been calculated at the altitude where the unit was shipped. Above 2,000 ft the input rate is adjusted 4% for every 1,000 ft.

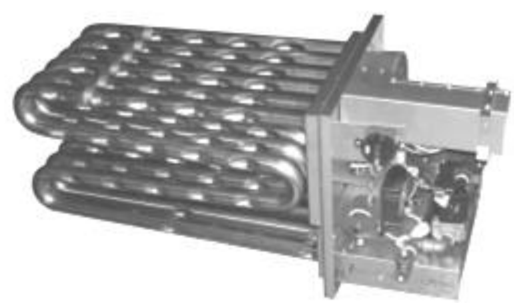


Figure 30 - RN Series Gas Heat Exchanger

Table 15 - Natural Gas (ft^3/hr) Maximum Piping Capacities
Specific Gravity = 0.6, Supply Pressure ≤ 0.5 psi, Pressure Drop = 0.5” w.c.

Pipe Size	Length of Pipe				
	20 ft	50 ft.	100 ft.	150 ft.	200 ft.
1/2”	120	73	50	40	35
3/4”	250	151	103	84	72
1”	465	285	195	160	135
1-1/4”	950	580	400	325	280
1-1/2”	1460	900	620	500	430
2”	2750	1680	1150	950	800
2-1/2”	4350	2650	1850	1500	1280

Table 16 - Propane (kBtu/hr) Maximum Piping Capacities
Specific Gravity = 1.52, Supply Pressure = 11” w.c., Pressure Drop, 0.5” w.c.

Pipe Size	Length of Pipe				
	20 ft	50 ft.	100 ft.	150 ft.	200 ft.
1/2”	189	114	78	63	55
3/4”	393	237	162	132	112
1”	732	448	307	252	213
1-1/4”	1496	913	630	511	440
1-1/2”	2299	1417	976	787	675
2”	4331	2646	1811	1496	1260

Do not use gas piping smaller than unit gas connections. Natural gas pipe runs longer than 20 feet and propane gas pipe runs longer than 50 feet may require a larger supply pipe than the unit connection size. Some utility companies may also require pipe sizes larger than the minimum sizes listed.

Piping Sizing Examples
A 100 ft pipe run is needed for a 1080 MBH natural gas heater. The natural gas has a rating of 1000 Btu/ft^3 and a specific gravity of 0.6 (Obtain these values from the local gas supplier.)

$$1080MBH \times \frac{ft^3}{1000BTU} = 1080 \text{ ft}^3\text{/hr}$$

From the natural gas maximum capacities table, at 100 ft and 1080 ft^3/hr the required minimum pipe size is 2”.

A 100 ft pipe run is needed for a 270 MBH propane gas heater.
270 *MBH* = 270 kBtu/hr

From the propane gas maximum capacities table, at 100 ft and 270 kBtu/hr the required minimum pipe size is 1”.

Inlet and Manifold Pressures
For natural gas units, the minimum inlet gas pressure to the unit is 6” w.c. and maximum inlet gas pressure to the unit is 10.5” w.c. For propane units, the minimum inlet gas pressure to the unit is 11” w.c. and the maximum inlet gas pressure to the unit is 13” w.c. A field provided 1/8” NPT pressure tap is required to be installed in the piping just upstream of the shutoff valve for test gage connection to allow checking of the gas supply pressure at the unit.

A factory installed pressure tap on the outlet end of the gas valve can be used to verify a manifold pressure of 3.5” w.c. for natural gas, or 10.5” w.c. for propane.

⚠ CAUTION

Heater should be disconnected from the gas supply piping during pressure testing of the supply piping system with pressures in excess of ½ psi. Gas valves can be damaged if subjected to more than ½ psi.

Gas Pressure Regulator & Overpressure Protection Device
A gas pressure regulator must be installed if natural gas supply pressure to the unit is greater than 10.5” w.c. and less than 2 psi (55.4” w.c.) and if propane gas supply pressure is greater than 13” w.c. and less than 2 psi (55.4” w.c.). Regulators must comply with the latest edition of the Standard for Line Pressure Regulators, ANSI Z21.80/CSA 6.22.

Both a gas pressure regulator and overpressure protection device (OPD) must be installed if gas supply pressure to the unit is greater than 2 psi (55.4” w.c.) and less than 5 psi (138.4” w.c.), in compliance with ANSI Z21.80/CSA 6.22. For proper heater operation, pressure to the regulator MUST NOT be greater than 5 psi (138.4” w.c.).

Piping Supports
Gas supply piping must be supported directly at the connection to the unit and at intervals listed in the following table with metal straps, blocks, or hooks. Piping should not be strained or bent.

Table 17 - Gas Piping Supports

Pipe Size	Support Intervals
1/2” to 3/4”	Every 6 ft
3/4” to 1”	Every 8 ft
1-3/4” or Larger (Horizontal)	Every 10 ft
1-1/4” or Larger (Vertical)	Every Floor

Additional Gas Piping Considerations
Local codes will usually require a field provided and installed manual main shutoff valve and union external to the unit. Main shutoff valve should be labeled. A drip leg should be installed near the unit connection to trap sediment and condensate. Pipe joint compounds used on all gas piping connections should be resistant to liquid petroleum gases. If flexible gas piping to the unit, or in the unit, must be replaced connectors cannot be reused, only new connectors may be used.

Heat exchanger comes equipped with a condensate drain which should be plumbed to the appropriate drain according to the (United States) National Fuel Gas Code ANSI-Z223.1/NFPA 54 or the current (Canada) National Fuel & Propane Installation Code CSA B149.1 or B149.2, the International Building Code, and any applicable local and regional codes and regulations.

The condensate drain connection is located next to the gas entry location. For 6-50, 60 and 70 ton units, the heat exchanger condensate drain connection from the unit is a 5/8” barbed nylon elbow connection. For 55, 65 and 75-140 ton units, the heat exchanger condensate drain connection from the unit is a 1/2” PVC connection. For 55, 65 and 75-140 ton units, the heat exchanger condensate drain can be tied into the evaporator condensate drain, if code allows.

AAON gas fired heat exchangers are designed to be non-condensing. These heat exchangers are mounted downstream of the cooling coils. During the cooling season the ambient air inside the heat exchanger tubes can condense due to cold air being blown over the outside of the tubes. The amount of condensation will vary depending on the ambient air temperature and humidity as well as air temperature over the tubes. This condensation can be drained onto the roof or into any waste drain.

Typically during the heating season the heat exchanger will not make any condensation. However, short-cycling of the heater can prevent the flue gases from reaching temperatures above dew point (about 130^{0}F) which can cause condensation in the heat exchanger.

Staged or modulated heat exchangers may produce condensate depending on the firing rate, ambient air temperature and humidity as well as the percentage and temperature of outside air being introduced to the unit. This condensate is generally between a 2.9 and 4 pH level.

Condensation made in the heat exchanger during the heating mode may need to be managed and not just drained onto the roof depending on national and local code requirements and the application of the final user. This condensate can stain the roof and it can cause rust in some cases on metal roofs. It is the responsibility of the end user or contractor to determine if the condensate will damage the roofing material.

Below freezing ambient air temperatures during the heating mode can freeze any condensation made in the drain lines. Smaller amounts of condensation may not cause any issues but for larger amounts of condensate and low ambient air temperatures (below freezing for multiple consecutive days) the internal and external drain lines for the unit will need to be heat traced to prevent freezing. Heat traced internal drain lines are required and a factory provided standard feature on the condensate drain with the high turndown modulating gas option.

A condensate neutralizer vessel and connecting tubing can be added to the equipment if required. For below freezing ambient temperature applications the neutralizer, connecting tubing and drain lines will require heat tracing to prevent condensate freezing. These components are the responsibility of the installer.

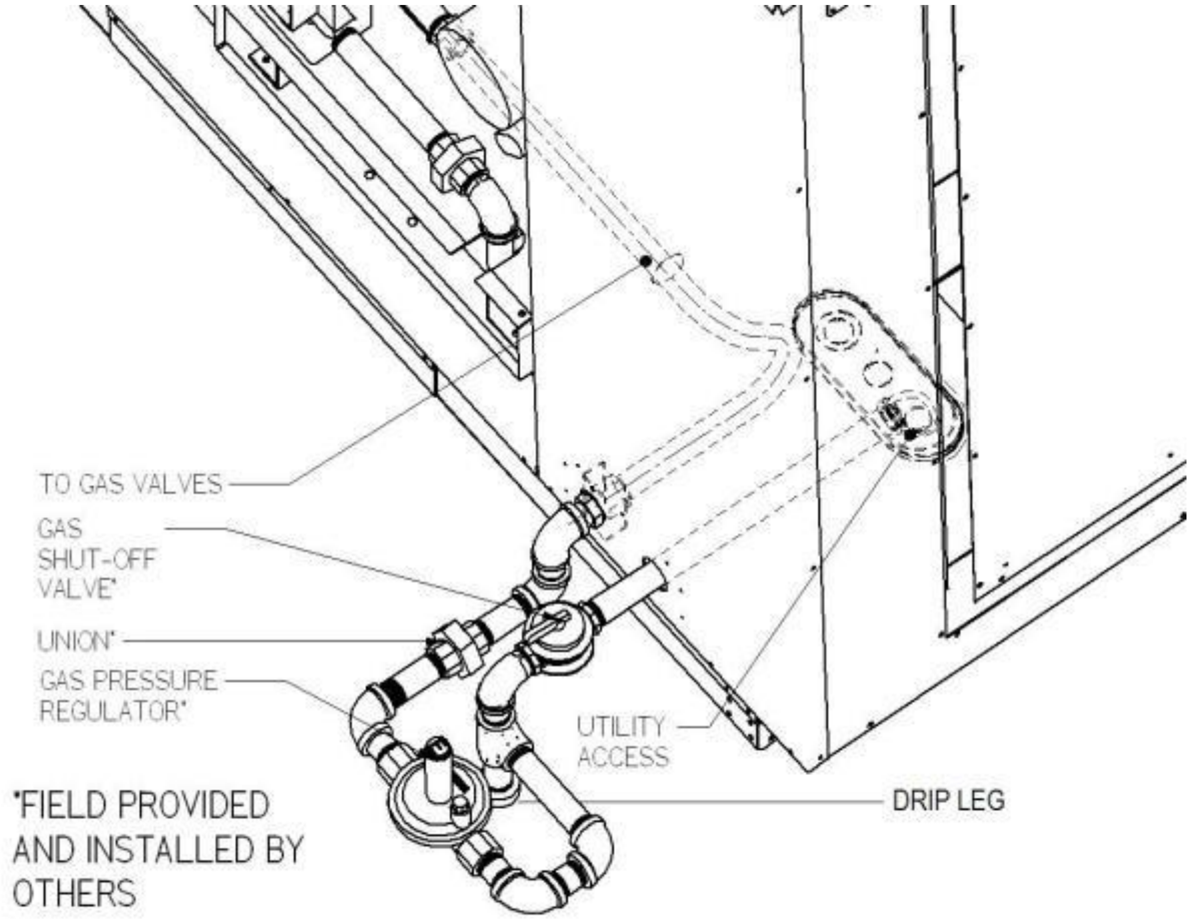


Figure 31 - Example 6-50, 60 & 70 ton through the Base Gas Piping

Leak Testing

All components of gas supply system, including manual shut off valves and the piping in the interior of the unit, should be leak tested with a soap solution before operating the appliance and at least on an annual basis thereafter.

DANGER

LEAK CHECK GAS PIPE

The gas pipe in the unit should be checked for leaks before startup. Leak checking is the responsibility of the installing contractor. All connections should be checked for leaks annually after installation. Failure to leak check could result in fire, explosion, or other hazardous situations.

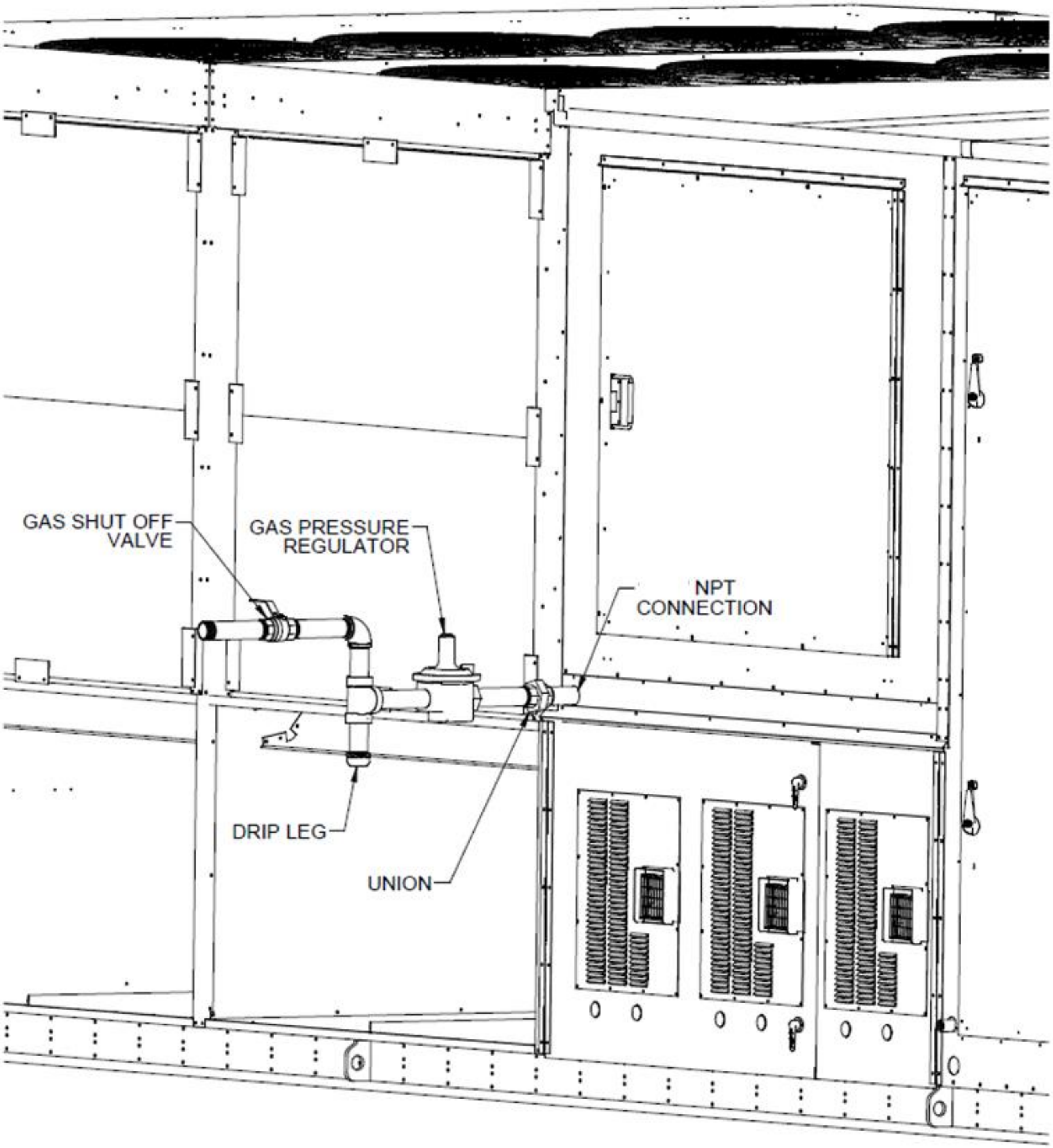


Figure 32 - Example 55, 65 and 75-140 ton for across the Roof Gas Piping
Note: There will be two gas connections, one on each side of the unit

DANGER

Do not use open flame or other source of ignition for leak testing. Fire or explosion could result causing property damage, personal injury, or death.

CAUTION

Some soaps used for leak detection can be corrosive to certain metals. Rinse piping thoroughly after leak test has been completed.

All gas fired heat exchangers are completely tested at the factory before shipment. This will remove nearly all of the oils that have been used in the manufacturing process. However, trace amounts may remain. When performing the initial startup at the jobsite, it is highly recommended that people or any other living animals, which may be sensitive to the residual odors or gases, NOT be present in the conditioned space during the startup. In all cases, including the initial factory firing and testing, any of the gases will be under the acceptable level of concentration for human occupancy.

WARNING

Those sensitive to odors or gases from trace amounts of residual oils should NOT be present in the conditioned space during the startup of a gas fired installation.

Refrigerant-to-Water Heat Exchanger

Condenser water pump, condenser water piping, cooling tower or geothermal loop, pressure gauges, strainers, piping insulation and all components of the waterside piping must be field installed.

Water-Source Heat Pump Applications

Water-source heat pump units using 100% outside air must have electric preheat if the application has a potential for operation with air entering the indoor coil below 43°F with a water loop temperature of 70°F.

CAUTION

WATER-SOURCE HEAT PUMP APPLICATIONS

Water-source heat pump units using 100% outside air must have electric preheat if the application has a potential for heat pump heating operation with air entering the indoor coil below 43°F with an entering water loop temperature of 70°F.

Open Loop Applications

This product contains one or more refrigerant-to-water heat exchangers made of 316 Stainless Steel. 316 Stainless Steel is subject to severe corrosion and failure when exposed to chlorides.

WARNING

OPEN LOOP APPLICATIONS

Failure of the condenser as a result of chemical corrosion is excluded from coverage under AAON Inc. warranties and the heat exchanger manufacturer’s warranties.

Do not allow water containing any form of chlorides to enter this heat exchanger.

Common forms of chlorides include:

1. Sea water mist entering an open cooling tower system.
2. Contaminated makeup water containing salt water.
3. Disinfecting the water loop with solutions containing sodium hypochlorite.

Chlorides will result in a premature failure of the condenser.

Failure of the condenser as a result of chemical corrosion is excluded from coverage under AAON warranties and the heat exchanger manufacturer warranties.

Failure of the condenser will allow water to enter the refrigerant circuit and will cause extensive damage to the refrigerant circuit components. Any damage to the equipment as a result of condenser failure from chemical corrosion due to the fluid in the condenser is excluded from coverage under AAON warranties and the heat exchanger manufacturer warranties.

WARNING

OPEN LOOP APPLICATIONS

SMO 254 brazed plated refrigerant-to-water heat exchangers are recommended with all open loop applications. Failure to use a SMO 254 heat exchanger may result in premature failure of your system and possible voiding of the warranty.

CAUTION

Cleaning the cooling tower or condenser water loop with harsh chemicals such as hydrochloric acid (muriatic acid), chlorine or other chlorides, can damage the refrigerant-to-water heat exchanger. Care should be taken to avoid allowing chemicals to enter the refrigerant-to-water heat exchanger. See Appendix A - Heat Exchanger Corrosion Resistance for more information.

Freezing Water in the Heat Exchanger

This product contains one or more refrigerant-to-water heat exchangers. A refrigerant-to-water heat exchanger contains refrigerant in one passage and water in another passage. Water is subject to freezing at 32°F. When water freezes in a heat exchanger significant forces are exerted on the components of the heat exchanger where the water is confined.

WARNING

WATER FREEZING

Failure of the condenser due to freezing will allow water to enter the refrigerant circuit and will cause extensive damage to the refrigerant circuit components. Any damage to the equipment as a result of water freezing in the condenser is excluded from coverage under AAON warranties and the heat exchanger manufacturer warranties.

Failure of the condenser due to freezing will allow water to enter the refrigerant circuit and will cause extensive damage to the refrigerant circuit components. Any damage to the equipment as a result of water freezing in the condenser is excluded from coverage under AAON warranties and the heat exchanger manufacturer warranties.

Unit is capable of operating with Entering Water Temperatures (EWT) as low as 57°F, during the cooling mode, without the need for head pressure control. If the EWT is expected to be lower than 57°F or a more stable operation is desired, a factory provided head pressure control water valve option is available.

Glycol solution should be used if ambient temperatures are expected to fall below freezing or if the loop entering water temperature to the unit is below 50°F while operating in the heating mode (heat pump units only). Adding glycol to condenser water causes an increase in pressure drop and also results in a decrease in unit performance. A minimum concentration of 20% glycol solution is recommended.

Table 18 - Glycol Freezing Points

% Glycol	Ethylene Glycol	Propylene Glycol
20	18°F	19°F
30	7°F	9°F
40	-7°F	-6°F
50	-28°F	-27°F

Water loop piping runs through unheated areas or outside the building should be insulated.

Water Piping

Water flow switch is installed between the condenser water supply and return connections. This sensor provides a signal to the unit controller that water flow is present in the refrigerant-to-water heat exchanger and the unit can operate without damaging unit components.

WARNING

WATER PRESSURE

Prior to connection of condensing water supply, verify water pressure is less than maximum pressure shown on unit nameplate. To prevent injury or death due to instantaneous release of high pressure water, relief valves should be field supplied on water piping. Supply water connection may require a backflow preventer to prevent supply makeup water from backing up into the public water system.

Table 19 - Standard Brazed Plate Heat Exchanger Water Connections

Model (RN-)	Supply and Return Connection Size
006, 007	1” NPT
008, 010, 009, 011, 013, 015, 016, 018, 020	1 1/2” NPT
025, 030	2” NPT
026, 031, 040	2 1/2” Grooved Pipe
050, 055, 060, 070	3” Grooved Pipe
065, 075, 090, 105	4” Grooved Pipe
120, 130, 140	5” Grooved Pipe

Table 20 - SMO 254 Brazed Plate Heat Exchanger Water Connections

Model (RN-)	Supply and Return Connection Size
016, 018, 020, 025, 030	1 1/2” NPT

Only use approved water pipe material. Avoid using galvanized material for water lines/fittings as the material is corrosive and may cause fouling of the water system.

Condenser water pump must be field sized and installed between the cooling tower/geothermal loop and self-contained unit. System should be sized in accordance with the ASHRAE Handbook. Use engineering guidelines to maintain equal distances for supply and return piping and limit bend radiuses to maintain balance in the system. Balancing valves, permanent thermometers and gauges may be required.

Before connection to the unit the condenser water system should be flushed to remove foreign material that could cause condenser fouling. A screen strainer with a minimum of 20 Mesh is provided ahead of the condenser inlet to prevent condenser fouling and internal tube damage.

Mineral content of the condenser water must be controlled. All makeup water has minerals in it and as the water is evaporated in the cooling tower, these minerals remain. As the mineral content of the water increases, the conductivity of the water increases.

⚠ CAUTION

WATER PIPING

Follow national and local codes when installing water piping. Connections to the unit should incorporate vibration eliminators to reduce noise and vibration and shutoff valves to facilitate servicing. Supply and return water piping must be at least as large as the unit connections and larger depending on length of runs, rise and bends.

Field provided and installed water treatment program must be compatible with stainless steel, copper, aluminum, ABS plastic, and PVC. Batch feed processes should never be used as concentrated chemicals can cause corrosion. Never use hydrochloric acid (muriatic acid) or chlorine as it will corrode stainless steel.

⚠ CAUTION

PVC (Polyvinyl Chloride) and CPVC (Chlorinated Polyvinyl Chloride) are vulnerable to attack by certain chemicals. Polyolester (POE) oils used with R-410A and other refrigerants, even in trace amounts, in a PVC or CPVC piping system will result in stress cracking of the piping and fittings and complete piping system failure.

⚠ CAUTION

Each heat exchanger may be equipped with a refrigerant pressure relief device to relieve pressure should excessive condensing pressures (>675 psig) occur. Codes may require installing contractor to connect and route relief piping outdoors. The relief valve has a 5/8” male flare outlet connection.

NOTE: Ball valves should be installed in the condenser water supply and return lines for unit isolation and water flow balancing. All manual flow valves should be of the ball valve design. Globe or gate valves should not be used due to high pressure drops and poor throttling characteristics.

Pressure and temperature ports are recommended in condenser water supply and return lines for system balancing. These openings should be 5 to 10 pipe diameters from the unit water connections. To allow for mixing and temperature stabilization, wells in the water piping should extend at least ½ pipe diameter into the pipe.

CAUTION

Installing contractor is responsible for properly sizing and installing water system components. Improper fluid flow due to valves, piping, or improper pump operation may result in unacceptable unit operation and void warranty.

Piping systems should not exceed 10 ft/sec fluid velocity to ensure tube wall integrity and reduce noise.

Condensate Drain Piping

6-25 and 30 ton units are equipped with one condensate drain pan connection, on the right side of the unit, and are furnished with a p-trap for field installation. 26 and 31-140 ton units are equipped with two condensate drain connections, one on the left side of the unit and one on the right side of the unit, and p-traps must be field provided.

All drain connections must be used and individually trapped to ensure a minimum amount of condensate accumulation in the drain pans. ABS type cement should be used to join the drain pipe connections.

Note: The drain pan connections are 1" MPT fitting for 6-50, 60, and 70 tons (A-D Cabinet sizes).The drain pan connections are 1.5" MPT fitting for 55,65, 75-140 tons (E Cabinet size).

Drainage of condensate directly onto the roof may be acceptable in certain areas, refer to local codes. If condensate is to drain directly onto the roof a small drip pad should be placed below the drain to protect the roof from possible damage.

If condensate is piped into the building drainage system, the drain pipe should penetrate the roof external to the unit itself. The drain line should be pitched away from the unit at least 1/8 inch per foot. On longer runs an air break should be used to ensure proper drainage.

CAUTION

Unit should not be operated without a p-trap. Failure to install a p-trap may result in overflow of condensate water into the unit.

Draw-through cooling coils will have a negative static pressure in the drain pan area. This will cause an un-trapped drain to back up due to air being pulled up through the condensate drain piping.

Condensate drain trapping and piping should conform to all applicable governing codes.

Draw-Through Coils

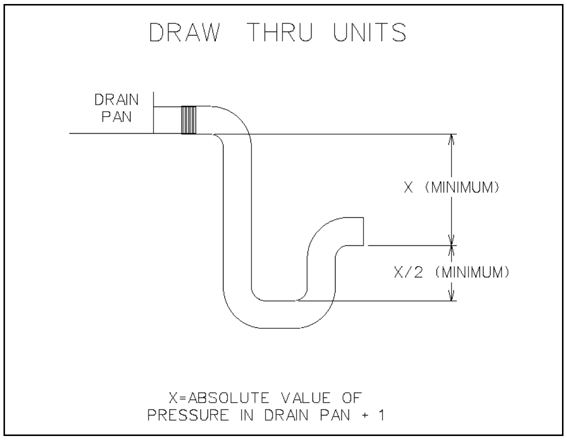


Figure 33 - Draw-Through Drain Trap

The X dimension on the draw-through trap should be at least equal to the absolute value of the negative static pressure in the drain pan plus one inch. To calculate the static pressure at the drain pan add the pressure drops of all components upstream of the drain pan, including the cooling coil, and add the return duct static pressure. Include the dirt allowance pressure drop for the filters to account for the worst-case scenario.

The height from top of the bottom bend of the trap to the bottom of the leaving pipe must be at least equal to one half of the X dimension. This ensures that enough water is stored in the trap to prevent losing the drain seal during unit startup

Note: The absolute value of the fan inlet pressure will always be greater than or equal to the absolute value of the static pressure in the drain pan on draw-through units, so the fan inlet pressure is a safe value to use for the drain pan static pressure.

Table 21 - Draw-Through Drain Trap Dimensions

Draw-Through		
Drain Pan Pressure	Trap Dimensions	
Negative Static	X	X/2
(inches of water)	(inch)	(inch)
-0.50	1.50	0.75
-1.00	2.00	1.00
-1.50	2.50	1.25
-2.00	3.00	1.50
-2.50	3.50	1.75
-3.00	4.00	2.00
-3.50	4.50	2.25
-4.00	5.00	2.50
-4.50	5.50	2.75
-5.00	6.00	3.00
-5.50	6.50	3.25
-6.00	7.00	3.50
-6.50	7.50	3.75
-7.00	8.00	4.00
-7.50	8.50	4.25
-8.00	9.00	4.50

⚠ CAUTION

All condensate drains must be trapped individually before they are connected to a common line.

⚠ CAUTION

All condensate drain connections must be used. Drain pans are sloped towards connections.

Heating Coils

One or two row hot water and steam heating and preheating coils can be factory installed. All valve controls for heating operation are field supplied and field installed. Hot water and steam coil connections are spun copper tube.

Water coils should not be subjected to entering air temperatures below 38°F to prevent coil freeze-up. If air temperature across the coil is going to be below this value, use a glycol solution to match the coldest air expected.

Table 22 - Steam Coil Connection Sizes

Model (RN-)	Steam Coil Connection Size	Steam Preheat	Coil Connection Quantity*
006, 007, 008, 010	2" MPT	2" MPT	1/1
009, 011, 013, 015	2" MPT	2" MPT	1/1
014, 016, 018, 020, 025, 030	2" MPT	2" MPT	1/1
026, 031, 040, 050, 060, 070	2" MPT	2" MPT	1/1
055, 065, 075, 090, 105, 120, 130, 140	2" MPT	2 1/8" MPT	2/2

* In/Out Connections

Table 23 - Hot Water Coil Connection Sizes

Model (RN-)	Hot Water Coil Connection Size	Hot Water Preheat	Coil Connection Quantity*
006, 007, 008, 010	7/8"	1 3/8"	1/1
009, 011, 013, 015	1 3/8"	1 3/8"	1/1
014, 016, 018, 020, 025, 030	1 5/8"	1 3/8"	1/1
026, 031, 040, 050, 060, 070	2 1/8"	1 3/8"	1/1
055, 065, 075, 090, 105, 120, 130, 140	2 1/8"	1 3/8"	2/2

* In/Out Connections

Chilled Water Coil

Four or six row chilled water cooling coils can be factory installed. All valve controls for cooling operation are field supplied and field installed. Chilled water coil connections are spun copper tube.

Table 24 - Chilled Water Coil Connection Sizes

Model (RN-)	Chilled Water Coil Connection Size	Coil Connection Quantity*
006, 007, 008, 009, 010, 011, 013, 015	1 5/8"	1/1
016, 018, 020, 025, 030	2 1/8"	1/1
026, 031, 040	2 5/8"	1/1
050, 055, 060, 065, 070,	2 1/8"	2/2
075, 090, 105, 120, 130, 140	2 1/8"	4/4

* In/Out Connections

⚠ WARNING

Piping shall be in accordance with national and local codes. Pressure limiting devices, backflow preventers and all other safety requirements are the sole responsibility of the installing contractor.

⚠ CAUTION

Installing Contractor is responsible for proper sealing of the water piping entries into the unit Failure to seal the entries may result in damage to the unit and property.

Electric Preheat

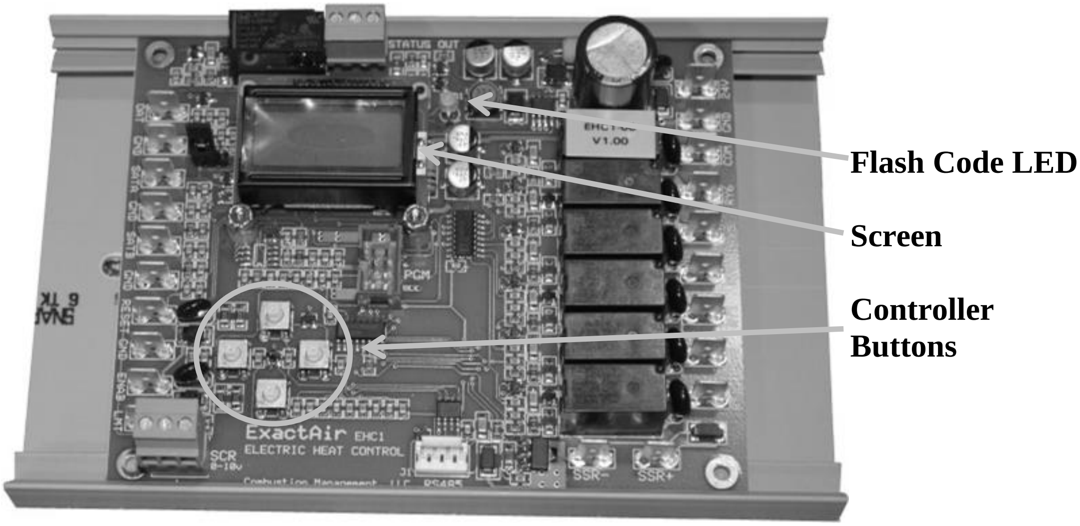
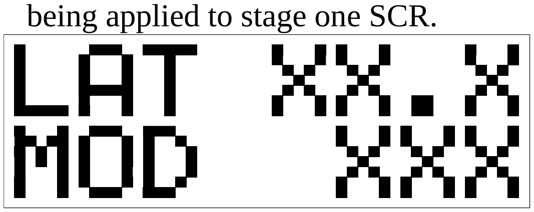


Figure 34 - Preheat Controller

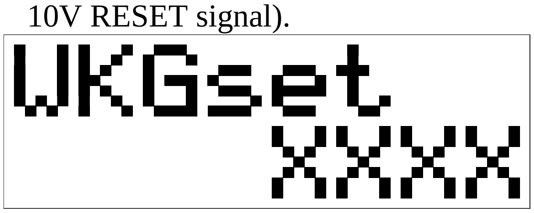
The electric preheat controller is factory installed within the preheat cabinet. The following details are for EHC1 version 1.10 of the preheat controller.

Status Display Screens
These screens are access by pressing either the left or right controller buttons and scrolling through the following displays.

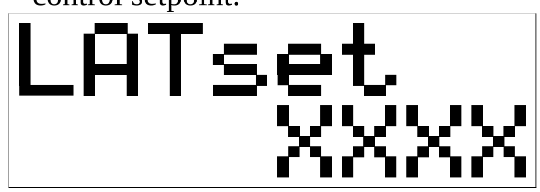
1. **LAT** - Measured leaving air temperature (LAT), average of LAT A and B probes.
   MOD - Modulation rate % currently being applied to stage one SCR.



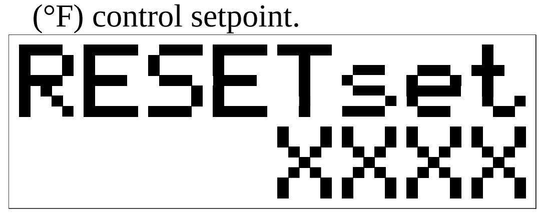
2. **WKGset** - "Working" LAT setpoint (°F) (LATeet>>RESETset as adjusted by 0-10V RESET signal).



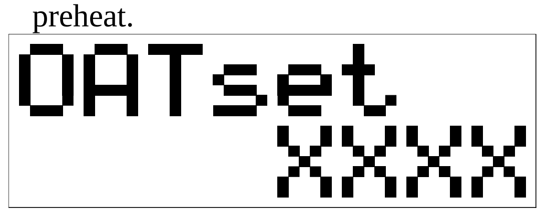
3. **LATset** - Leaving air temperature (°F) control setpoint.



4. **RESETset** - "Reset" air temperature (°F) control setpoint.



5. **OATset** - Outside air temperature (°F) control setpoint, measured outside temperature must be less to enable preheat.



6. **LLTset** - “Low Limit Time” temperature (°F) setpoint. If this temperature is not reached at full output, relay will pull in.

```
LLTset
    XXXX
```

7. **Stage** - Current operating stage 1-6.

```
Stage
  X of X
```

8. **Stage** - Current operating stage 1-6.
   MOD - Modulation rate % being applied to stage one heat strip SCR.

```
Stage   X
MOD    XX
```

9. **OAT** - Outside air inlet temperature (°F).

```
OAT
   XXX.X
```

10. **LATA** - Leaving air probe "A" temperature (°F).

```
LATA
    XX.X
```

11. **LATB** - Leaving air probe "B" temperature (°F).

```
LATB
    XX.X
```

12. **ManSTG** - Manual override stage for system testing. Any override automatically cancels after ten minutes; 0 indicates normal operation, 1-6 corresponds to stages 1-6 being forced on. Stage 1, the SCR, is forced to 50%.

```
ManSTG
       X
```

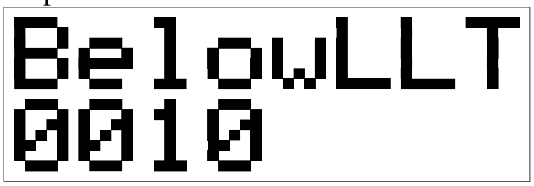
System Setting Screens

These screens are access by pressing the up button and then entering the technician password **2425**. The screens are scrolled through by pressing either right or left buttons on the controller. Adjustment is made by pressing the up and down buttons. After a short time of inactivity, the screen will go back to the Status Display Screens.

1. **StartDly -** Seconds of delay after the 'Enable' call before heating starts. This is to allow the Supply Fan to come up to speed. Supply Fan VFD’s have a 45 second ramp up time. Range = 1sec-60sec, and the default is 15sec.

```
StartDly
0015
```

2. **BelowLLT** - "Below Low Limit Time". Range = 10sec-1800sec, and the default is 10sec. If ‘LLTset’ temperature is not reached within ‘BelowLLT’ after reaching full output, the status relay will operate.



3. **Stages** - Number of stages. Range = 1-6, and the default is 1. The number of stages can be determined using Table 25.

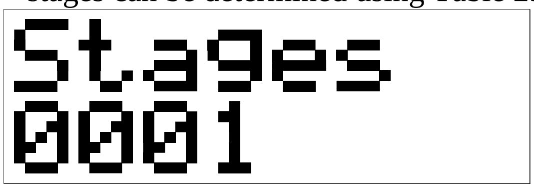
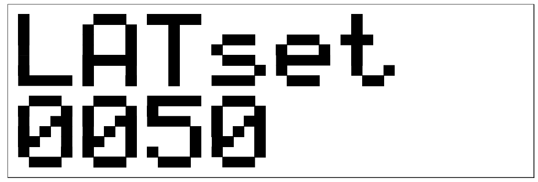


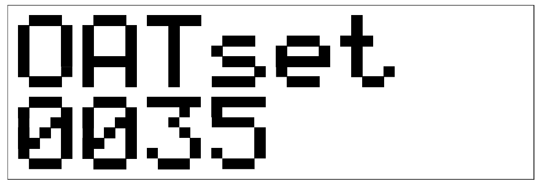
Table 25 - Stages of Electric Preheat

Tonnages	Feature 14B	Stages
A Cabinet RN 6-8 and 10 tons	G = 10 kW	1
	J = 20 kW	
	K = 30 kW	2
	L = 40 kW	
	M = 50 kW	3
	N = 60 kW	
B Cabinet RN 9 and 11-15 tons	J = 20 kW	1
	K = 30 kW	2
	L = 40 kW	
	M = 50 kW	3
	N = 60 kW	
	P = 70 kW	4
	Q = 80 kW	
C Cabinet RN 16-25 and 30 tons	J = 20 kW	1
	K = 30 kW	2
	L = 40 kW	
	M = 50 kW	3
	N = 60 kW	
	P = 70 kW	4
	Q = 80 kW	
	R = 90 kW	5
	S = 100 kW	
	T = 110 kW	6
	U = 120 kW	

4. **LATset** - Leaving air temperature setpoint. Range = 35°F-80°F, and the default is 50°F.

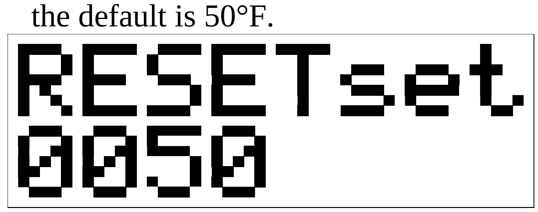


5. **OATset** - Outside air temperature setpoint. Range = 35°F-60°F, and the default is 35°F.



6. **LLTset** - “Low Limit Time” temperature setpoint. Range = 35°F-50°F, and the default is 35°F. If ‘LLTSet’ temperature is not reached within ‘BelowLLT’ time after reaching full output, the status relay will operate.

7. **RESETset** - “Reset Setpoint” temperature. Range = 35°F-80°F, and the default is 50°F.



8. **ManSTG -** Temporary manual override a specified stage testing, 0=normal operation, 1-6 to override corresponding stages. Range = 0-6, and the default is 0. The manual override may be used for unit testing of each stage. Stage 1 will be at 50% to test SCR and stages 2-6 will be full capacity. A manual override will expire in ten minutes if not manually

cancelled by resetting ‘ManSTG’ back to zero.

```
ManSTG
0000
```

LED Flash Alarm Codes
The flashing red LED will be to the right of the screen. The number of blinks is described below. The LCD screen will also display the screens.

1 = LATA probe open/short

```
FLT: LAT
Probe A
```

2 = LATB probe open/short

```
FLT: LAT
Probe B
```

3 = OAT sensor open/short

```
FLT: OAT
Probe
```

4 = Leaving air temp over limit

```
FLT: LAT
Hi Limit
```

5 = Cooling down after hi limit’ event

```
Hi LAT
Cooldown
```

6 = LAT below low limit

```
LATbelow
Lo Limit
```

7 = Stage 1 only recovery after mechanical limit

```
Mech Lmt
Recovery
```

8 = Shutdown after too many hi limit events

```
Mech Lmt
Shutdown
```

9 = Short or overload on the 0-10VDC analog signal output

```
FLT: SCR
0-10 Sig
```

Operation
Controller receives 24VAC preheat enable

Controller evaluates if outside air temperature “OAT” is below setpoint ‘OATset’

If OAT < ‘OATset’, controller will delay heating startup by time setpoint ‘STARTDLY’, then stage up preheat to maintain the setpoint 'LATset' to a maximum number of stages set in setpoint 'Stages'.

If a safety is reached with the controller's safety sensors then the electric preheat will be de-energized for a period of 2 minutes. Electric preheat will turn on stage one at 100% for 3 minutes to test if fault conditions still exist after the cool down period. The controller will repeat this and if 3 trips are recorded in 60 minutes then the controller will lockout and require manually cycling power to reset.

The modulating electric preheat option is designed to temper the incoming outside air to the unit based on an enable control signal and the outside air conditions.
A 24VAC enable signal must be provided to the [PHE] terminal to enable the operation of the electric preheat. Once the preheat controller is enabled it will monitor the outside air temperature to determine if any capacity of preheat is needed. If the outside air temperature falls below the outside air temperature setpoint the electric preheat will be started up and maintain the leaving air temperature setpoint with both SCR controlled and staged electric preheat. Both setpoints are set with push button LCD interface on the preheat controller. Outside air temperature sensors and preheat discharge supply air temperature sensors are factory installed and wired to the preheat controller. Electric preheat has maximum operating outside air temperature of 60°F and a maximum preheat discharge air temperature of 80°F.

[COM], [PHO] & [PHC] feedback terminals are provided to communicate if the electric preheat is in operation. PHO is a normally open contact, PHC is a normally closed contact, and COM is the common. These terminals are not required to be connected.

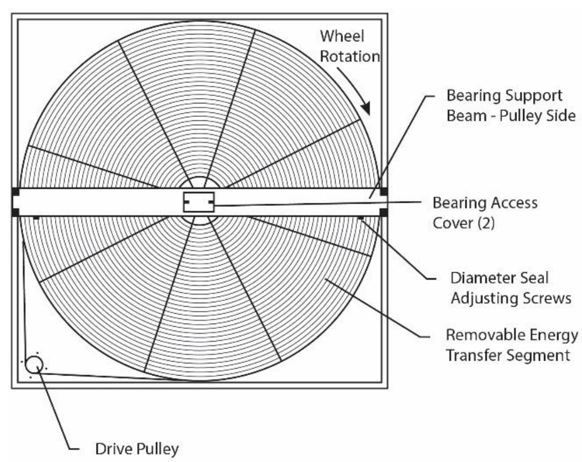
[PHE] is the electric preheat operation enable. [PH+] and [PH-] are the preheat set point reset terminals.

Energy Recovery Units

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Startup and service must be performed by a Factory Trained Service Technician.

General Information
AAONAIRE® units have been equipped with an energy recovery wheel. This section is provided to assure the energy recovery feature will be properly setup to perform in accordance with the job specifications for your particular application.



Energy Recovery Wheel

The Energy Recovery Cassette consists of a frame wheel, wheel drive system, and energy transfer segments. Segments are removable for cleaning or replacement. The segments rotate through counter flowing exhaust and outdoor air supply streams where they transfer heat and/or water vapor from the warm, moist air stream to the cooler and/or drier air stream.

The initial setup and servicing of the energy recovery wheel is very important to maintain proper operation efficiency and building occupant comfort.

Normal maintenance requires periodic inspection of filters, the cassette wheel, drive belts, air seals, wheel drive motor, and its electrical connections.

Wiring diagrams are provided with each motor. When wired according to wiring diagram, motor rotates clockwise when viewed from the shaft/pulley side.

By carefully reviewing the information within this section and following the instructions, the risk of improper operation and/or component damage will be minimized.

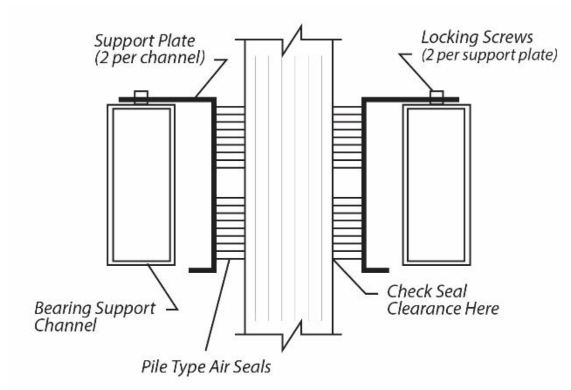
It is important that periodic maintenance be performed to help assure trouble free operation.

Initial Mechanical Check and Setup
Outdoor units equipped with outside air intake will have an outside air hood. The outside air hood must be opened prior to unit operation.

Outdoor air intake adjustments should be made according to building ventilation, or local code requirements.

After the unit installation is complete, open the cassette access door and determine that the energy wheel rotates freely when turned by hand. Apply power and observe that the wheel rotates at approximately 30 RPM. If the wheel does not rotate when power is applied, it may be necessary to readjust the "diameter air seals".

Air Seal Adjustments
Pile type air seals across both sides of the energy wheel diameter are factory adjusted to provide close clearance between the air seal and wheel. Racking of the unit or cassette during installation, and/or mounting of the unit on a non-level support or in other than the factory orientation can change seal clearances. Tight seals will prevent rotation.



Cross Section of Air Seal Structure

Wheel to Air Seal Clearance
To check wheel to seal clearance; first disconnect power to the unit, in some units the energy recovery wheel assembly can be pulled out from the cabinet to view the air seals. On larger units, the energy recovery wheel may be accessible inside the walk-in cabinet.

A business card or two pieces of paper can be used as a feller gauge, (typically each .004" thick) by placing it between the face of the wheel and pile seal.

Using the paper, determine if a loose slip fit exist between the pile seal and wheel when the wheel is rotated by hand.

To adjust air seal clearance, loosen all seal plate retaining screws holding the separate seal retaining plates to the bearing support channels and slide the seals plates away from the wheel. Using the paper feeler gauge, readjust and retighten one seal plate at a time to provide slip fit clearance when the wheel is rotated by hand.

Confirm that the wheel rotates freely. Apply power to the unit and confirm rotation.

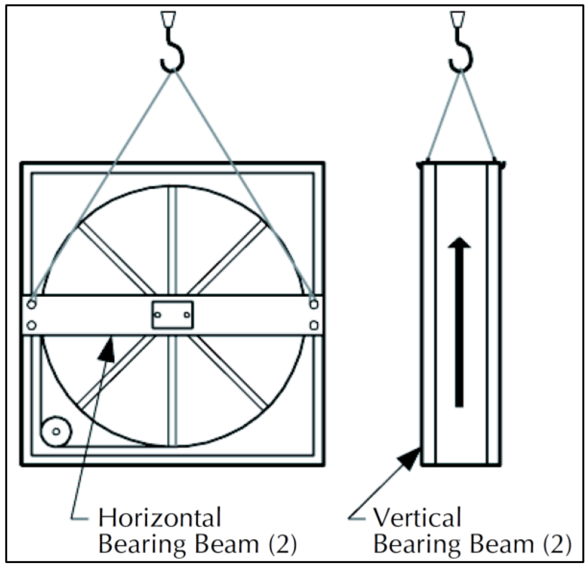
Airflow Balancing and Checking
High performance systems commonly have complex air distribution and fan systems. Unqualified personnel should not attempt to adjust fan operation, or air circulation, as all systems have unique operations characteristics. Professional air balance specialists should be employed to establish actual operating conditions, and to configure the air delivery system for optimal performance.

Controls
A variety of controls and electrical accessories may be provided with the equipment. Identify the controls on each unit by consulting appropriate submittal, or order documents, and operate according to the control manufacturer's instructions. If you cannot locate installation, operation, or maintenance information for the specific controls, then contact your sales representative, or the control manufacturer for assistance.

⚠ WARNING

Do not alter factory wiring. Deviation from the supplied wiring diagram will void all warranties, and may result in equipment damage or personal injury. Contact the factory with wiring discrepancies.

Routine Maintenance and Handling
Handle cassettes with care. All cassettes should be lifted by the bearing support beam. Holes are provided on both sides of the bearing support beams to facilitate rigging as shown in the following illustration.



Lifting Hole Locations

Routine maintenance of the Energy Recovery Cassettes includes periodic cleaning of the Energy Recovery Wheel as well as inspection of the Air Seals and Wheel Drive Components as follows:

Cleaning
The need for periodic cleaning of the energy recovery wheel will be a function of operating schedule, climate and contaminants in the indoor air being exhausted and the outdoor air being supplied to the building.

The energy recovery wheel is "self-cleaning" with respect to dry particles due to its laminar flow characteristics. Smaller particles pass through; larger particles land on the surface and are blown clear as the flow direction is reversed. Any material that builds up on the face of the wheel can be

removed with a brush or vacuum. The primary need for cleaning is to remove oil based aerosols that have condensed on energy transfer surfaces.
A characteristic of all dry desiccants, such films can close off micron sized pores at the surface of the desiccant material, reducing the efficiency by which the desiccant can adsorb and desorb moisture and also build up so as to reduce airflow.

In a reasonably clean indoor environment such as a school or office building, measurable reductions of airflow or loss of sensible (temperature) effectiveness may not occur for several years. Measurable changes in latent energy (water vapor) transfer can occur in shorter periods of time in applications such as moderate occupant smoking or cooking facilities. In applications experiencing unusually high levels of occupant smoking or oil based aerosols such as industrial applications involving the ventilation of machine shop areas for example, annual washing of energy transfer may be necessary to maintain latent transfer efficiency. Proper cleaning of the energy recovery wheel will restore latent effectiveness to near original performance.

To clean, gain access to the energy recovery wheel and remove segments. Brush foreign material from the face of the wheel. Wash the segments or small wheels in a 5% solution of non-acid based coil cleaner or alkaline detergent and warm water.

⚠ CAUTION

Do not use acid based cleaners, aromatic solvents, steam or temperatures in excess of 170°F; damage to the wheel may occur!

Soak in the solution until grease and tar deposits are loosened (Note: some staining of the desiccant may remain and is not harmful to performance). Before removing, rapidly run finger across surface of segment to separate polymer strips for better cleaning action. Rinse dirty solution from segment and remove excess water before reinstalling in wheel.

Air Seals
Four adjustable diameter seals are provided on each cassette to minimize transfer of air between the counter flowing airstreams.

To adjust diameter seals, loosen diameter seal adjusting screws and back seals away from wheel surface. Rotate wheel clockwise until two opposing spokes are hidden behind the bearing support beam. Using a folded piece of paper as a feeler gauge, position paper between the wheel surface and diameter seals.

Adjust seals towards wheel surface until a slight friction on the feeler gauge (paper) is detected when gauge is moved along the length of the spoke. Retighten adjusting screws and recheck clearance with “feeler” gauge.

Wheel Drive Components
The wheel drive motor bearings are pre-lubricated and no further lubrication is necessary.

The wheel drive pulley is secured to the drive motor shaft by a combination of either a key or D slot and set screw.

The set screw is secured with removable locktite to prevent loosening. Annually confirm set screw is secure. The wheel drive belt is a urethane stretch belt designed to provide constant tension through the life of the belt. No adjustment is required. Inspect the drive belt annually for proper tracking and tension. A properly tensioned belt will turn the wheel immediately after power is applied with no visible slippage during start-up.

Installation Considerations

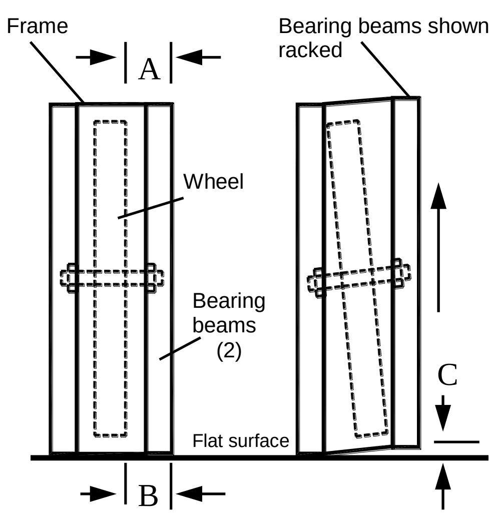
Energy recovery cassettes are incorporated within the design of packaged units, packaged air handlers and energy recovery ventilators. In each case, it is recommended that the following considerations be addressed:

Accessibility

The cassette and all its operative parts; i.e.: motor, belt, pulley, bearings, seals and energy transfer segments must be accessible for service and maintenance. This design requires that adequate clearance be provided outside the enclosure. Where cassettes are permanently installed in a cabinet, access to both sides of the cassette must be provided.

Orientation & Support

The Energy Recovery Cassette may be mounted in any orientation. However, Care must be taken to make certain that the cassette frame remains flat and the bearing beams are not racked.



Avoid Racking of Cassette Frame

To verify, make certain that the distance between wheel rim and bearing beam is the same at each end of the bearing beam, to within 1/4 of an inch (dimension A & B). This amount of racking can be compensated for by adjusting the diameter seals.

If greater than 1/4 inch (dimension C), racking must be corrected to ensure that drive belt will not disengage from wheel.

Operation

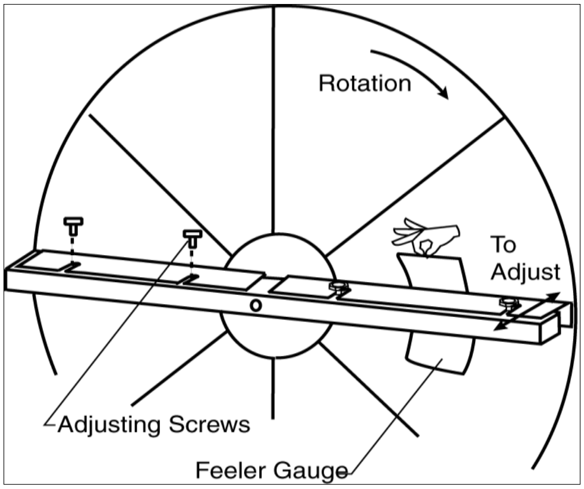
CAUTION

Keep hands away from rotating wheel! Contact with rotating wheel can cause physical injury.

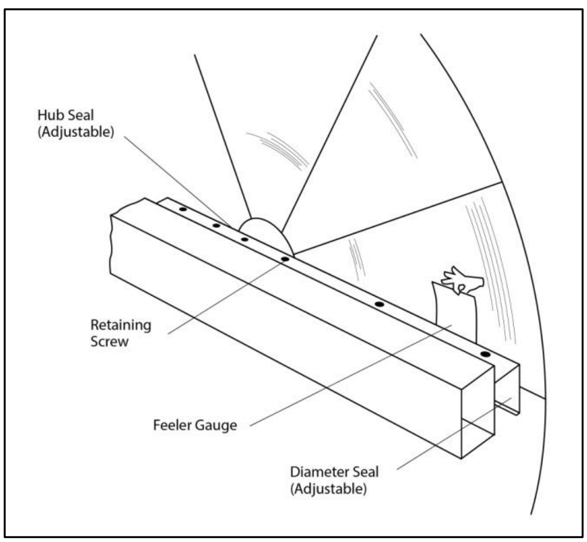
Startup Procedure

1. By hand, turn wheel clockwise (as viewed from the pulley side), to verify wheel turns freely through 360º rotation.
2. Before applying power to drive motor, confirm wheel segments are fully engaged in wheel frame and segment retainers are completely fastened. (See Segment Installation Diagram).
3. With hands and objects away from moving parts, activate unit and confirm wheel rotation. Wheel rotates clockwise (as viewed from the pulley side).
4. If wheel has difficulty starting, turn power off and inspect for excessive interference between the wheel surface and each of the four (4) diameter seals. To correct, loosen diameter seal adjusting screws and back adjustable diameter seals away from surface of wheel, apply power to confirm wheel is free to rotate, then re-adjust and tighten hub and diameter seals, as shown in hub seal adjustment diagram.

5. Start and stop wheel several times to confirm seal adjustment and to confirm belt is tracking properly on wheel rim (approximately 1/4” from outer edge of rim).



Diameter Seal Adjustment

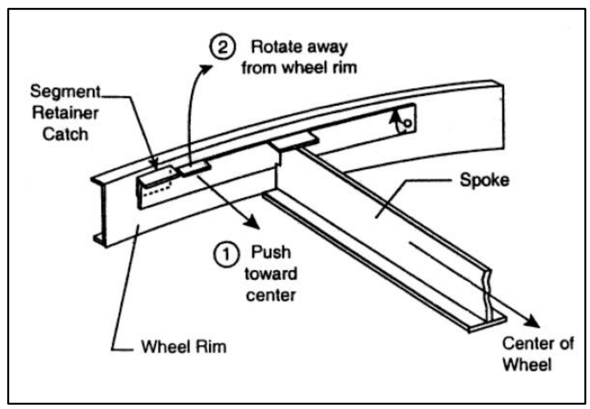


Hub Seal Adjustment

Service

> **⚠ CAUTION**
>
> Disconnect electrical power before servicing energy recovery cassette. Always keep hands away from bearing support beam when installing or removing segments. Failure to do so could result in severe injury to fingers or hand.

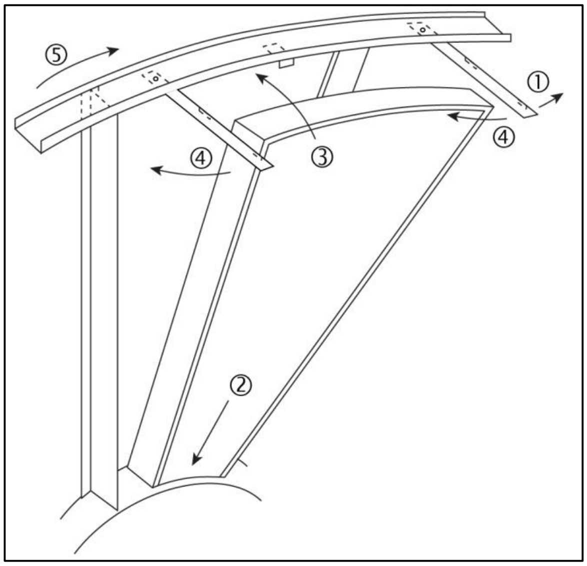
Segment Installation & Replacement
Wheel segments are secured to the wheel frame by a Segment Retainer which pivots on the wheel rim and is held in place by a Segment Retaining Catch.



Segment Retainer

To install wheel segments follow steps one through five below. Reverse procedure for segment removal.

1. Unlock two segment retainers (one on each side of the selected segment opening.
2. With the embedded stiffener facing the motor side, insert the nose of the segment between the hub plates.



Segment Installation

3. Holding segment by the two outer corners, press the segment towards the center of the wheel and inwards against the spoke flanges. If hand pressure does not fully seat the segment, insert the flat tip of a screw driver between the wheel rim and outer corners of the segment and apply downward force while guiding the segment into place.
4. Close and latch each Segment Retainer under Segment Retaining Catch.
5. Slowly rotate the wheel 180º. Install the second segment opposite the first for counterbalance. Rotate the two installed segments 90º to balance the wheel while the third segment is installed. Rotate the wheel 180º again to install the fourth segment opposite the third. Repeat this sequence with the remaining four segments.

Wheel Drive Motor and Pulley Replacement
1. Disconnect power to wheel drive motor.
2. Remove belt from pulley and position temporarily around wheel rim.
3. Loosen set screw in wheel drive pulley using a hex head wrench and remove pulley from motor drive shaft.
4. While supporting weight of drive motor in one hand, loosen and remove (4) mounting bolts.
5. Install replacement motor with hardware kit supplied.
6. Install pulley to dimension as shown and secure set screw to drive shaft.
7. Stretch belt over pulley and engage in groove.
8. Follow start-up procedure.

Belt Replacement
1. Obtain access to the pulley side bearing access plate if bearing access plates are provided. Remove two bearing access plate retaining screws and the access plate.
2. Using hexagonal wrench, loosen set screw in bearing locking collar. Using light hammer and drift (in drift pin hole) tap collar in the direction of wheel rotation to unlock collar. Remove collar.
3. Using socket wrench with extension, remove two nuts which secure bearing housing to the bearing support beam. Slide bearing from shaft. If not removable by hand, use bearing puller.
4. Form a small loop of belt and pass it through the hole in the bearing support beam. Grasp the belt at the wheel hub and pull the entire belt down.

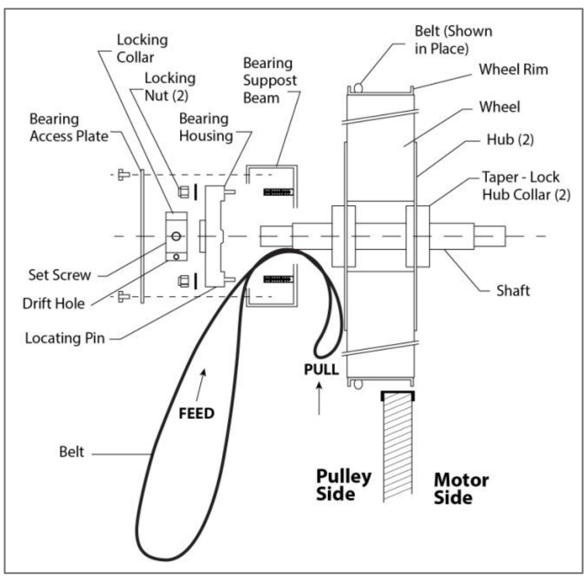
Note: Slight hand pressure against wheel rim will lift weight of wheel from inner race of bearing to assist bearing removal and installation.

⚠ CAUTION

Protect hands and belt from possible sharp edges of hole in Bearing Support Beam.

5. Loop the trailing end of the belt over the shaft (belt is partially through the opening).

6.Reinstall the bearing onto the wheel shaft, being careful to engage the two locating pins into the holes in the bearing support beam. Secure the bearing with two self-locking nuts.
7. Install the belts around the wheel and pulley according to the instructions provided with the belt.
8. Reinstall diameter seals or hub seal and tighten retaining screws. Rotate wheel in clockwise direction to determine that wheel rotates freely with slight drag on seals.
9. Reinstall bearing locking collar. Rotate collar by hand in the direction the wheel rotates (see label provided on each cassette for wheel rotation).
10. Lock in position by tapping drift pin hole with hammer and drift. Secure in position by tightening set screw.
11. Reinstall Bearing Access Cover.
12. Apply power to wheel and ensure that the wheel rotates freely without interference.



Belt Replacement

Energy Recovery Wheel Defrost Timer Setting
Set Mode to A

T1 is the on time

- Set T1 range to 10m (10 minutes)
- The scale should show 0-6 on the dial
- Set T1 dial to 3 which equals 30 minutes of run time

T2 is the off time

- Set T2 range to 1m (1 minute)
- The scale should show 0-6 on the dial
- Set T2 dial to 2 which equals 2 minutes of off time

Adjust temperature dial to set the point at which any temperature below will activate the defrost timer. Recommended setting is 35°F.

Once the OA Temperature goes below the setpoint, the wheel timer will stop for 2 minutes and run for 30 minutes and will continue to cycle at this rate as long as OA Temperature is below setpoint. If more off time is required to defrost the wheel, increase the T2 Knob time to a greater off time than 2 minutes.

Figure 35 - Defrost Timer

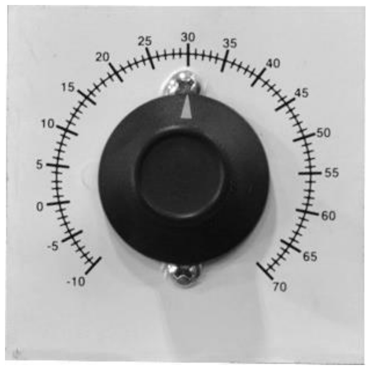


Figure 36 – Temperature Dial

Startup

(See back of the manual for startup form.)

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Startup and service must be performed by a Factory Trained Service Technician.

⚠ WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

During startup, it is necessary to perform routine checks on the performance of the unit. This includes checking the air flow, air filters, condenser water flow, dampers, heaters, and refrigerant charge.

Supply Fans

RN Series units are equipped with direct drive backward curved plenum fan assemblies that are selected to deliver the air volume specified according to unit size and job requirements. This is either done with air volume bands in the blower wheels or with variable frequency drives. Field airflow adjustment may be required at startup.

Air volume bands for the wheels are sized according to the unit's air delivery specifications and can also be ordered from the factory for field installation. Wheels come standard with a 10% air volume band, as a safety factor, in case additional air volume is required from the unit.

Air Flow Adjustment

If reduced air volume is required an air volume band or larger air volume band can be installed within the blower wheel to reduce the amount of air delivered by the wheel.

If the unit is factory equipped with the air volume band and additional air volume is required, the band can be removed from the wheel.

Use fan program in AAON ECat to determine the new band size for the required cfm and static pressure.

The following photos of a wheel are provided for practical guidelines only in order to identify the air band location in the wheel. Actual field installation of the air band into the wheel will require access into and through the blower wheel venture, which may require removal of the blower motor and wheel.

Air volume bands are made of aluminum, sized and equipped with easy bend tabs that are to be inserted into pre-punched slots provided on the wheel. Once the band has been inserted into the slots, it MUST BE secured by bending the tabs over from the back side of the wheel and also MUST BE secured from the inside by connecting the ends together with a pop-rivet in the holes provided on the ends of the band.

If the band is field installed, a hand held pop-rivet tool is recommended for connecting the band ends together. Caution must be taken to assure that the band is tightly installed and no damage, denting or alteration to the wheel or blades occurs during the installation.

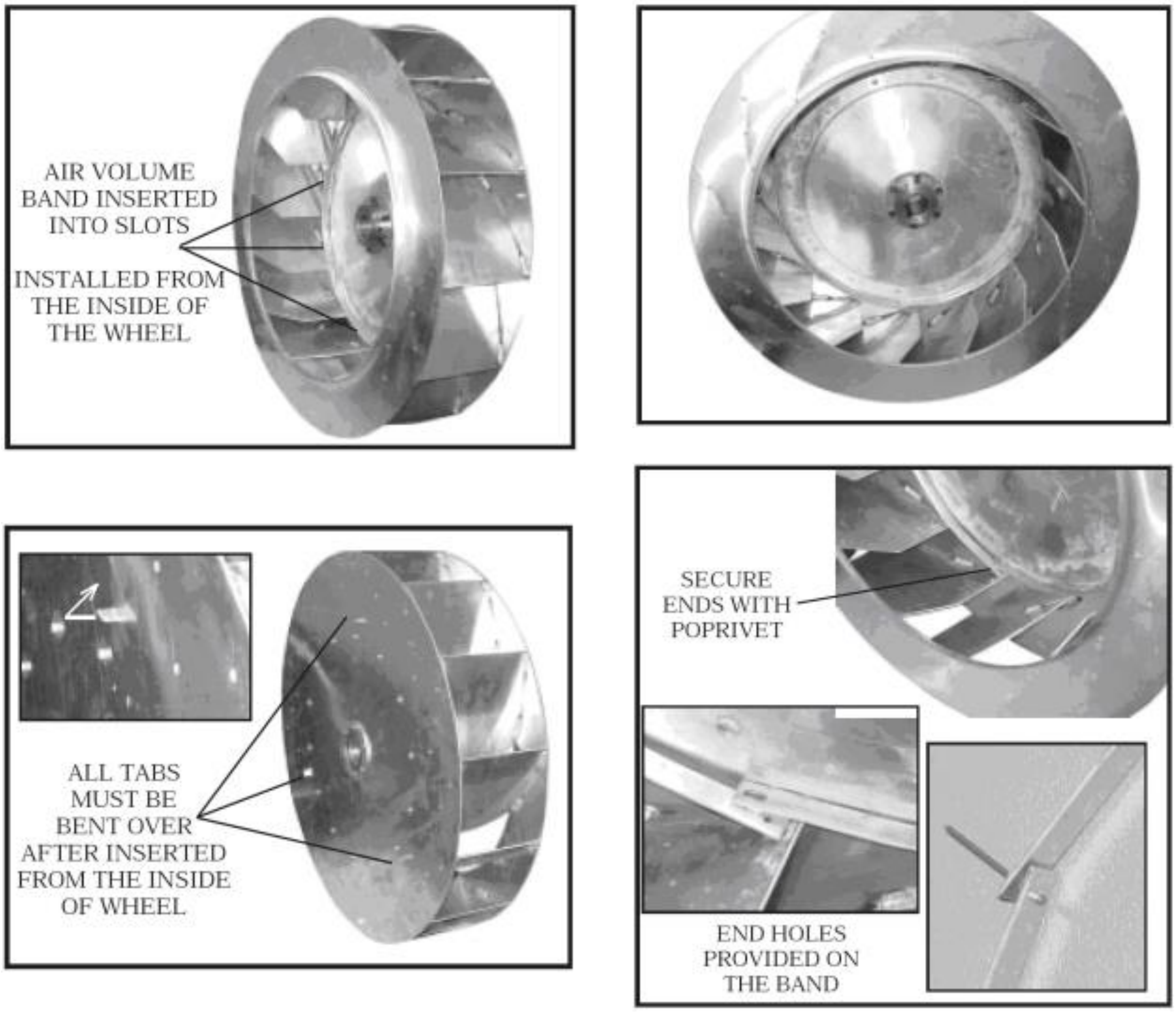


Figure 37 - Supply Fan Banding

For single set screw applications, tighten the set screw to the required torque setting (Table 26) using a calibrated torque wrench. For double set screw applications, tighten one set screw to half of the required torque setting (Table 26) using a calibrated torque wrench. Tighten the second set screw to the full required torque setting then tighten the first set screw to the full required torque setting.

Table 26 - Plenum Fan Set Screw Specifications

SET SCREW DIAMETER	TORQUE (IN-LBS)
1/4"	80
5/16"	126
3/8"	240

The gap tolerances that are allowed between the blower and the inlet cone for the plenum fan blowers are shown in Figure 38. The inlet cone can be moved as necessary to center the cone in relation to the blower. The blower can be moved on the motor shaft to set the correct overlap. These tolerances are critical to the performance of the blower.

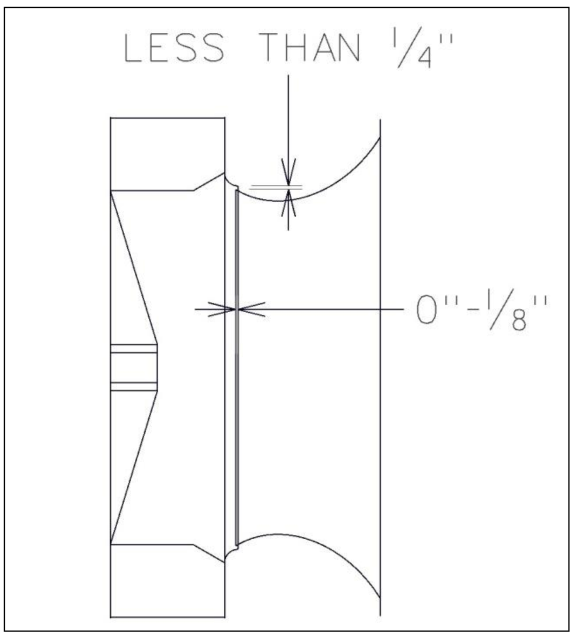


Figure 38 - Plenum Fan Gap Tolerances

Power Return Axial Flow Fans (16-25 and 30 tons)
Blade Pitch Angle Setting Instructions

Step 1: Determine the new required pitch for the fan blades
Use the fan program in AAON ECat.

Step 2: Maintain the balance of fan

Mark the HUB/RET castings across a single joint, so the fan can be reassembled in the same orientation.

Mark the location of any balancing weight. Balancing weight will be on the outer bolt circle, in the form of washers, and/or longer bolts, or an additional balancing nut.

Number the blades and blade sockets, so that they can be replaced into their original positions.

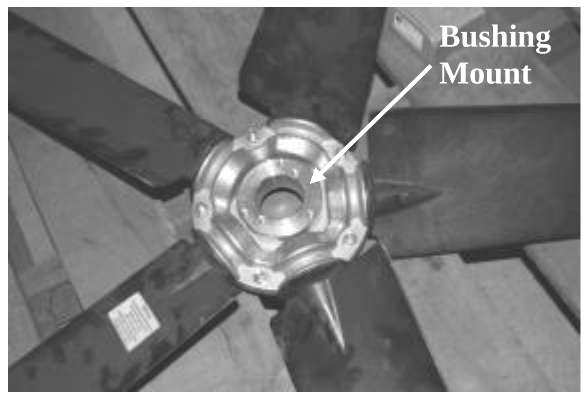


Figure 39 - Fan with the HUB on the Top and RET on the Bottom

Step 3: Determine the direction of rotation
Right, R, is clockwise when facing the discharge side of the fan and Left, L, is counterclockwise when facing the discharge side of the fan.

Step 4: Determine the bushing mount location
The bushing mount is the center section of the hub through which the fan is mounted to the shaft, and typically contains either setscrews or a center-tapered hole where the bushing inserts.

Location A is with the bushing mount on air inlet side of the fan.
Location B is with the bushing mount on air discharge side of the fan.

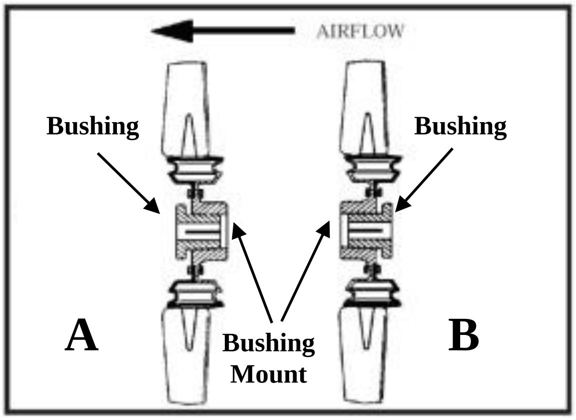


Figure 40 - Bushing Mount Location

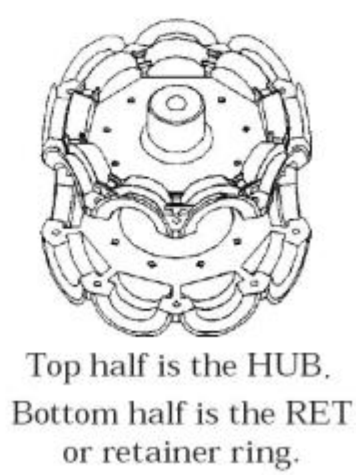


Figure 42 - Fan HUB and RET Castings

Step 5: Determine the pin location groove
Disassemble fan on a flat surface and note in which groove the pin is located.

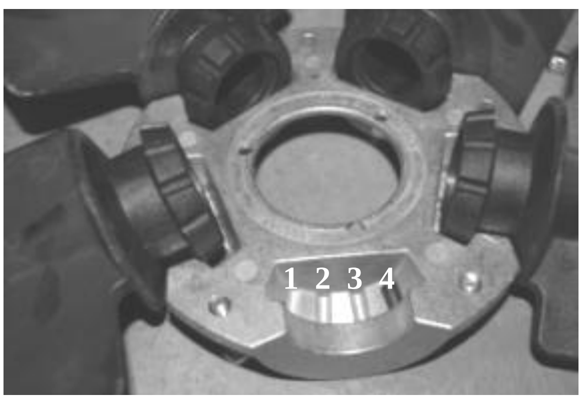


Figure 41 - RET with Pin in Groove 4

Step 6: Determine whether the pin is in the HUB or RET
Step 7: Determine the current blade pitch and the pin location for the new blades

Table 27 - Pin Location

Type	Bushing Mount	Blade Pitch Angle									
		20°	25°	28°	30°	33°	35°	38°	40°	45°	50°
5Z	A	-	RET	-	RET	RET	RET	HUB	HUB	HUB	HUB
	B	-	HUB	-	HUB	HUB	HUB	RET	RET	RET	RET

Table 28 - Pin Groove Location

Type	Rot.	Blade Pitch Angle									
		20°	25°	28°	30°	33°	35°	38°	40°	45°	50°
5Z	R	-	4	-	3	2	1	4	3	2	1
	L	-	1	-	2	3	4	1	2	3	4

Step 8: Replace fan blades in the new pin location and reassemble the fan

Replace the blades with the pin in the 1, 2, 3, or 4 groove position of either the HUB or RET. Assemble the fan making sure to place the blades in their previous blade sockets, to match up the previous orientation of HUB and RET and to replace any balancing weights in their previous locations. Tighten bolts in a cross pattern to 5-6 ft-lbs. of torque.

Power Return and Exhaust Axial Flow Fans (26 and 31-140 tons)

Blade Pitch Angle Setting Instructions

Step 1: Determine the new required pitch for the fan blades

Use the fan program in AAON ECat. Contact the AAON parts department to acquire the new pitch pins for the fan blades.

Step 2: Maintain the balance of fan

Mark the hub plate castings across a single joint, so the fan can be reassembled in the same orientation.

Mark the location of any balancing weight. Balancing weight will be on the outer bolt circle, in the form of washers, and/or longer bolts, or an additional balancing nut.

Number the blades and blade sockets, so that they can be replaced into their original positions.

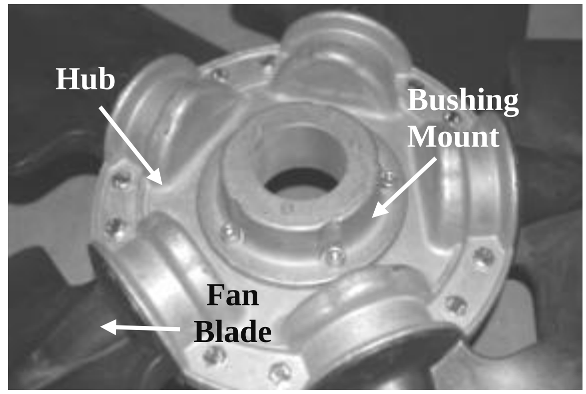


Figure 43- Assembled Fan

Step 3: Remove the mounting nuts and bolts and separate hub plate castings

Figure 44 - Back of the Fan

Step 4: Remove the fan blades and replace the pitch pins

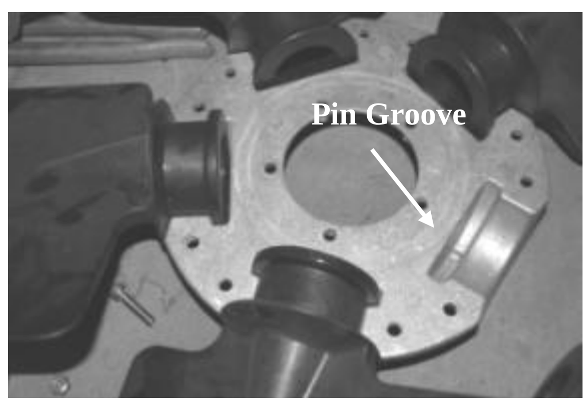


Figure 45 - Pin Groove Location

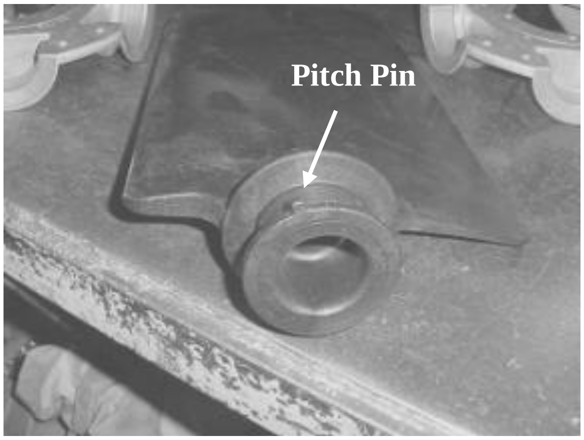


Figure 46 - Pitch Pin Location


Figure 47 - Example Pitch Pin

Step 5: Replace the fan blades with the pitch pin of the blade in the same groove and reassemble the fan.
Replace the blades and assemble the fan making sure to place the blades in their previous blade sockets, to match up the previous orientation of hub plate casings and to replace any balancing weights in their previous locations. Tighten bolts in a cross pattern to 6.7 ft-lbs. of torque.

Step 6: Install the fan in the unit.
After placing the fan on the shaft, place the key in the shaft, make sure the screw on the bushing is aligned over the key and then tighten the screw to 9 ft-lbs torque.

Filters
Do not operate the unit without filters in place. Unit should be checked for correct filter placement during startup. Operation of the equipment without filters will result in a clogged evaporator coil.

⚠ CAUTION

Before completing startup and leaving the unit a complete operating cycle should be observed to verify that all components are functioning properly.

Adjusting Refrigerant Charge
Adjusting the charge of a system in the field must be based on determination of liquid sub-cooling and evaporator superheat. On a system with an expansion valve liquid sub-cooling is more representative of the charge than evaporator superheat but both measurements must be taken.

⚠ CAUTION

The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFC's and HCFC's) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for non-compliance.

<u>Before Charging</u>
Unit being charged must be at or near full load conditions before adjusting the charge. Units equipped with hot gas reheat must be charged with the hot gas reheat valves closed while the unit is in cooling mode to get the proper charge. After charging, unit should be operated in reheat (dehumidification) mode to check for correct operation.

Units equipped with heat pump options should be charged in heating mode to get the proper charge. After charging, unit should be operated in cooling mode to check for correct charge. Charge may need to be adjusted for cooling mode. If adjustments are made in the cooling mode heating mode must be rerun to verify proper operation.

After adding or removing charge the system must be allowed to stabilize, typically 10-15 minutes, before making any other adjustments.

The type of unit and options determine the ranges for liquid sub-cooling and evaporator superheat. Refer to the table below when determining the proper sub-cooling.

Checking Liquid Sub-Cooling
Measure the temperature of the liquid line as it leaves the condenser coil.

Read the gauge pressure at the liquid line close to the point where the temperature was taken. You must use liquid line pressure as it will vary from discharge pressure due to condenser coil pressure drop.

Convert the pressure obtained to a saturated temperature using the appropriate refrigerant temperature-pressure chart.

Subtract the measured liquid line temperature from the saturated temperature to determine the liquid sub-cooling.

Compare calculated sub-cooling to the tables below for the appropriate coil and system type and options.

Checking Evaporator Superheat
Measure the temperature of the suction line close to the compressor.

Read gauge pressure at the suction line close to the compressor.

Convert the pressure obtained to a saturated temperature using the appropriate refrigerant temperature-pressure chart.

Subtract the saturated temperature from the measured suction line temperature to determine the evaporator superheat.

Compare calculated superheat to the tables below for the appropriate coil and system type and options.

⚠ CAUTION

Expansion valve must be adjusted to approximately 8-15°F of suction superheat. Failure to have sufficient superheat will damage the compressor and void the warranty.

Table 29 - Acceptable Fin & Tube Air-Cooled Condenser Coil Refrigeration Circuit Values

Air-Cooled Cond./Air-Source Heat Pump In Cooling Mode	
Sub-Cooling	8-15°F / 2-4°F (HP)*
Sub-Cooling with Hot Gas Reheat	8-15°F /2-6°F (HP)*
Superheat	8-15°F

Table 30 - Acceptable Water-Cooled Refrigeration Circuit Values

Water-Cooled Cond./Water Source Heat Pump In Cooling Mode	
Sub-Cooling	4-8°F
Superheat	8-15°F

Table 31 - Acceptable Microchannel Air-Cooled Condenser Coil Liquid Sub-Cooling Values

	Cooling Mode Liquid Sub-Cooling Values(°F)				
Ambient (°F)	Evaporator Coil Saturation Temperature (°F)				
	40	45	48	50	55
67	9 - 14	8 - 13	8 - 13	7 - 12	5 - 10
72	10 - 15	9 - 14	9 - 14	8 - 13	7 - 12
82	10 - 15	10 - 15	10 - 15	9 - 14	7 - 12
95	10 - 15	10 - 15	10 - 15	9 - 14	8 - 13
105	11 - 16	11 - 16	10 - 15	10 - 15	8 - 13
115	10 - 15	11 - 16	11 - 16	11 - 16	9 - 14

Notes:

1. Microchannel condenser coils are more sensitive to charge. The system must be running in cooling mode with compressor, supply airflow & condenser fan speed at full load. The sub-cooling value changes depending on the ambient temperature reading and the microchannel evaporator coil saturation temperature. To find the correct sub-cooling value, find the ambient temperature on the first column and follow that across to the SST (40-55°F).
2. Superheat for Microchannel condenser coils must be between 8 - 15°F

Adjusting Sub-cooling and Superheat Temperatures

The system is overcharged if the sub-cooling temperature is too high and the evaporator is fully loaded (low loads on the evaporator result in increased sub-cooling) and the evaporator superheat is within the temperature range as shown in the table above (high superheat results in increased sub-cooling).

Correct an overcharged system by reducing the amount of refrigerant in the system to lower the sub-cooling.

The system is undercharged if the superheat is too high and the sub-cooling is too low.

⚠ CAUTION

DO NOT OVERCHARGE!

Refrigerant overcharging leads to excess refrigerant in the condenser coils resulting in elevated compressor discharge pressure.

Correct an undercharged system by adding refrigerant to the system to reduce superheat and raise sub-cooling.

If the sub-cooling is correct and the superheat is too high, the expansion valve may need adjustment to correct the superheat.

Suction Filter

In an effort to help protect the compressors from contaminants during testing and startup, AAON is now factory installing pleated replaceable core suction line filters on the RNE Series products (55, 65, and 75-140 tons)

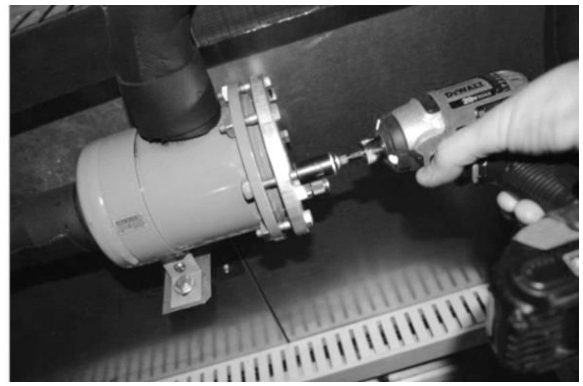
Figure 48 - RPE-48-BD filter element

One month after startup, remove the RPE-48-BD filter element for the lowest possible pressure drop. Removing the suction line filter will improve the efficiency and capacity of the unit. AAON installs isolation ball valves on both sides of the suction line filter so the complete system will not have to be reclaimed/evacuated.

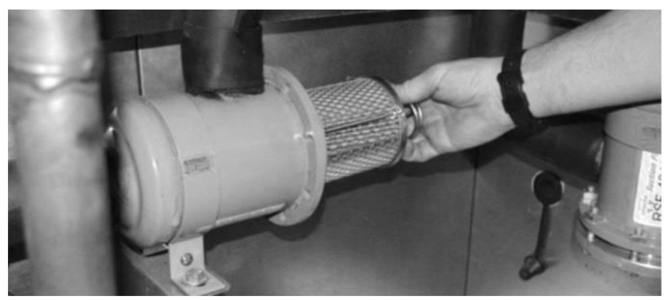
Suction Filter Removal Instructions

1. Shut down operation of the unit
2. Close both shut-off valves to isolate the suction filter
3. Reclaim the refrigerant from the suction filter section

4. Remove the bolts from the suction filter end plate



5. Remove the pleated filter assembly



6. Replace the suction filter end plate and bolts
7. Evacuate the suction filter assembly to 300 microns
8. Open both shut-off valves

Table 32 - R-410A and R-22 Refrigerant Temperature-Pressure Chart

	PSIG			PSIG			PSIG			PSIG			PSIG	
(°F)	R-410A	R-22	(°F)	R-410A	R-22	(°F)	R-410A	R-22	(°F)	R-410A	R-22	(°F)	R-410A	R-22
20	78.3	43.1	**50**	142.2	84.1	**80**	234.9	143.6	**110**	364.1	226.4	**140**	540.1	337.4
21	80.0	44.2	**51**	144.8	85.7	**81**	238.6	146.0	**111**	369.1	229.6	**141**	547.0	341.6
22	81.8	45.3	**52**	147.4	87.4	**82**	242.3	148.4	**112**	374.2	232.8	**142**	553.9	345.9
23	83.6	46.5	**53**	150.1	89.1	**83**	246.0	150.8	**113**	379.4	236.1	**143**	560.9	350.3
24	85.4	47.6	**54**	152.8	90.8	**84**	249.8	153.2	**114**	384.6	239.4	**144**	567.9	354.6
25	87.2	48.8	**55**	155.5	92.6	**85**	253.7	155.7	**115**	389.9	242.8	**145**	575.1	359.0
26	89.1	50.0	**56**	158.2	94.4	**86**	257.5	158.2	**116**	395.2	246.1	**146**	582.3	363.5
27	91.0	51.2	**57**	161.0	96.1	**87**	261.4	160.7	**117**	400.5	249.5	**147**	589.6	368.0
28	92.9	52.4	**58**	163.8	98.0	**88**	265.4	163.2	**118**	405.9	253.0	**148**	596.9	372.5
29	94.9	53.7	**59**	166.7	99.8	**89**	269.4	165.8	**119**	411.4	256.5	**149**	604.4	377.1
30	96.8	55.0	**60**	169.6	101.6	**90**	273.5	168.4	**120**	416.9	260.0	**150**	611.9	381.7
31	98.8	56.2	**61**	172.5	103.5	**91**	277.6	171.0	**121**	422.5	263.5			
32	100.9	57.5	**62**	175.4	105.4	**92**	281.7	173.7	**122**	428.2	267.1			
33	102.9	58.8	**63**	178.4	107.3	**93**	285.9	176.4	**123**	433.9	270.7			
34	105.0	60.2	**64**	181.5	109.3	**94**	290.1	179.1	**124**	439.6	274.3			
35	107.1	61.5	**65**	184.5	111.2	**95**	294.4	181.8	**125**	445.4	278.0			
36	109.2	62.9	**66**	187.6	113.2	**96**	298.7	184.6	**126**	451.3	281.7			
37	111.4	64.3	**67**	190.7	115.3	**97**	303.0	187.4	**127**	457.3	285.4			
38	113.6	65.7	**68**	193.9	117.3	**98**	307.5	190.2	**128**	463.2	289.2			
39	115.8	67.1	**69**	197.1	119.4	**99**	311.9	193.0	**129**	469.3	293.0			
40	118.1	68.6	**70**	200.4	121.4	**100**	316.4	195.9	**130**	475.4	296.9			
41	120.3	70.0	**71**	203.6	123.5	**101**	321.0	198.8	**131**	481.6	300.8			
42	122.7	71.5	**72**	207.0	125.7	**102**	325.6	201.8	**132**	487.8	304.7			
43	125.0	73.0	**73**	210.3	127.8	**103**	330.2	204.7	**133**	494.1	308.7			
44	127.4	74.5	**74**	213.7	130.0	**104**	334.9	207.7	**134**	500.5	312.6			
45	129.8	76.1	**75**	217.1	132.2	**105**	339.6	210.8	**135**	506.9	316.7			
46	132.2	77.6	**76**	220.6	134.5	**106**	344.4	213.8	**136**	513.4	320.7			
47	134.7	79.2	**77**	224.1	136.7	**107**	349.3	216.9	**137**	520.0	324.8			
48	137.2	80.8	**78**	227.7	139.0	**108**	354.2	220.0	**138**	526.6	329.0			
49	139.7	82.4	**79**	231.3	141.3	**109**	359.1	223.2	**139**	533.3	333.2			

Gas Heater Instructions

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

A. This appliance does not have a pilot. It is equipped with a ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

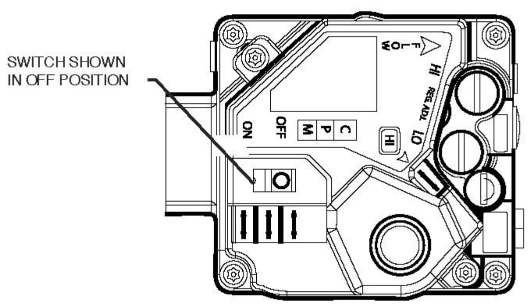
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to move the on/off switch.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.



5. Remove control access panel.
6. Move the on/off switch to the "OFF" position.
7. WAIT five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to the next step.
8. Move the on/off switch to the "ON" position.
9. Replace control access panel.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas to Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be preformed.
3. Remove control access panel.
4. Move the on/off switch to the "OFF" position.
5. Replace control access panel.

Direct Ignition • P72570

Figure 49 - Gas Heater Instructions

Freeze Stat Startup

Freeze Stat is an adjustable temperature sensor (-10 to 70°F) mounted on the tubing of the first cooling circuit and wired to de-energize all cooling circuits if tubing temperature falls below setpoint. Option is used to prevent freezing of evaporator coil.

Recommended Setting: 32° F to 35° F

Condenser Fan Electronically Commutated Motor (ECM) Startup

The fan cycling option uses a fan cycle switch to switch between one of the discrete speed inputs (see Table 33) on the motor thus cycling between two preset speeds based upon discharge pressure of the unit. By connecting 24VAC to a single or combination of the yellow, white, or orange wires, the motor will run at the discrete speeds in Table 33.

With Customer Provided Unit Controls or WattMaster Unit Controls the WattMaster Condenser Head Pressure Module is used for variable speed control of the motor to maintain a head pressure. The motor should be factory wired to the PWM outputs of the WattMaster Condenser Head Pressure Module. See WattMaster literature for further information.
(http://www.orioncontrols.com)

Note

High voltage wires out of the motor:
Black & Brown - 1 Phase Line Voltage
Green - Ground

Low control voltage wires out of the motor:
Blue - Common
Yellow - Variable Speed Control

Table 33 - ECM Condenser Fan Cycling Options

Color	Terminal	Customer Connection	Option 1	Option 2	Option 3	Option 4	Option 5
Black	0.50 BWS	L1	208-230 VAC	208-230 VAC	208-230 VAC	208-230 VAC	208-230 VAC
Brown	0.50 BWS	L2	208-230 VAC	208-230 VAC	208-230 VAC	208-230 VAC	208-230 VAC
Green	#10 EYELET	Ground	GND	GND	GND	GND	GND
Blue	0.50 BWS	Common	Common	24 VAC	24 VAC	24 VAC	24 VAC
Yellow	0.50 BWS	Signal	PWM		24 VAC		24 VAC
White	0.50 BWS	Signal				24 VAC	24 VAC
Orange	0.50 BWS	Signal		24 VAC		24 VAC	
		RPM	300-1100	300	500	850	1100
		Rotation	CCW	CCW	CCW	CCW	CCW
		ECM Toolbox ID	Variable	Speed 4	Speed 3	Speed 2	Speed 1
		20% PWM RPM	300				
		100% PWM RPM	1100				

VFD Controlled Condenser Fan Startup

With Customer Provided Unit Controls the VFD's are factory provided and factory programmed. VFD's receives input from pressure transducers on each refrigerant circuit and vary the fan speed based on the pressure inputs to maintain a discharge (head) pressure. Standard pressure setpoint is 340 psi for standard air-cooled systems and 400 psi for modulating hot gas reheat air-cooled systems.

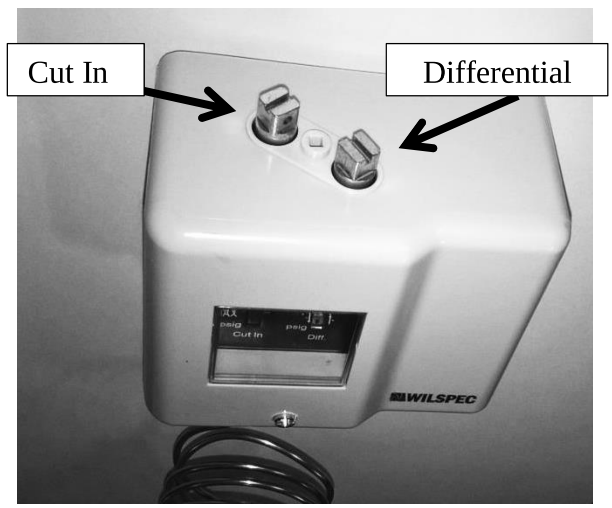
With WattMaster Unit Controls the WattMaster Condenser Head Pressure Module is used to maintain a discharge pressure. The VFD should be factory wired to the outputs of the WattMaster Condenser Head Pressure Module. See WattMaster literature for additional information. (http://www.orioncontrols.com).

Adjustable Fan Cycling Switch Procedure

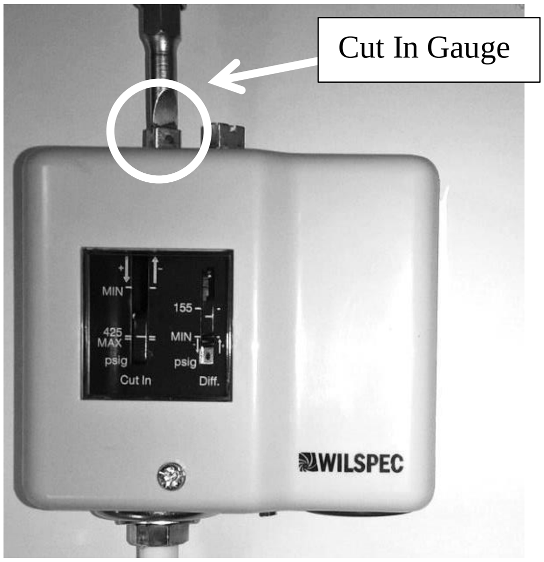
Recommended Settings
The switch will come factory set to cut-in at 425psi (+/– 5psi) and a differential of 155psi (or open at 270psi (+/– 5psi)).

To adjust the fan cycle switch you will need a flathead screwdriver.

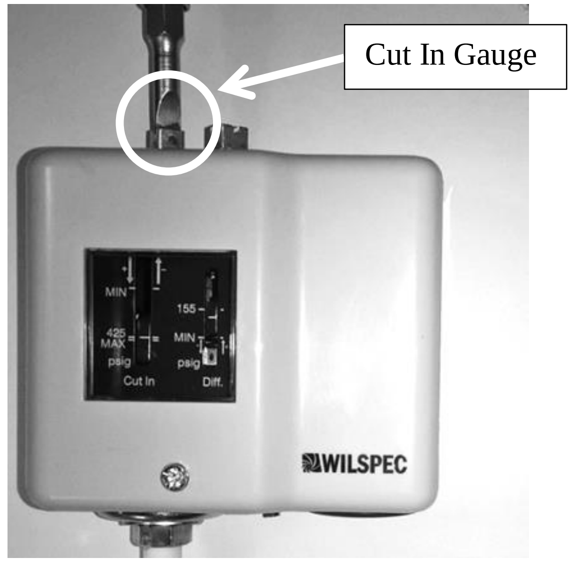
Settings for CUT IN and DIFFERENTIAL PRESSURE are indicated with two slider gauges.



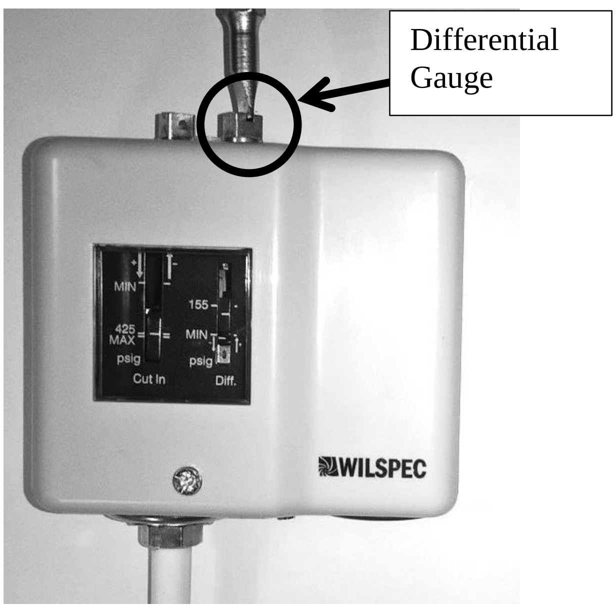
Each adjustment screw sits above the setting that it controls.



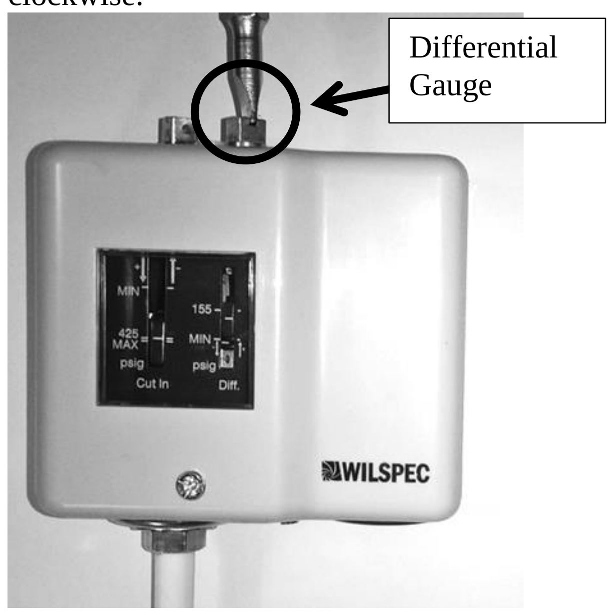
To lower the pressure set point for the **CUT IN** gauge, turn the adjustable screw clockwise.



To raise the pressure set point for the **CUT IN** gauge, turn the adjustable screw counter clockwise.



To raise the pressure set point for the **DIFFERENTIAL** Gauge, turn the adjustable screw clockwise.



To lower the pressure set point for the **DIFFERENTIAL** Gauge, turn the adjustable screw counter clockwise.

NOTE: The pressure values on the gauge should be verified with gauges on the refrigerant line. The gauge scale is for illustration purposes only.

Operation

Unit operations should be controlled with thermostat, or unit controller, never at the main power supply, except for servicing, emergency, or complete shutdown of the unit.

Thermostat Operation

Heating

Thermostat system switch - "Heat"
Thermostat fan switch - "Auto" or "On"
Thermostat temperature set to desired point.

Cooling

Thermostat system switch - "Cool"
Thermostat fan switch - "Auto" or "On"
Thermostat temperature set to desired point.

Air Circulation

Thermostat system switch - "Off"
Thermostat fan switch - "Auto" or "On"
No change of the thermostat temperature.
With these settings, the supply blower will run continuously but the supply air will not be heated, cooled, or dehumidified.

System Off

Thermostat system switch - "Off"
Thermostat fan switch - "Auto"
No change of the thermostat temperature.
With these settings the system is shut down, with the exception of control system power.

Night and Weekend Unoccupied Operation

To reduce the operating time of the unit when the space is unoccupied, such as nights and weekends, it is recommended that the temperature setting be raised about 5°F while unoccupied during the cooling season and lowered about 10°F during the heating season.

Packaged DX Cooling Operation and Control

When a call for cooling (G and Y1, Y2, etc.) is made the supply blower motors and compressors will energize.

⚠ WARNING

COMPRESSOR CYCLING

5 MINUTE MINIMUM OFF TIME
To prevent motor overheating compressors must cycle off for a minimum of 5 minutes.

5 MINUTE MINIMUM ON TIME
To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 6 starts per hour.

Note: When using field controls any variable capacity compressors should run at 100% for 1 minute when starting.

Gas Heater Operation

When heat (G and W1, W2, etc.) is called for the combustion motor starts and the ignition control is energized. The control sends 24 VAC to the main gas valve and high voltage to the igniter. If a burner flame has been detected within 10 seconds, the spark is extinguished and the flame continues. If a flame has not been detected after 10 seconds, the gas valve closes, the spark ceases and the induced draft blower continues to purge the heat exchanger. After 45 seconds of purge, the ignition system will attempt to light the burners again. Should no flame be detected after 3 tries, the ignition control will lock out the system. Power to the ignition control must be cycled to reset the heater control.

On a fault the gas train is shut down by a main limit located in the heat exchanger area or by an auxiliary limit mounted in the supply fan compartment.

Electric Heating Operation
When a call for heating (G and W1, W2, etc.) is made the supply blower motors and electric resistance heaters will energize. Heating is accomplished by passing electrical current through a specified amount of resistance heaters which will produce the required heat.

On a fault condition the main limit located in the supply air or the auxiliary limit located downstream the supply blower will remove power from all contactors.

Steam or Hot Water Preheating and Heating Operation
Valve control for steam and hot water heating coils are by others. Heating is accomplished by passing steam or hot water through the steam or hot water coil assembly.

Modulating Electric Preheat
Electric preheat is used to temper the incoming outside air to the unit based on an enable control signal and outside air conditions. Electric preheat has a maximum operation outside air temperature of 60°F and a maximum preheat discharge air temperature of 80°F.

Chilled Water or Non-Compressorized DX Cooling Operation
Controls for chilled water cooling coils and non-compressorized DX coil are by others.

Maintenance

(See back of the manual for maintenance log)

At least once each year, a trained, qualified service technician should check out the unit. Fans, evaporator coils, and filters should be inspected at least monthly.

Gas Heating

WARNING

Once a year, before the unit is in operation for the heating season, a qualified service technician should inspect all flue product carrying areas of the furnace and main burners for continued safe operation.

DANGER

LEAK CHECK GAS PIPE

The gas pipe in the unit should be checked for leaks before startup. Leak checking is the responsibility of the installing contractor. All connections should be checked for leaks annually after installation. Failure to leak check could result in fire, explosion, or other hazardous situations.

Make sure all gas supply lines have been purged of air before turning on the electrical power switch. Turn the gas valve to the on position (see startup instructions). Turn the main electrical power on and set the controls to the heating mode of operation.

The combustion ventilation motor should operate. The control will automatically supply energy to the igniter and the gas valve after the heating call is made.
The flame sensing probe detects the presence of the flame. Should no flame be

detected in 10 seconds, the ignition system will recycle. If no flame is detected after 3 tries, ignition system will lockout.

Remove the call for heating. The main gas valves should be extinguished.

The supply fans are controlled by the ignition system. In the fan "Auto" mode the fan comes on 45 seconds after the flame is proved and goes off 120 seconds after the heating call is removed.

Furnace combustion ventilation air and flue openings should be checked annually for debris and obstructions. If vent extensions are used they must meet category III requirements.

This appliance contains a wire screen at the vent outlet. Each heating season, prior to placing the appliance in heat mode maintenance check that no debris or foreign matter has accumulated in the vent outlet. A good practice is to check for debris each time the air filters are changed.

In the event the vent outlet becomes blocked do not attempt to start the appliance in heat mode until the entire vent opening is cleared.

In the event the unit shut down because the vent was blocked a qualified technician or service agency should monitor the unit prior to re-starting.

The gas burner and heat exchanger should never require cleaning. If cleaning is necessary, this indicates faulty operation of the unit. Cleaning should only be done by a qualified service agency and only after consultation with an AAON service representative.
If induced draft blower/motor assembly has to be replaced, care must be taken to provide an airtight seal between the blower housing and the burner box.

Gas Heat Exchanger Removal

WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

DANGER

LEAK CHECK GAS PIPE

The gas pipe in the unit should be checked for leaks before startup. Leak checking is the responsibility of the installing contractor. All connections should be checked for leaks annually after installation. Failure to leak check could result in fire, explosion, or other hazardous situations.

Removal
Disconnect all wiring on the heat exchanger.

Disconnect flex gas lines and pull out of the way.

Remove screws around the perimeter of the heat exchanger face plate that connect it to the unit. Only the outermost screws should be removed.
Pull the heat exchanger straight back and out of the unit. It may be necessary to remove some of the control door jambs.

Reinstallation
Ensure that the neoprene isolator is installed around the perimeter of the heat exchanger.
Insert heat exchanger into opening so that the back of the main plate is against the unit bulkhead.

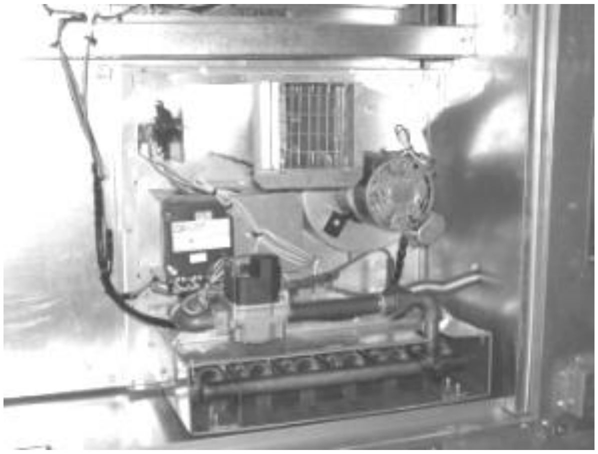


Figure 50 - Gas Heat Exchanger

Attach the heat exchanger to the bulkhead using the holes around the perimeter.

Connect flex gas lines to the piping on the heat exchanger. If flexible gas piping in the unit must be replaced connectors cannot be reused, only new connectors must be used.

Connect wiring per the wiring diagram on the controls compartment door.
Purge gas lines to the gas valves at the unit.

DX Cooling
Set unit controls to cooling mode of operation with supply fans on. Check the fan for correct operating direction, amperage and voltage. Check compressor operation, rotation, amperage and voltage to the unit nameplate (check the amperage on the load side of the compressor contactor).

Condenser Fans (6-25 and 30 ton)
Condenser fans and motors can be removed and reinstalled as individual assemblies.

⚠ WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

⚠ WARNING

Improper installation, adjustment, alteration, service, or maintenance can cause property damage, personal injury, or loss of life. Startup and service must be performed by a Factory Trained Service Technician.

Removal
Take off the fan grill by removing the screws that attach it to the orifice.

The condenser fan motor wires can then be accessed and disconnected.

Remove the screws that attach the orifice to the condenser assembly. The screws are located on the top of the orifice around the perimeter, and in some cases, through the side of the condenser assembly into the orifice.

With the wires disconnected and the screws removed, the fan, motor and orifice assembly can be lifted off the unit.

Figure 51 - Removal of a Condenser Fan Assembly

Reinstallation
Set the condenser fan, motor and orifice assembly back into the condenser assembly with the motor wires on the side closest to the control panel.

Attach the orifice to the condenser assembly using all of the points where screws were removed.

Reconnect the fan motor wires.

Attach the fan grill at all of the points where screws were removed.

Condensate Drain Pans
Drain pans will have moisture present and require periodic cleaning to prevent microbial growth. Cleaning of the drain pans will also prevent any possible plugging of the drain lines and overflow of the pan itself. Cleaning of the drain pans and inside of the unit should be done only by qualified service technician.

Evaporator Coil (6-25 and 30 ton)

⚠ WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

Removal
Evacuate refrigerant from the systems.

Remove the expansion valve bulbs from the suction lines. Disconnect the suction and liquid line copper connections to the evaporator coil.

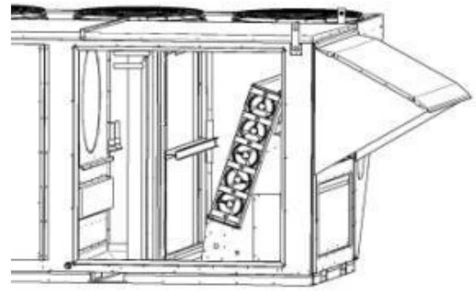


Figure 52 - Evaporator Coil Access

Remove the screws attaching the filter rack to the evaporator coil blank-off panels at the door opening and along the top of the coil.

Remove the screws attaching the filter rack to the back wall. Angle filter rack away from coil so it fits through the door opening. It may be necessary to remove economizer damper assembly.

Remove screws attaching access side, back, and top blank-off panels to the evaporator coil and the unit.

Angle the coil so that it fits through the door opening.
Remove the evaporator coil.

Reinstallation
Install the coil in the unit drain pan. There should be about a 1/4” gap between the upstream side of the coil and the back of the drain pan.

Secure the coil to the back wall of the unit with the blank-off panel. Attach the top and access side blank-off panels to the coil.

Attach the filter rack to the back, top, and access side coil blank-off panels upstream of the coil. Reinstall economizer damper assembly if necessary.

Connect the suction and liquid copper connections to the evaporator coil. Reinstall the expansion valve bulbs on the suction lines.

Evacuate the refrigerant systems. Weigh in the nameplate refrigerant charge.

See Adjusting Refrigerant Charge section to check for proper sub-cooling and superheat of the refrigerant systems.

Brazed Plate Heat Exchanger Cleaning
Because of a normally high degree of turbulence in brazed plate heat exchangers, for many applications the heat exchanger channels are self cleaning. For applications that are not self cleaning (i.e. hard water at high temperatures, etc.) or applications where additional cleaning is desired, it is possible to clean the brazed plate heat exchanger by circulating a cleaning liquid.

Use a tank with weak acid, 5% phosphoric acid (H_3PO_4) or, if the exchanger is frequently cleaned, 5% oxalic acid ($H_2C_2O_4$). Pump the cleaning liquid through the exchanger. For optimum cleaning, the cleaning solution flow rate should be a minimum of 1.5 times the normal flow rate, preferably in a back-flush mode. After cleaning, the heat exchanger must be rinsed with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO) before the last rinse ensures that all acid is neutralized.

E-Coated Coil Cleaning
Documented routine cleaning of e-coated coils is required to maintain coating warranty coverage for fin and tube and microchannel coils.

WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

Surface loaded fibers or dirt should be removed prior to water rinse to prevent restriction of airflow. If unable to back wash the side of the coil opposite of the coils entering air side, then surface loaded fibers or dirt should be removed with a vacuum cleaner. If a vacuum cleaner is not available, a ***soft non-metallic*** bristle brush may be used. In either case, the tool should be applied in the direction of the fins. Coil surfaces can be easily damaged (fin edges bent over) if the tool is applied across the fins.

Use of a water stream, such as a garden hose, against a surface loaded coil will drive the fibers and dirt into the coil. This will make cleaning efforts more difficult. Surface loaded fibers must be completely removed prior to using low velocity clean water rinse.

A ***monthly*** clean water rinse is recommended for coils that are applied in coastal or industrial environments to help to remove chlorides, dirt, and debris. It is very important when rinsing, that water temperature is less than 130°F and pressure is less than 100 psig to avoid damaging the fin edges. An elevated water temperature (not to exceed 130°F) will reduce surface tension, increasing the ability to remove chlorides and dirt.

⚠ CAUTION

High velocity water from a pressure washer or compressed air should only be used at a very low pressure to prevent fin and/or coil damages. The force of the water or air jet may bend the fin edges and increase airside pressure drop. Reduced unit performance or nuisance unit shutdowns may occur.

Quarterly cleaning is essential to extend the life of an e-coated coil and is required to maintain coating warranty coverage. Coil cleaning shall be part of the unit's regularly scheduled maintenance procedures. Failure to clean an e-coated coil will void the warranty and may result in reduced efficiency and durability.

⚠ CAUTION

Harsh chemicals, household bleach, or acid cleaners should not be used to clean outdoor or indoor e-coated coils. These cleaners can be very difficult to rinse out of the coil and can accelerate corrosion and attack the e-coating. If there is dirt below the surface of the coil, use the recommended coil cleaners.

For routine quarterly cleaning, first clean the coil with the below approved coil cleaner. After cleaning the coils with the approved cleaning agent, use the approved chloride remover to remove soluble salts and revitalize the unit.

Recommended Coil Cleaner

The following cleaning agent, assuming it is used in accordance with the manufacturer's directions on the container for proper mixing and cleaning, has been approved for use on e-coated coils to remove mold, mildew, dust, soot, greasy residue, lint, and other particulate:

Enviro-Coil Concentrate, Part Number H-EC01.

Recommended Chloride Remover

CHLOR*RID DTS™ should be used to remove soluble salts from the e-coated coil, but the directions must be followed closely. This product is not intended for use as a degreaser. Any grease or oil film should first be removed with the approved cleaning agent.

Remove Barrier - Soluble salts adhere themselves to the substrate. For the effective use of this product, the product must be able to come in contact with the salts. These salts may be beneath any soils, grease or dirt; therefore, these barriers must be removed prior to application of this product. As in all surface preparation, the best work yields the best results.

Apply CHLOR*RID DTS - Apply directly onto the substrate. Sufficient product must be applied uniformly across the substrate to thoroughly wet out surface, with no areas missed. This may be accomplished by use of a pump-up sprayer or conventional spray gun. The method does not matter, as long as the entire area to be cleaned is wetted. After the substrate has been thoroughly wetted, the salts will be soluble and is now only necessary to rinse them off.

Rinse - It is highly recommended that a hose be used, as a pressure washer will damage the fins. The water to be used for the rinse is recommended to be of potable quality, though a lesser quality of water may be used if a small amount of CHLOR*RID DTS is added. Check with CHLOR*RID International, Inc. for recommendations on lesser quality rinse water.

Microchannel Coil Cleaning

Air-cooled heat exchangers may include microchannel coils.

Cleaning microchannel coils is necessary in all locations. In some locations it may be necessary to clean the coils more or less often than recommended. In general, a condenser coil should be cleaned at a minimum of once a year. In locations where there is commonly debris or a condition that causes dirt/grease build up it may be necessary to clean the coils more often. Proper procedure should be followed at every cleaning interval. Using improper cleaning technique or incorrect chemicals will result in coil damage, system performance fall off, and potentially leaks requiring coil replacement.

Documented routine cleaning of microchannel coils with factory provided e-coating is required to maintain coating warranty coverage. Use the E-Coated Coil Cleaning section for details on cleaning e-coated coils.

Field applied coil coatings are not recommended with microchannel coils.

Allowed Chemical Cleaners and Procedures

AAON recommends certain chemicals that can be used to remove buildup of grime and debris on the surface of microchannel coils. These chemicals have been tested for performance and safety and are the only chemicals that AAON will warrant as correct for cleaning microchannel coils.

There are two procedures that are outlined below that will clean the coils effectively without damage to the coils. Use of any other procedure or chemical may void the warranty to the unit where the coil is installed. **With all procedures make sure the unit is off before starting.**

⚠ WARNING ⚠

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

The water pressure used to clean should not exceed 140 psi, from no closer than 6 inches from the coils, and with the water aimed perpendicular to the coils.

#1 Simple Green

Simple Green is available from AAON Parts and Supply (Part# T10701) and is biodegradable with a neutral 6.5 pH. Recommendation is to use it at a 4 to 1 mix. Use the following procedure.

1. Rinse the coil completely with water. Use a hard spray but be careful not to bend or damage the fins. A spray that is too hard will bend the fins. Spray from the fan side of the coil.
2. With a pump sprayer filled with a mix of 4 parts water to one part Simple Green spray the air inlet face of the coil. Be sure to cover all areas of the face of the coil.
3. Allow the coil to soak for 10-15 minutes.
4. Rinse the coil with water as in step one.
5. Repeat as necessary.

#2 Water Flush

This procedure can be used when the only material to cause the coil to need cleaning is debris from plant material that has impinged the coil face.

1. Rinse the coil completely with water. Use a hard spray but be careful not to bend or damage the fins. A spray that is too hard will bend the fins. Spray from the fan side of the coil.
2. Spray and rinse the coil from the face.

⚠ CAUTION

Use pressurized clean water, with pressure not to exceed 140 psi. Nozzle should be 6” and 80° to 90° from coil face. Failure to do so could result in coil damage.

Application Examples

The two procedures can be used to clean microchannel coils. They will fit with the application depending on the area. In some areas where the spring/summer has a large cottonwood bloom #2 might work fine if the unit is installed on an office building and no other environmental factors apply.

Generally the best and broadest based procedure is #1. The grease cutting effect of the Simple Green is good for restaurant applications.

Other Coil Cleaners

There are many cleaners on the market for condenser coils. Before using any cleaner that is not covered in this section you must get written approval from the AAON warranty and service department. Use of unapproved chemicals will void the warranty.

AAON testing has determined that unless a chemical has a neutral pH (6-8) it should not be used.

Beware of any product that claims to be a foaming cleaner. The foam that is generated is caused by a chemical reaction to the aluminum fin material on tube and fin coils and with the fin, tube, and coating material on microchannel coils.

Microchannel coils are robust in many ways, but like any component they must be treated correctly. This includes cleaning the coils correctly to give optimal performance over many years.

Roofing
The cleaning procedures outlined here use relatively benign ingredients. When working with a rooftop unit care should be taken to make sure the chemicals will not adversely affect the roof coating. Checking with the roofing supplier/manufacturer is the best way to proceed. If the roofing supplier/manufacturer is not available testing of the chemicals on the roof coating is recommended.

Commercial roofing material manufacturers using PVC and EPDM have been contacted and indicate that there should be no problem with any of the procedures outlined above.

Supply Fans

⚠ WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

⚠ CAUTION

Blower wheels and bands must be inspected for excessive dust build up periodically and cleaned if required. Excessive dust build up on blower wheels may cause an unbalanced state; leading to vibration and/or component failure. Damages due to excessive dust build up will not be covered under factory warranty.

Lubrication
All original fan motors and bearings are furnished with factory lubrication. Some applications will require that bearings be re-lubricated periodically. The schedule will depend on the operating duty, temperature variations or other severe atmospheric conditions.

Bearings should be re-lubricated when at normal operating temperatures, but not running. Rotate the fan shaft by hand and add only enough grease to purge the seals. DO NOT OVERLUBRICATE.

Recommended greases are:
SHELL OIL - DOLIUM R
CHEVRON OIL - SRI No. 2
TEXACO INC. - PREMIUM RB

Removal (6-25 and 30 tons)
Remove fan access panel. Panel is attached with eight 3/8” bolts.

Remove the wire connections from Auxiliary Limit Switch (if applicable) which is mounted in the brace at the fan opening.

Remove the brace located at the fan opening.

Remove the six bolts that connect the motor mount to the blower frame. Two bolts are on the angle on the back of the motor mount box, two are on the bottom inside the motor mount box and two are on the inside front of the motor mount box.

Figure 53 - 9-25 and 30 ton Supply Fan

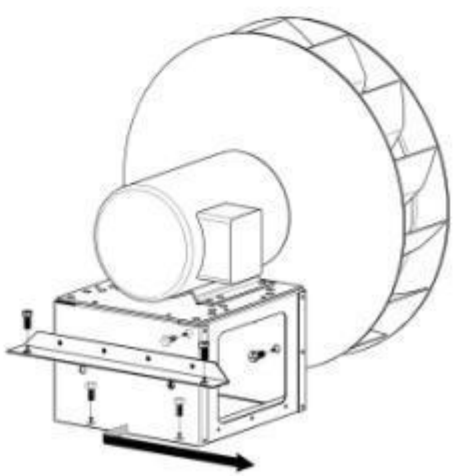


Figure 54 - Bolts which Connect Motor Mount to Blower Fan

Slide the motor mount back away from the air inlet, so that the blower wheel is clear of the inlet. A screw driver or crowbar can be used to help accomplish this. Use the pry slots on the back side of the motor mount.

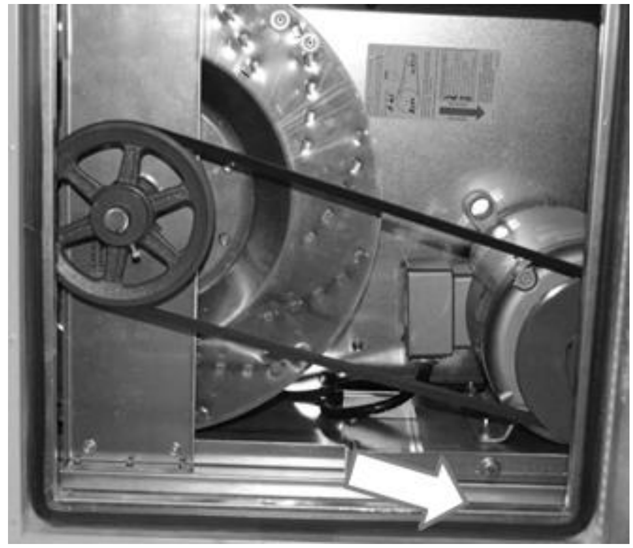
Pull the motor mount to the edge of the blower frame at the opening.

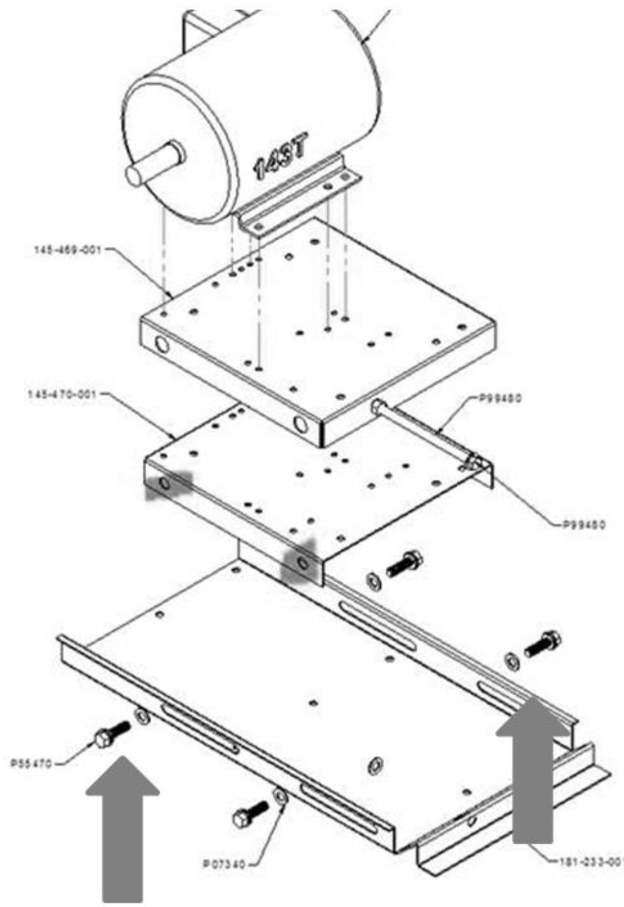
Remove the motor mount with the motor and blower wheel attached. Large motors will require more than one person.

Care must be taken not to damage the compressors or refrigerant lines when removing the motor and fan assembly.

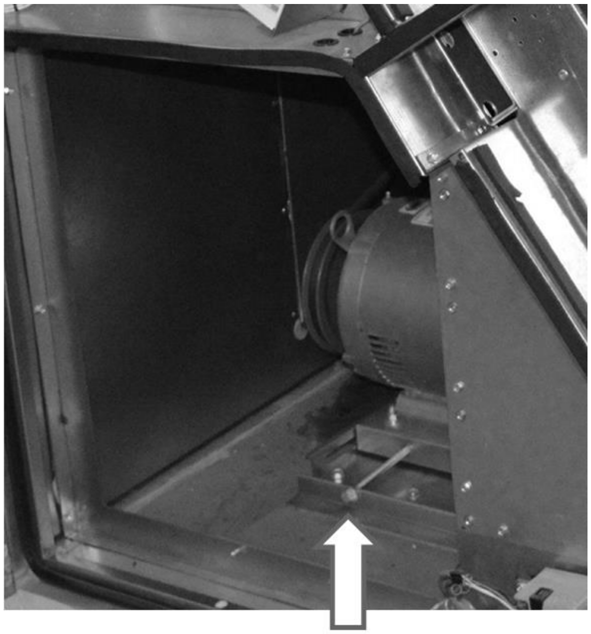
Power Exhaust Motor and Belt Removal

1. Remove the four bolts holding the motor mount. There are rivet nuts on the backside.





2. Remove the belt tensioner bolt completely, as indicated by the arrow below.



3. At this point the motor mount can be slid toward the wheel, and the belt can be removed.
4. Once the belt is removed the motor and mount can be lifted out. Make sure the wires to the motor are loose.

Phase and Brownout Protection Module

The DPM is a Digital Phase Monitor that monitors line voltages from 200VAC to 240VAC 1ϕ and 200VAC to 600VAC 3ϕ. The DPM is 50/60 Hz self-sensing. DPM should be wired according to unit specific wiring diagram include in the control compartment

When the DPM is connected to the line voltage, it will monitor the line and if everything is within the setup parameters, the output contacts will be activated. If the line voltages fall outside the setup parameters, the output relay will be de-energized after the trip delay.

Once the line voltages recover, the DPM will re-energize the output relay after the restart time delay. All settings and the last 4 faults are retained, even if there is a complete loss of power.

DPM Setup Procedure

With the supply voltage active to the module, you can setup all of the DPM's settings without the line voltage connected.

To change the setpoint parameters use the right arrow key to advance forward through the setpoint parameters and the left arrow to backup if needed. When each parameter is displayed use the up/down keys to change and set the parameter.

After adjustments are made or if no adjustments are made it will take 2 to 4 minutes before the DPM energizes the output relay unless there is an out of tolerance issue with the incoming line voltage.

Recommended Default Set-up

Line Voltage	460VAC, 3Ø
Over & Undervoltage	±10%
Trip Time Delay	5 Seconds
Re-Start Time Delay	2 Minutes
Phase Imbalance	5%

Screens

Manufacturer's Screen

R-K Electronics
DPM v0.0.00

Average Voltage Screen

VAvg	Imb	Hz	
460	0	60	off

Default – the default screen shows the real time voltage detected in each of the 3 phases:

A-B	B-C	C-A	
460	459	461	ON

Voltage Selection Screen (Vertical Format) Default = 460V, 3Ø

200, 1Ø; 208, 1Ø; 220, 1Ø; 230, 1Ø; 240, 1Ø;
200, 3Ø; 208, 3Ø; 220, 3Ø; 230, 3Ø; 240, 3Ø; 380, 3Ø; 415, 3Ø; 440, 3Ø; 460, 3Ø; 480 3Ø; 575, 3Ø; 600, 3Ø;

Over/Under voltage Percentage Screen (Vertical Format) Default = 10%

7% 8% 9% 10% 11% 12% 13% 14% & 15%

Trip Time Delay Screen (Vertical Format) Default = 5 sec

2S, 3S, 4S, 5S, 6S, 27S, 8S, 9S & 10S

Re-Start Time Delay Screen (Vertical Format) Default = 2 sec

Manual, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 30S, 1M, 2M, 3M & 4M

Phase Imbalance Percentage Screen (Vertical Format) Default = 5%

3% 4% 5% 6% 7% 8% 9% & 10%

Fault Screen (Vertical Format)

"0" most recent faults, "1" previous fault "2" third oldest fault & "3" fourth oldest fault.

Fault Words:

"Phase a Loss"	(There is no voltage sensed on 3-L1/S)
"Voltage Low"	(Average line voltage is less than selected Undervoltage Percentage)
"Voltage High"	(Average line voltage is more than selected Overvoltage Percentage)
"Imbalance"	(One phase is lower than the average voltage by more than the Imbalance percentage)
"Phase Loss	(One phase is more than 30% below the Line Voltage selection)
"Bad Rotation"	(The phase rotation sequence is reversed)
"Bad Freq"	(Line frequency out of allowable range of 45 to 65 Hz)

Variable Capacity Compressor Controller

Units with variable capacity scroll compressors may include the following compressor controller. The following is an explanation of the terminals and troubleshooting alert flash codes of the controller. For more information on the compressor controller, see Emerson Climate Bulletin AE8-1328.

Note: When using field controls any variable capacity compressors should run at 100% for 1 minute when starting.

Figure 55 - Variable Capacity Compressor Controller

⚠ WARNING

To avoid damaging the Compressor Controller do not connect wires to terminals C3, C4, T3, T4, T5, or T6.

Low Voltage Terminals

24COM	Module Common
24VAC	Module Power
C1 & C2	Demand Input – & +
P1	Pressure Common
P2	Pressure Input
P3	Pressure Power 5VDC
P4	Pressure Shield
P5 & P6	Pressure Output – & +
T1 & T2	Discharge Temperature Sensor

High Voltage Terminals

A1 & A2	Alarm Relay Out
M1 & M2	Contractor
L1	Control Voltage N
L2	Control Voltage L
U1 & U2	Digital Unloader Solenoid
V1 & V2	Vapor Injection Solenoid

The compressor controller modulates the compressor unloader solenoid in an on/off pattern according to the capacity demand signal of the system. The following table shows the linear relationship between the demand signal and compressor capacity modulation. The compressor controller protects the compressor against high discharge temperature. Refer to Appendix B for the relationship between thermistor temperature readings and resistance values.

Table 34 - Demand Signal vs. Compressor Capacity Modulation

Demand Signal (VDC)	Loaded %	Unloaded %	Time Loaded	Time Unloaded	% Compressor Capacity
1.00	Off	Off	Off	Off	0%
1.44	10%	90%	1.5 sec	13.5 sec	10%
3.00	50%	50%	7.5 sec	7.5 sec	50%
4.20	80%	20%	12 sec	3 sec	80%
5.00	100%	0%	15 sec	0 sec	100%

LED Descriptions
Green LED - 24VAC Power
Yellow LED - Unloader Solenoid On
Red LED - ALERT Flash Code

- Flashing Green LED indicates anti-short cycle timer active
- All LEDs flashing at same rate indicates 24VAC supply too low for operation
- All LEDs solid at same time indicates controller failure
- Reset ALERT code or lockout by removing 24VAC supply to module
- All ALERTs close alarm relay contacts
- All ALERTs deenergize contactor and solenoids except Code 6
- Compressor always unloads for 0.1 second at startup
- Compressor only starts when Demand signal input is above 1.45 VDC and no ALERTs are present

Troubleshooting ALERT Flash Codes

Code 1 Reserved for future use

Code 2 High Discharge Temperature
Discharge thermistor above trip set point or thermistor short circuited.
Resets after 30 minutes and motor cools down.
If 5 events occur within 4 hours, the compressor is locked out.

Code 3 Compressor Protector Trip
No compressor current is detected when compressor should be running.
Resets when compressor current is detected.

Code 4 Locked Rotor
Locked rotor condition is detected. Compressor is locked out.

Code 5 Demand Signal Loss
Demand input signal is below 0.5VDC. Resets after demand input signal rises above 1.0VDC.

Code 6 Discharge Thermistor Fault
Thermistor is not connected. Reset by reconnecting thermistor.

Code 7 Reserved for future use

Code 8 Compressor Contactor Fault
Compressor current is detected when compressor should be off. Resets when current is no longer detected.

Code 9 Low 24VAC Supply
Supply voltage to module has dropped below 18.5VAC. Resets after voltage rise above 19.5VAC.

Figure 56 - Compressor Controller Flash Code Details

Filter Replacement
Monthly air filter inspection is required to maintain optimum unit efficiency.

⚠ WARNING

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

It is strongly recommended that filter media be replaced monthly. Filters are located upstream of the evaporator coil in the filter and economizer section. Open access door and pull filters straight out to inspect all of the filters. Replace filters with the size indicated on each filter or as shown in the tables below. Arrow on the replacement filters must point towards the blower. (RAB = Return Air Bypass, PE = Power Exhaust and PR = Power Return)

Table 35 - 6-8 and 10 ton Pre Filters

<table>
<tr><th>Feature 6A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td>0</td><td>No Pre Filters</td><td></td></tr>
<tr><td>A, E</td><td>4 / 16” x 20” x 2”</td><td>Pleated, MERV 8</td></tr>
<tr><td>B, E</td><td>2 / 16” x 20” x 1”</td><td>Metal Mesh, Outside Air</td></tr>
<tr><td rowspan="2">C</td><td>2 / 40” x 16” x 5/16”</td><td rowspan="2">Lint Screen</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
2 / 40” x 16” x 5/16”</td></tr>
</table>

Table 36 - 9 and 11-15 ton Pre Filters

<table>
<tr><th>Feature 6A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td>0</td><td>No Pre Filters</td><td></td></tr>
<tr><td>A, E</td><td>4 / 20” x 25” x 2”</td><td>Pleated, MERV 8</td></tr>
<tr><td>B, E</td><td>2 / 20” x 25” x 1”</td><td>Metal Mesh, Outside Air</td></tr>
<tr><td rowspan="2">C</td><td>2 / 49” x 20” x 5/16”</td><td rowspan="2">Lint Screen</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
3 / 47” x 12” x 5/16”</td></tr>
</table>

Table 37 – 14, 16-25 and 30 ton Pre Filters

<table>
<tr><th>Feature 6A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td>0</td><td>No Pre Filters</td><td></td></tr>
<tr><td>A, E</td><td>6 / 20” x 25” x 2”</td><td>Pleated, MERV 8</td></tr>
<tr><td>B, E</td><td>3 / 20” x 25” x 1”</td><td>Metal Mesh, Outside Air</td></tr>
<tr><td rowspan="2">C</td><td>2 / 55” x 25” x 5/16”</td><td rowspan="2">Lint Screen</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
3 / 55” x 16” x 5/16”</td></tr>
</table>

Table 38 - 26, 31, and 40 ton Pre Filters

<table>
<tr><th>Feature 6A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td>0</td><td>No Pre Filters</td><td></td></tr>
<tr><td rowspan="2">A, E</td><td>8 / 24” x 24” x 2”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 2”</td></tr>
<tr><td rowspan="2">B, E</td><td>6 / 16” x 25” x 1”</td><td rowspan="2">Metal Mesh, Outside Air</td></tr>
<tr><td>with PE or PR, Feature 1A = B, C
4 / 16” x 25” x 1”</td></tr>
<tr><td>C</td><td>8 / 24” x 24” x 5/16”</td><td>Lint Screen</td></tr>
</table>

Table 39 - 50, 60, and 70 ton Pre Filters

<table>
<tr><th>Feature 6A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td>0</td><td>No Pre Filters</td><td></td></tr>
<tr><td>A, E</td><td>24 / 12” x 24” x 2”</td><td>Pleated, MERV 8</td></tr>
<tr><td rowspan="2">B, E</td><td>6 / 16” x 25” x 1”</td><td rowspan="2">Metal Mesh, Outside Air</td></tr>
<tr><td>with PE or PR, Feature 1A = B, C
4 / 16” x 25” x 1”</td></tr>
<tr><td>C</td><td>12 / 47” x 12” x 5/16”</td><td>Lint Screen</td></tr>
</table>

Table 40 - 55, 65, and 75 ton Pre Filters

Feature		Quantity / Size	Type
6A	6B		
0	0,B,C,F,G,H	No Pre Filters	
A, E	0,B,C,F,G,H	15 / 20” x 24” x 2” & 5 / 16” x 20” x 2”	Pleated, MERV 8
B, E	0,B,C,F,G,H	28 / 20” x 20” x 1”	Metal Mesh, Outside Air
C	0,C	8 / 40” x 18” x 5/16” & 8 / 20” x 18” x 5/16”	Lint Screen
C	B,F,G,H	1 / 60” x 16” x 5/16” & 3 / 60” x 24” x 5/16” & 1 / 40” x 16” x 5/16” & 3 / 40” x 24” x 5/16”	

Table 41 - 90-140 ton Pre Filters

Feature		Quantity / Size	Type
6A	6B		
0	0,B,C,F,G,H	No Pre Filters	
A, E	0,B,C,F,G,H	21 / 20” x 24” x 2” & 7 / 16” x 20” x 2”	Pleated, MERV 8
B, E	0,B,C,F,G,H	28 / 20” x 20” x 1”	Metal Mesh, Outside Air
C	0,C	11 / 20” x 18” x 5/16” & 12 / 40” x 18”	Lint Screen
C	B,F,G,H	2 / 40” x 16” x 5/16” & 6 / 40” x 24” x 5/16” & 1 / 60” x 16” x 5/16” & 3 / 60” x 24” x 5/16”	

Table 42 - 26, 31-50, 60, and 70 ton Preheat Filters

Feature		Quantity / Size	Type
14A	14B		
A, B, C, D	A, B, C, D, E, F	6 / 16” x 25” x 1”	Metal Mesh, Outside Air
		with PE or PR, Feature 1A = B, C 4 / 16” x 25” x 1”	

Table 43 - 6-8 and 10 ton Unit Filters

<table>
<tr><th>Feature 6B</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="2">0</td><td>4 / 16” x 20” x 2”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
2 / 20” x 20” x 2” and
1/12” x 24” x 2”</td></tr>
<tr><td rowspan="2">B</td><td>4 / 16” x 20” x 4”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
2 / 20” x 20” x 4” and
1/12” x 24” x 4”</td></tr>
<tr><td rowspan="2">C</td><td>4 / 16” x 20” x 2”</td><td rowspan="2">Permanent Filter Frame - Replaceable Media</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
2 / 20” x 20” x 2” and
1/12” x 24” x 2”</td></tr>
<tr><td>F</td><td rowspan="3">4 / 16” x 20” x 4”</td><td>Pleated, MERV 11</td></tr>
<tr><td>G</td><td>Pleated, MERV 13</td></tr>
<tr><td>H</td><td>Pleated, MERV 14</td></tr>
</table>

Table 44 - 9 and 11 ton Unit Filters

<table>
<tr><th>Feature 6B</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="2">0</td><td>4 / 20” x 25” x 2”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
6 / 12” x 24” x 2”</td></tr>
<tr><td rowspan="2">B</td><td>4 / 20” x 25” x 4”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
6 / 12” x 24” x 4”</td></tr>
<tr><td rowspan="2">C</td><td>4 / 20” x 25” x 2”</td><td rowspan="2">Permanent Filter Frame - Replaceable Media</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
6 / 12” x 24” x 2”</td></tr>
<tr><td>F</td><td rowspan="3">4 / 20” x 25” x 4”</td><td>Pleated, MERV 11</td></tr>
<tr><td>G</td><td>Pleated, MERV 13</td></tr>
<tr><td>H</td><td>Pleated, MERV 14</td></tr>
</table>

Table 45 - 13 and 15 ton Unit Filters

Feature 6B	Quantity / Size	Type
0	4 / 20” x 25” x 2”	Pleated, MERV 8
	with RAB, Feature A2 = Q, R 6 / 12” x 24” x 2”	
B	4 / 20” x 25” x 4”	Pleated, MERV 8
	with RAB, Feature A2 = Q, R 6 / 12” x 24” x 4”	
C	4 / 20” x 25” x 2”	Permanent Filter Frame - Replaceable Media
	with RAB, Feature A2 = Q, R 6 / 12” x 24” x 2”	
F	4 / 20” x 25” x 4”	Pleated, MERV 11
G		Pleated, MERV 13
H		Pleated, MERV 14

Table 46 – 14, 16-25 and 30 ton Unit Filters

Feature 6B	Quantity / Size	Type
0	6 / 20” x 25” x 2”	Pleated, MERV 8
	with RAB, Feature A2 = Q, R 9 / 16” x 20” x 2”	
B	6 / 20” x 25” x 4”	Pleated, MERV 8
	with RAB, Feature A2 = Q, R 9 / 16” x 20” x 4”	
C	6 / 20” x 25” x 2”	Permanent Filter Frame - Replaceable Media
	with RAB, Feature A2 = Q, R 9 / 16” x 20” x 2”	
F	6 / 20” x 25” x 4”	Pleated, MERV 11
G		Pleated, MERV 13
H		Pleated, MERV 14

Table 47 - 26, 31, and 40 ton Unit Filters

<table>
<tr><th>Feature 6B</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="2">0</td><td>8 / 24” x 24” x 2”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 2”</td></tr>
<tr><td rowspan="2">B</td><td>8 / 24” x 24” x 4”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 4”</td></tr>
<tr><td rowspan="2">C</td><td>8 / 24” x 24” x 2”</td><td rowspan="2">Permanent Filter Frame -
Replaceable Media</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 2”</td></tr>
<tr><td rowspan="2">F</td><td>8 / 24” x 24” x 4”</td><td rowspan="2">Pleated, MERV 11</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 4”</td></tr>
<tr><td rowspan="2">G</td><td>8 / 24” x 24” x 4”</td><td rowspan="2">Pleated, MERV 13</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 4”</td></tr>
<tr><td rowspan="2">H</td><td>8 / 24” x 24” x 4”</td><td rowspan="2">Pleated, MERV 14</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
16 / 12” x 24” x 4”</td></tr>
</table>

Table 48 - RN Series 50, 60, and 70 ton Unit Filters

<table>
<tr><th>Feature 6B</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="2">0</td><td>24 / 12” x 24” x 2”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
28 / 12” x 24” x 2”</td></tr>
<tr><td rowspan="2">B</td><td>24 / 12” x 24” x 4”</td><td rowspan="2">Pleated, MERV 8</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
28 / 12” x 24” x 4”</td></tr>
<tr><td rowspan="2">C</td><td>24 / 12” x 24” x 2”</td><td rowspan="2">Permanent Filter Frame -
Replaceable Media</td></tr>
<tr><td>with RAB, Feature A2 = Q, R
28 / 12” x 24” x 2”</td></tr>
<tr><td>F</td><td rowspan="3">24 / 12” x 24” x 4”</td><td>Pleated, MERV 11</td></tr>
<tr><td>G</td><td>Pleated, MERV 13</td></tr>
<tr><td>H</td><td>Pleated, MERV 14</td></tr>
</table>

Table 49 - 55, 65, and 75 ton Unit Filters

Feature 6B	Quantity / Size	Type
0	25 / 18” x 20” x 2”	Pleated, MERV 8
B	15 / 20” x 24” x 4” & 5 / 16” x 20” x 4”	Pleated, MERV 8
C	25 / 18” x 20” x 2”	Permanent Filter Frame - Replaceable Media
F	15 / 20” x 24” x 4” & 5 / 16” x 20” x 4”	Pleated, MERV 11
G		Pleated, MERV 13
H		Pleated, MERV 14

Table 50 - 90-140 ton Unit Filters

Feature 6B	Quantity / Size	Type
0	35 / 18” x 20” x 2”	Pleated, MERV 8
B	21 / 20” x 24” x 4” & 7 / 16” x 20” x 4”	Pleated, MERV 8
C	35 / 18” x 20” x 2”	Permanent Filter Frame - Replaceable Media
F	21 / 20” x 24” x 4” & 7 / 16” x 20” x 4”	Pleated, MERV 11
G		Pleated, MERV 13
H		Pleated, MERV 14

Table 51 - 6-8 and 10 ton Energy Recovery Wheel Filters

Feature 1A	Quantity / Size	Type
F, G, H, J, Q, R, S, T	(Prior to August 2014) 1 / 25” x 16” x 4”	Pleated, MERV 8
	(Prior to August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 1 / 25” x 16” x 2” EA - 1 / 25” x 16” x 2”	
	(After August 2014) With V-Bank Outside Air Filters OA - 2 / 25” x 14” x 2”	
	(After August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 2 / 25” x 14” x 2” EA - 1 / 25” x 16” x 2”	

Table 52 - 9 and 11-15 ton Energy Recovery Wheel Filters

<table>
<tr><th>Feature 1A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="4">F, G, H, J, Q, R, S, T,
U, V, W, Y, Z, 1, 2, 3</td><td>(Prior to August 2014)
2 / 16” x 20” x 4”</td><td rowspan="4">Pleated, MERV 8</td></tr>
<tr><td>(Prior to August 2014)
With Energy Recovery Wheel Exhaust
Air Filters, Feature 6A - D, F, G
OA - 2 / 16” x 20” x 2”
EA - 2 / 16” x 20” x 2”</td></tr>
<tr><td>(After August 2014)
With V-Bank Outside Air Filters
OA - 4 / 20” x 12” x 2”</td></tr>
<tr><td>(After August 2014)
With Energy Recovery Wheel Exhaust
Air Filters, Feature 6A - D, F, G
OA - 4 / 20” x 12” x 2”
EA - 2 / 16” x 20” x 2”</td></tr>
</table>

Table 53 – 14, 16-25 and 30 ton Energy Recovery Wheel Filters

<table>
<tr><th>Feature 1A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="4">F, G, H, J, Q, R, S, T,
U, V, W, Y, Z, 1, 2, 3</td><td>(Prior to August 2014)
3 / 20” x 25” x 4”</td><td rowspan="4">Pleated, MERV 8</td></tr>
<tr><td>(Prior to August 2014)
With Energy Recovery Wheel Exhaust
Air Filters, Feature 6A - D, F, G
OA - 3 / 20” x 25” x 2”
EA - 6 / 14” x 20” x 2”</td></tr>
<tr><td>(After August 2014)
With V-Bank Outside Air Filters
OA - 6 / 20” x 16” x 2”</td></tr>
<tr><td>(After August 2014)
With Energy Recovery Wheel Exhaust
Air Filters, Feature 6A - D, F, G
OA - 6 / 20” x 16” x 2”
EA - 6 / 14” x 20” x 2”</td></tr>
</table>

Table 54 - 26, 31-50, 60, and 70 ton Energy Recovery Wheel Filters

Feature 1A	Quantity / Size	Type
F, G, H, J, Q, R, S, T, U, V, W, Y, Z, 1, 2, 3	(Prior to August 2014) 4 / 24” x 24” x 4”	Pleated, MERV 8
	(After August 2014) With V-Bank Outside Air Filters OA - 8 / 24” x 18” x 2”	
	With Outside Air Preheat 4 / 24” x 24” x 4”	
	(Prior to August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 4 / 24” x 24” x 2” EA - 8 / 16” x 20” x 2”	
	(After August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 8 / 24” x 18” x 2” EA - 8 / 16” x 20” x 2”	
4	(Prior to August 2014) 3 / 24” x 24” x 4”	
	(After August 2014) With V-Bank Outside Air Filters OA - 6 / 24” x 24” x 2”	
	With Outside Air Preheat 3 / 24” x 24” x 4”	
	(Prior to August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 3 / 24” x 24” x 2” EA - 6 / 16” x 20” x 2”	
	(After August 2014) With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, F, G OA - 6 / 24” x 24” x 2” EA - 6 / 16” x 20” x 2”	

Table 55 - 55, 65, and 75-140 ton Energy Recovery Wheel Filters

<table>
<tr><th>Feature 1A</th><th>Quantity / Size</th><th>Type</th></tr>
<tr><td rowspan="2">F, G, H, J, Q, R, S, T</td><td>10 / 24” x 24” x 2”</td><td rowspan="4">Pleated, MERV 8</td></tr>
<tr><td>With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, G
OA - 10 / 24” x 24” x 2”
EA - 14 / 25” x 16” x 2”</td></tr>
<tr><td rowspan="2">U, V, W, Y, Z, 1, 2, 3</td><td>14 / 24” x 20” x 2”</td></tr>
<tr><td>With Energy Recovery Wheel Exhaust Air Filters, Feature 6A - D, G
OA - 14 / 20” x 24” x 2”
EA - 14 / 25” x 16” x 2”</td></tr>
</table>

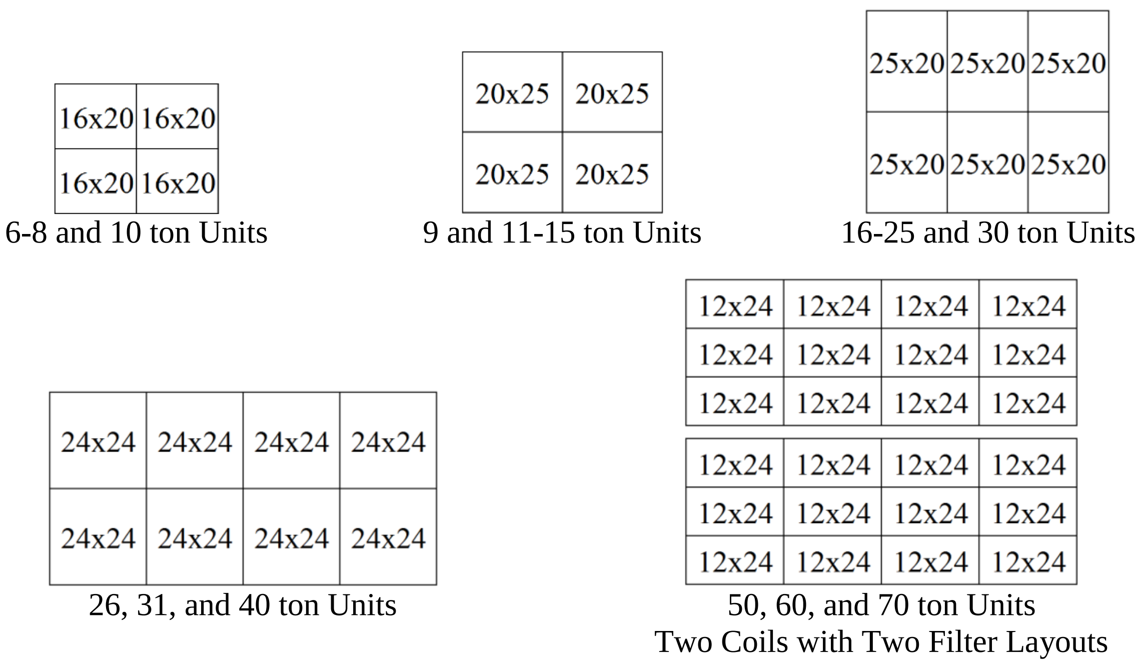


Figure 57 - RN Series 6-50, 60, and 70 ton Standard Filter Layouts

All dimensions are in inches and are height x length.
Layouts are viewed from the upstream side of the cooling coil.

18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20

55, 65, and 75 ton Units, 2" Filters

16x20	16x20	16x20	16x20	16x20
24x20	24x20	24x20	24x20	24x20
24x20	24x20	24x20	24x20	24x20
24x20	24x20	24x20	24x20	24x20

55, 65, and 75 ton Units, 4" Filters

18x20	18x20	18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20	18x20	18x20
18x20	18x20	18x20	18x20	18x20	18x20	18x20

90-140 ton Units, 2" Filters

16x20	16x20	16x20	16x20	16x20	16x20	16x20
24x20	24x20	24x20	24x20	24x20	24x20	24x20
24x20	24x20	24x20	24x20	24x20	24x20	24x20
24x20	24x20	24x20	24x20	24x20	24x20	24x20

90-140 ton Units, 4" Filters

Figure 58 - RN Series 55, 65, 70-140 ton Standard Filter Layouts

All dimensions are in inches and are height x length.
Layouts are viewed from the upstream side of the cooling coil.

Replacement Parts
Parts for AAON equipment may be obtained from your local AAON representative. Reference the unit serial number and part number when ordering parts.

AAON
Warranty, Service and Parts Department
2425 S. Yukon Ave.
Tulsa, OK 74107
Ph: 918-382-6450
techsupport@aaon.com
www.aaon.com

Note: Before calling, technician should have model and serial number of the unit available for the service department to help answer questions regarding the unit.

Appendix A - Heat Exchanger Corrosion Resistance

Corrosion Resistance of Copper and Stainless Steel in Brazed Plate Heat Exchangers - Points to Measure and Check in a Water Analysis

The resistance guide provides the corrosion resistance of stainless steel type AISI 316 and pure Copper (99.9%) in water, to a number of important chemical factors. The actual corrosion is a very complex process influenced by many different factors in combination.

Explanations: + Good resistance under normal conditions
0 Corrosion problems may occur especially when more factors are valued 0
- Use is not recommended

Water Containing	Concentration (mg/l or ppm)	Time Limits - Analyze Before	AISI 316	SMO 254	Copper Alloy	Nickel Alloy
Alkalinity (HCO_3^-)	< 70	Within 24 Hours	+	+	0	+
	70-300		+	+	+	+
	> 300		+	+	0/+	+
Sulfate (SO_4^{2-})	< 70	No Limit	+	+	+	+
	70-300		+	+	0/-	+
	> 300		0	0	-	+
HCO_3^-/ SO_4^{2-}	> 1.0	No Limit	+	+	+	+
	< 1.0		+	+	0/-	+
Electrical Conductivity	< 10µS/cm	No Limit	+	+	0	+
	10-500 µS/cm		+	+	+	+
	> 500 µS/cm		+	+	0	+
pH	< 6.0	Within 24 Hours	0	0	0	+
	6.0-7.5		0/+	+	0	+
	7.5-9.0		+	+	+	+
	> 9.0		+	+	0	+
Ammonium (NH_4^+)	< 2	Within 24 Hours	+	+	+	+
	2-20		+	+	0	+
	> 20		+	+	-	+
Chlorides (Cl^-)*	< 300	No Limit	+	+	+	+
	> 300		0	+	0/+	+
Free Chlorine (Cl_2)	< 1	Within 5 Hours	+	+	+	+
	1-5		+	+	0	+
	> 5		0/+	+	0/-	+
Hydrogen Sulfide (H_2S)	< 0.05	No Limit	+	+	+	+
	> 0.05		+	+	0/-	+
Free (aggressive) Carbon Dioxide (CO_2)	< 5	No Limit	+	+	+	+
	5-20		+	+	0	+
	> 20		+	+	-	+

*See Chloride Content Table

Water Containing	Concentration (mg/l or ppm)	Time Limits - Analyze Before	AISI 316	SMO 254	Copper Alloy	Nickel Alloy
Total Hardness (°dH)	4.0-8.5	No Limit	+	+	+	+
Nitrate (NO_3)	< 100	No Limit	+	+	+	+
	> 100		+	+	0	+
Iron (Fe)	< 0.2	No Limit	+	+	+	+
	> 0.2		+	+	0	+
Aluminum (Al)	< 0.2	No Limit	+	+	+	+
	> 0.2		+	+	0	+
Manganese (Mn)	< 0.1	No Limit	+	+	+	+
	> 0.1		+	+	0	+

Chloride Content

Chloride Content	Maximum Temperature			
	60°C (140°F)	80°C (176°F)	120°C (248°F)	130°C (266°F)
= 10 ppm	SS 304	SS 304	SS 304	SS 316
= 25 ppm	SS 304	SS 304	SS 316	SS 316
= 50 ppm	SS 304	SS 316	SS 316	Ti / SMO 254
= 80 ppm	SS 316	SS 316	SS 316	Ti / SMO 254
= 150 ppm	SS 316	SS 316	Ti / SMO 254	Ti / SMO 254
= 300 ppm	SS 316	Ti / SMO 254	Ti / SMO 254	Ti / SMO 254
> 300 ppm	Ti / SMO 254	Ti / SMO 254	Ti / SMO 254	Ti / SMO 254

Appendix B - Thermistor Temperature vs. Resistance Values

Deg C	Deg F	Resistance (kOhms)
-40	-40	2889.6
-35	-31	2087.22
-30	-22	1522.20
-25	-13	1121.44
-20	-4	834.72
-15	5	627.28
-10	14	475.74
-5	23	363.99
0	32	280.82
5	41	218.41
10	50	171.17
15	59	135.14
20	68	107.44
25	77	86.00
30	86	69.28
35	95	56.16
40	104	45.81
45	113	37.58
50	122	30.99
55	131	25.68
60	140	21.40
65	149	17.91

Deg C	Deg F	Resistance (kOhms)
70	158	15.07
75	167	12.73
80	176	10.79
85	185	9.20
90	194	7.87
95	203	6.77
100	212	5.85
105	221	5.09
110	230	4.45
115	239	3.87
120	248	3.35
125	257	2.92
130	266	2.58
135	275	2.28
140	284	2.02
145	293	1.80
150	302	1.59
155	311	1.39
160	320	1.25
165	329	1.12
170	338	1.01
175	347	0.92
180	356	0.83

RN Series Startup Form

Date:_______________
Job Name:____
Address:____
____
Model Number:____
Serial Number:____ Tag:________________
Startup Contractor:____
Address:____ Phone:______________
____

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size______________________ VAV Controls__________________

VFD Frequency_________________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐	Check Rotation ☐	FLA____________		
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature
Ambient Dry Bulb Temperature ________°F Ambient Wet Bulb Temperature ________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow ________GPM	
Water Inlet Temperature ________°F	
Water Outlet Temperature ________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ___________________________________		

Gas Heating			
Natural Gas ☐	Propane ☐	Purge Air from Lines ☐	Verify Pilot Spark ☐
Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating			
Stages___________			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	**Action Taken**	**Name/Tel.**

Literature Change History

May 2007
Update of IOM unit service clearances. Length of front and back clearances from 60" to 48" and length of left and right side clearances from 100" each to interchangeable 48" and 70". (Note: Units with hydronic heat must have 70" right side access for service.) Gas piping sizes table on page 10 was updated with new gas heater information.

November 2007
Update of the IOM *Gas Piping Connection Sizes* table. Connection sizes of Model Option B2 = A and B were changed to ¾" and the connection size of Model Option B2 = C, D, and E was changed to 1 ½".

September 2008
Update of the IOM adding information about 16-25 and 30 ton RN Series units.

May 2009
Update of the IOM adding information about 9-15 ton RN Series units. The part number for the IOM was changed from R15710 to R79510.

June 2009
Update of the IOM making corrections to some of the values in the tables of Appendix A and adding e-coated coil cleaning instructions.

August 2009
Update of the IOM correcting the Gas Heater Operation section to have the same sequence of operation for both natural gas and propane gas heaters.

September 2009
Update of the IOM adding Refrigerant-to-Water heat exchanger and Thermostat Control Wiring information and correcting Table I7 Natural Gas Maximum Piping Capacities.

April 2010
Update of the IOM adding information about 6-10 ton RN Series units. The part number for the IOM was changed from R79510 to R90720.

October 2010
Update of the IOM to include 100% Return Air option in Feature 1, and Single Zone VAV controllers in feature 13. Feature 15 was changed from an empty feature to include Glycol percentage options.

February 2011
Added information regarding the charging of a heat pump and added additional information regarding freezing water in the heat exchanger.

April 2011
Updated the condenser water connection sizes in Table I12 and added Table I13 – SMO 254 Brazed Plate Heat Exchanger Water Connections.

June 2011
Updated 2” Pleated 30% efficiency filters from MERV 7 to MERV 8.

March 2012
Updated manual to include 55, 65 and 75-140 unit sizes. Instructions for piping gas heat exchanger condensate, if code requires, were added in the gas heating section. Added hot water, steam, and chilled water coil connection sizes. The part number of this IOM was changed from R90720 to R90721.

June 2012
Update of the IOM adding brazed plate heat exchanger cleaning instructions and adding compressor lubricant warning.

October 2012
Update of the IOM adding seismic curb installation instructions and adding VFD controlled and ECM driven condenser fan information.

November 2012
Update of the IOM adding information about compressor cycling.

June 2013
Added options to the feature string, added curb gasket information, added auxiliary electric heating capacities table, added section for microchannel coil cleaning, added section for variable capacity compressor controller, and added Appendix B.

October 2013
Corrected the tables and figures of filters and pre filters for 55, 65, and 75-140 ton units, added end flashing installation section for 55, 65, and 75-140 ton units, and added cautions calling for the need to seal water, electrical, and gas entries into the unit.

January 2014
Added options for electric preheat for 6-25 and 30 ton units.

February 2014
Added energy recovery wheel installation, maintenance, and startup information.

June 2014
Added electric preheat controller operation information.

July 2014
Added VCB-X and 380V/50Hz features.

August 2014
Added energy recovery wheel v-bank filter sizes. Added more detailed microchannel coil cleaning instructions.

November 2014
Updated condensate drain pan section showing p-traps are no longer provided on the 26 and 31-140 ton units, added the p-trap sizing section, added plenum fan set screws specifications, added tandem compressor option for the 55, 65 and 75-140 ton units.

March 2015
Updated E cabinet unit clearances; the unit clearance for the back of the unit was updated to 100" from the end of the unit. Added *Tandem Circuited Variable Speed Compressor VFD Frequency Range* Table**.**

May 2015
Updated *Refrigerant to Water Heat Exchanger* section to state that a screen strainer is factory provided ahead of the condenser inlet and a pressure relief device may be provided on the heat exchanger.

July 2015
Removed 2" Throwaway Unit Filter-25% Efficient from Filter Replacement information. Table 4-*C Cabinet Unit Clearances* revised.

October 2015
Added Additional Gas Piping Considerations.

November 2015
Water Piping and *Filter* sections were updated.

February 2016
Added *Freeze Stat Startup* section and updated *Phase and Brownout Protection Module* section.

March 2016
Updated Metal Mesh Pre Filter quantity for RN-E cabinet. Updated RN-D cabinet energy recovery filters quantity and size for outside air preheat.

April 2016
Added the *Adjustable Fan Cycling Switch Procedure* section.

May 2016
Added the AAON Touchscreen Controller.

June 2016
Packaged Direct Expansion (DX) Units section was updated for clarification.

July 2016
Updated Neoprene statements and *E-Coated Cleaning* section. *Table 29 - Acceptable Refrigeration Circuit Values* has been updated.

August 2016
Updated *Energy Recovery Wheel Filters* replacement Tables 49-52. Added *Energy Recovery Wheel Defrost Timer* section.

September 2016
Added *Power Exhaust Motor and Belt Removal* section.

January 2017
Added *Two-Step Compressor* options.

February 2017
Updated *Figure 29.*

May 2017
Updated *Table 7* - Single Circuited Variable Speed Compressor VFD Frequency Range and *Table 8* - Tandem Circuited Variable Speed Compressor VFD Frequency Range. The maximum allowable voltage imbalance updated. Updated Factory Technical Support Phone number.

July 2017
Updated *Allowed Chemical Cleaners and Procedures.* Added *Outdoor Airflow Monitoring* options; Feature 14A. Added *Shaft Grounding* options; Feature 1B and Feature 5A. Added *High Condensate Level Switch*; Feature 11. Added *Shrink Wrap* Options; Feature 20. Added *High Turndown Modulating Gas* option; Feature B3. Updated modulating gas turndown ratios. Updated Note on MPT fitting.

August 2017
Updated *Table 53*; 55, 65, and 75-140 ton Energy Recovery Wheel Filters. Updated *Tables 38-39* Pre Filter information; 55, 65, 75 tons and 90-140 tons. Removed *VCM-X* options; Feature 22.

September 2017
Updated *Tables 33-39* Pre Filter information. Updated nomenclature for Feature 6A.

October 2017
Removed *On/Off Hot Gas Reheat* option. Updated Features 6A and 6B feature string nomenclature descriptions. Updated filter descriptions in *Tables 33-53*.

November 2017
Updated *Additional Gas Piping Considerations* section. Feature 1B Options updated to include TEFC Motor options. Feature 5 Options updated to include TEFC Motor options. Added *Suction Filter* and *Suction Filter Removal Instructions* sections.

January 2018
Updated the unit orientation on *Figure 4 – RN Series E Cabinet.* Added *Figure 32 - Example 55, 65 and 75-140 ton for across the Roof Gas Piping.* Updated tons on *Table 11* and *Table 12* Gas Connections tables. Added
Table 29 - Acceptable Fin & Tube Air-Cooled Condenser Coil Refrigeration Circuit Values, *Table 30 - Acceptable Water-Cooled Refrigeration Circuit Values*, Table 31 - *Acceptable Microchannel Air-Cooled Condenser Coil Liquid Sub-Cooling Values*.

May 2018
Updated *Figure 14 - Duct Connection.* Updated *Energy Recovery Wheel Defrost Timer* section.
Updated *Table 22 - Steam Coil Connection Sizes* and
Table 23 - Hot Water Coil Connection Sizes*.*

August 2018
Updated *Table 22 - Steam Coil Connection Sizes,*
Table 23 - Hot Water Coil Connection Sizes*, and Table 24 - Chilled Water Coil Connection Sizes.*

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RN Series
Installation, Operation & Maintenance
R90721 · Rev. D · 180815

Factory Technical Support: (918) 382-6450

Note: Before calling Technical Support, please have the model and serial number of the unit available.

Parts: For replacement parts please contact your local AAON Representative.

It is the intent of AAON to provide accurate and current product information. However, in the interest of product improvement, AAON reserves the right to change pricing, specifications, and/or design of its product without notice, obligation, or liability.

Controls

BUILDING CONTROLS AND SERVICES, INC.
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VCBX

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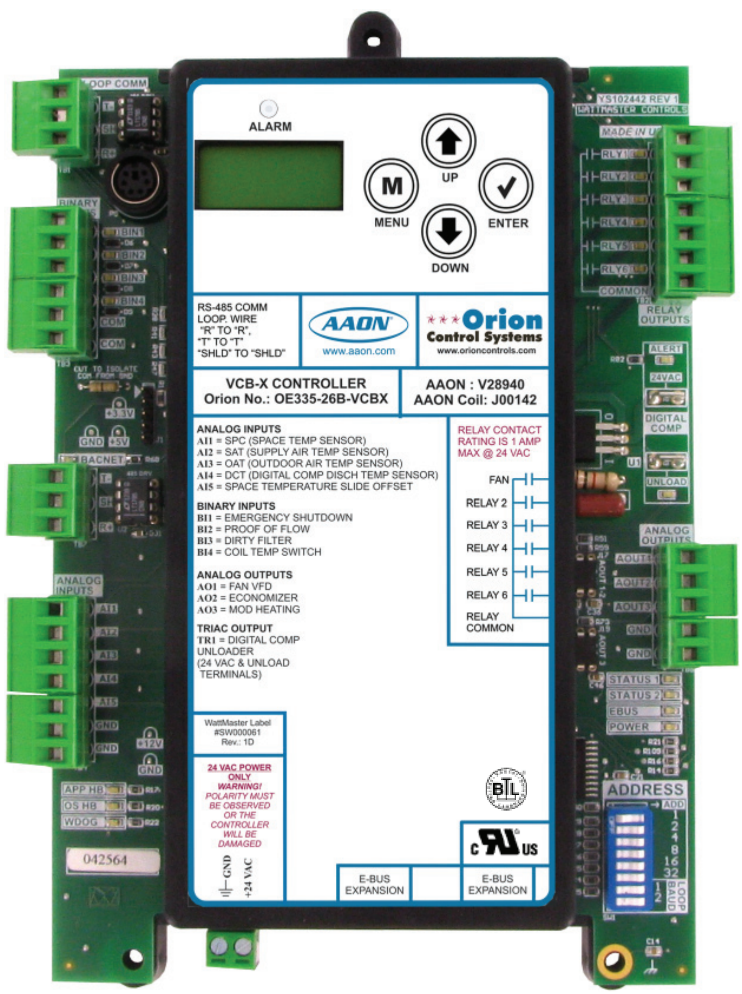
Orion Control Systems

VCB-X Controller Field Technical Guide

VCB-X Controller Code: SS1051 Version 2.0 and up
Requires Service Tool SD Code: SS1063 Version 1.0 and up
Requires System Manager SD Code: SS1068 Version 1.0 and up
Requires System Manager TS II Code: SS7002 Version 2.0 and up



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Orion Control Systems
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Visit our web site at www.orioncontrols.com
WattMaster Form: OR-VCBX-FIELD-TGD-01W

Features

The VCB-X Controller (OE335-26B-VCBX-A) is designed with 5 analog inputs, 3 analog outputs, 1 triac output, 4 binary inputs, and 6 relay outputs. It also has an on-board BACnet® port for connection to an MS/TP network. The Controller contains a 2 x 8 LCD character display and 4 buttons that allow for status and alarm display and force modes as well as BACnet configuration.

The VCB-X EM1 Expansion Module (OE336-23-EM1-A) provides an additional 6 analog inputs, 4 analog outputs, 3 binary inputs, and 5 configurable relay outputs. The VCB-X EM2 Expansion Module (OE336-23-EM2-A) provides an additional 1 analog input, 2 analog outputs, and 3 binary inputs. The VCB-X 12 Relay Expansion Module (OE358-23E-12R-A) provides up to 12 additional configurable relay outputs.

There are also 2 E-BUS Expansion Ports which allow for the connection of the three expansion modules listed above, communicating sensors, an EBTRON® or GreenTrol™ Airflow Monitoring system, and future E-BUS Modules via modular cable assemblies. There are presently 5 communicating sensors available. Two of these sensors have LCD displays: E-BUS Digital Space Temperature Only Sensor or E-BUS Digital Space Temperature and Humidity Sensor. There is a communicating E-BUS Space Temperature and Humidity Sensor with no LCD display as well as an E-BUS Space CO_2 Sensor, and E-BUS Duct CO_2 Sensor with no LCD display.

The VCB-X Controller provides for Constant Volume, VAV, Single Zone VAV, MUA, and Air to Air Heat Pump applications.

Most common HVAC unit control applications can be configured using only the VCB-X Controller. If the application requires more inputs and/or outputs, the optional expansion modules are available to provide for additional analog, binary, or digital inputs and outputs as required.

Other features of the VCB-X include:

- Direct Digital Control of (1) Copeland Digital Scroll™ Compressor
- Modulating Cooling Output for Chilled Water Valve Control
- Modulating Heating Output (Hot Water Valve, Steam Valve, SCR Electric Heat Control)
- Full Integration with the AAON® MODGAS-X Modulating Natural Gas Controller
- Full Integration with the AAON® MHGRV-X Modulating Hot Gas Reheat Controller
- Configurable for Heat Pump Applications
- Heat Pump Defrost Operation
- Advanced Dehumidification Capabilities
- Auxiliary and Emergency Heat Options for Heat Pumps
- Air Flow Monitoring of Outdoor Air, Supply Air, Return Air, and Exhaust Air Streams
- Air Flow Control of Outdoor Air Damper
- Single Zone VAV Control w/Optional CAV Heating
- Primary/Secondary Heating Control
- Remote Forced Cooling, Heating, and Dehumidification Control
- Remote SAT Reset Signal
- Return Air Bypass Control
- Adaptive Supply Air Reset
- Selectable Mode Enable Sensor
- Fan Proving Interlock
- Dirty Filter Alarm
- Emergency Shutdown Input (Smoke Detector/ Firestat or other Shutdown Conditions)
- Drybulb/Wetbulb/Dewpoint Control of Economizer Operation
- Building Pressure Control (Direct or Reverse Acting)
- Remote Forced Occupied Capability
- Configurable for AAON® PAC and DPAC Applications
- IAQ Economizer Reset
- Title 24 Economizer Certified
- 7-Day, 2-Event-per-Day Scheduling
- 14 Holiday Event Scheduling
- Daylight Savings Time Adjustment
- Trend Logging Capability
- Static Pressure Control for Filter Loading Applications
- Heat Wheel - On/Off Control
- Head Pressure Control
- Water Source Heat Pump Monitoring
- On-board BACnet® port for connection to an MS/TP network (See Appendices B & C)

Applications

Variable Air Volume Unit

The VCB-X can control VAV units that are typically designed for occupied Cooling Mode only, where VAV boxes equipped with reheat satisfy heating demands in individual spaces. In this application, unit heat is typically used for Morning Warm-Up. Morning Cool-Down is also available. The controller can be configured to control the supply fan VFD to maintain a duct static pressure setpoint.

The VCB-X can also control VAV units that may require occupied Heating operation to "temper" the outdoor air if it is too cold outside for the mixed air to maintain the Cooling Supply Air Setpoint.

Constant Air Volume Unit

The VCB-X can be configured for Constant Volume applications, that are typically Space Temperature or Return Air Temperature controlled.

The VCB-X can also be used for restaurant kitchen or lab applications that are 100% Outdoor Air part of the time and recirculating air part of the time. A Hood On binary contact closure input forces the VCB-X to switch to 100% Outdoor Air control based on an exhaust hood switch activation. The VCB-X requires Outdoor and Indoor Air Temperature (and Humidity) Sensors to accomplish this application.

Single Zone VAV

This is a hybrid CAV/VAV application for a unit serving a single space and using Space Temperature Setpoints to enable Heating and Cooling Modes. Heating and Cooling are controlled to their respective Supply Air Setpoints while the supply fan modulates to maintain the Space Temperature Setpoints. Single Zone VAV applications can be configured for VAV Cooling and either VAV or CAV Heating. Single Zone VAV operation requires the use of modulating Heating or Cooling sources.

Space Temperature Control of High Percentage Outdoor Air Units

This application allows the unit to be configured to use the space temperature to initiate Cooling and Heating Modes on units that are high percentage outdoor air or 100% outdoor air units. Before entering the space Vent Mode, the controller will first determine if the outdoor air temperature is above or below special outdoor air Cooling and Heating setpoints. If so, the unit will leave stages of Cooling or Heating on as necessary to achieve a neutral supply air temperature – thus avoiding dumping very hot or cold air into the space.

Make-Up Air Unit

The VCB-X can be configured for 100% Outdoor Air control for Make-Up Air units. All HVAC Modes are determined from the Outdoor Temperature and Humidity Sensors. The Outdoor Air Volume should be at least 50% or higher to be configured for Outdoor Air control.

AAON® Return Air Bypass Control

This control scheme can only be used on Constant Volume HVAC units that are equipped with a Return Air Bypass Damper and that use Space Temperature and Humidity Sensors as the Controlling Sensors.

AAON® Return Air Bypass Control provides improved moisture removal capabilities while utilizing internal space loads for reheat by redirecting Return Air from the upstream side of the DX Evaporator Coil to the downstream side of the coil during Dehumidification.

Zone Voting

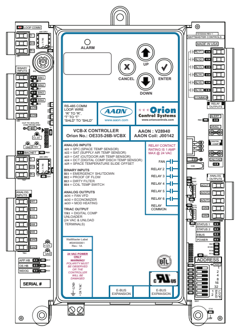
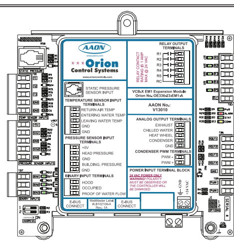
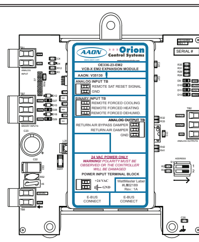
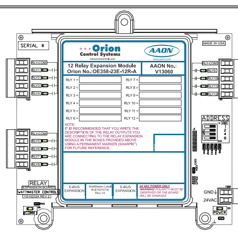
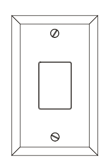
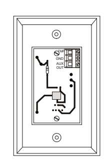
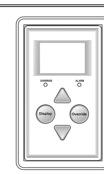
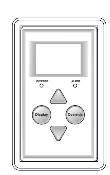
The VCB-X can be configured to be the unit controller in a zone voting system where the individual zones vote to put the unit into occupied Cooling or Heating Mode. To be used in this application, Orion zone controllers must also be used in order to allow communication between the zones and the VCB-X Controller. Duct static pressure control can be accomplished with a supply fan VFD or a bypass damper.

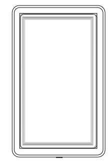
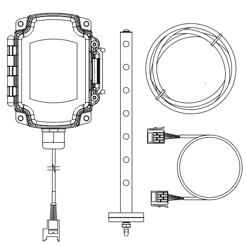
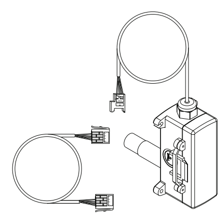
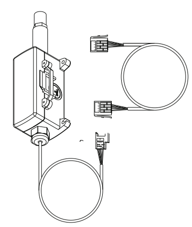
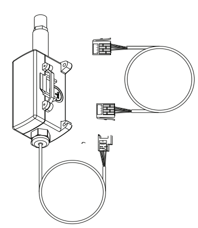
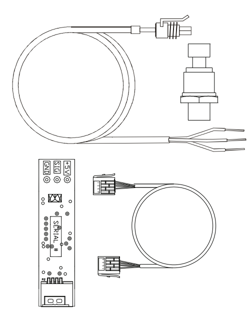
Part Number Cross Reference

PART DESCRIPTION	ORION PART NUMBER
VCB-X Controller	OE335-26B-VCBX-A / OE335-26B-VCBX-C
VCB-X 12 Relay Expansion Module	OE358-23E-12R-A
VCB-X EM1 Expansion Module	OE336-23-EM1-A / OE336-23-EM1-C
VCB-X EM2 Expansion Module	OE336-23-EM2-A
Building Static Pressure Sensor	OE258-01
CommLink 5 Communications Interface	OE361-13
Duct Static Pressure Sensor	OE271
EBC E-BUS Cable Assembly E-BUS Power & Comm 1.5 Ft, 3 Ft, 10 Ft, 25 Ft, 50 Ft, 75 Ft, 100 Ft, 150 Ft, 250 Ft, and 1000 Foot Spool	EBC-1.5-F-A, EBC-3-F-A, EBC-10-F-A, EBC-25-F-A, EBC-50-F-A, EBC-75-F-A, EBC-100-F-A, EBC-150-F-A, EBC-250-F-A, EBC-SPOOL-A
E-BUS Adapter Hub	MS000248
E-BUS Adapter Hub with 1.5 Ft. EBC Cable	HZ-EBC-248
E-BUS Adapter Board	OE365-15-EBA-A
E-BUS CO_2 Sensor with Remote Pickup - Duct Mounted	OE256-07-A
E-BUS CO_2 Sensor - Space	OE256-05-A
E-BUS Digital Room Sensor - LCD Display - Temp. Only	OE217-02-A
E-BUS Digital Room Sensor - LCD Display - Temp & RH	OE217-03-A
E-BUS Digital Room Sensor - No LCD Display - Temp & RH	OE217-04-A
E-BUS Horizontal Outside Air Temperature & RH Sensor	OE265-15-A / OE265-15-C
E-BUS Vertical Outside Air Temperature & RH Sensor	OE265-16-A
E-BUS Return Air Temperature & RH Sensor	OE265-17-A
GPC-X Controller	OE332-23-GPCX
GPC-XP Controller	OE338-23-GPCXP
Immersion Well for OE230 Water Temperature Sensor	OE291
IP Module Kit	OE415-02
MHGRV-X Controller	OE377-26-00059
MiniLink Polling Device 5	OE364-23-OR
MODGAS-X Controller	OE377-26-00058
Modular Service Tool SD - Operator Interface	OE391-12
Modular System Manager SD - Operator Interface	OE392-12
Outdoor Air Temperature Sensor	OE250
PREHEAT-X Controller	OE377-26-00061
Return Air Temperature Sensor	OE231
Standard Room Sensor - Plain	OE210
Standard Room Sensor - W/ Override	OE211
Standard Room Sensor - W/ Slide Adjust	OE212
Standard Room Sensor - W/ Override & Slide Adjust	OE213
Static Pressure Pickup Tube	OE290
Strap-On Temperature Sensor Kit	OE233
Suction Pressure Sensor Kit with E-BUS Adapter	OE275-03-A
Supply Air Temperature Sensor	OE231
System Manager TS II - Operator Interface	OE392-10
System Manager TS-L (Touch Screen - Limited Access)	OE392-11
USB-Link 2 Kit	OE366
Water/Air Temperature Sensor	OE230

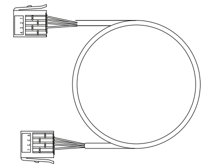
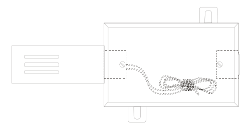
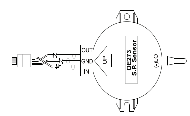
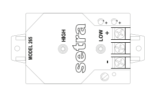
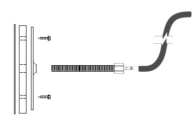
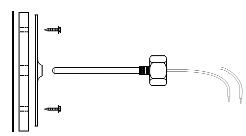
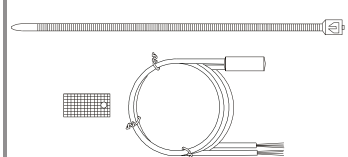
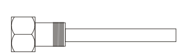
OVERVIEW

Parts and Descriptions

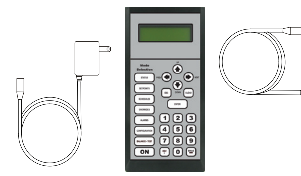
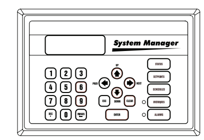
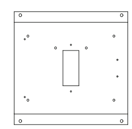
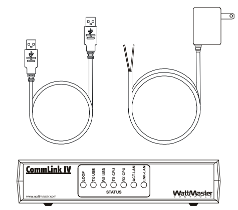
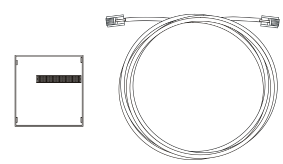
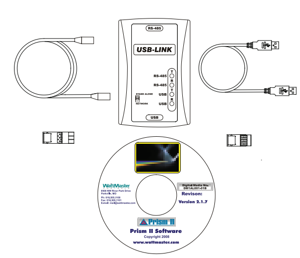
PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE335-26B-VCBX-A	**VCB-X Controller** The VCB-X Controller provides 5 analog inputs, 3 analog outputs, 1 triac input, 4 binary inputs, and 6 user-configurable relays. It also has an on-board BACnet port for connection to an MS/TP network. The Controller contains a 2 x 8 LCD character display and 4 buttons that allow for status and alarm display as well as BACnet configuration. It presently allows for the addition of the EM1 Expansion Module and the 12 Relay Expansion Module described below. **NOTE:** Set-up, configuration, and monitoring of the VCB-X Controller requires one of the following communication interfaces—Prism 2 Front-End Software used with a personal computer, System Manager Touch Screen, or Modular Service Tool SD.		*Page 20*
OE336-23-EM1-A	**VCB-X EM1 Expansion Module** The EM1 Expansion Module adds VAV applications, building pressure control, head pressure control, water source heat pump monitoring, and other functions. It provides 6 additional analog inputs, 3 binary inputs, 5 additional relays, and 4 analog outputs. It connects with an EBC E-BUS cable to the VCB-X Controller.		*Page 36*
OE336-23-EM2-A	**VCB-X EM2 Expansion Module** The EM2 Expansion Module adds remote forced heating, cooling, and dehumidification using 3 additional binary inputs. It provides 2 analog outputs for controlling a Return Air Bypass Damper and a Return Damper in Return Air Bypass applications. It also has an analog input that can be used as a remote voltage input to reset the Supply Air Setpoint or as a Title 24 Economizer feedback signal. It connects with an EBC E-BUS cable to the VCB-X Controller.		*Page 47*
OE358-23E-12R-A	**VCB-X E-BUS 12 Relay Expansion Module** The VCB-X 12 Relay Expansion Module adds 12 configurable relays to the VCB-X Control System. It connects to the VCB-X Controller with an EBC E-BUS cable.		*Page 50*
OE210 **OE211** **OE212** **OE213**	**Standard Room Sensor–Plain, w/Override, w/Override & Slide Adjust & w/Slide Adjust Only** Includes: Standard Room Sensor - Plain, with Override, with Override and Slide Adjust & with Slide Adjust only. For wall mounting. Use with VCB-X Controller only. Connects to controller via field fabricated wiring.	 	*Page 25*
OE217-02	**E-BUS Digital Room Sensor - Temp. Only** LCD Display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The OE217-02 is used with the VCB-X Controller for room air temperature sensing applications. Uses EBC E-BUS cable.		*Page 22*
OE217-03	**E-BUS Digital Room Sensor - Temp and Humidity** LCD Display and keypad allow for setpoint adjustment, override, and display of certain status and setpoints. The OE217-03 is used with the VCB-X Controller for room air temperature and humidity sensing applications. Uses EBC E-BUS cable.		*Page 22*

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE217-04	**E-BUS Digital Room Sensor - Temp and Humidity** The OE217-04 is used with the VCB-X Controller for room air temperature and humidity sensing applications. Contains no LCD Display or keypad. Uses EBC E-BUS cable.		*Page 22*
OE256-05	**E-BUS CO_2 Wall-Mounted Sensor** Used with the VCB-X for CO_2 sensing applications where wall mounting in the space is desired. Connects to the VCB-X Controller with an EBC E-BUS cable of required length. Cable sold separately.		*Page 23*
OE256-07	**E-BUS CO_2 Duct Sensor with Remote Pickup Tube** Used with the VCB-X Controller for duct mounted CO_2 sensing applications. Connects to the VCB-X Controller with an EBC E-BUS cable of required length. Includes: Duct Mounted CO_2 Sensor, Integral Aspiration Box, Airflow Pickup Tube and 10 ft. EBC Cable.		*Page 24*
OE265-15-A	**E-BUS Horizontal Outdoor Air Temperature & Humidity Sensor** Used for outdoor temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Horizontal Outside Air Temperature & Humidity Sensor, mounted in a weatherproof handy box with attached 3 foot EBC E-BUS Cable with jack.		*Page 28*
OE265-16-A	**E-BUS Vertical Outdoor Air Temperature & Humidity Sensor** Used for outdoor temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Vertical Outside Air Temperature & Humidity Sensor, mounted in a weatherproof handy box with attached 3 foot EBC E-BUS Cable with jack. A 10 foot EBC cable is included to connect to the VCB-X Controller. If a longer EBC cable is required, it must be ordered separately.		*Page 28*
OE265-17-A	**E-BUS Return Air Temperature & Humidity Sensor** Used for return air temperature and humidity sensing applications. Connects to VCB-X Controller or E-BUS Adapter Hub using EBC E-BUS cable. Includes: 10k Ohm E-BUS Return Air Temperature & Humidity Sensor, mounted in a weatherproof handy box attached 3 foot EBC E-BUS Cable with jack. A 50 foot EBC cable is included to connect to the VCB-X Controller. If a longer EBC cable is required, it must be ordered separately.		*Page 29*
OE275-03-A	**Suction Pressure Transducer Kit with E-BUS Adapter** Used for suction pressure sensing applications. Connects to VCB-X Controller using E-BUS Adapter Board and EBC E-BUS cable. Includes: OE275-01 Suction Pressure Transducer, modular cable with a modular connector on one end and bare stripped wires on the other end, E-BUS Adapter, and 3 Foot EBC E-BUS cable.		*Page 30*

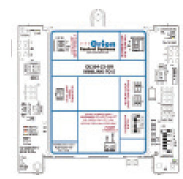
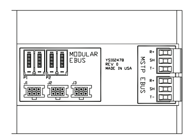
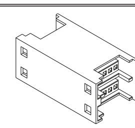
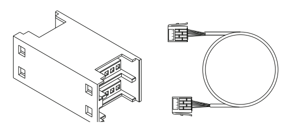
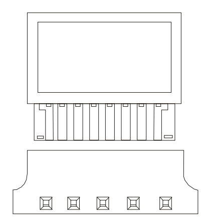
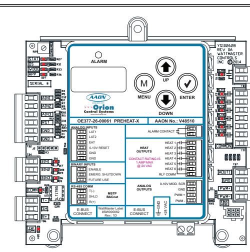
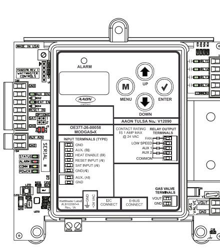
Parts and Descriptions

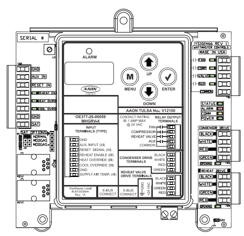
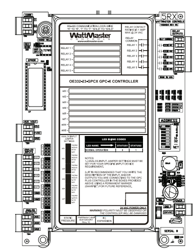
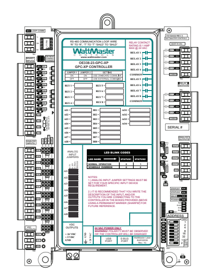
PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
EBC-1.5-F **EBC-3-F** **EBC-10-F** **EBC-25-F** **EBC-50-F** **EBC-75-F** **EBC-100-F** **EBC-150-F** **EBC-250-F** **EBC-SPOOL**	**EBC E-BUS Cables** The EBC E-BUS Expansion Cables attach to the VCB-X Controller, VCB-X Expansion Modules, and E-BUS Sensors. The EBC E-BUS cables can be crimped and clamped to the E-BUS connector. Different lengths can be joined together using an E-BUS extension adapter. The EBC E-BUS Cables are available in 1.5, 3, 10, 15, 25, 50, 75, 100, 150, 250 & 1000 feet lengths. Includes: EBC E-BUS Cable Assembly.		*N/A*
OE250	**Outdoor Air Temperature Sensor** Used for temperature sensing applications. Includes: 10k Ohm Outside Air Temperature Sensor, 2 wire, mounted in a weatherproof handy box only.		*Page 27*
OE271	**Duct Static Pressure Sensor** Used for duct static pressure sensing applications. Includes: 0-5″ W.C., 0-5 VDC, Static Pressure Sensor only.		*Page 38*
OE258-01	**Building Static Pressure Sensor** Used for Building Pressure Sensing. Includes: -0.25 to +0.25″ W.C., 0-5 VDC, 24 VAC/VDC supply power Building Pressure Sensor only.		*Page 41*
OE290	**Static Pressure Pick-up Tube** Used with OE271 Static Pressure Sensor for static pressure sensing applications. Includes: Static Pressure Pick-up Tube with 1 ft. length of FRP tubing, gasketed mounting bracket, and screws.		*Page 38*
OE230 **OE231**	**Duct Temperature Sensor - 6” Probe** **Duct Temperature Sensor - 12" Probe** OE230 = 6″ probe length. OE231 = 12″ probe length. Used for return or supply air temperature sensing applications. Includes: 10k Ohm Duct Temperature Sensor, 2 wire only.		*Pages 39 & 40*
OE233	**Strap-on Temperature Sensor Kit** Includes: 10k Ohm, Type 3, Strap-on Temperature Sensor, 2 wire. Used for water temperature sensing applications. Includes sensor, thermal mastic, and plastic mounting strap.		*Pages 40 & 41*
OE291	**Immersion Well for OE230 Water Temperature Sensor** Includes: Stainless steel thermowell to be used with the OE230 Temperature Sensor listed above. The thermowell is designed to thread into a ½″ FPT elbow or tee in the water piping system.		*Page 40*
OE392-10	**System Manager TS II Operator Interface** The System Manager TS II provides a direct, graphic-enhanced, menu-driven link to enable the system operator to view the status and adjust the setpoints of any controller on the VCB-X control system. The System Manager TS is equipped with a 4.3” 480 x 272 WQVGA RGB TFT LCD Touch Screen Display. The System Manager TS is furnished with hardware for flush mounting into hollow drywall or surface mounting on concrete brick or plaster surfaces. Includes: System Manager TS with 12 ft. long pigtail cable assembly.		*See System Manager Touch Screen II Technical Guide*

Parts and Descriptions

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE391-12	**Modular Service Tool SD** Includes: Modular Service Tool, power supply, communication cables, 4 Gigabyte SD card, and (4) AA batteries. Used to program and monitor all Orion controllers.		*See VCB-X Controller Operator Interfaces SD Technical Guide*
OE392-12	**Modular System Manager SD** Includes: Modular System Manager SD with 4 Gigabyte SD card and 12 ft. long pigtail cable assembly. Used to program and monitor all Orion controllers. Designed for hollow core wall mounting. When System Manager is to be mounted on a solid wall (concrete), you will also need to order the solid wall mounting bracket below.		*See VCB-X Controller Operator Interfaces SD Technical Guide*
EB101505	**Solid Wall Mounting Bracket for Modular System Manager SD** Includes: 22 gauge galvanized sheet metal mounting bracket with mounting holes and wire routing opening. Dimensions are 9.25″W x 8.00″H x 0.50″DP. The Wall Mounting Bracket provides wiring clearance between the System Manager and the wall mounting surface when the System Manager is to be mounted on a concrete or other solid wall surface. Not for use with System Manager TS.		*N/A*
OE361-13	**CommLink 5 Communications Interface** The CommLink 5 connects to your control system using a USB computer connection to provide direct on-site communications with the control system from a computer with the Prism 2 software installed. For remote communications, see OE415-02 IP Module Kit. Includes: CommLink 5, 6 ft. long USB cable, and 120/24 VAC power supply. Required on all networked systems or if direct computer or remote computer connection is required. Connects to your computer's USB 1.1 or 2.1 port. Prism 2 computer front-end software must be installed on the direct connected or remote connected computer in order to communicate with your system.		*See CommLink 5 Technical Guide*
OE415-02	**IP Module Kit - Internet/LAN Connection** Used for Internet or Local Area Network communications with the control system. Field installs by plugging into the CommLink 5 circuit board and provides an addressable Ethernet connection to the controls system from any computer connected to your building's LAN. It can also be configured to allow access to the control system from the Internet through your LAN if your Ethernet firewall is configured for this option. Includes: IP Link module, 10 ft. long Ethernet cable, and installation instructions. Prism 2 computer front-end software must be installed on the remote computer in order to dial-up and communicate with the controls system.		*See IP Module Technical Guide*
OE366	**USB-Link 2 Kit** The USB-Link 2 is a pocket-sized communications interface used to connect a laptop computer to your controls system for programming and monitoring purposes, utilizing a modular cable to allow connection to the service port connector on the controllers and a USB cable to connect to a laptop computer. Includes: USB-Link 2 for multiple or single loop systems, USB cable, modular connection cable, two mini-DIN to terminal adapters, and Prism 2 software.		*See USB-Link 2 Technical Guide*

Parts and Descriptions

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE364-23-OR	**MiniLink Polling Device 5** Includes: MiniLink PD 5. Used with all Orion controllers to provide network communications, zone voting, alarming, and tenant logging capabilities. A MiniLink PD 5 is required on each loop of a Networked system.		*N/A*
OE508	**Prism 2 Front-End Computer Software** Prism 2 provides standard, easy to understand status screens for each type of VCB-X equipment installed. Prism software has provisions for custom screens which allow floor plans, equipment photos, or user-defined summary screens to be implemented to meet their own individual needs. All controlling setpoints, trend logs, and alarm conditions are accessed in the Prism environment. Prism can be configured for direct on-site installation, remote modem connection, or TCP/IP Internet connection to several installations.		*Page 55*
OE365-15-EBA-A	**E-BUS Adapter Board** The E-BUS Adapter Board is used for connecting the EBTRON®, GreenTrol™, or Paragon Airflow Measurement Digital Transmitter to the VCB-X Control System. The E-BUS Adapter Board connects to the VCB-X Controller with an EBC E-BUS cable. Cable supplied separately.		*Pages 28, 29 & 51*
MS000248	**E-BUS Adapter Hub** The E-BUS Adapter Hub is used for connecting E-BUS devices and Controllers together with EBC E-BUS cables of varying lengths. Includes: E-BUS Adapter Hub.		*Pages 28 & 29*
HZ-EBC-248	**E-BUS Adapter Hub with 1.5 Foot EBC E-BUS Cable** The E-BUS Adapter Hub is used for connecting E-BUS devices and Controllers together with EBC E-BUS cables of varying lengths. Includes: E-BUS Adapter Hub and 1.5 foot EBC E-BUS cable.		*Pages 28 & 29*
OE437-03	**Communication Surge Protector Kit** Used to isolate power surges to the communications wiring caused by lightning strikes for communications wiring loops that are routed outdoors or between buildings. One kit is required at each point where the communications wiring leaves or enters a building. Includes: Communication Bus Surge Protector, Base Module, and Mounting/Wiring Instructions.		*N/A*
OE377-26-00061	**PREHEAT-X Controller** The PREHEAT-X Controller is designed to control fixed stages of Preheat or optional modulating Preheat to maintain a desired Preheat Leaving Air Temperature Setpoint. The PREHEAT-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable.		*See the PREHEAT-X Controller Technical Guide*
OE377-26-00058	**MODGAS-X Controller** The MODGAS-X Controller modulates up to (2) gas valves to maintain a desired Discharge Air Temperature. It also controls the speed of the induced draft fan to maintain proper combustion in the heat exchanger. The MODGAS-X Controller connects to the VCB-X Controller via an EBC E-BUS cable. Available only from AAON.		*Page 53*

PART NO.	PART DESCRIPTION	ILLUSTRATION	PAGE NO.
OE377-26-00059	**MHGRV-X Controller** The MHGRV-X Controller controls a Modulating Hot Gas Reheat Valve to maintain a desired Supply Air Temperature and Dehumidification setpoint. The MHGRV-X Controller connects to the VCB-X Controller via an EBC E-BUS cable. Available only from AAON.		*Page 52*
OE332-23-GPCX	**GPC-X Controller** The GPC-X Controller provides the flexibility to control, schedule, and/or monitor equipment such as unit heaters, exhaust fans, motorized louvers, etc. The GPC-X has (6) configurable inputs which will accept signals from thermistor temperature sensors, 4-20mA or 0-5 VDC transmitters, or dry contact closures. An additional modular input is provided for connection of an OE271 Static Pressure Sensor. The GPC-X has (5) relay outputs for on/off control and (2) analog outputs. The GPC-X also has (5) separate 2-events-per-day schedules, each with its own optimal start functions built in. In addition, the GPC-X provides Lead/Lag start capabilities. Use the GPC-X to provide additional schedules for your controllers. Includes: OE332-23-GPCX Controller.		*See the GPC-X Controller Technical Guide*
OE338-23-GPCXP	**GPC-XP Controller** The GPC-XP Controller is used for controlling equipment or processes that cannot be controlled using a standard HVAC controller. Prism 2 computer front end software is used to interface with the GPC-XP Controller functions. The GPC-XP Controller provides the flexibility to control, schedule, and/or monitor equipment such as unit heaters, exhaust fans, motorized louvers, and other mechanical equipment. In addition, the GPC-XP provides Lead/Lag start capabilities. The GPC-XP has 8 configurable analog inputs which will accept signals from thermistor temperature sensors, 4-20mA or 0-5VDC or 0-10VDC transmitters. Custom forumulas created by available math functions and operators can be used in conjunction with the analog inputs to create a calculated value to be used and displayed for a specific analog input. The inputs are set for the desired scaling by means of a jumper bar. An additional input is available for communicating sensors available from WattMaster Controls. The GPC-XP also supports 8 wet contact binary inputs which can be configured for either normally open or normally closed operation. The GPC-XP has 8 relay outputs for on/off control and 4 analog outputs for proportional control signals. Highest/lowest/average of the analog input values can be used in the GPC-XP logic or broadcast to other controllers on the control system loop. The GPC-XP also has 8 separate 2 events per day schedules which can be assigned to any input or output for operational control or alarm recognition based on time of day. These schedules can also be configured to broadcast to other WattMaster HVAC equipment installed on the control system loop. Includes: OE338-23-GPCXP Controller.		*See the GPC-XP Controller Technical Guide*

VCB-X Controller Dimensions

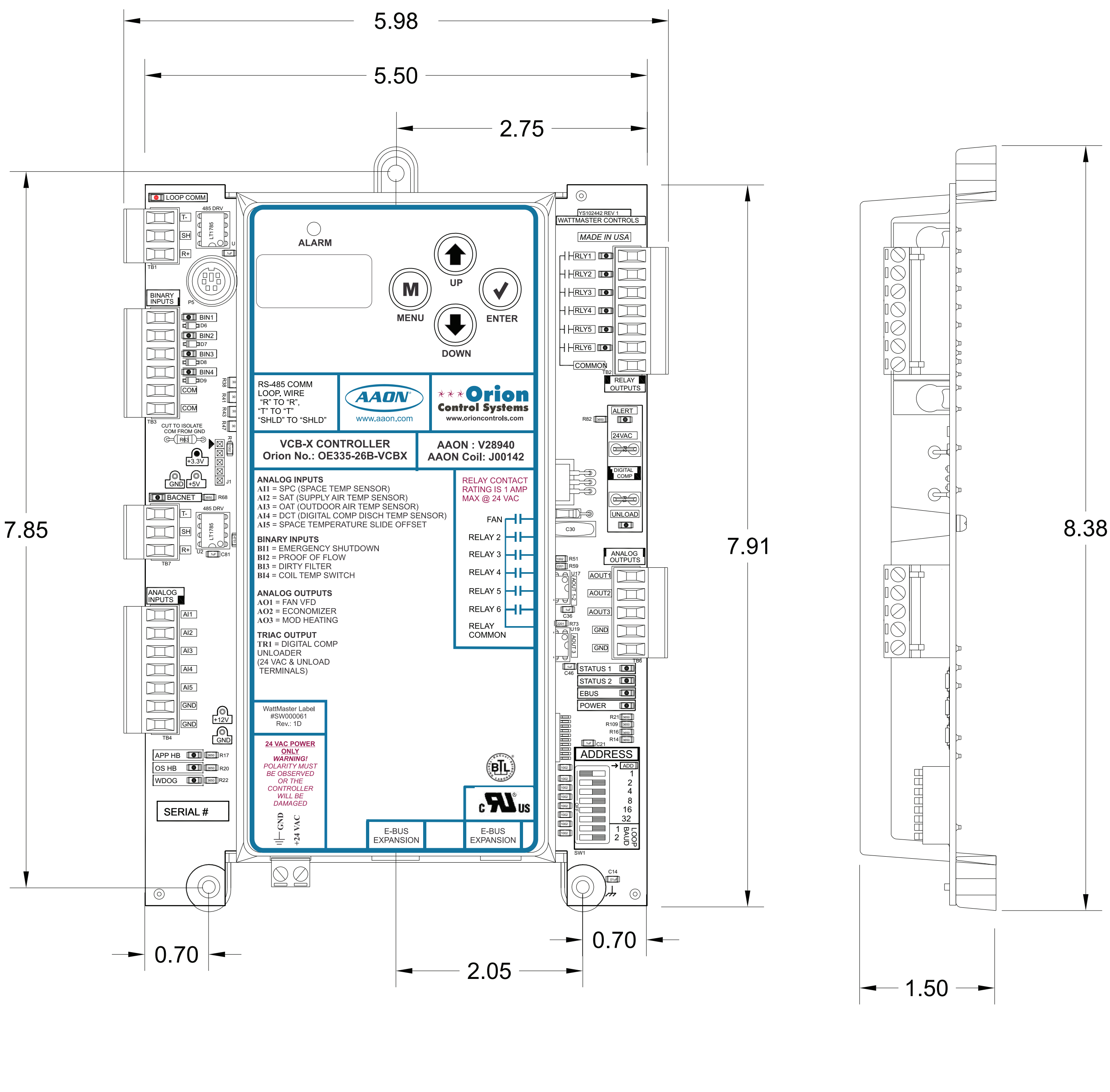


Figure 1: VCB-X Controller Dimensions

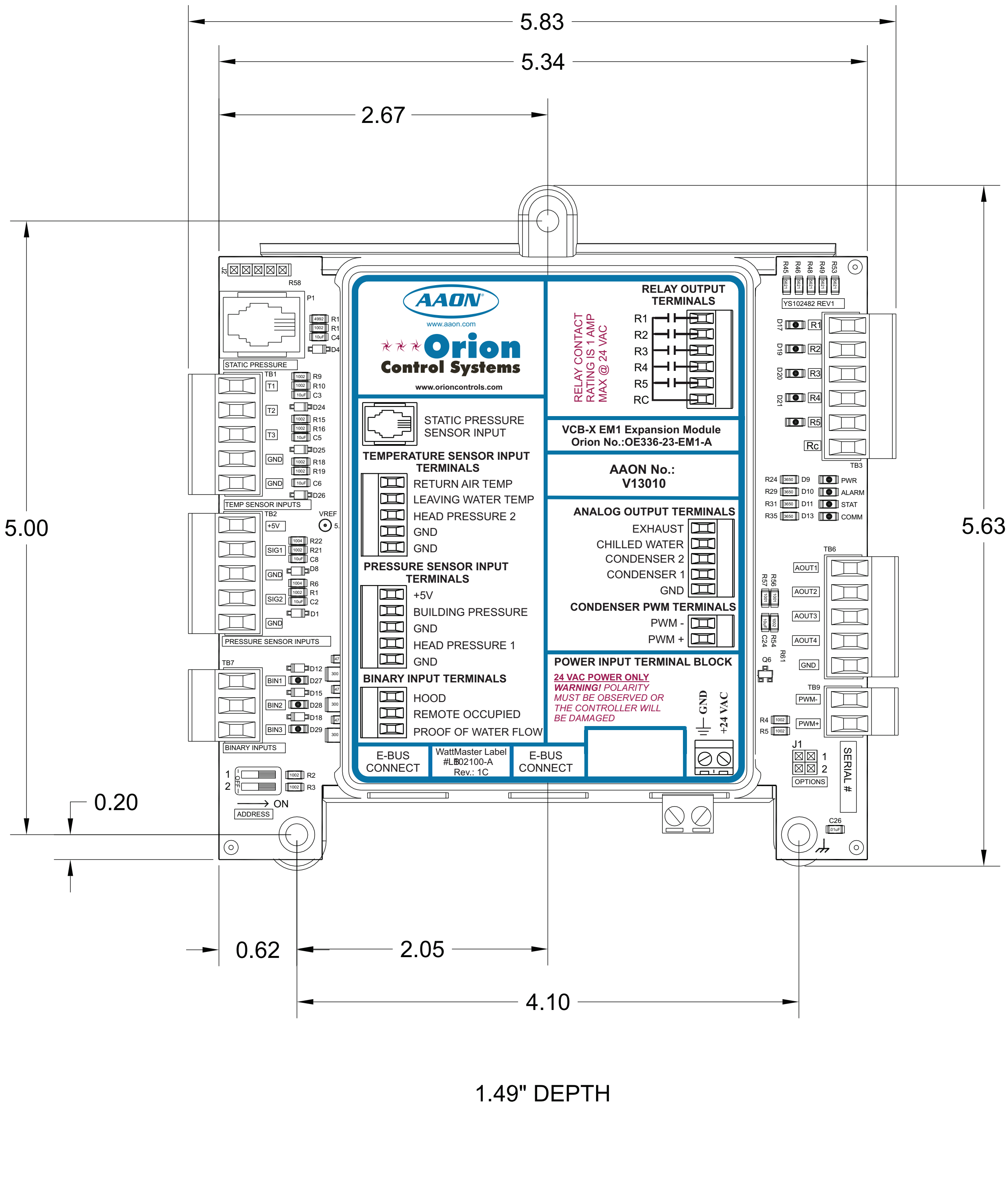


Figure 2: VCB-X EM1 Expansion Module Dimensions

VCB-X EM2 Dimensions

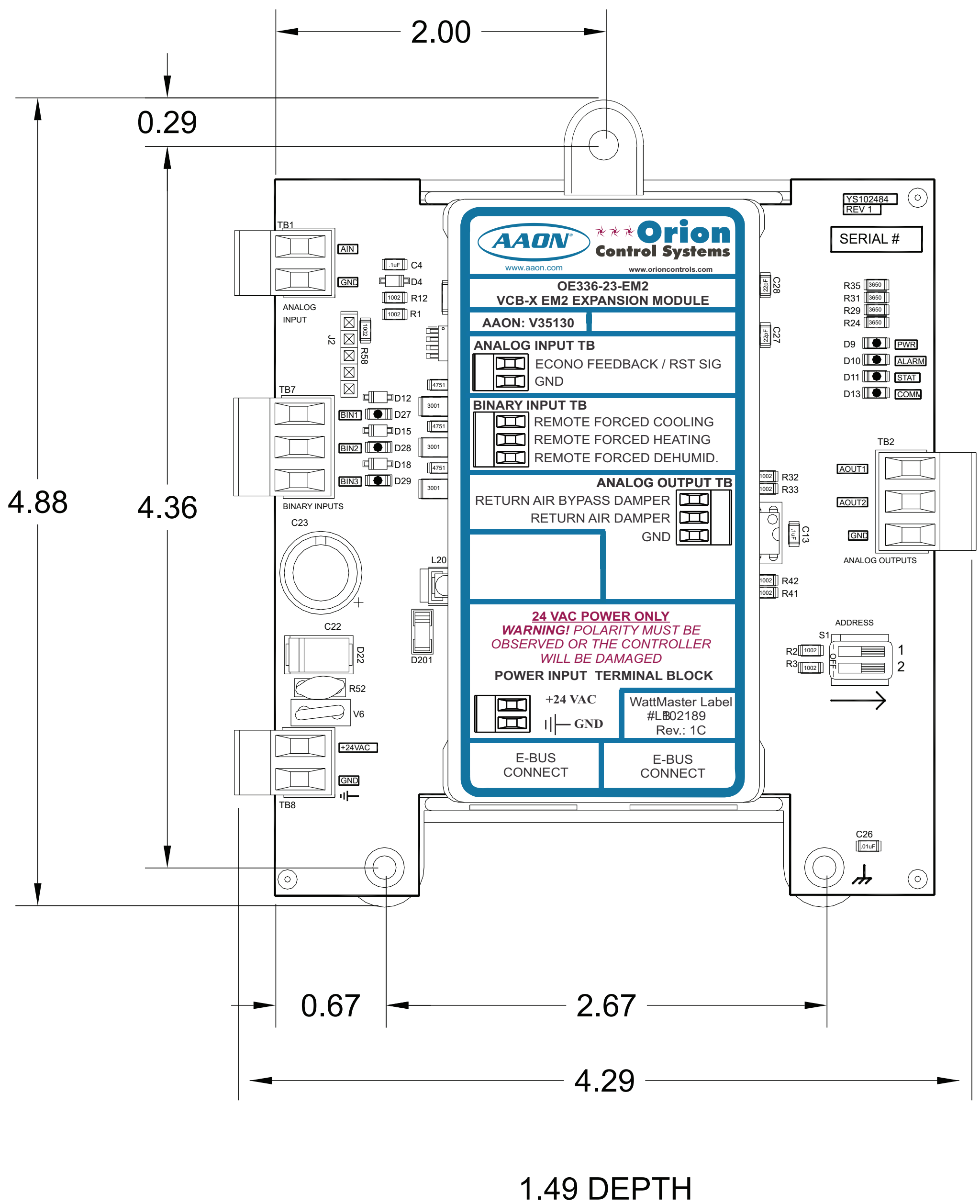


Figure 3: VCB-X EM2 Expansion Module Dimensions

VCB-X 12 Relay Module Dimensions

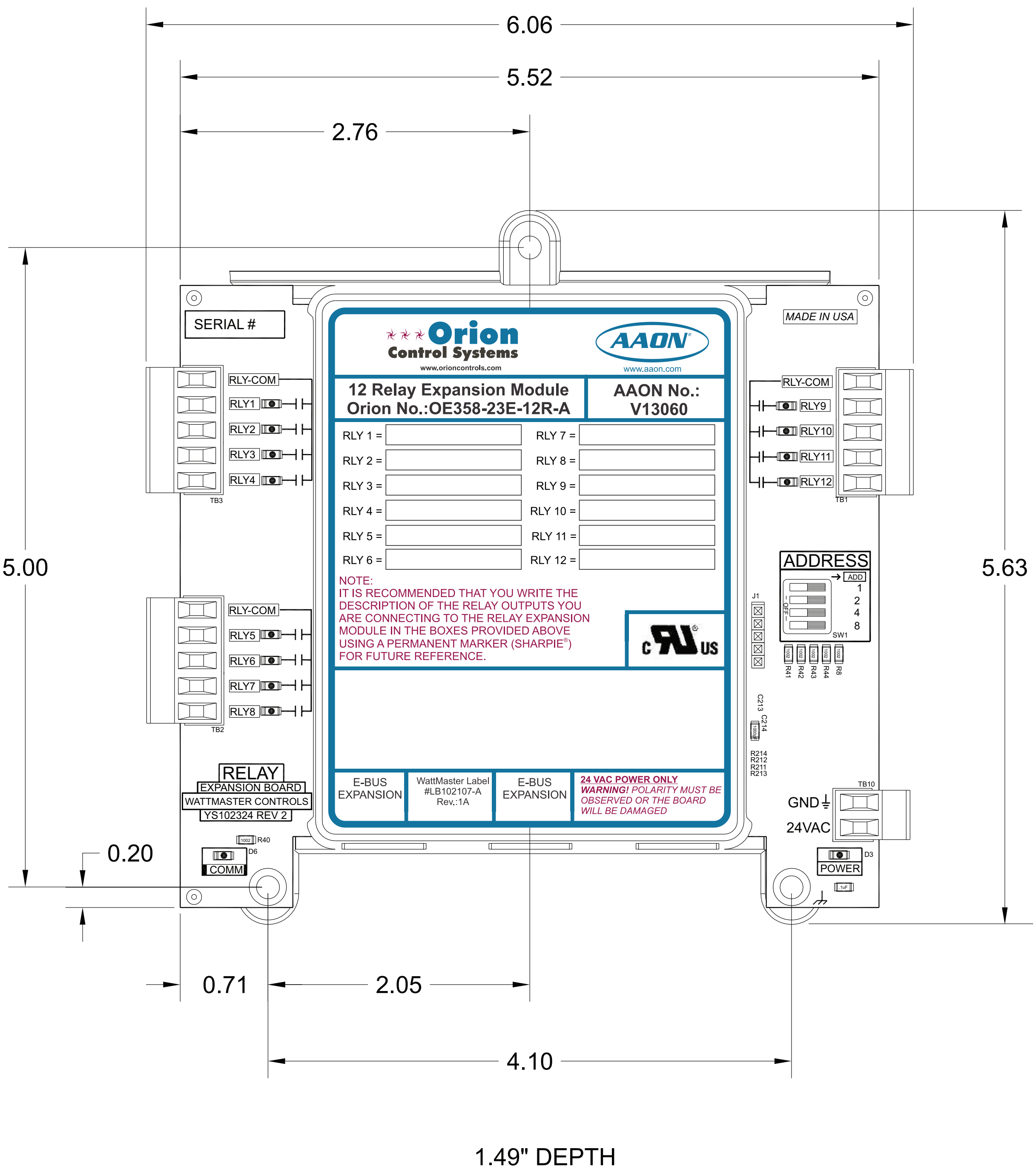


Figure 4: VCB-X 12 Relay Module Dimensions

Controller with Enclosure Components

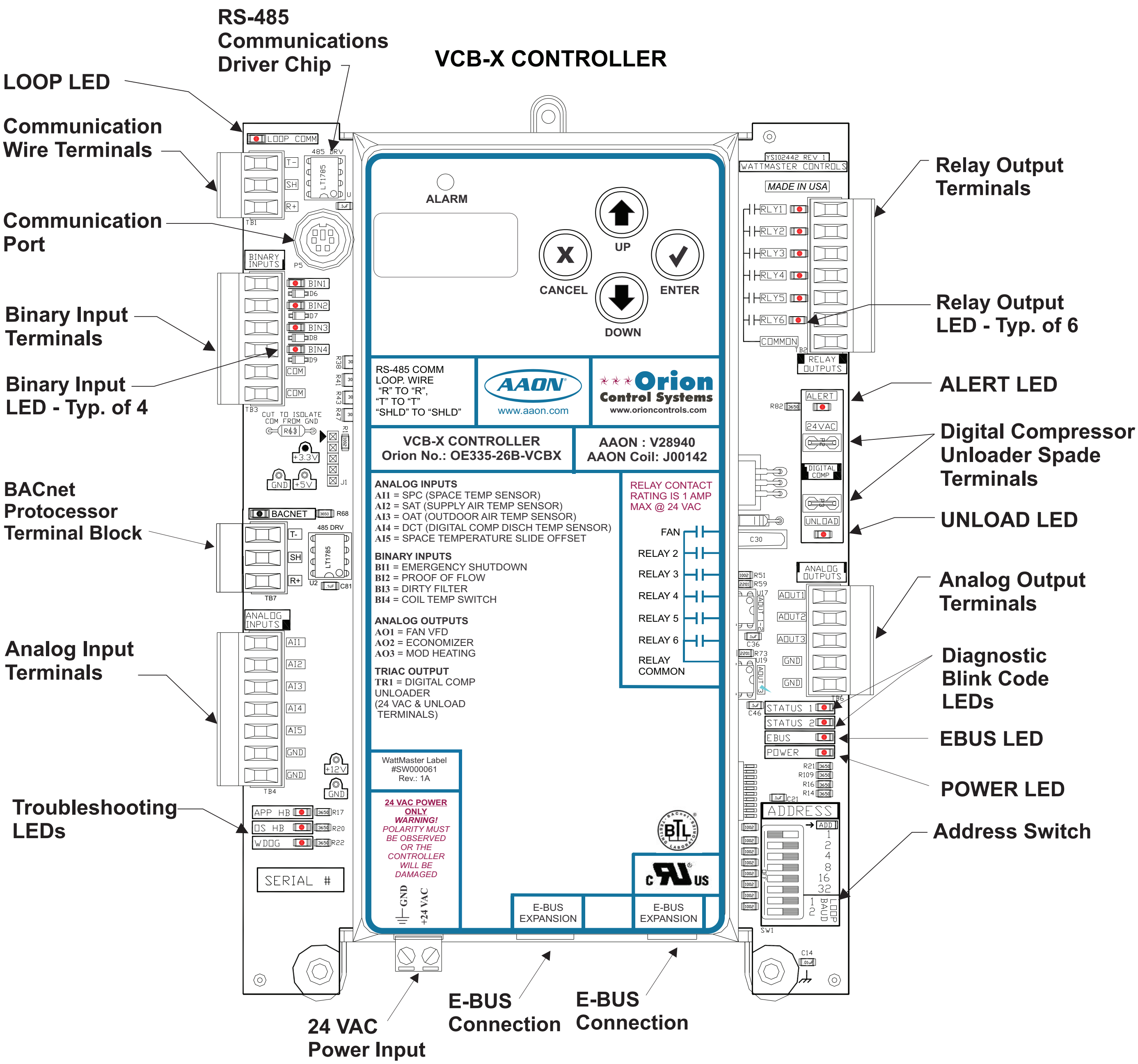


Figure 5: VCB-X Controller w/Enclosure Components

General

Correct wiring of the VCB-X Controller is the most important factor in the overall success of the controller installation process. In general, most VCB-X Controllers are factory installed and wired at the AAON® factory. It is also possible to purchase these controllers through your local AAON®/Orion representative for installation in the field. Some of the following information pertains to field wiring and may not apply to your installation if it was pre-wired at the factory. However, if troubleshooting of the controller is required, it is a good idea to be familiar with the system wiring, no matter if it was factory or field wired.

Controller Mounting

When the controller is to be field mounted, it is important to mount the controller in a location that is free from extreme high or low temperatures, moisture, dust, and dirt. See **Table 1** for a list of the required operating conditions for the VCB-X Controller and associated expansion modules.

The VCB-X Controller is housed in a plastic enclosure. It is designed to be mounted by using the 3 mounting holes in the enclosure base. The VCB-X Controller needs to be installed in an environment which can maintain a temperature range between -30°F and 150°F not to exceed 90% RH levels (non-condensing). Be careful not to damage the electronic components when mounting the controller.

Considerations

The VCB-X Controller and expansion modules must be connected to a 24 VAC power source of the proper size for the calculated VA load requirements. All transformer sizing should be based on the VA rating listed in **Table 1**.

Control Device	Voltage	VA Load	Temperature	Humidity (Non-Condensing)
OE335-26B-VCB-X-A VCB-X Controller	24VAC	8	-30°F to 150°F	90% RH
OE336-23-EM1-A	24VAC	5	-30°F to 150°F	90% RH
OE336-23-EM2-A	24VAC	5	-30°F to 150°F	90% RH
OE358-23E-12R-A	24VAC	15	-30°F to 150°F	90% RH

Table 1: Voltage and Environment Requirements

WARNING: When using a single transformer to power more than one controller or expansion module, the correct polarity must always be maintained between the boards. Failure to observe correct polarity will result in damage to the VCB-X Controller and expansion modules.

Please carefully read and apply the following information when wiring the VCB-X Controller or the Expansion Modules. See **Figures 6 & 7** for VCB-X input and output wiring. See **Figures 22 & 23** for the VCB-X EM1 Expansion Module wiring, **Figures 34 & 35** for VCB-X EM2 Expansion wiring, and **Figure 36** for the VCB-X 12 Relay Expansion Module wiring.

1. All wiring is to be in accordance with local and national electrical codes and specifications.

2. All 24 VAC wiring must be connected so that all ground wires remain common. Failure to follow this procedure can result in damage to the controller and connected devices.

3. Minimum wire size for 24 VAC wiring should be 18-gauge.

4. Minimum wire size for all sensors should be 24-gauge. Some sensors require 2-conductor wire and some require 3-or 4-conductor wire.

5. Minimum wire size for 24 VAC thermostat wiring should be 22 gauge.

6. Be sure that all wiring connections are properly inserted and tightened into the terminal blocks. Do not allow wire strands to stick out and touch adjoining terminals which could potentially cause a short circuit.

7. When communication wiring is to be used to interconnect VCB-X Controllers together or to connect to other communication devices, all wiring must be plenum-rated, minimum 18-gauge, 2-conductor, twisted pair with shield. WattMaster can supply communication wire that meets this specification and is color coded for the network or local loop. Please consult your WattMaster distributor for information. If desired, Belden #82760 or equivalent wire may also be used.

8. Before applying power to the VCB-X Controller, be sure to recheck all wiring connections and terminations thoroughly.

VCB-X Controller Input Wiring

VCB-X Controller Inputs

The VCB-X Controller is designed with 5 analog inputs, 3 analog outputs, 1 triac output, 4 binary inputs and 6 relay outputs.

There are also 2 E-BUS Expansion Ports which allow the use of communicating sensors and the E-BUS Modules.

See **Figures 6 & 7** for wiring details. Detailed wiring for all inputs and outputs are found on the pages that follow.

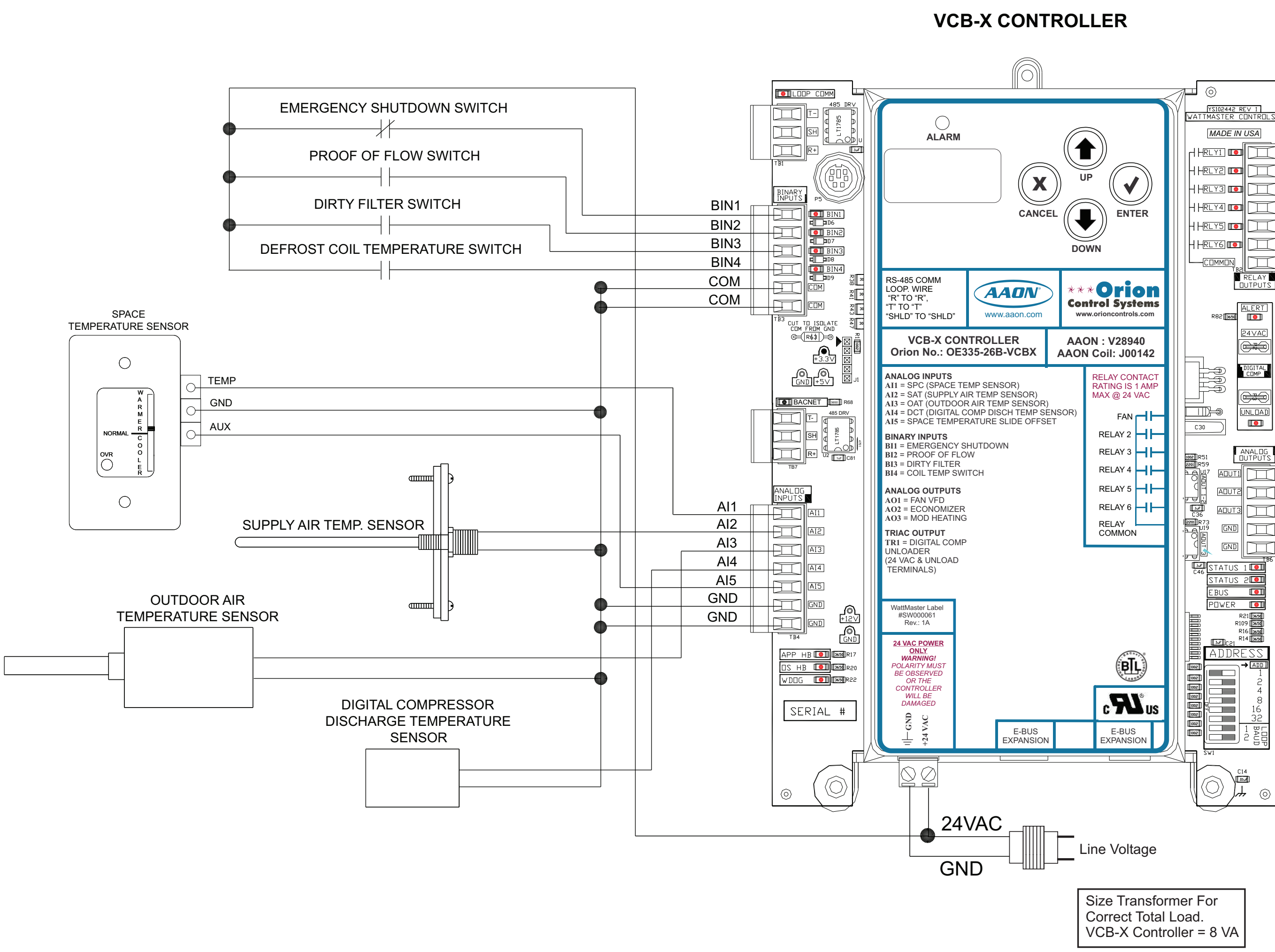


Figure 6: VCB-X Controller Input Wiring

VCB-X Controller Outputs

The VCB-X Controller must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the Controller.

Also please note that when wiring the VCB-X Controller, its contacts must be wired as wet contacts (connected to 24 VAC).

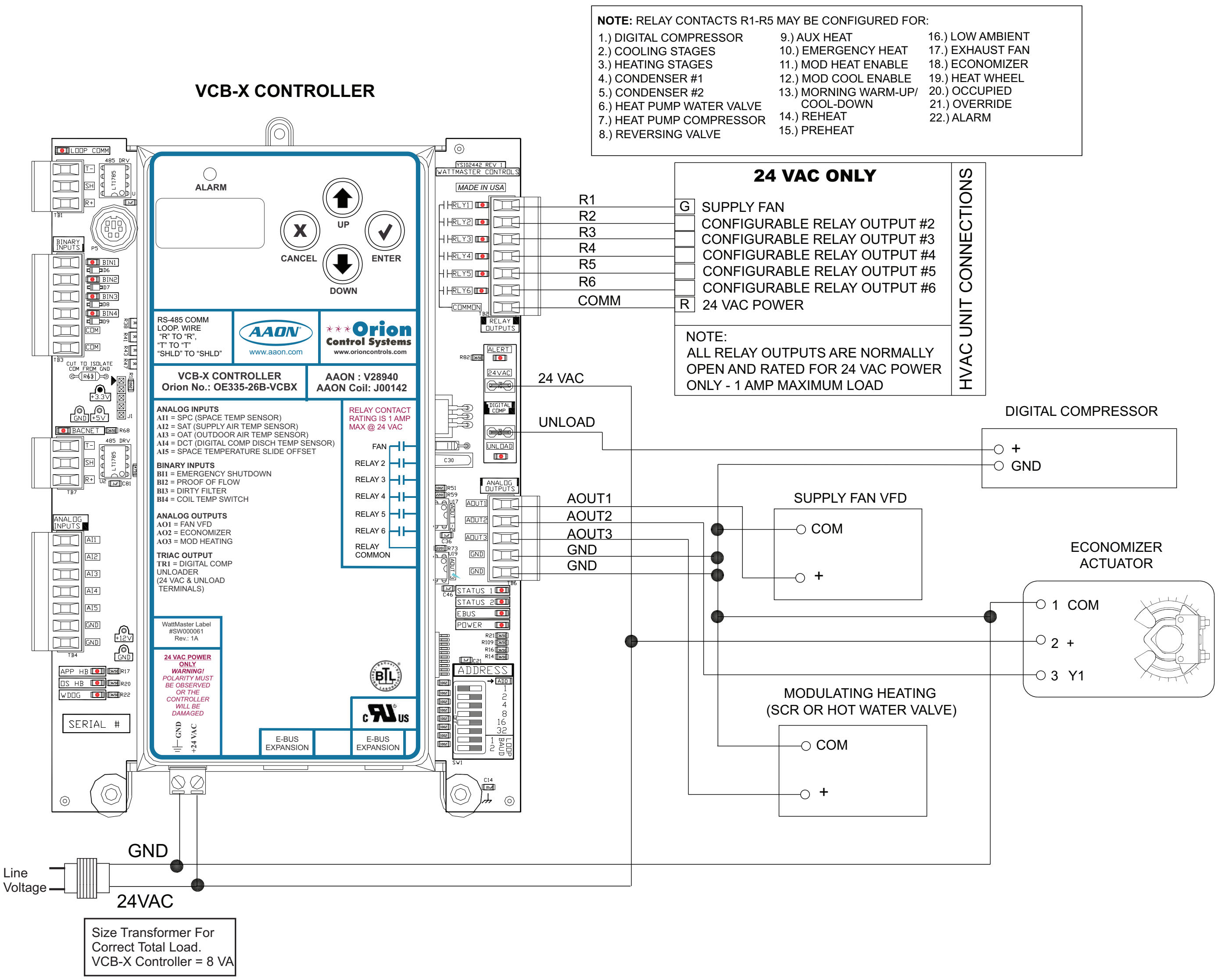


Figure 7: VCB-X Controller Output Wiring

E-BUS Digital Room Sensor Wiring

E-BUS Digital Room Sensor

The OE217-02 E-BUS Digital Room Temperature Sensor can be used to sense Space Temperature. The OE217-03 or OE217-04 E-BUS Digital Room Temperature Sensor can be used to sense Space Temperature and Humidity. The OE217-04 has no LCD display or keypad. The Sensor connects to the VCB-X Controller with the EBC E-BUS expansion cable. It can also be daisy-chained with a CO_2 Sensor for applications requiring both a wall mounted CO_2 sensor and space temperature sensor.

The E-BUS Digital Room Sensor should be mounted at approximately 5 Ft. above the floor on the wall in an area that does not have drafts or is exposed to direct sunlight. See **Figure 8** for wiring details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

NOTE: Only one indoor combination Temperature/ Humidity Sensor should be used - either Space or Return Air. If both a Space and Return Air Sensor are used, the unit will only use the Return Air Humidity value and will display that value for both the Space and Return Air Humidity Status.

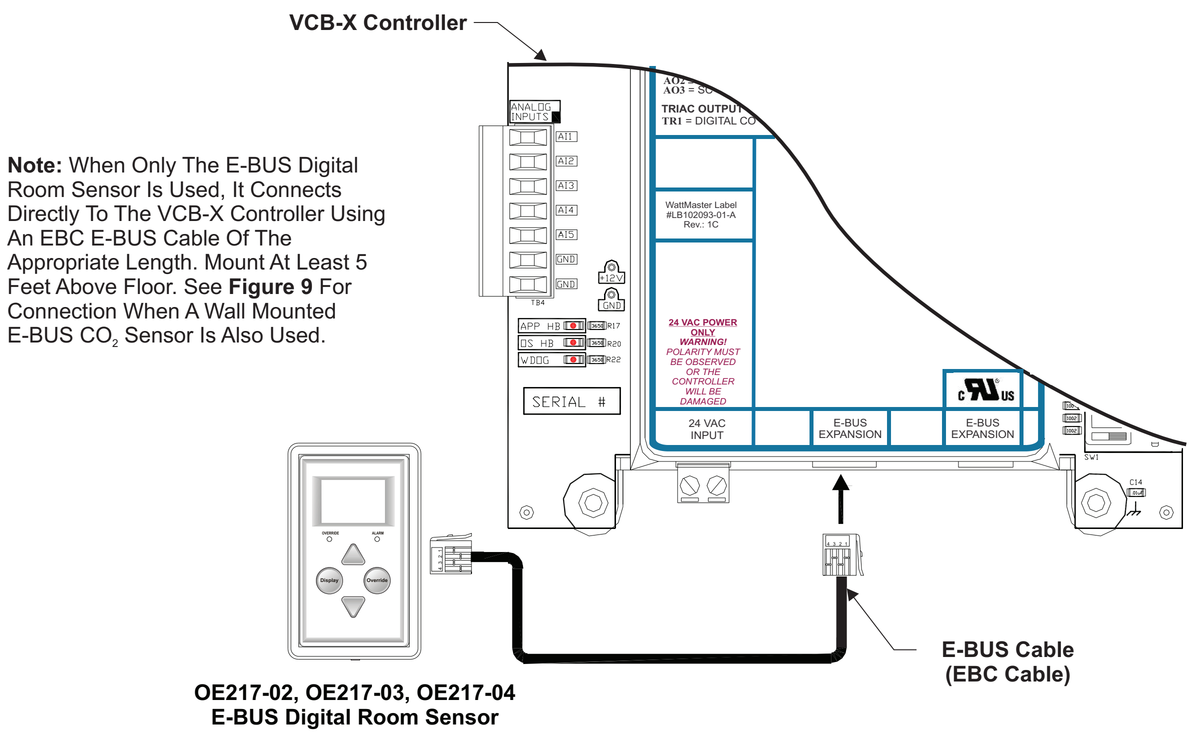


Figure 8: OE217-02, OE217-03, OE217-04 – E-BUS Digital Room Sensor Wiring

E-BUS CO_2 Wall-Mounted Sensor

The OE256-05 Wall Mounted E-BUS CO_2 Sensor is used to monitor CO_2 levels in the space served by the HVAC unit. The E-BUS CO_2 Sensor connects to the VCB-X Controller with an EBC E-BUS cable. It can be daisy-chained with the E-BUS Digital Room Sensor (OE217-02, OE217-03, OE217-04) for applications requiring both a room CO_2 sensor and room temperature sensor.

It should be mounted at approximately 5 Ft. above the floor on the wall in an area that does not have drafts or is exposed to direct sunlight. See **Figure 9** for wiring details and installation notes. A Duct Mounted E-BUS CO_2 Sensor can be used if desired instead of the Wall Mounted E-BUS CO_2 Sensor. See **Figure 10** for Duct Mounted E-BUS CO_2 Sensor wiring details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

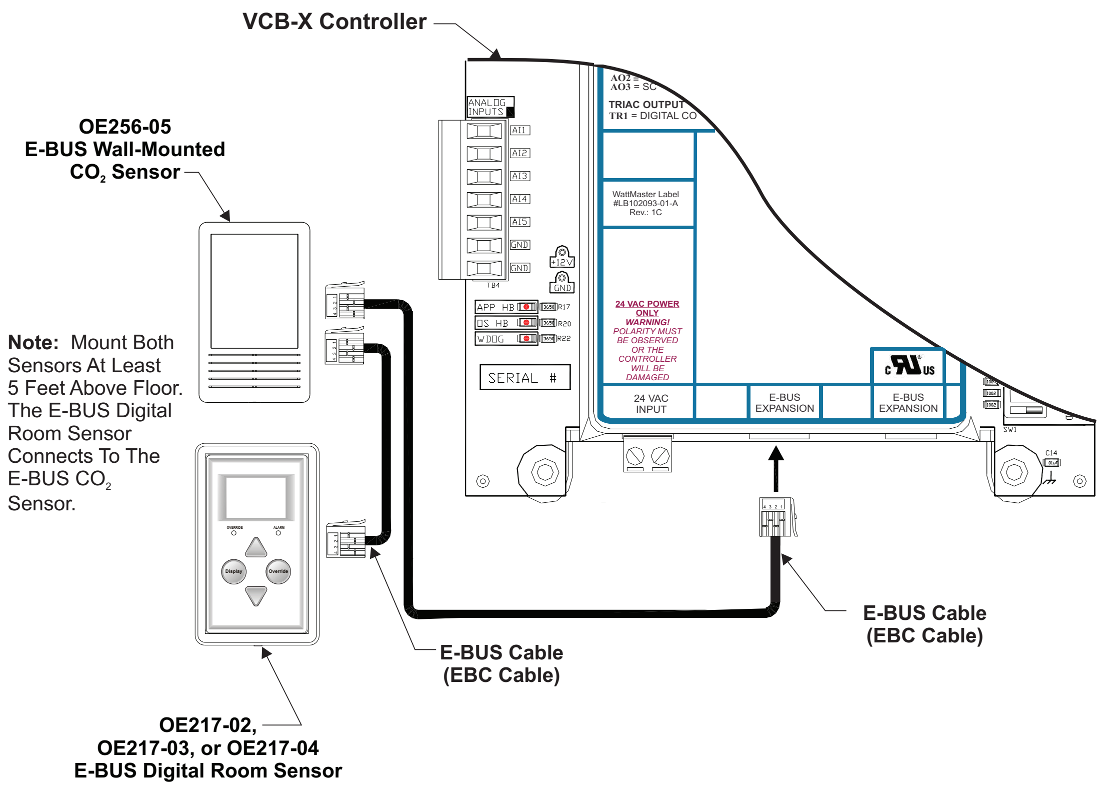


Figure 9: OE256-05 – Wall Mounted E-BUS CO_2 Sensor Wiring

Duct Mounted E-BUS CO_2 Sensor

The OE256-07 Duct Mounted E-BUS CO_2 Sensor with Remote Pickup Tube is used for sensing the current CO_2 level in the HVAC unit's return air stream. This is useful when you want an average CO_2 reading in the area served by the HVAC unit or when you don't want a wall mounted E-BUS CO_2 Sensor due to sensor tampering concerns in the space.

The OE256-07 Duct Mounted Return Air CO_2 Sensor is comprised of the CO_2 Sensor, the WattMaster Aspiration Box Assembly, and a Remote Pickup Tube.

The Duct Mounted Return Air E-BUS CO_2 Sensor with Remote Pickup Tube is designed to be mounted in the return air duct of the HVAC unit and uses its integral aspiration box to sample the CO_2 level in the duct. See **Figure 10** below for wiring and installation details.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

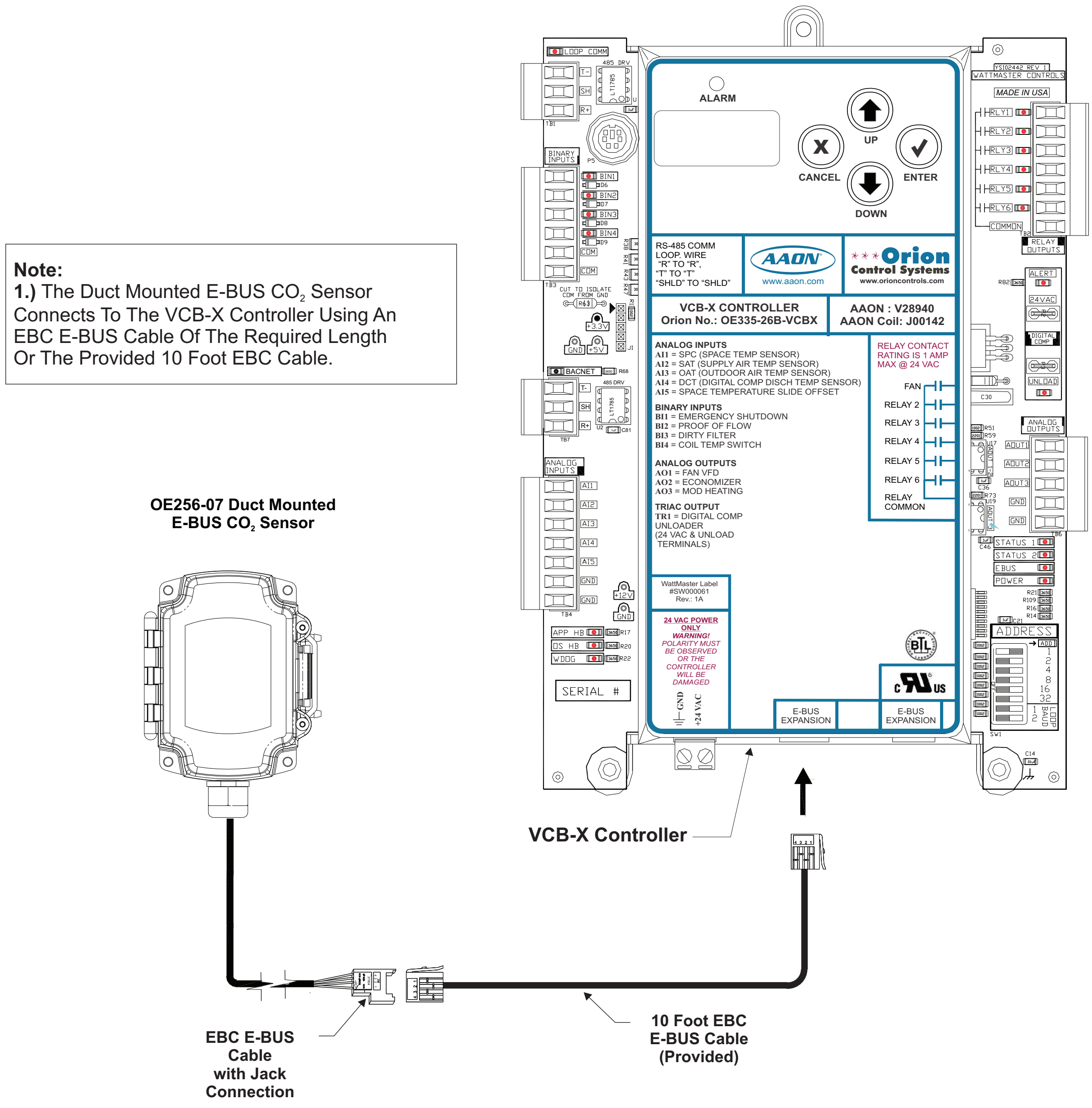


Figure 10: OE256-07 - Duct Mounted E-BUS CO_2 Sensor Wiring

Space Temperature Sensor

The OE210, OE211, OE212, OE213 Space Temperature Sensor is typically used for constant volume HVAC unit applications controlling one zone. The Space Temperature Sensor is a 10K Type III thermistor sensor and should be mounted approximately 5 feet above the floor in the space that is to be controlled.

The Space Temperature Sensor is available as a sensor only, sensor with override button, sensor with slide adjust, and sensor with slide adjust and override configurations.

See **Figure 11** below for complete Space Temperature Sensor wiring details.

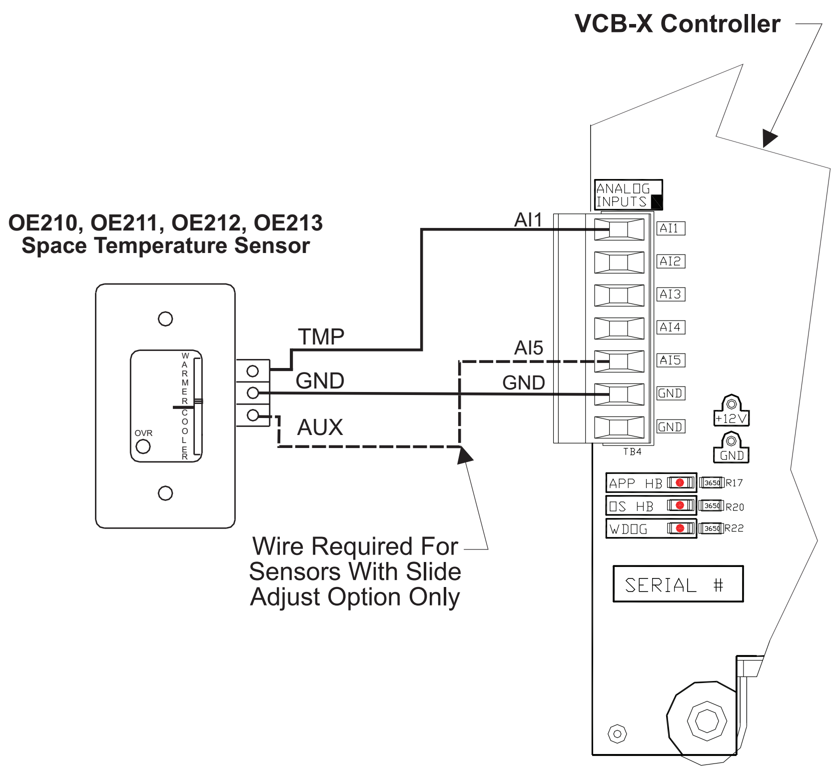


Figure 11: OE210, OE211, OE212, OE213 – Space Temperature Sensor Wiring and Slide Adjust

Supply Air Temperature Sensor Wiring

Supply Air Temperature Sensor

The OE231 Supply Air Temperature Sensor must be wired as shown for proper operation. The Supply Air Temperature Sensor is a 10K Type III thermistor sensor. The Supply Air Temperature Sensor should be mounted in the unit discharge plenum or in the supply air duct. See **Figure 12** below for details.

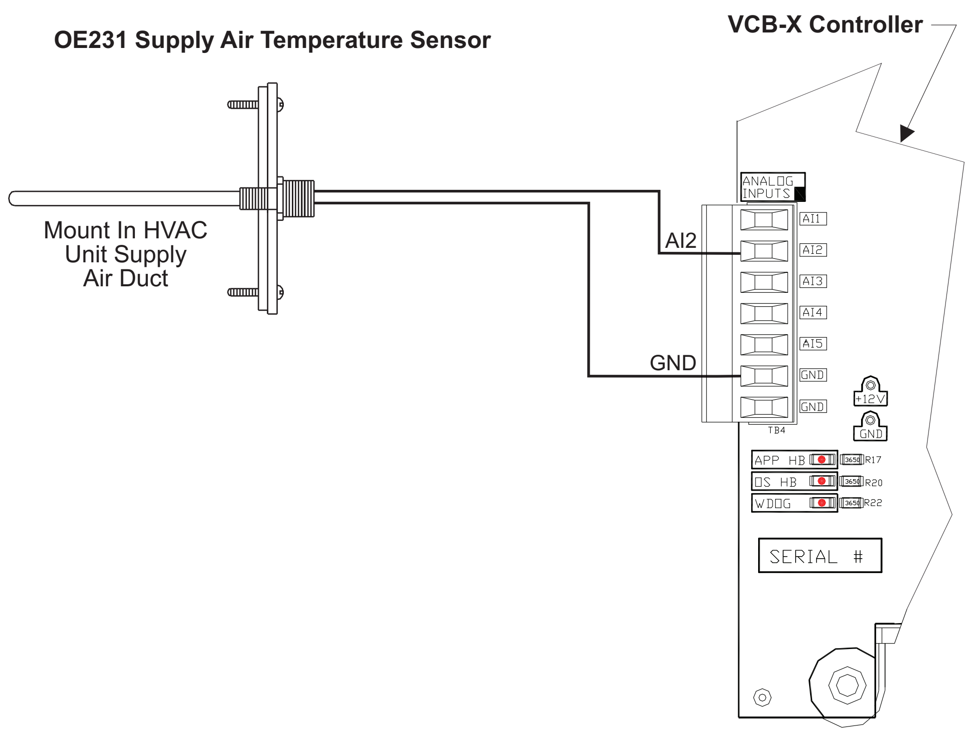


Figure 12: OE231 – Supply Air Temperature Sensor Wiring

Outdoor Air Temperature Sensor

The OE250 Outdoor Air Temperature Sensor must be wired as shown for proper operation of the VCB-X Controller. The Outdoor Air Temperature Sensor is a 10K Type III thermistor sensor. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. Be sure to make the wiring splices inside of the Outdoor Air Temperature Sensor weather-tight enclosure. See **Figure 13** below for details.

For applications involving Outdoor Air Humidity, the OE265-15-A E-BUS Outside Air & Humidity Sensor must be used instead. See **Figure 14** for details.

CAUTION: Be sure to mount the Outdoor Air Temperature Sensor in an area that is not exposed to direct sunlight. The shaded area under the HVAC unit rain hood is normally a good location. Unused conduit opening(s) must have closure plugs installed and must be coated with sealing compound to provide a rain-tight seal. Water can damage the sensor.

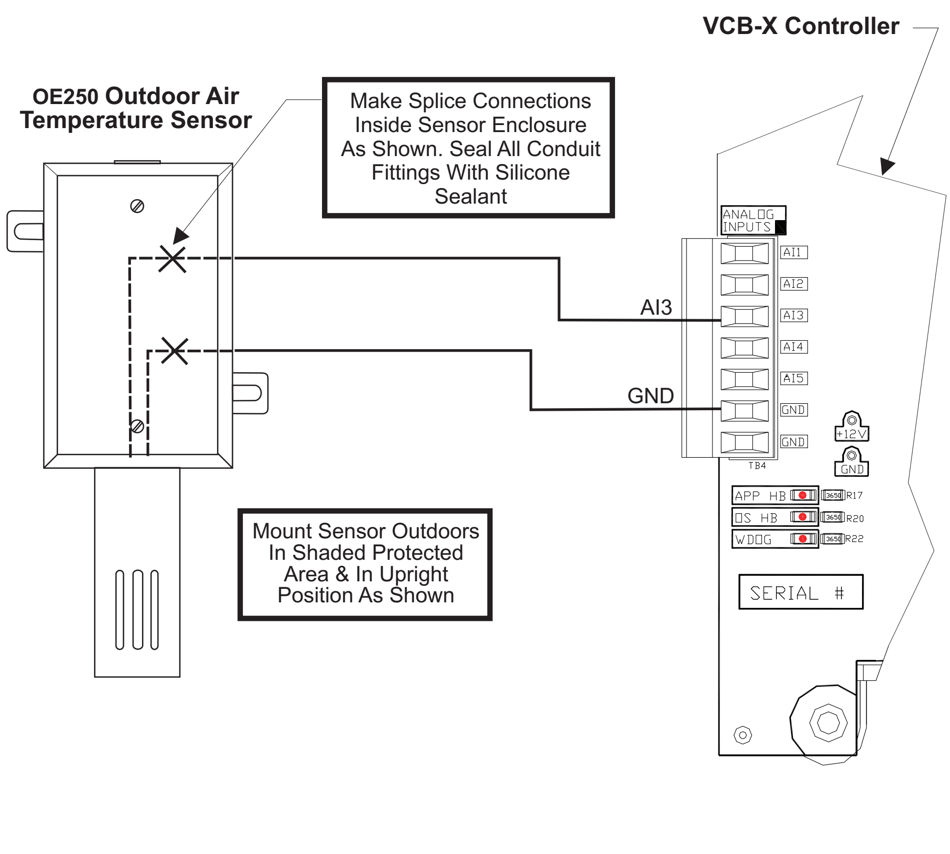


Figure 13: OE250 – Outdoor Air Temperature Sensor Wiring

E-BUS Outdoor Air Temperature & Humidity Sensor Wiring

E-BUS Horizontal or Vertical Outdoor Air Temperature & Humidity Sensor

The OE265-15-A (Horizontal) or OE265-16-A (Vertical) E-BUS Outdoor Air Temperature & Humidity Sensor connects to the VCB-X Controller. An EBC E-BUS cable plugs into the Sensor's attached 3 foot cable and then plugs into the E-BUS port of the VCB-X Controller or other E-BUS Expansion Board. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. See **Figure 14** below for details.

CAUTION: Be sure to mount the Outdoor Air Temperature & Humidity Sensor in an area that is not exposed to direct sunlight. The shaded area under the HVAC unit rain hood is normally a good location. Unused conduit opening(s) must have closure plugs installed and must be coated with sealing compound to provide a rain-tight seal. Water can damage the sensor.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

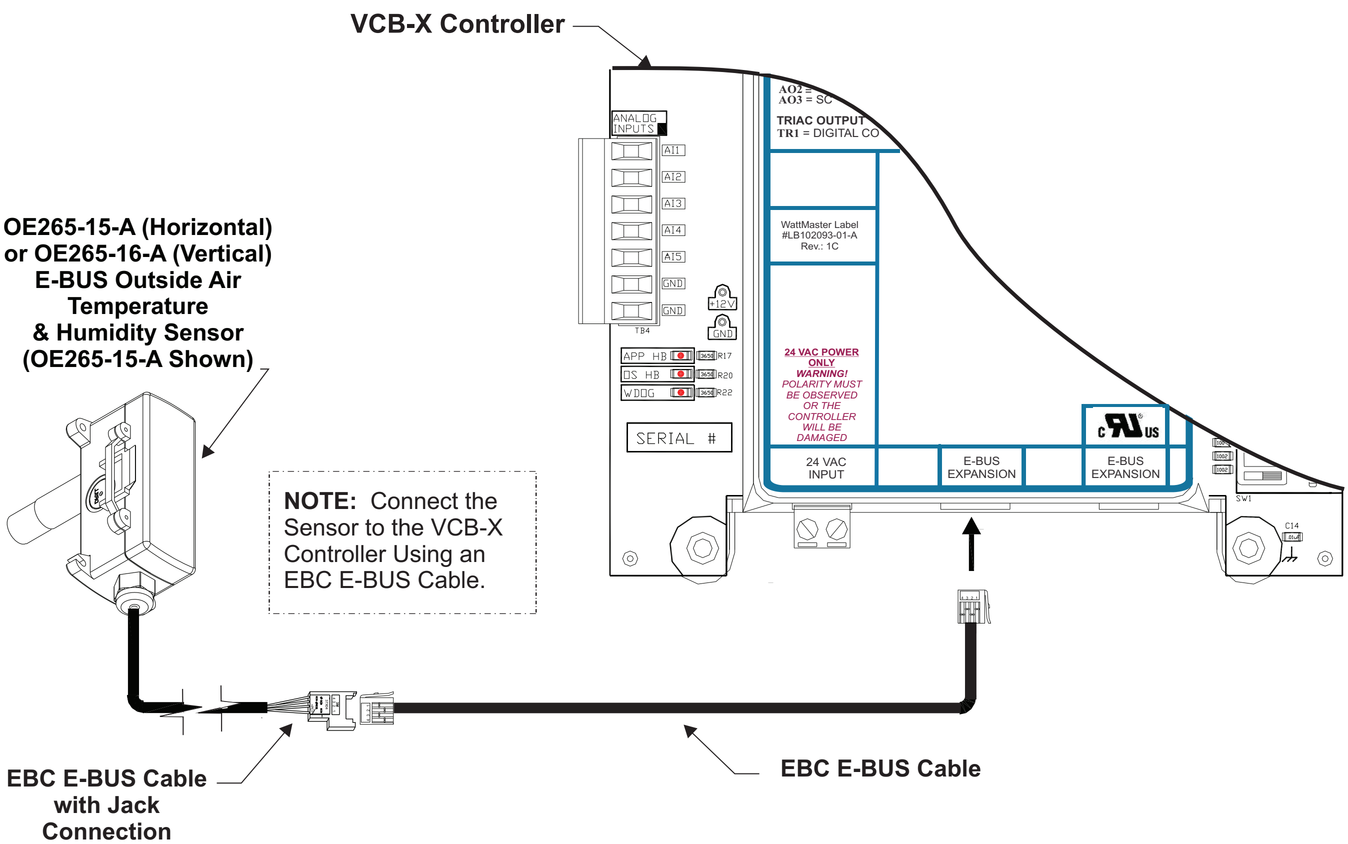


Figure 14: OE265-15-A & OE265-16-A – E-BUS Outdoor Air Temperature & Humidity Sensor Wiring

E-BUS Return Air Temperature & Humidity Sensor

The OE265-17-A E-BUS Return Air Temperature & Humidity Sensor connects to the VCB-X Controller. A 50 foot EBC E-BUS cable (provided) plugs into the Sensor's attached 3 foot cable and then plugs into the E-BUS port of the VCB-X Controller or other E-BUS Expansion Board. The sensor should be mounted in the upright position as shown in an area that is protected from the elements and direct sunlight. See **Figure 15** below for details.

NOTE: Only one indoor combination Temperature/ Humidity Sensor should be used - either Space or Return Air. If both a Space and Return Air Sensor are used, the unit will only use the Return Air Humidity value and will display that value for both the Space and Return Air Humidity Status.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

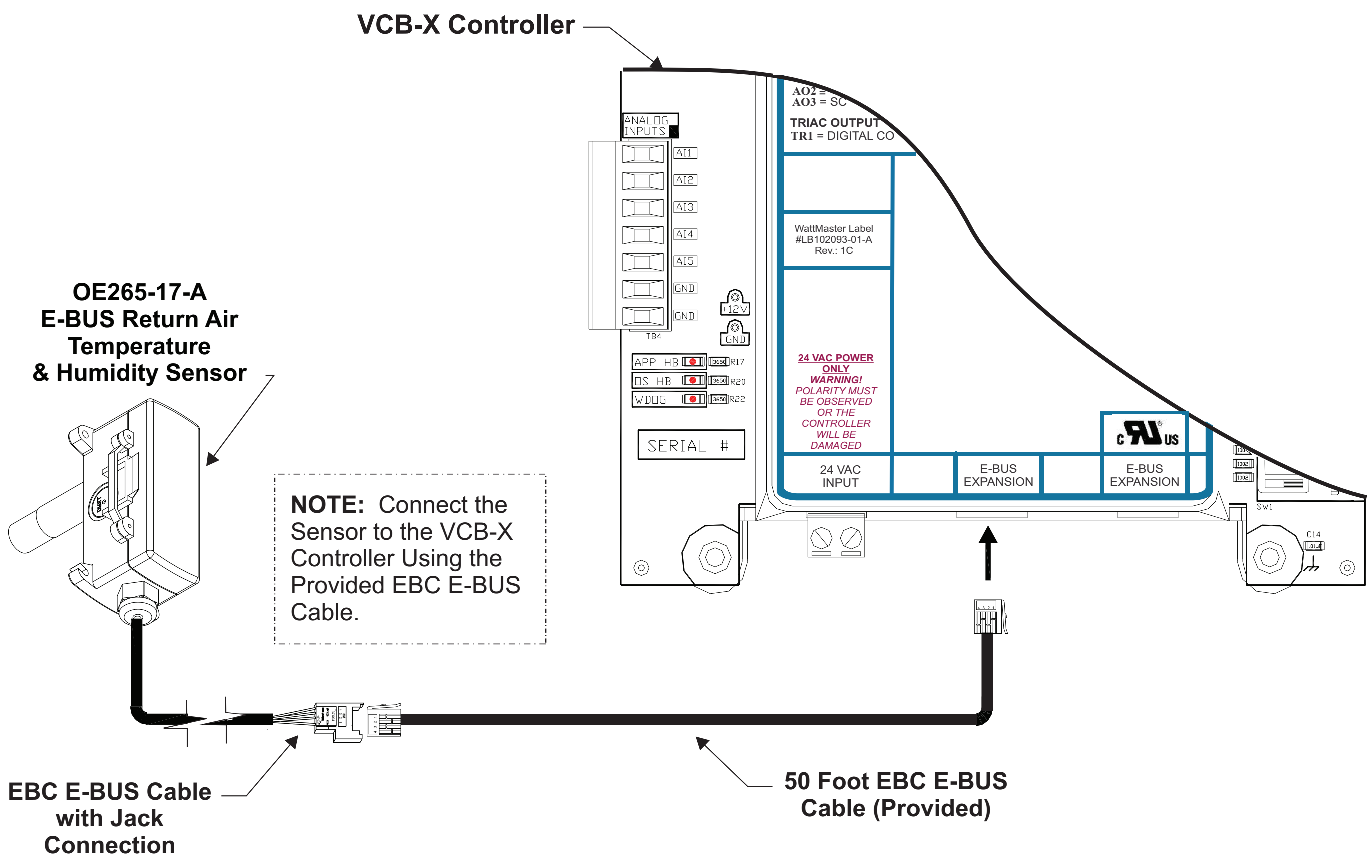


Figure 15: OE265-17-A – E-BUS Return Air Temperature & Humidity Sensor Wiring

Suction Pressure Transducer Wiring

Suction Pressure Transducer Kit

The OE275-03-A Suction Pressure Transducer Kit is comprised of the OE275-01 Suction Pressure Transducer, modular cable with a modular connector on one end and bare stripped wires on the other end, an E-BUS Adapter Board, and a 3 foot EBC E-BUS Cable. It is required for any VCB-X application with DX Cooling that requires Dehumidification and for Water Source Heat Pump applications.

The Suction Pressure Transducer is used to measure suction pressure at the HVAC unit's DX evaporator coil suction line. This suction line pressure is converted to saturated refrigerant temperature by the VCB-X Controller. This temperature is used by the VCB-X Controller to accurately control the compressors to a suction temperature setpoint to provide optimum performance from the system during Dehumidification operation and to provide compressor protection on Water Source Heat Pump units.

The Suction Pressure Transducer wires to the VCB-X Controller as shown in **Figure 16** below. In this application, the Suction Pressure Transducer connects to the E-BUS Adapter Board's V, SIG, and GND terminals through a cable. The cable is supplied with a 3-pin Packard mating connector for attachment to the sensor on one end and has 3 color-coded stripped wires on the other end. The stripped wire ends can be spliced to other wires to extend the wiring length when required. The EBC E-BUS Cable connects to the E-BUS Adapter Board. This cable must then connect to the VCB-X Controller directly or to a VCB-X Expansion Board connected to the VCB-X Controller.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) or E-BUS Adapter Board (OE365-15-EBA) may be required.

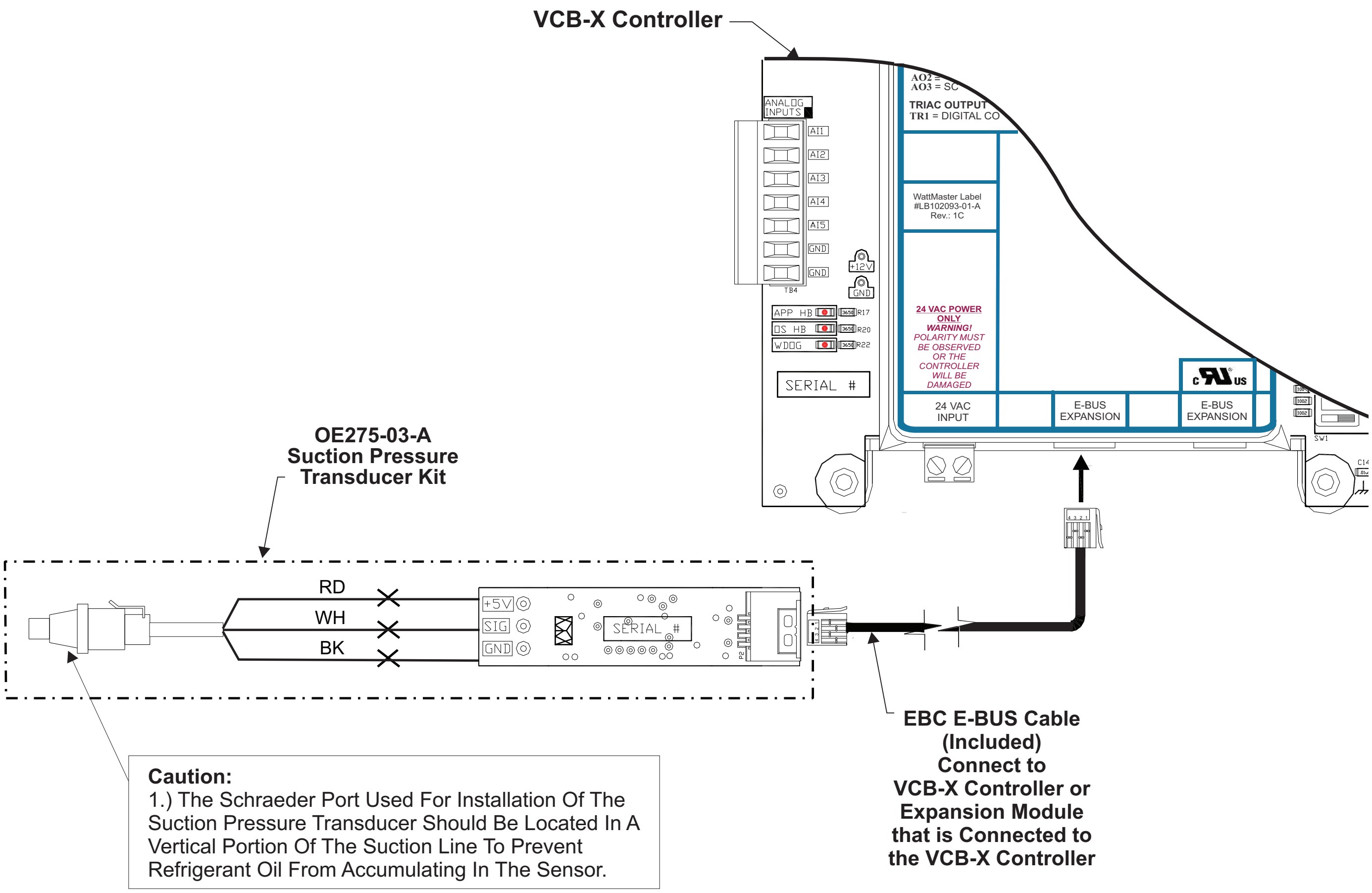


Figure 16: OE275-03-A – Suction Pressure Transducer Kit Wiring

Digital Compressor Discharge Temperature Sensor

A Digital Compressor Discharge Temperature Sensor (by others) must be wired as shown in **Figure 17** below for proper operation of the VCB-X Controller's Digital Scroll Compressor.

The Discharge Temperature Input is a thermistor input. There is no polarity requirement for the thermistor.

NOTE: For thermistor signal wiring, short wire runs are recommended.

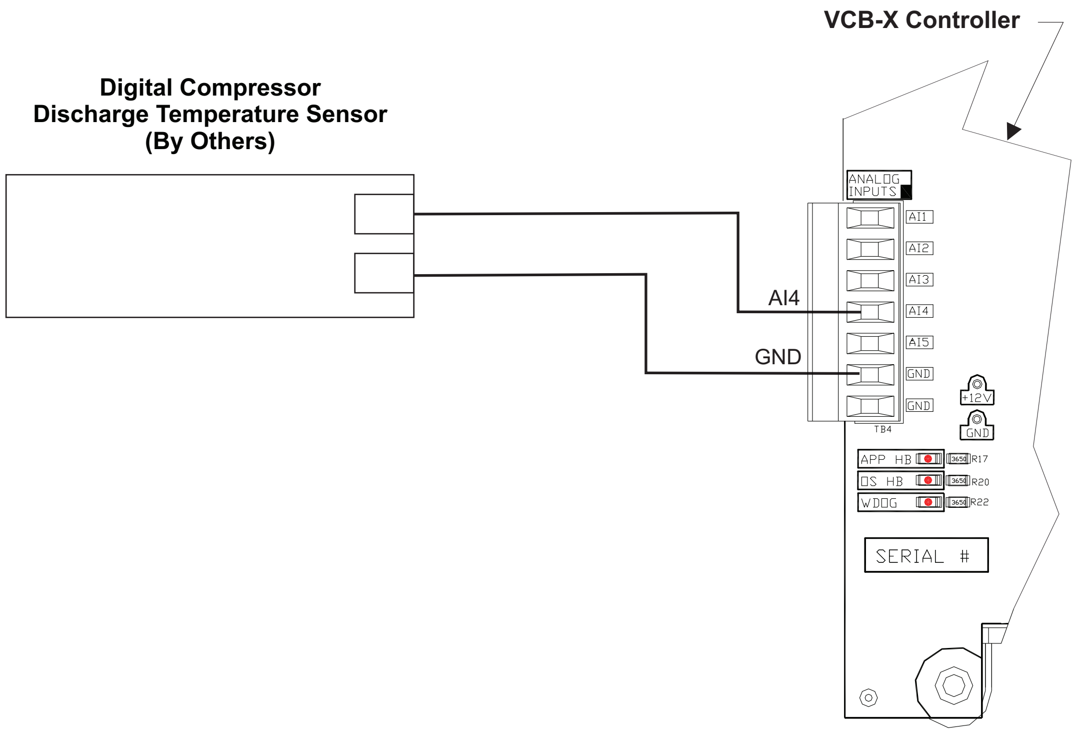


Figure 17: Digital Compressor Discharge Temperature Sensor Wiring

Digital Compressor Unloader Wiring

Digital Compressor Unloader

The Digital Compressor Unloader uses a solenoid unloader as the capacity control method. The unloader solenoid is energized in an on/off pattern to deliver the capacity needed by the digital compressor to achieve setpoint.

The Unloader Solenoid output is a triac output. The maximum continuous solenoid load is 0.5A and the peak inrush current is 6A.

Only (1) Digital Compressor can be controlled with the VCB-X Controller.

See **Figure 18** below for wiring details.

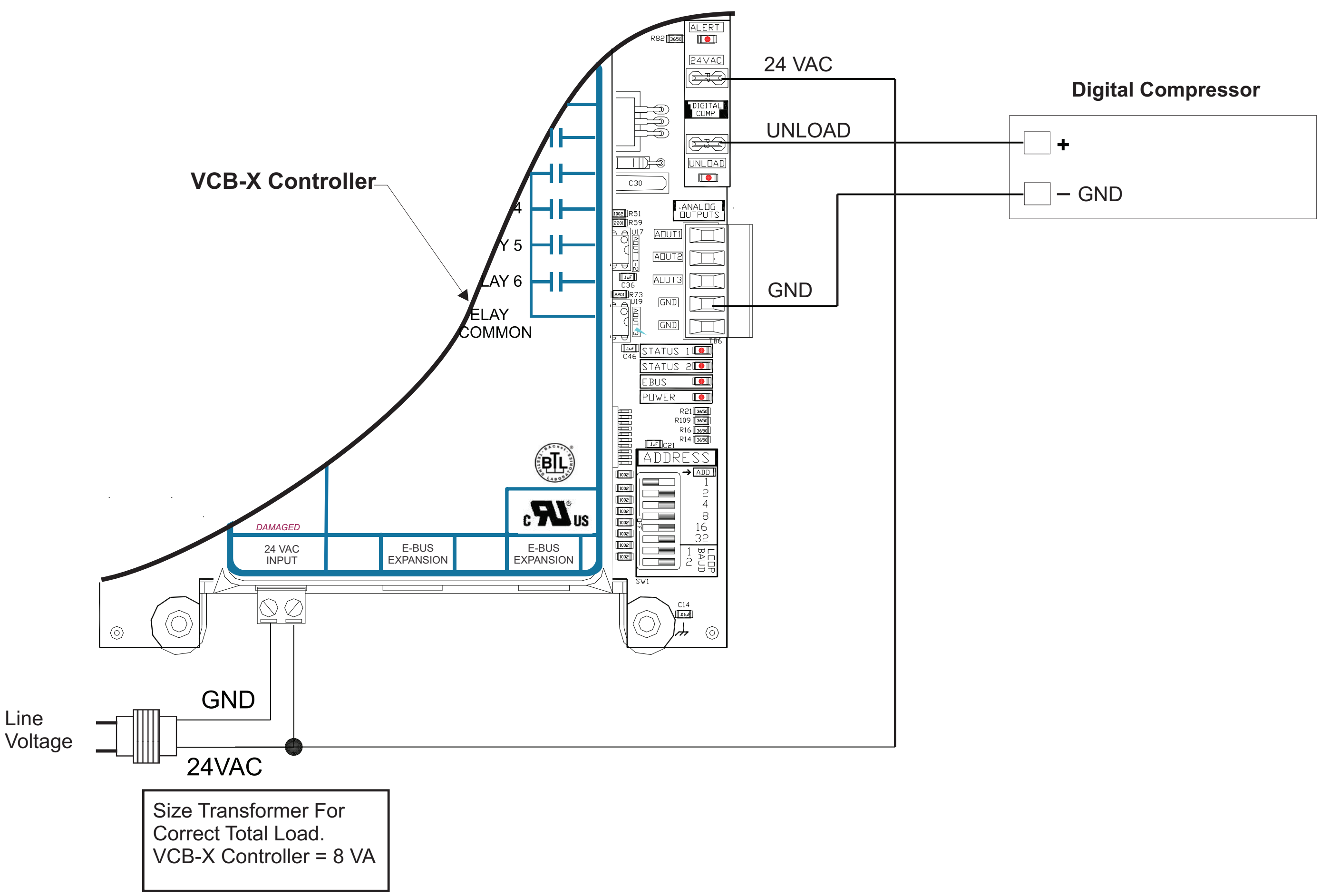


Figure 18: Digital Compressor Unloader Wiring

Supply Fan VFD Signal

The Supply Fan VFD Signal is a user-adjustable signal with a range of 0-10 VDC from AOUT1 on the VCB-X Controller. This signal output can be connected to the Supply Fan Variable Frequency Drive to modulate the Supply Fan speed.

See **Figure 19** below for detailed wiring.

CAUTION: Variable Frequency Drive units can cause large transient noise spikes which can cause interference to be propagated on other electronic equipment. Use shielded wire wherever possible and route all sensor and controller wiring away from the Variable Frequency Drive and the HVAC Unit electrical wiring.

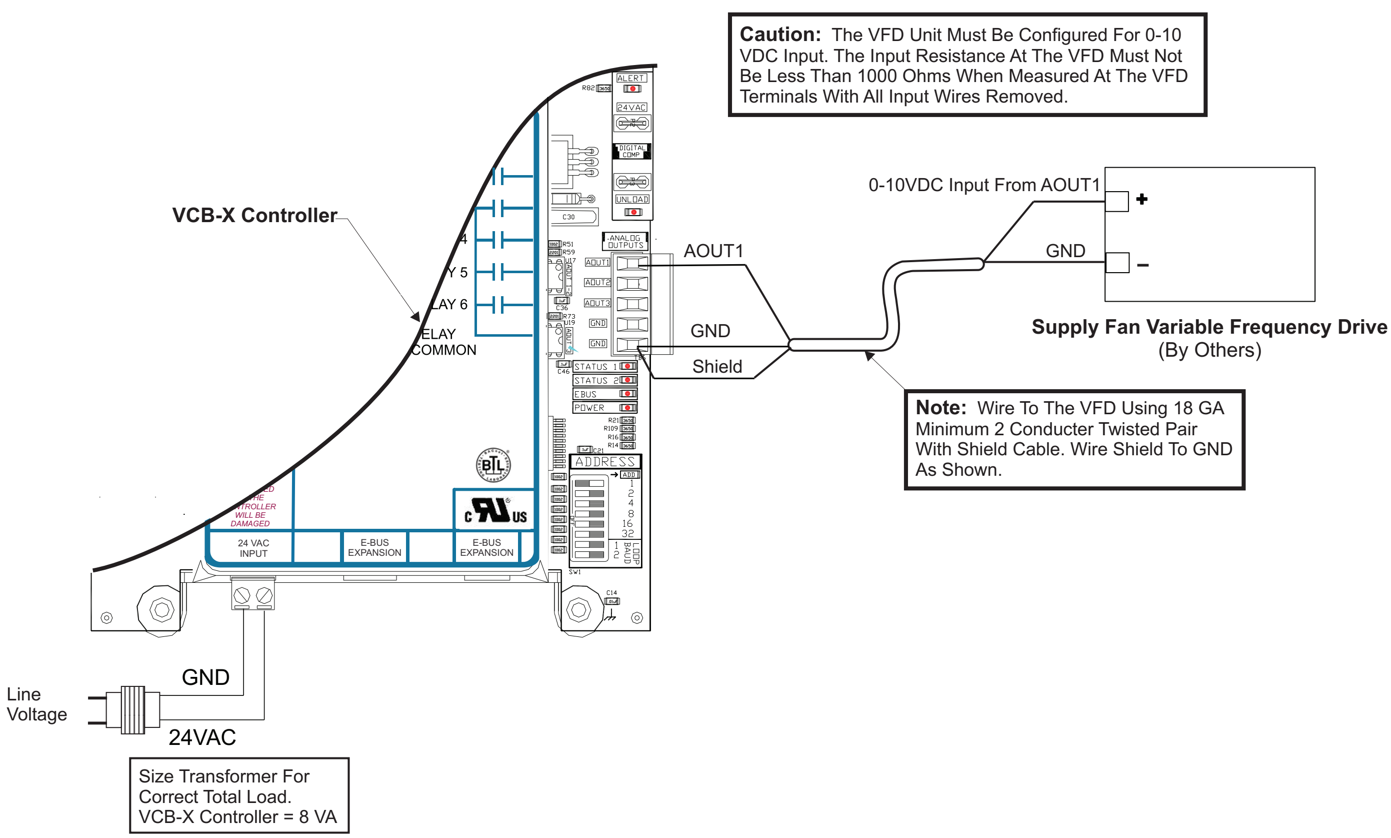


Figure 19: Supply Fan VFD Wiring

Economizer Actuator Wiring

Economizer Damper Actuator

The Economizer Damper Actuator signal voltage output (using AOUT2) is user-adjustable, but must be set to 2-10 VDC for this application. This signal output is used by the VCB-X Controller to modulate the Economizer Damper Actuator in order to control the amount of Outdoor Air delivered to the HVAC unit for Free Cooling and/or Indoor Air Quality requirements. See **Figure 20** for detailed wiring.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity will result in damage to the actuator or VCB-X Controller.

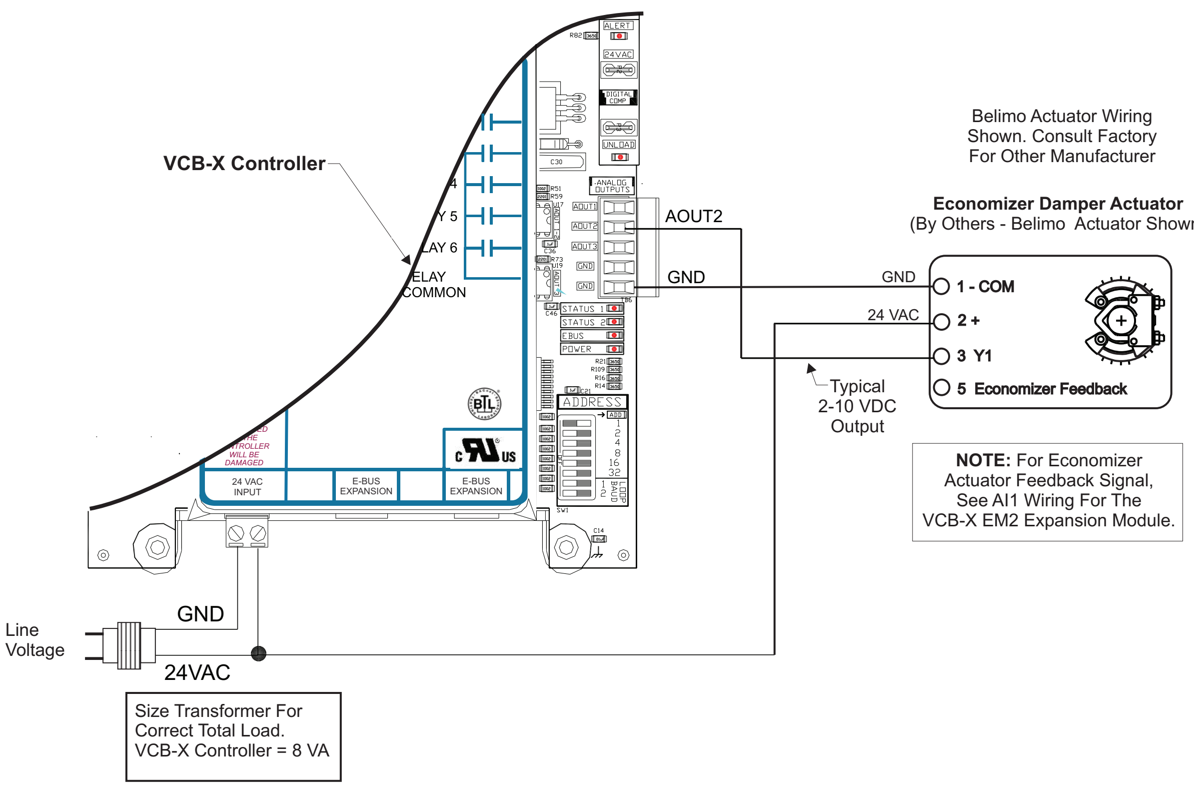


Figure 20: Economizer Damper Actuator Wiring

Modulating Heating Device

The Modulating Heating Device signal voltage output is a user-adjustable signal with a range of 0-10 VDC from AOUT3 when programming the controller. The output signal can be configured for either Direct Acting or Reverse Acting operation as required.

The Output signal is normally used to control a Modulating Hot Water Valve or Modulating Steam Valve or is used for SCR Control of an Electric Heating Coil.

See **Figure 21** below for detailed wiring of the Modulating Heating Device.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity could result in damage to the Modulating Heating Device or the VCB-X Controller.

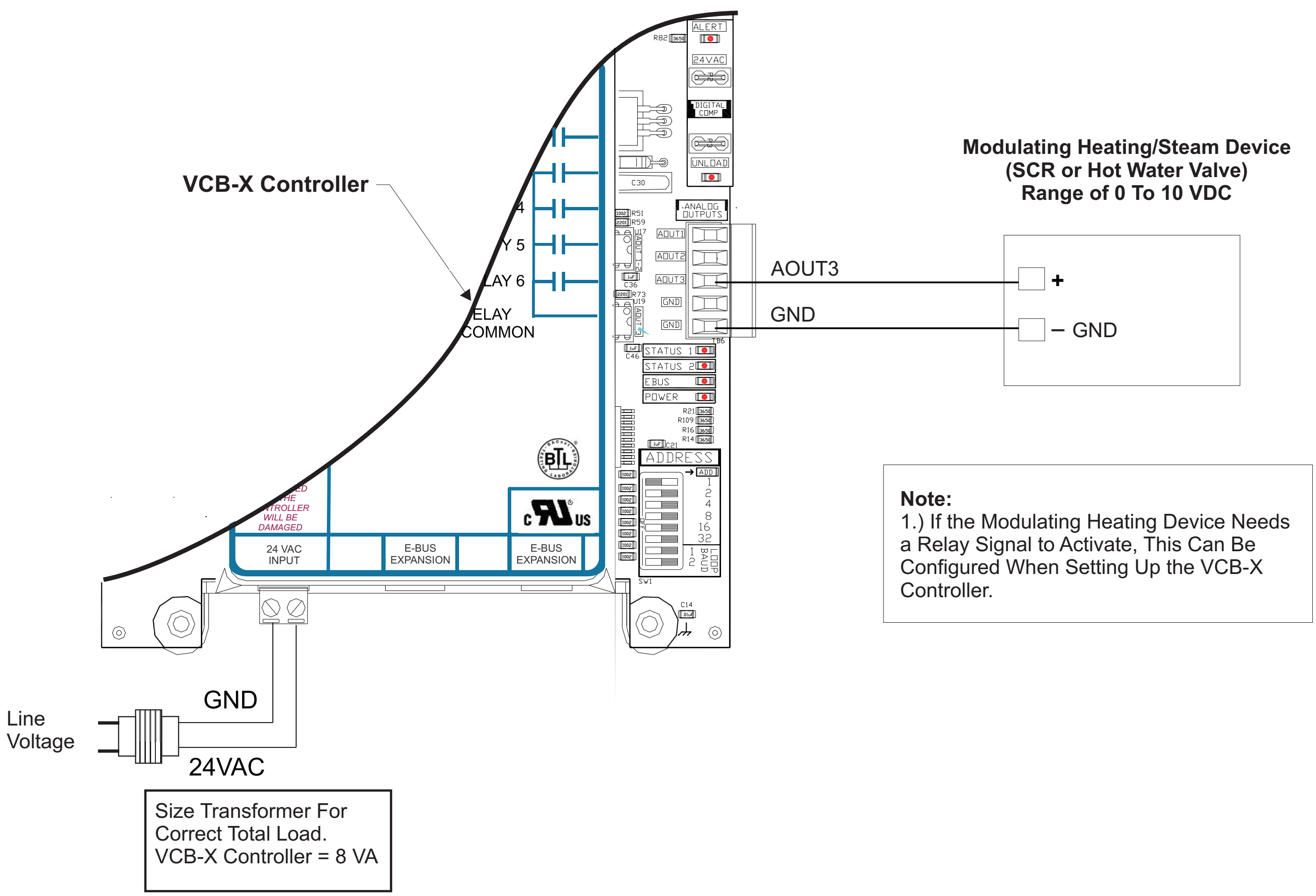


Figure 21: Modulating Heating Device Wiring

VCB-X EM1 Expansion Module Input Wiring

VCB-X EM1 Expansion Module Inputs

The VCB-X EM1 Expansion Module (OE336-23-EM1-A) provides an additional 6 analog inputs, 4 analog outputs, 3 binary inputs, and 5 configurable relay outputs. See **Figures 22 & 23** for complete wiring details.

The VCB-X EM1 Expansion Module can be used in conjunction with the VCB-X EM2 Expansion Module (OE336-23-EM2-A) and the E-BUS 12-Relay Expansion Module (OE358-23E-12R-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

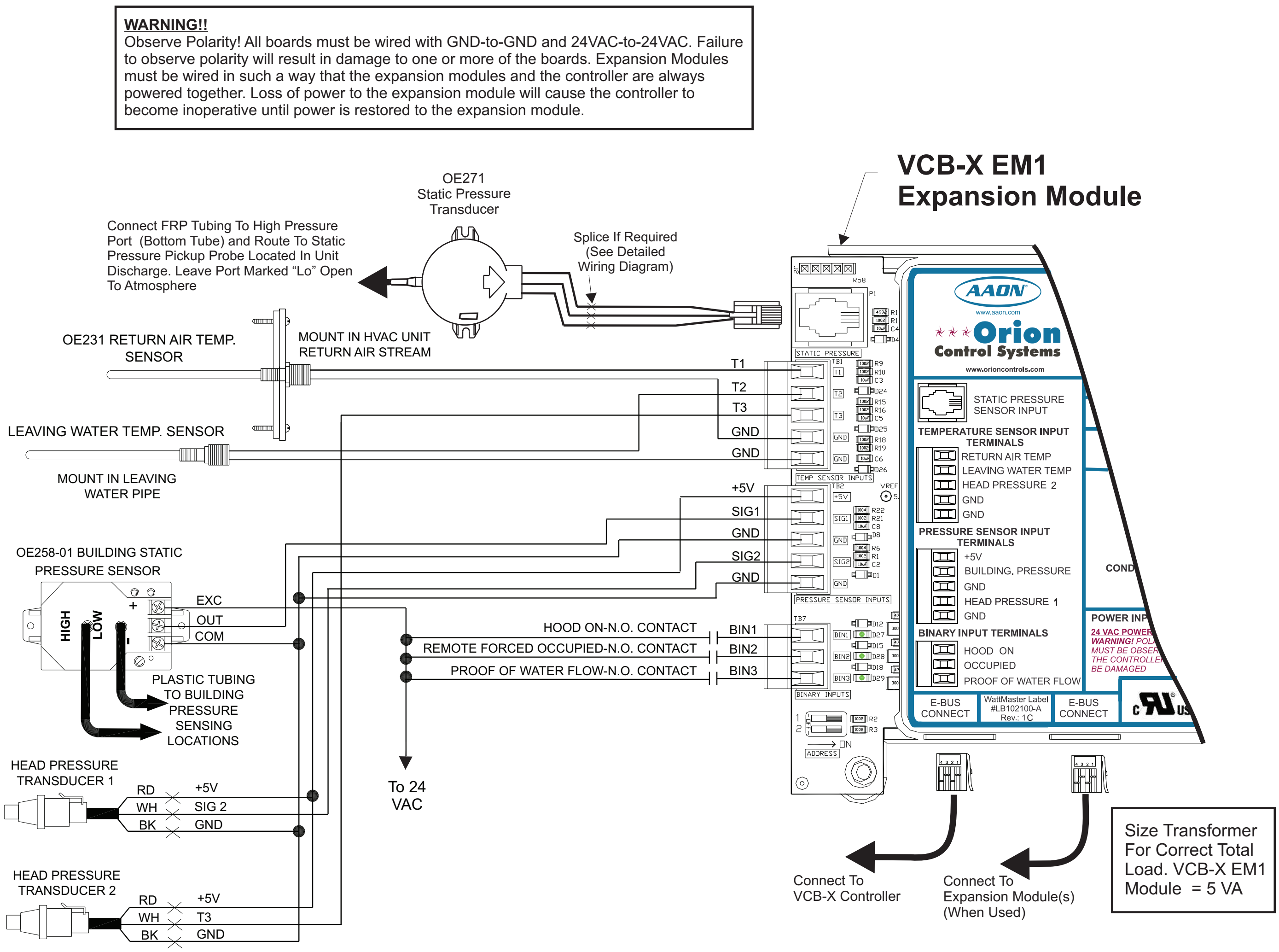


Figure 22: VCB-X EM1 Expansion Module Input Wiring Diagram

VCB-X EM1 Expansion Module Outputs

The VCB-X EM1 Expansion Module must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the expansion module.

Also, please note that when wiring the VCB-X EM1 Expansion Module, its contacts must be wired as wet contacts (connected to 24 VAC).

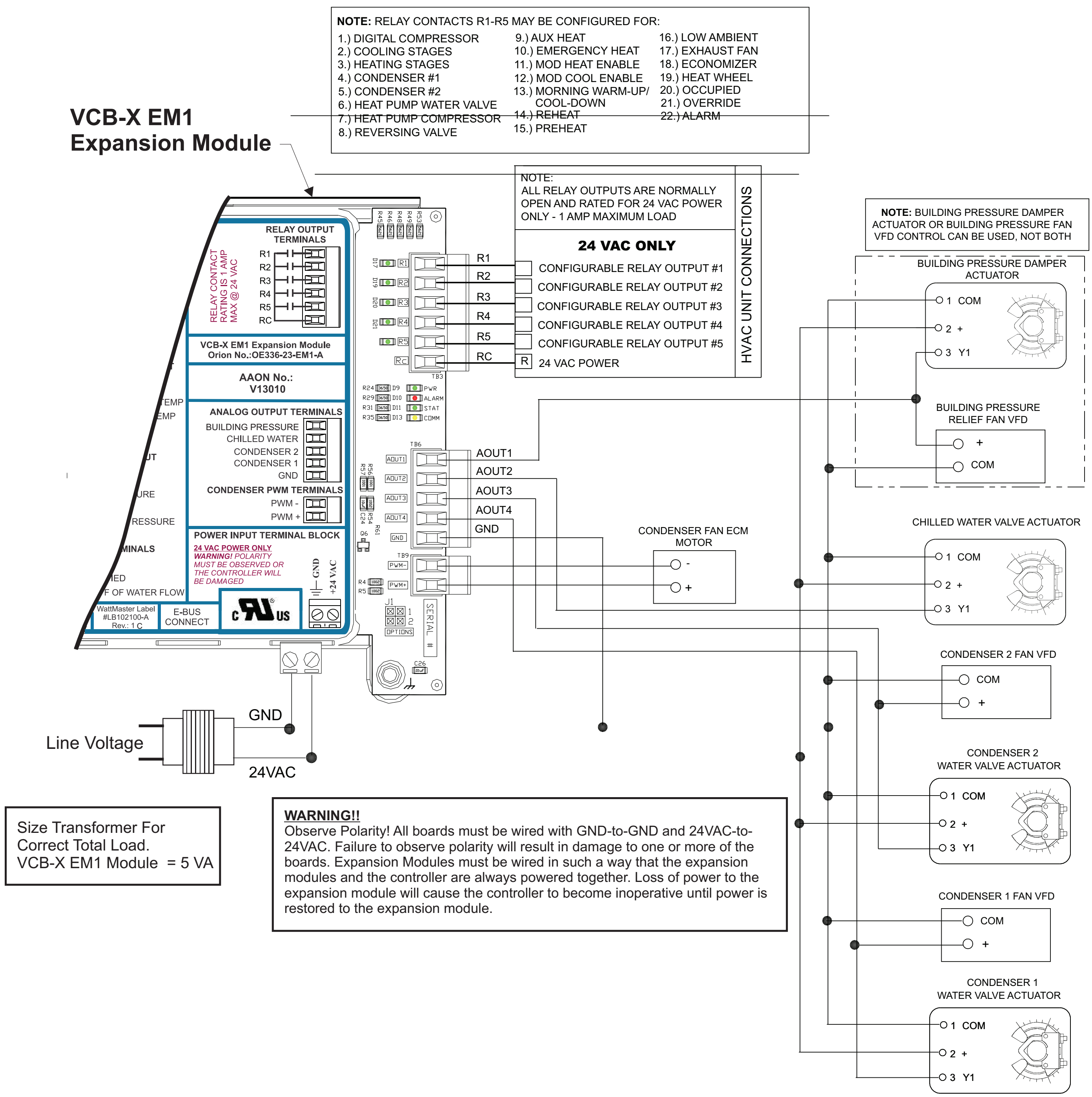


Figure 23: VCB-X EM1 Expansion Module Output Wiring Diagram

Static Pressure Transducer

The OE271 Static Pressure Transducer plugs directly into the VCB-X EM1 Expansion Module's Static Pressure port. The Duct Static Pressure Sensor reading is used to determine current Duct Static Pressure. This Static Pressure reading is used to control the output signal supplied to the Supply Fan VFD or Zoning Bypass Damper Actuator. If you have configured the HVAC unit for Constant Volume operation, this Sensor is optional. If it is installed on a Constant Volume unit, it will not affect operation, but rather will be used as a status-only reading. See **Figure 24** below for detailed wiring.

CAUTION: It is strongly recommended that you use pneumatic tubing instead of relocating the sensor. Extending the wires could cause voltage drop problems.

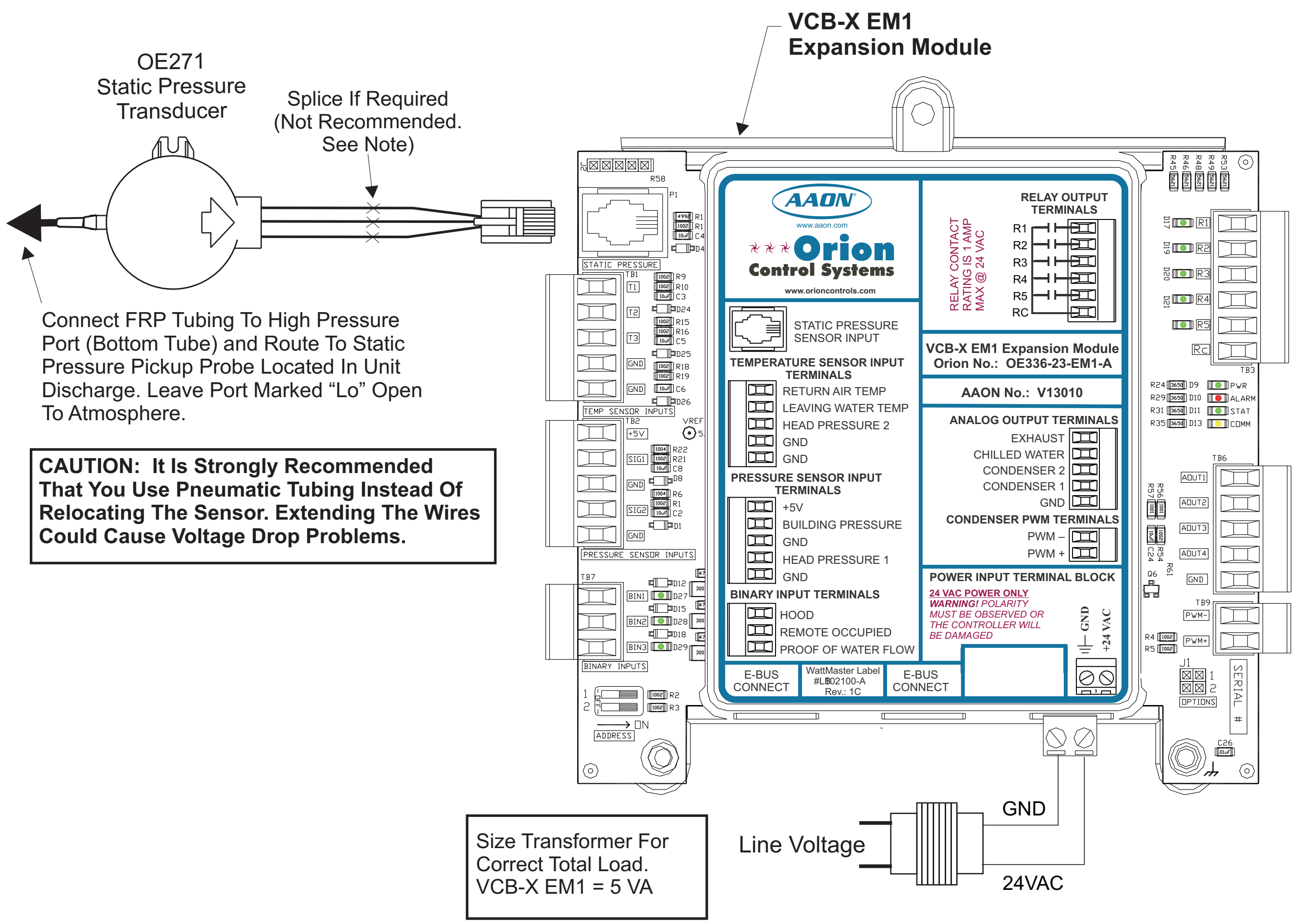


Figure 24: OE271 Static Pressure Transducer Wiring Diagram

Return Air Temperature Sensor

The OE231 Return Air Temperature Sensor must be wired as shown in **Figure 25** below. The Return Air Temperature Sensor is a 10K Type III thermistor sensor. The Return Air Temperature Sensor should be mounted in the return air duct. If the system has a Zoning Bypass Damper installed, be sure the return air sensor is located upstream of the bypass duct connection.

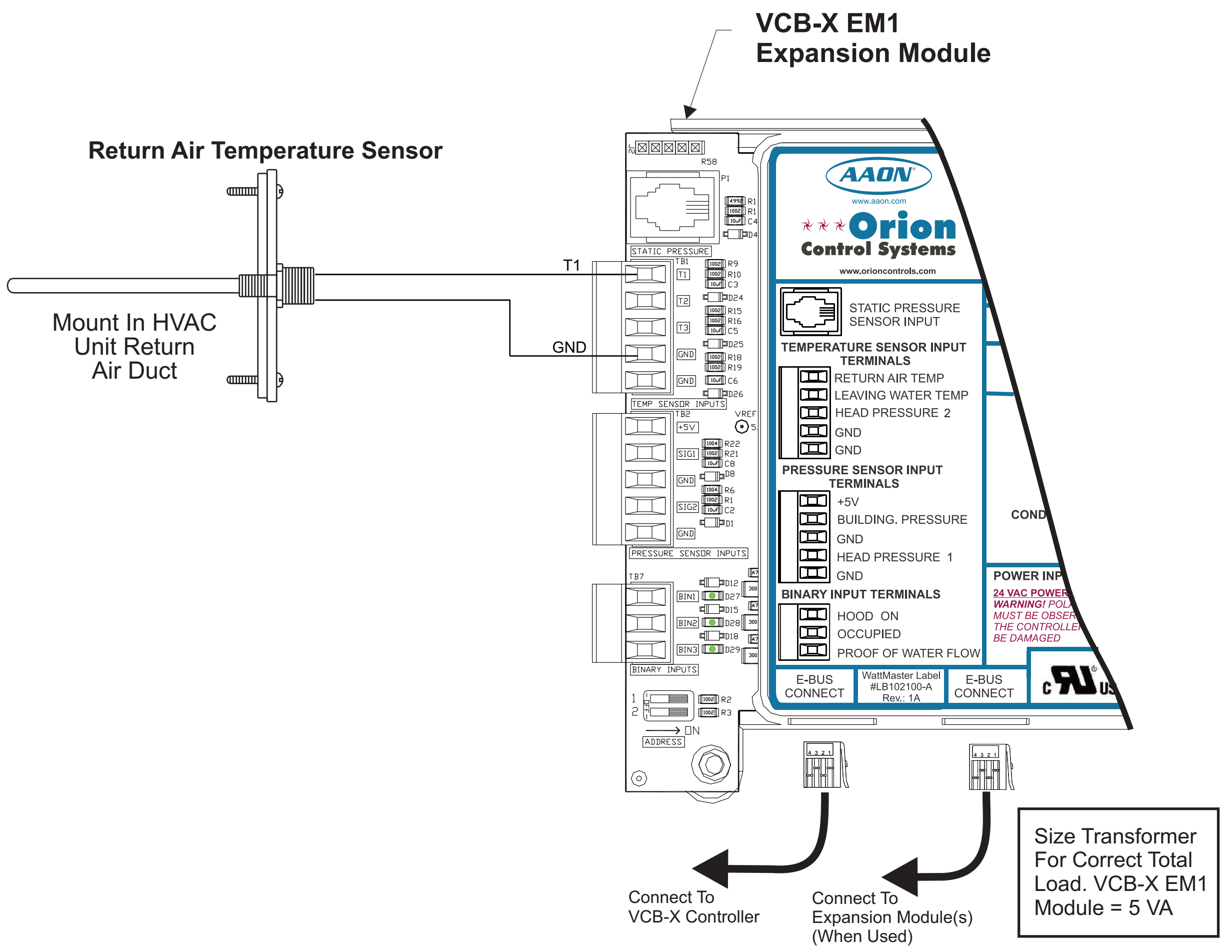


Figure 25: OE231 Return Air Temperature Sensor Wiring Diagram

Leaving Water Temperature Sensor Wiring

Leaving Water Temperature Sensor

The OE230 (with OE291 Immersion Well) or strap-on OE233 Leaving Water Temperature Sensor must be wired as shown in **Figure 26** below. The Leaving Water Temperature Sensor is a 10K Type III thermistor sensor.

The Leaving Water Temperature Sensor should be mounted in the leaving water piping. See **Figure 27** for installation instructions.

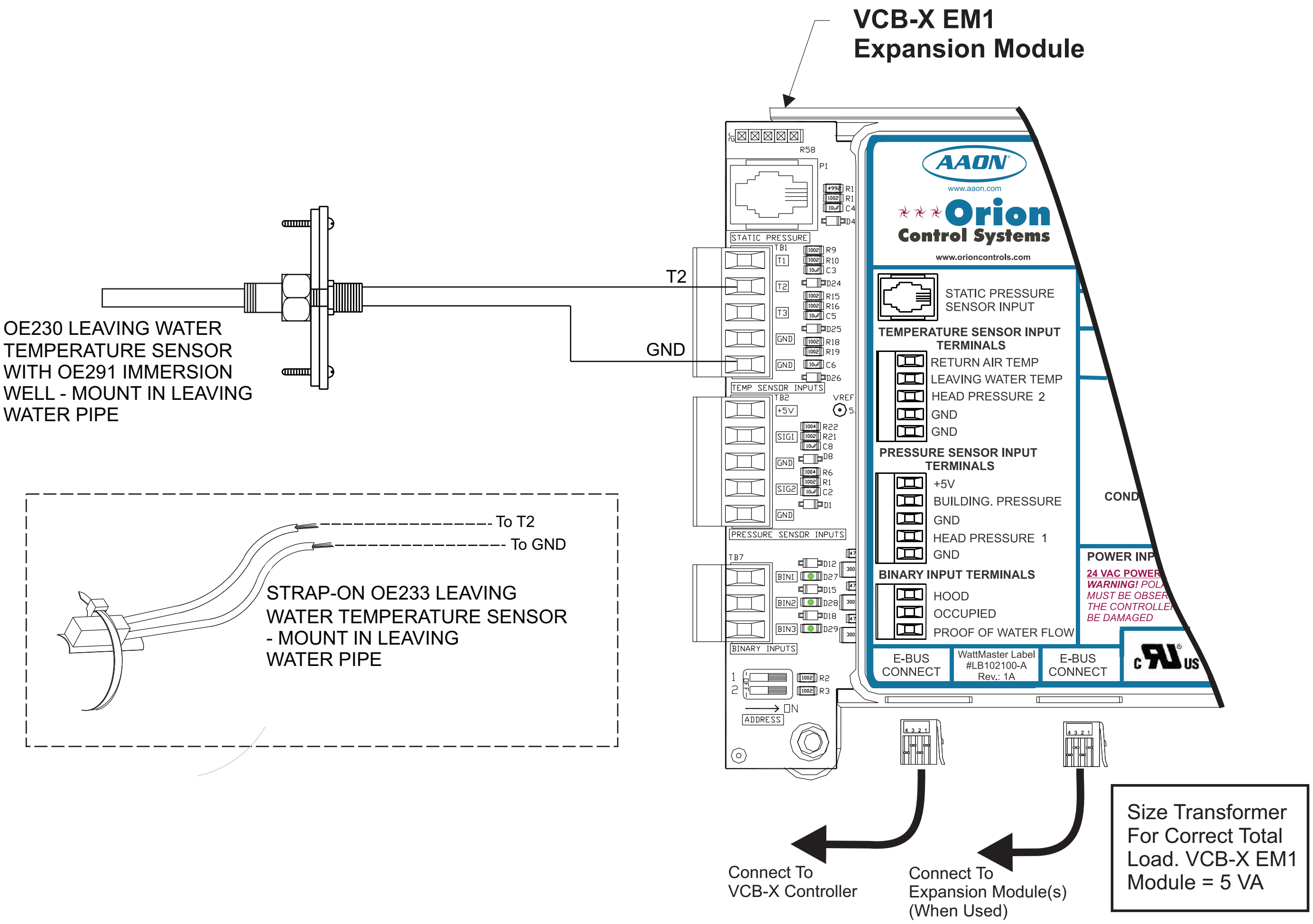
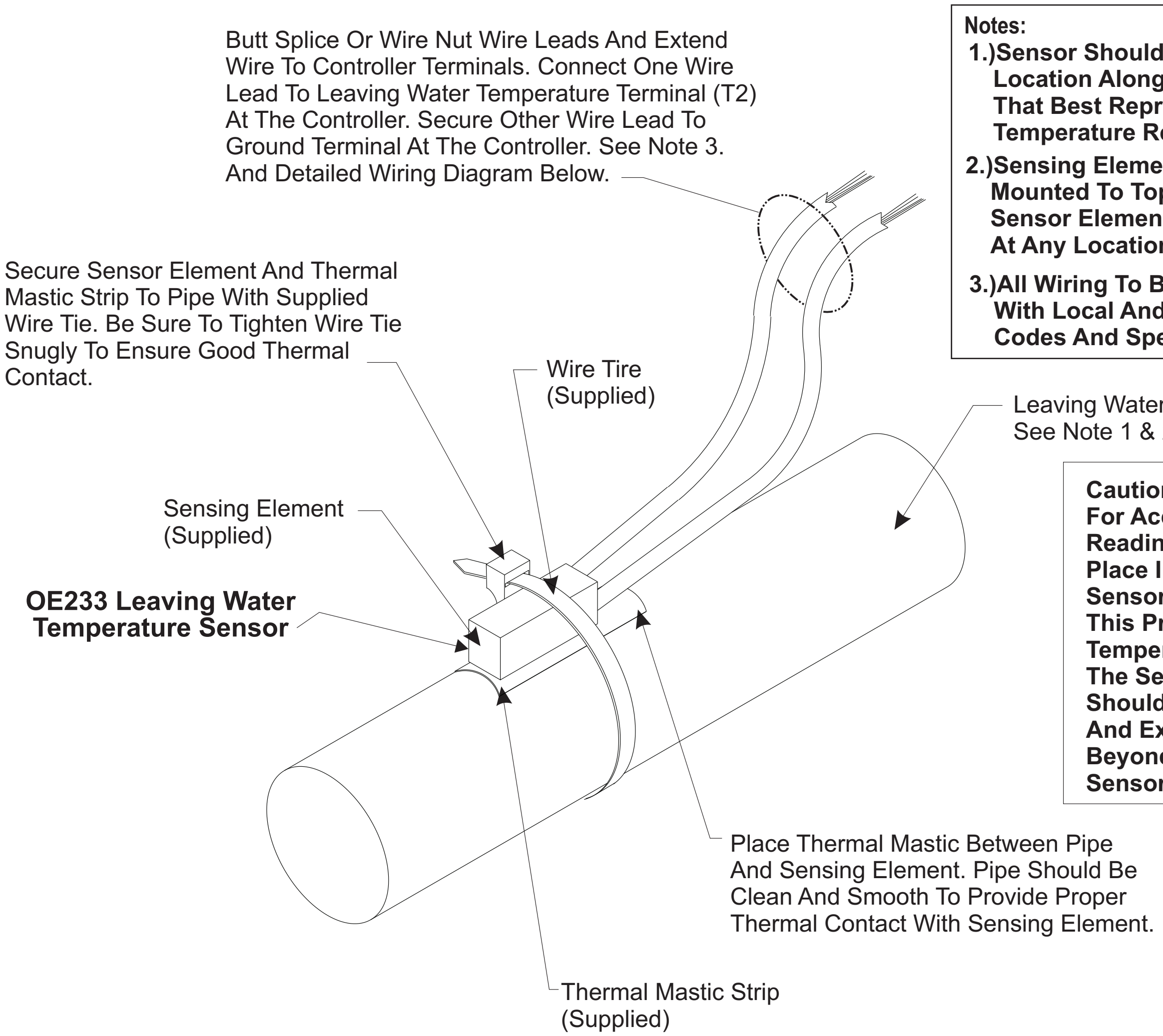


Figure 26: OE230 and OE233 Leaving Water Temperature Sensor Wiring Diagram

Strap-On Leaving Water Temperature Sensor Wiring



Notes:

1.)**Sensor Should Be Mounted At Location Along Pipe Length That Best Represents Desired Temperature Reading.**

2.)**Sensing Element Shown Mounted To Top Of Pipe. The Sensor Element May Be Located At Any Location Around Pipe.**

3.)**All Wiring To Be In Accordance With Local And National Electrical Codes And Specifications.**

Caution:
For Accurate Temperature Readings It Is Necessary To Place Insulation Over The Sensor After Installation. This Prevents The Ambient Temperature From Affecting The Sensor. Insulation Should Cover The Sensor And Extend 6” to 12” Beyond Each End Of The Sensor.

Figure 27: OE233 Strap-On Leaving Water Temperature Sensor Installation

Building Static Pressure Sensor Wiring

Building Static Pressure Sensor

The OE258-01 Building Static Pressure Sensor must be wired as shown in **Figure 28** below. There are 3 terminal connections on the Building Static Pressure Sensor. Connect the power side of the 24 VAC power source to the terminal labeled "+ EXC." Connect the GND side of the 24 VAC power source to the terminal labeled "- COM." Connect the remaining terminal labeled "OUT" to SIG1 on the VCB-X EM1 terminal block.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity will result in damage to the HVAC Unit Controller, Building Static Pressure Sensor, and the VCB-X Expansion Module.

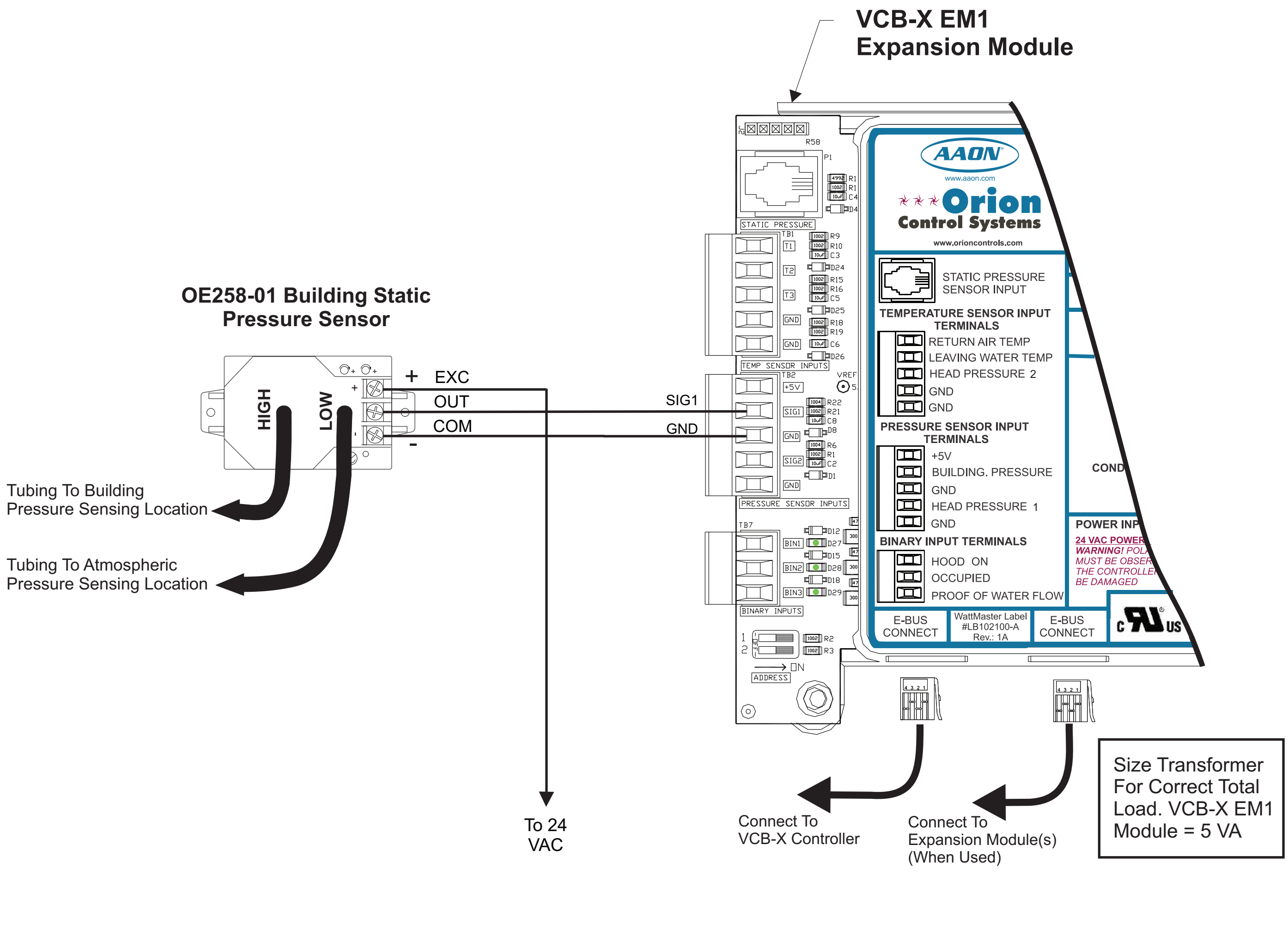


Figure 28: OE258-01 Building Static Pressure Sensor Wiring Diagram

Head Pressure Transducers

The Head Pressure Transducer(s) (by others) must be wired as shown in **Figure 29** below.

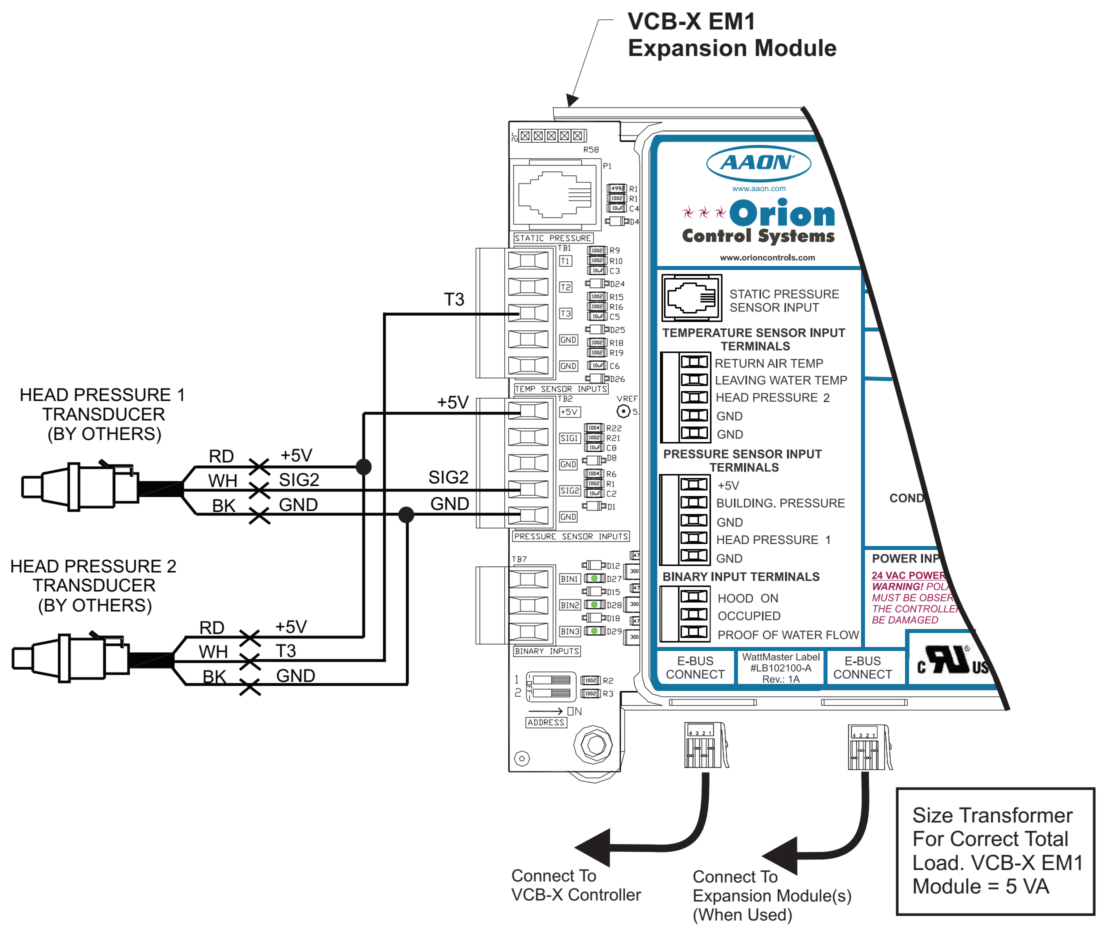


Figure 29: Head Pressure Transducers Wiring Diagram

Building Pressure Control Output Wiring

Building Pressure Control Output

The Building Pressure Control Output is a 0-10 VDC or 2-10 VDC signal sent from the VCB-X EM1 Expansion Module. When using the output for Direct Building Pressure Control (output signal rises on a rise in building pressure), the output signal can be connected to either a Variable Frequency Drive controlling an exhaust fan or to a damper actuator controlling an exhaust damper (both by others). When used in this manner, the output signal must be configured for Direct Acting operation. See **Figure 30** below for detailed wiring of the Building Pressure Control Output Signal.

When using this output for Reverse Building Pressure Control (output signal rises on a fall in building pressure), a damper actuator controlling an OA Damper or Supply Fan VFD would be used. When using the OA damper for Reverse Building Pressure Control, the output signal must be configured for Reverse Acting operation. A Building Pressure Sensor connected to SIG1 on the VCB-X EM1 Expansion Module is used to sense and control the signal to the Building Pressure Output. The OE258-01 Building Static Pressure Sensor must be connected in order for the Building Pressure Output to operate correctly.

CAUTION: Variable Frequency Drive units can cause large transient noise spikes that can cause interference to be propagated on other electronic equipment. Use shielded wire wherever possible and route all sensor and controller wiring away from the Variable Frequency Drive and the HVAC unit electrical wiring.

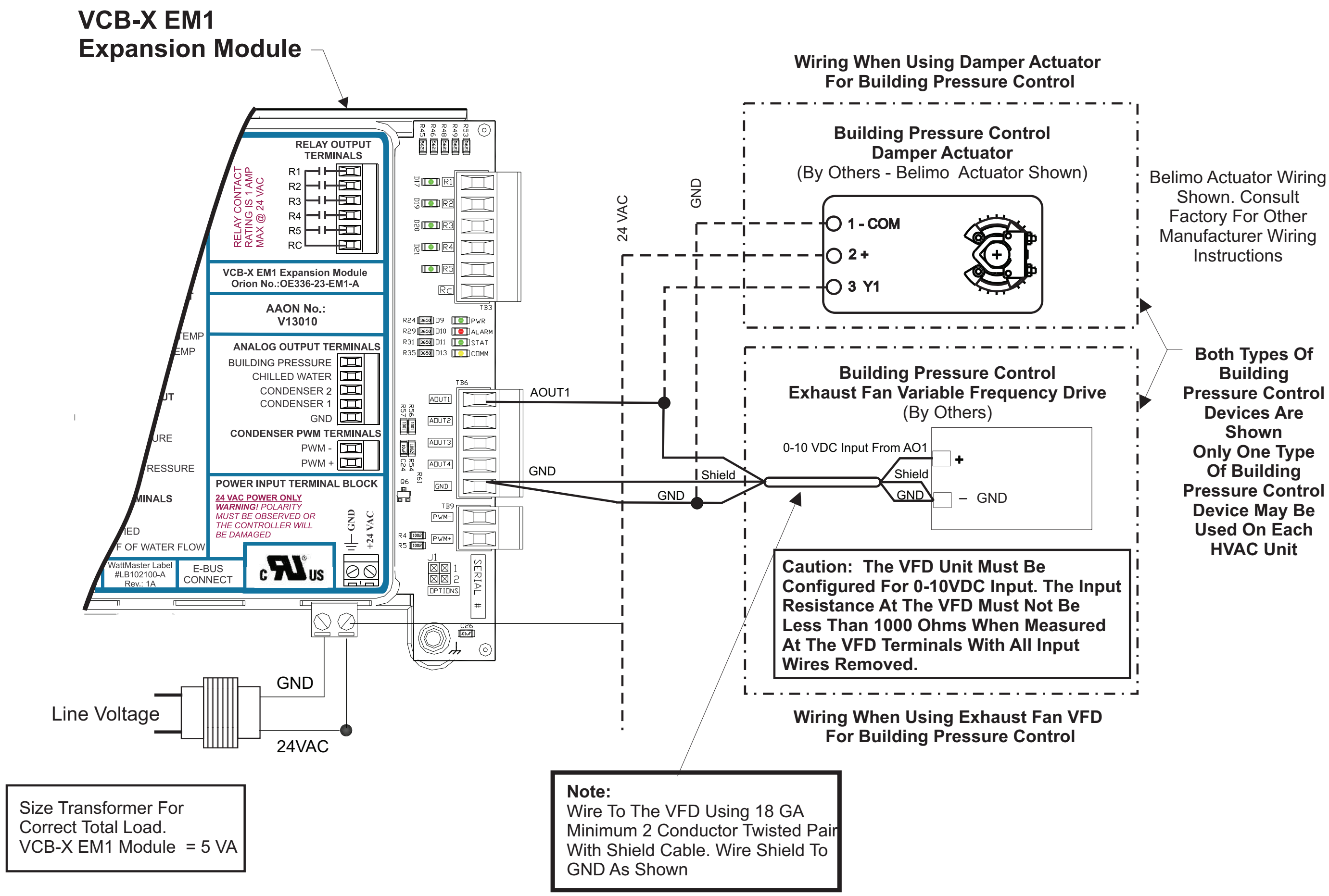


Figure 30: Building Pressure Control Output Wiring Diagram

Modulating Cooling Output

This output is used to control a Modulating Chilled Water Valve to maintain the Cooling Supply Air Temperature Setpoint. The output is configured for either 0-10 VDC or 2-10 VDC operation and can be configured for direct acting or reverse acting operation. See **Figure 31** for wiring details.

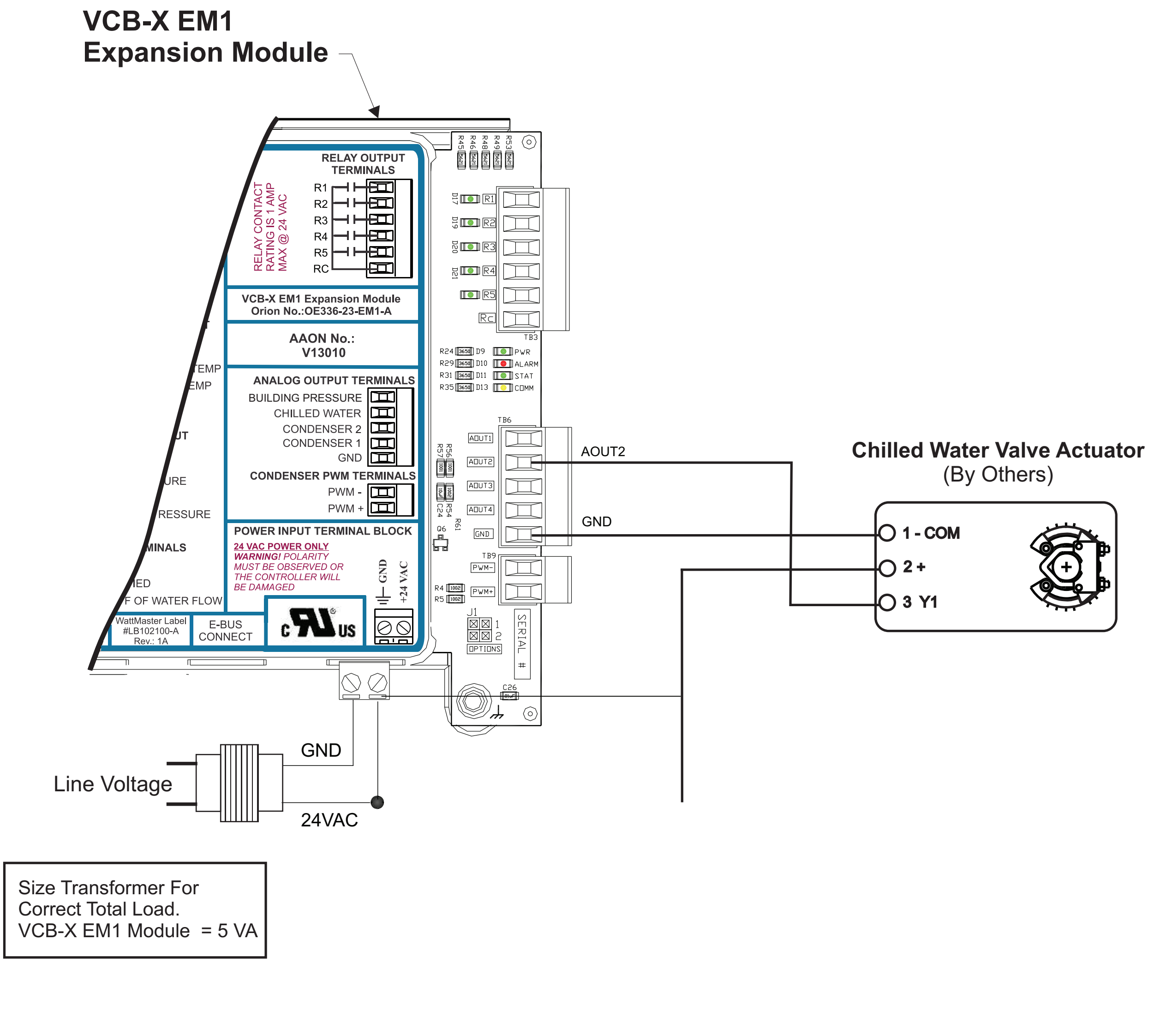


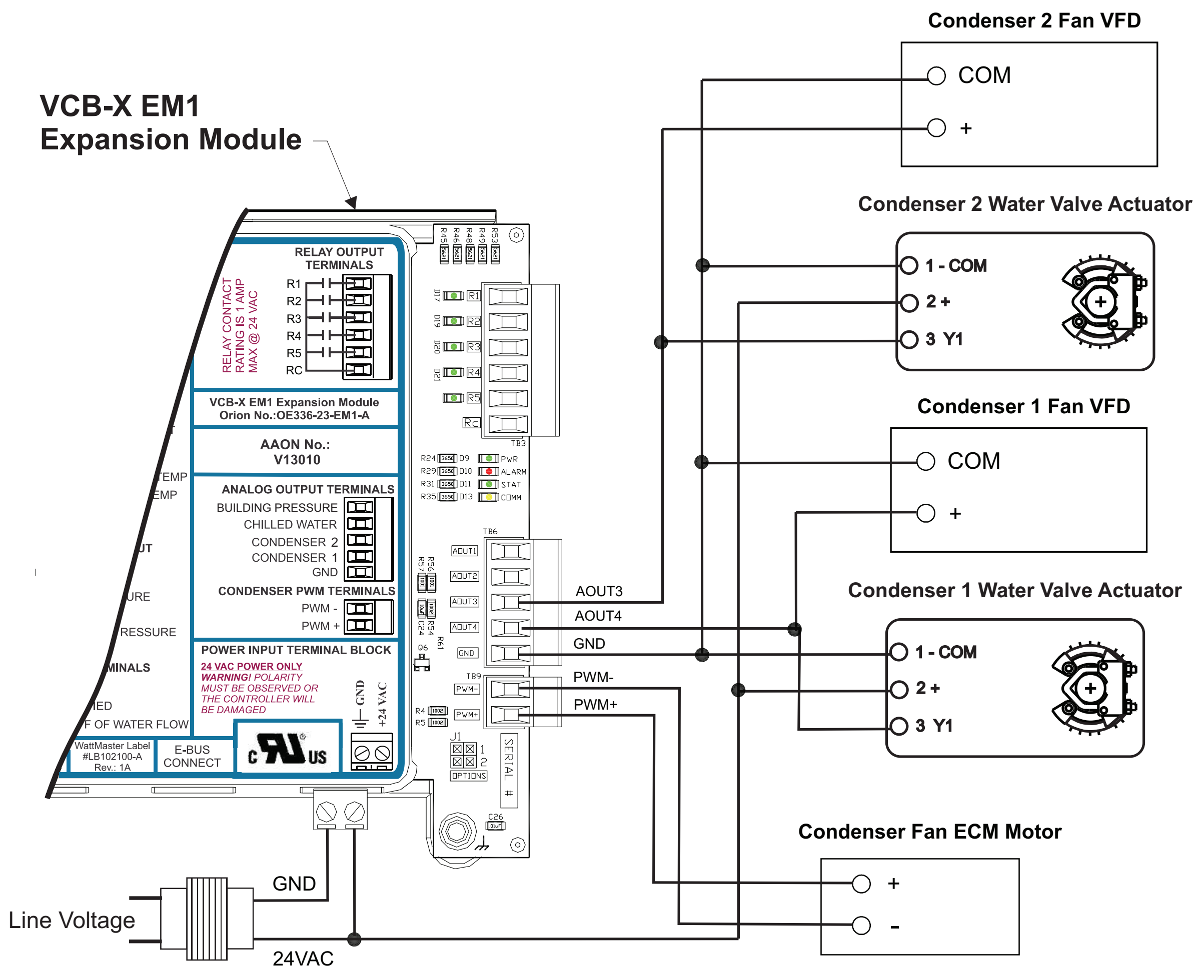
Figure 31: Chilled Water Valve Actuator Wiring Diagram

Condenser Fan ECM Motor and VFD or Water Valve Actuator Wiring

Head Pressure Control Output

The VCB-X EM1 Expansion Module can monitor up to (2) Head Pressure Transducers and control up to (2) Condenser Fans or Condenser Water Valves to maintain a Head Pressure Setpoint. The VCB-X Controller can be configured for an Air Cooled Condenser (default) or for a Water Cooled Condenser. See **Figure 32** for wiring

On an Air Cooled Unit, the Condenser Fan will be controlled with 0-10 VDC output signal or a PWM output signal. Both outputs operate simultaneously. On a Water Cooled Unit, the Condenser Water Valve will be controlled with a 2-10 VDC output signal.



Size Transformer For
Correct Total Load.
VCB-X EM1 Module = 5 VA

Figure 32: Condenser Fan ECM Motor and (2) Condenser Fans VFD or (2) Condenser Water Valves Actuator Wiring Diagram

VCB-X EM2 Expansion Module

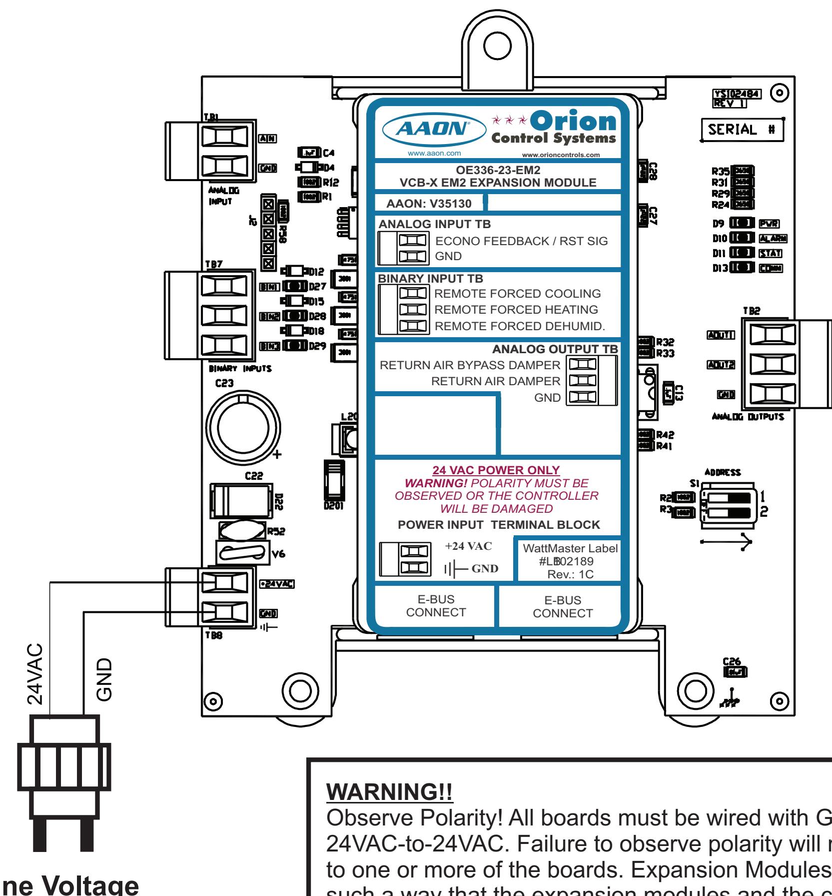
The VCB-X EM2 Expansion Module (OE336-23-EM2-A) provides 1 additional analog input, 2 analog outputs, and 3 binary inputs. See **Figures 34 & 35** for complete wiring details.

The VCB-X EM2 Expansion can be used in conjunction with the VCB-X EM1 Expansion Module (OE336-23-EM1-A) and the E-BUS 12-Relay Expansion Module (OE358-23E-12R-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

The VCB-X EM2 Expansion Module must be connected to 24 VAC as shown in the wiring diagram below. Please see **Table 1** for correct VA requirements to use when sizing the transformer(s) used for powering the expansion module.

Also please note that when wiring the VCB-X EM2 Expansion Module, its contacts must be wired as wet contacts (connected to 24 VAC).

VCB-X EM2
Expansion Module



WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

Size Transformer For Correct Total Load. VCB-X EM2 Module = 5 VA

Figure 33: VCB-X EM2 Expansion Module

VCB-X EM2 Input Wiring

AIN1

Analog Input #1 can be used for one of the following options:

Title 24 Economizer Feedback

If the controller has been configured for Title 24 Economizer operation, the Economizer Actuator Feedback signal will be wired to this input.

Remote SAT Reset Signal

If Title 24 Economizer operation has not been configured, a Remote Supply Air Temperature Reset Signal can be connected to AIN1 for applications requiring Remote Reset of the Supply Air Temperature Setpoint.

When the Slide Offset option on the Room Sensor is used, the Remote Supply Air Temperature Reset Signal cannot be used. Only one of these options may be used for VCB-X Controller applications.

This input on the VCB-X EM2 Expansion Module can accept a configurable voltage signal from 0-10 VDC (Direct or Reverse Acting). See **Figure 34** below for complete wiring details.

BIN1-BIN3 - Remote Forced Cooling, Heating, and Dehumidification

The VCB-X Controller can be configured to accept 24 VAC wet contact closures to force the unit into Cooling, Heating, and Dehumidification. If the Forced Contact configuration option is selection, it applies to all three modes. See **Figure 34** below for wiring details.

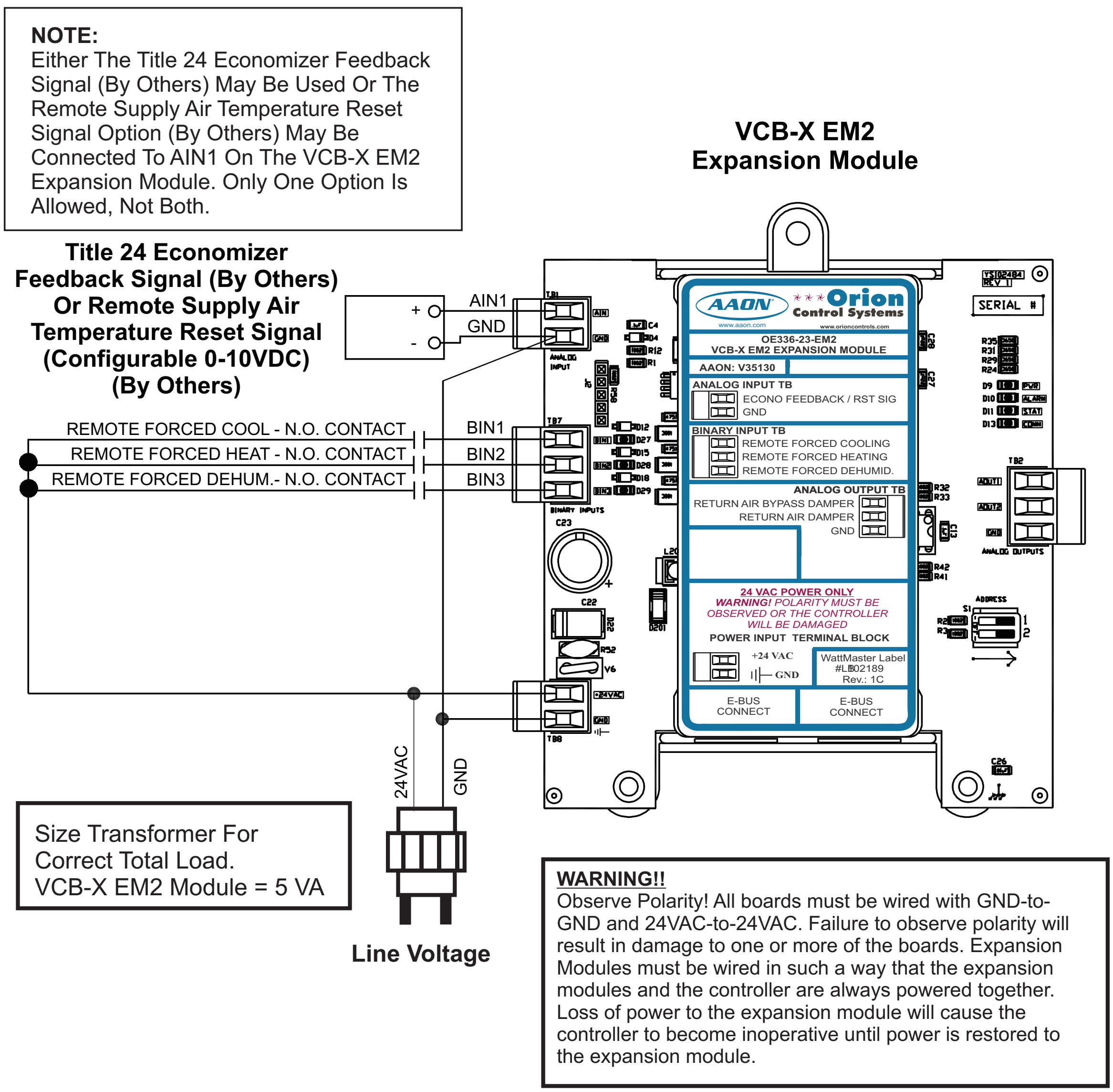


Figure 34: VCB-X EM2 Inputs Wiring

Return Air Bypass

The VCB-X Controller can be configured for AAON® PAC or DPAC applications. Both AAON® PAC and DPAC control schemes provide improved moisture removal capabilities while utilizing internal space loads for reheat by redirecting Return Air around the Evaporator Coil instead of through the coil. See the AAON® PAC and DPAC applications section of this manual on **page 6** for complete operation details.

The AAON® PAC and DPAC control applications utilize a Return Air Bypass Damper Actuator and a Return Air Damper Actuator to modulate the Return Air and Return Air Bypass Dampers to control the amount of air that is redirected around the Evaporator Coil.

The AAON® DPAC control scheme provides improved moisture removal capabilities and tighter temperature control than the AAON® PAC controls scheme by combining Copeland Digital Scroll™ Compressor control in addition to Return Air Bypass control. See the Return Air Bypass Sequence for more details.

See **Figure 35** below for detailed wiring of the Return Air Bypass and Return Air Damper Actuators.

WARNING: It is very important to be certain that all wiring is correct as shown in the wiring diagram below. Failure to observe the correct polarity could result in damage to the Damper Actuator or the VCB-X Expansion Module.

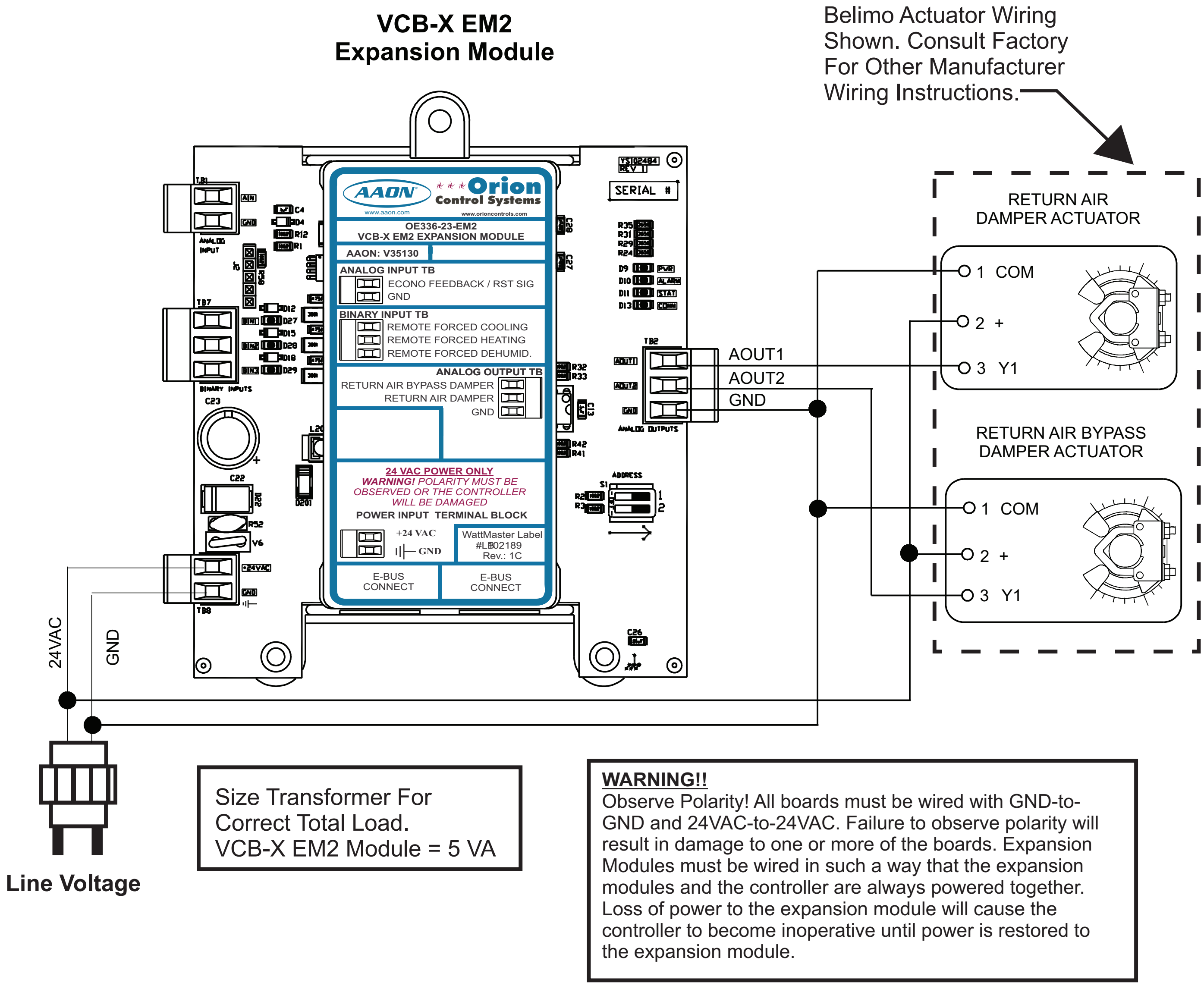


Figure 35: Return Air Bypass Wiring

12-Relay E-BUS Expansion Module Wiring

E-BUS 12-Relay Expansion Module

The E-BUS 12-Relay Expansion Module (OE358-23E-12R-A) provides for 12 Dry Contact Configurable Relay Outputs. See **Figure 36** below for complete wiring details.

The E-BUS 12-Relay Expansion Module can be used in conjunction with the VCB-X EM1 Expansion Module (OE336-23-EM1-A) and the VCB-X EM2 Expansion Module (OE336-23-EM2-A). The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

The expansion modules can be used individually or together to provide the required inputs and outputs for your specific applications.

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

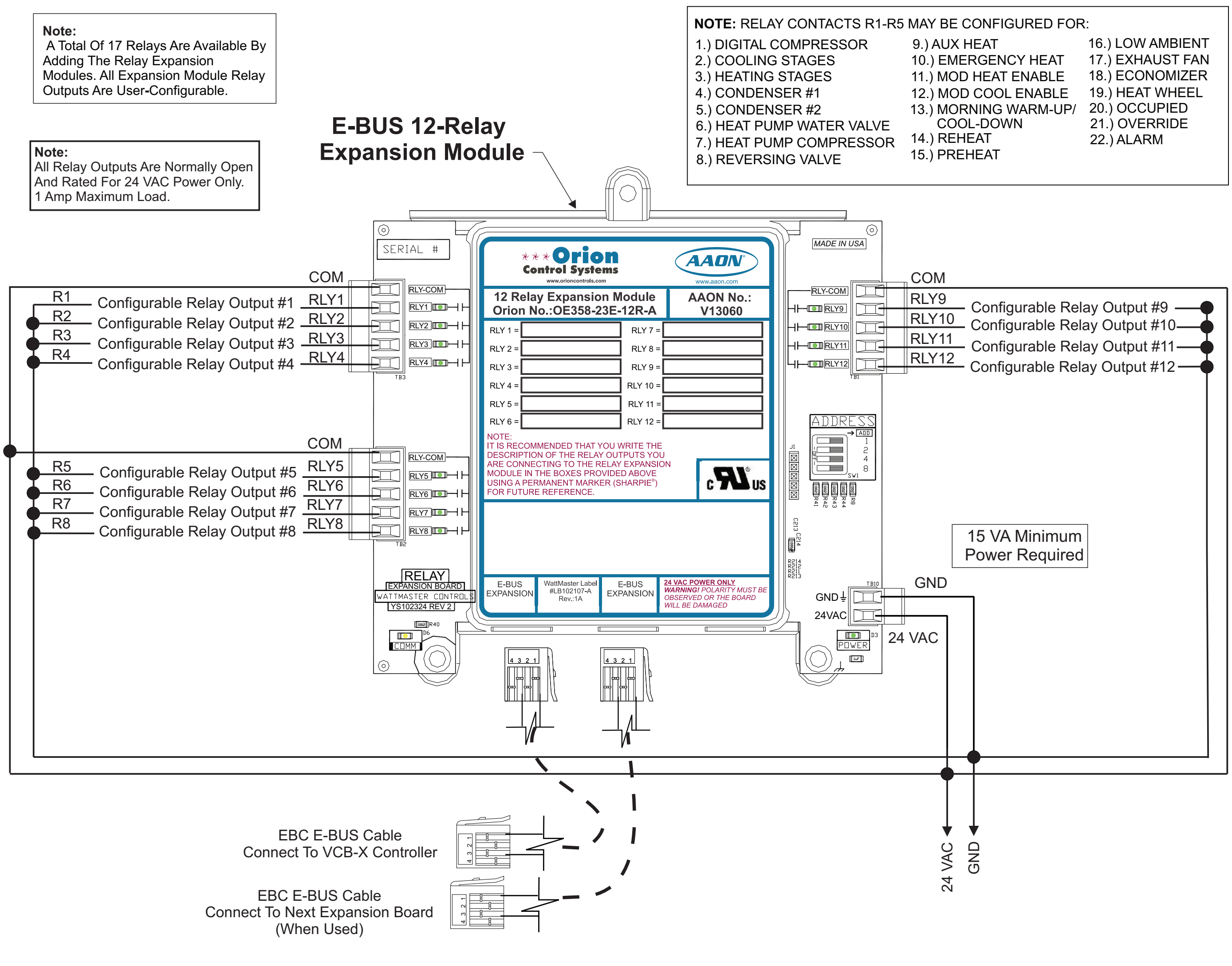


Figure 36: OE358-23E-12R-A – E-BUS 12-Relay Expansion Module Wiring

EBTRON®, GreenTrol™, and Paragon Air Flow Measurement Digital Transmitters

NOTE: Only the EBTRON® GTC116 series, GreenTrol™ GA-200-N Module (with GF series Airflow Station), or Paragon MicroTrans[EQ] series of MODBUS RTU transmitters are compatible with the VCB-X Controller. No other series of transmitters will work for this application. Contact WattMaster Controls for information on other airflow station options.

The OE365-15-EBA E-BUS Adapter Board attaches to the VCB-X Controller with an EBC E-BUS cable. The Adapter Board is used for connecting the EBTRON®, GreenTrol™, or Paragon Airflow Measurement Digital Transmitter to the VCB-X Control System. You must wire the Airflow Measurement Digital Transmitter to the Adapter Board as shown in **Figure 37**.

NOTE: The Airflow Station's baud rate needs to be set to 19,200 in order to communicate with the VCB-X Controller.

NOTE: Up to 4 EBTRON®, GreenTrol™, or Paragon Airflow Measurement Digital Transmitters can be attached to each Adapter Board.

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub (HZ-EBC-248 or MS000248) may be required.

***NOTE:** When configuring the GTC116 Series, be sure to set the Parity to "NO PARITY, 1 STOP BIT."

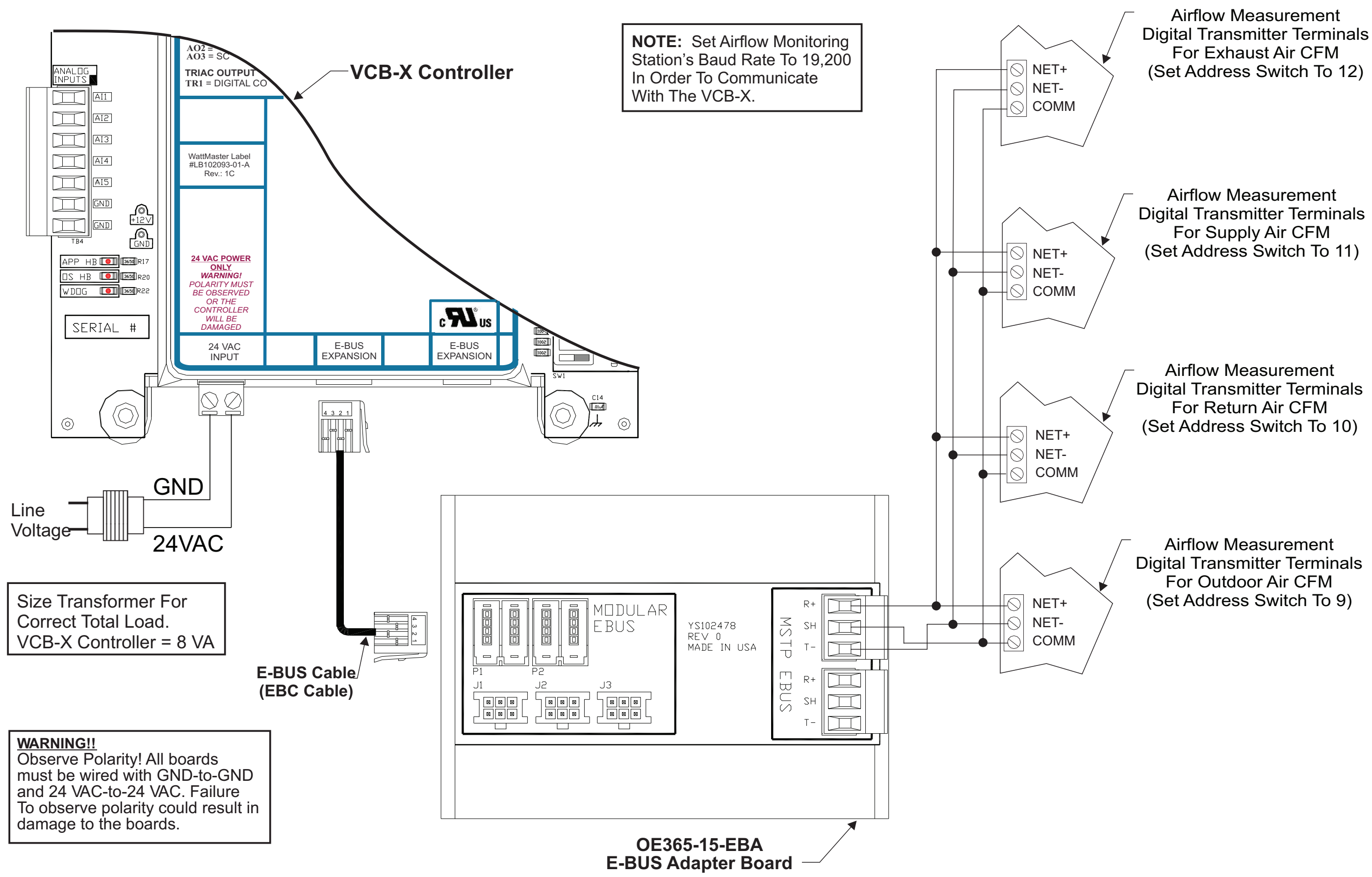


Figure 37: EBTRON® GTC116 Series, GreenTrol™ GA-200-N Series, and Paragon MicroTrans[EQ] Series Air Flow Measurement Digital Transmitter Wiring

MHGRV-X Controller Wiring

The OE377-26-00059 MHGRV-X Controller (AAON part number V12100) is designed to control a Modulating Hot Gas Reheat Valve to maintain a desired Supply Air Temperature and Dehumidification setpoint. The MHGRV-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable. See **Figure 38**.

The following information will be passed between the MHGRV-X controller and the VCB-X Controller:

- Reheat Enable command
- Supply Air Temperature Setpoint
- The Reset Supply Air Temperature Setpoint
- The Supply Air Temperature Reset Signal
- If the communication is interrupted between the MHGRV-X Controller and the VCB-X Controller, the MHGRV-X controller will revert to stand-alone operation.

For more information, refer to the *MHGRV-X Controller Technical Guide.*

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

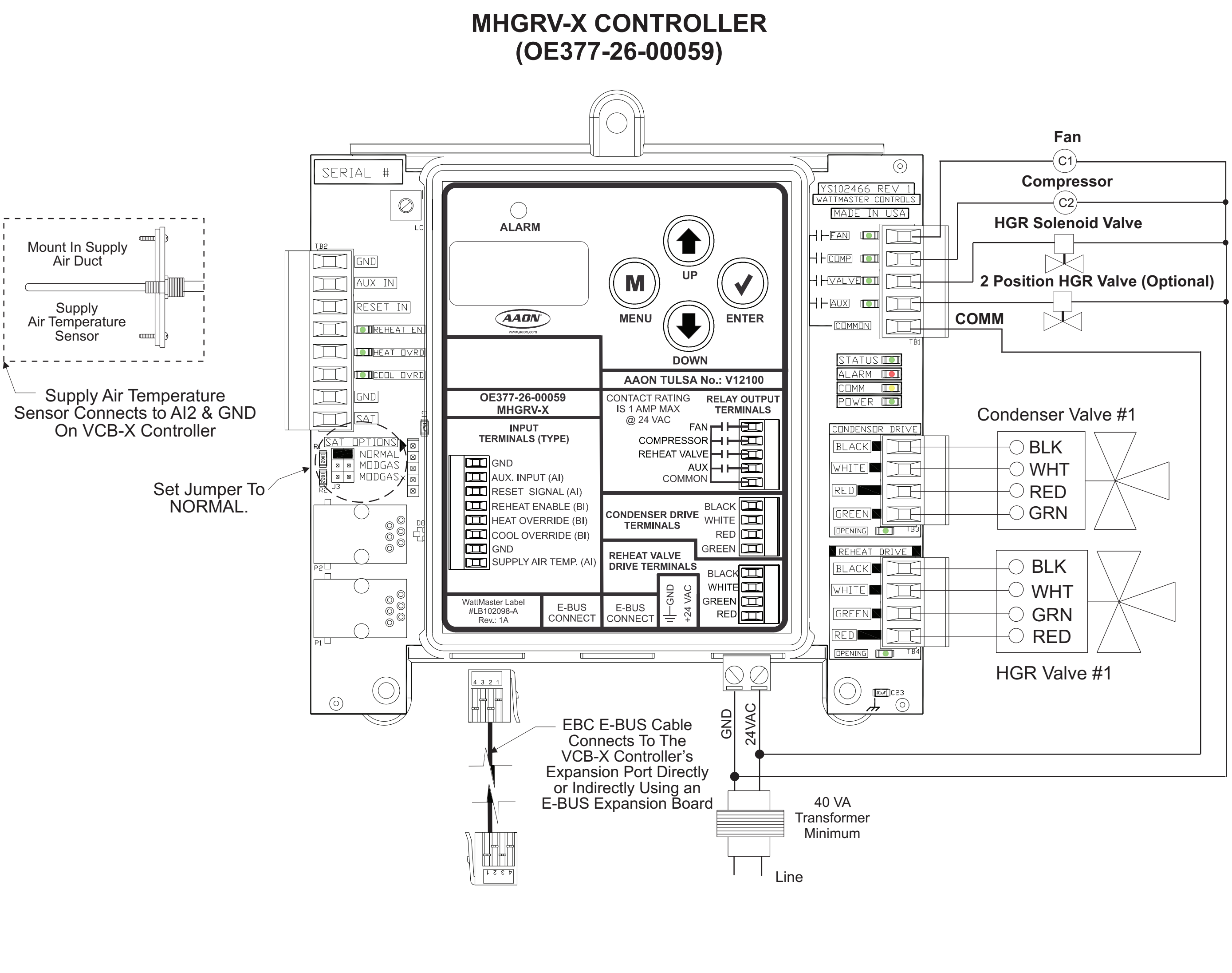


Figure 38: MHGRV-X Controller to VCB-X Controller Wiring

MODGAS-X Controller Wiring

The OE377-26-00058 MODGAS-X Controller (AAON Part No. V12090) is designed to modulate up to (2) gas valves to maintain a desired Discharge Air Temperature. It also controls the speed of the induced draft fan to maintain proper combustion in the heat exchanger. The MODGAS-X Controller directly connects to the VCB-X Controller or indirectly using an E-BUS Expansion Board via an EBC E-BUS cable. See **Figure 39**.

The following information will be passed between the MODGAS-X controller and the VCB-X Controller:

- Heat activation command
- Heating Discharge Setpoint
- The offset for the Supply Air Temperature Sensor
- High Limit Temperature Setpoint
- If the communication is interrupted between the MODGAS-X Controller and the VCB-X Controller, the MODGAS-X controller will revert to stand-alone operation.

For more information, refer to the *MODGAS-X Controller Technical Guide.*

NOTE: If using multiple E-BUS Sensors or Modules, the E-BUS Hub or Adapter Board may be required.

MODGAS-X CONTROLLER (OE377-26-00058)

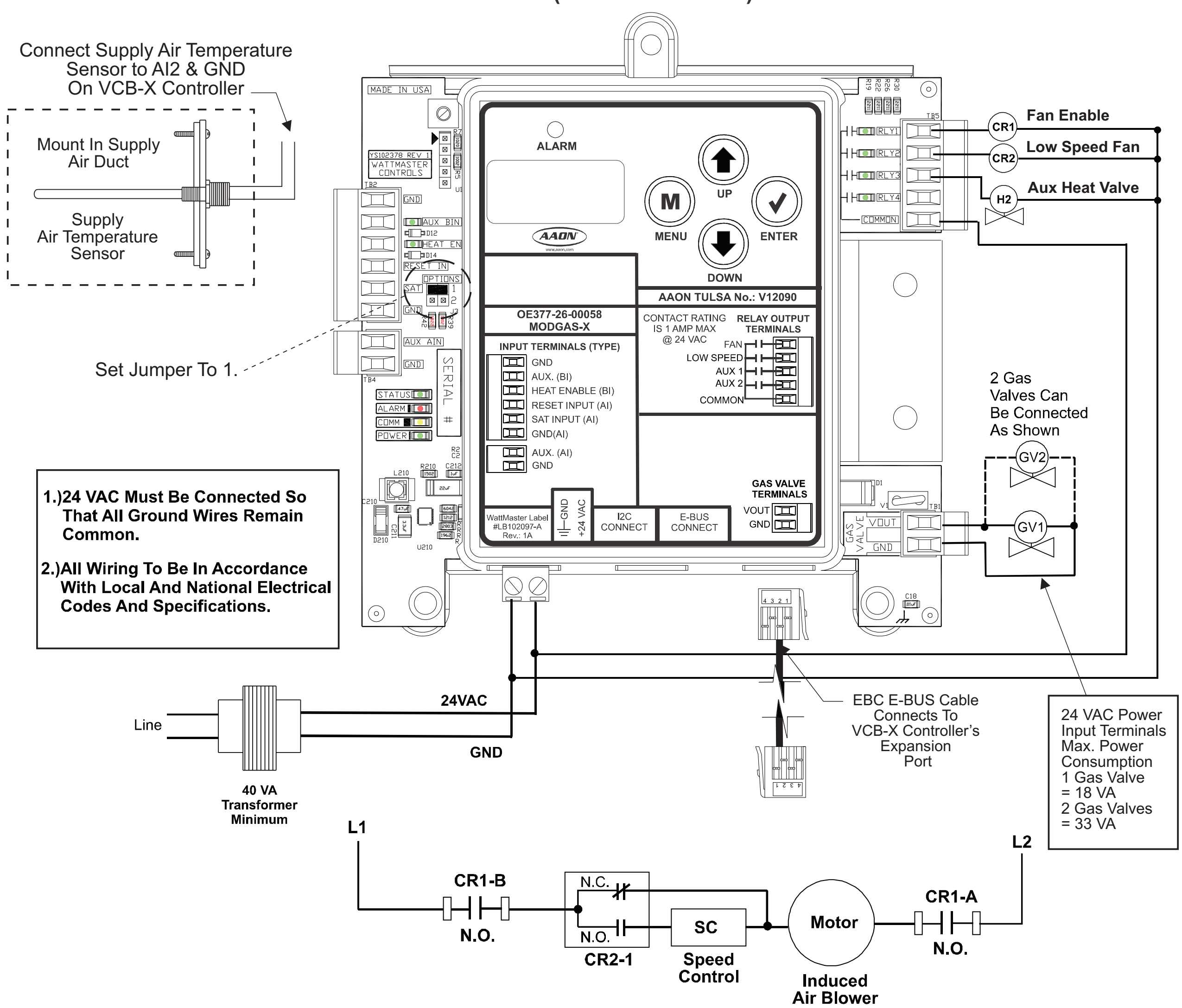


Figure 39: MODGAS-X Controller to VCB-X Controller Wiring Diagram

Addressing, Baud Rate & Powering Up

Before Applying Power

In order to have a trouble free start-up, it is important to follow a few simple procedures. Before applying power for the first time, it is very important to correctly address the controller and run through a few simple checks.

Controller Addressing and Baud Rate

All VCB-X Controllers are equipped with address switches. If the VCB-X Controller is to operate as a stand-alone system (not connected to any other HVAC unit or VAV/Zone Controllers), the controller address switch should be set for address 1. When using the Modular Service Tool or System Manager to program and configure the VCB-X Controller, you would enter this address to communicate with the controller. When the system is to be connected to other HVAC unit controllers on a communication loop, each controller's address switch must be set with a unique address between 1 and 59.

Address switches 7 and 8 are used for the baud rate selection. See **Figure 40** below for address switch and baud rate setting information.

Power Wiring

One of the most important checks to make before powering up the system for the first time is to confirm proper voltage and transformer sizing for each controller. Each VCB-X Controller requires 8 VA of power delivered to it at 24 VAC. You may use separate transformers for each device (preferred) or power several devices from a common transformer. If several devices are to be powered from a single transformer, correct polarity must be followed.

WARNING: Observe Polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity will result in damage to one or more of the boards.

Check all wiring leads at the terminal block for tightness. Be sure that wire strands do not stick out and touch adjacent terminals. Confirm that all sensors required for your system are mounted in the appropriate location and wired into the correct terminals on the VCB-X Controller.

After all the above wiring checks are complete, apply power to the VCB-X Controller.

Note:
The Power To The Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

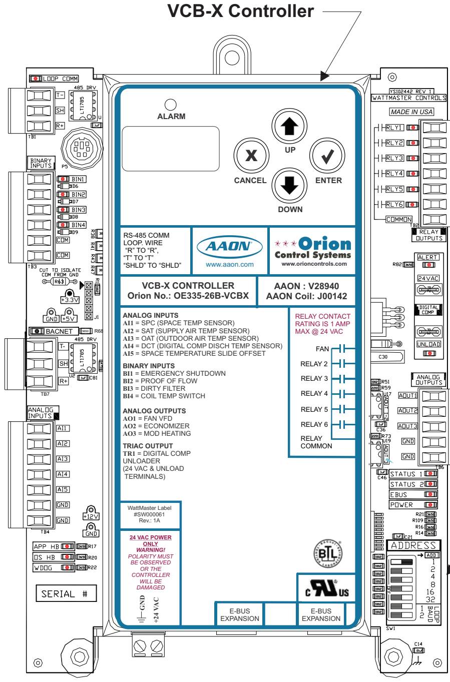
Caution:
Disconnect All Communication Loop Wiring From The Controller Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.

BAUD RATE SELECTION

Baud	Switch 7	Switch 8	Communication Setting
9600	OFF	OFF	CommLink IV
9600	OFF	OFF	CommLink 5 Set at Low Speed*
57600	OFF	ON	CommLink 5 Set at High Speed* or VCB-X is Stand Alone

* The CommLink 5 must be set to Low Speed if it is being used on a system that includes the VCM-X Controller or older generation of Orion Controllers.
** The CommLink 5 can be set to High Speed if is being used on a system that only includes VCB-X, VCC-X, or GPC-XP Controllers.

VCB-X Controller



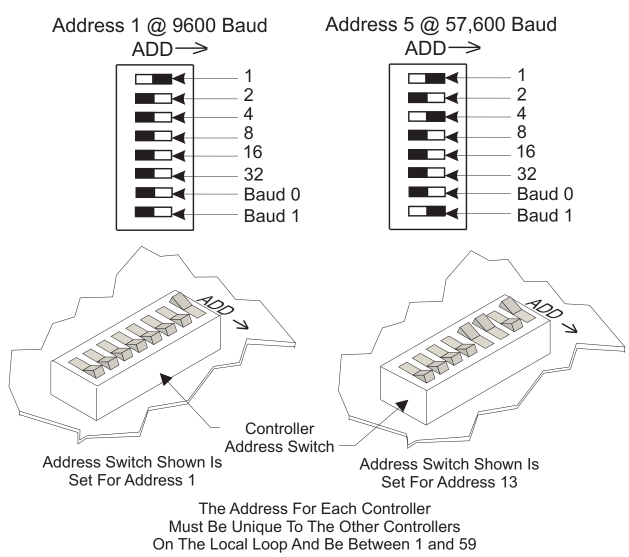


Figure 40: VCB-X Controller Address Switch and Baud Rate Setting

Initialization

When power is first applied, STATUS 1 LED and STATUS 2 LED will flash out the controller address. STATUS 1 LED will flash to represent the tens position. STATUS 2 LED will flash to represent the ones position. After the controller address has flashed, STATUS 1 LED and STATUS 2 LED will flash the diagnostic blink codes.

Example of a controller address of 59:
STATUS 1 LED will flash 5 times. STATUS 2 LED will flash 9 times.

See **Table 5** in the Troubleshooting Section of this manual for detailed diagnostic blink code information.

Programming the Controller

The next step is programming the controller for your specific requirements. In order to configure and program the VCB-X Controller, you must use an operator interface. Three different operator interfaces are available for programming and monitoring of the VCB-X Controller. See **Figure 41**. They are as follows:

- Modular Service Tool SD
- System Manager Touch Screen II
- Personal Computer with Prism 2 Software and CommLink 5 Installed

Any of these devices or a combination of them can be used to access the status, configuration, and setpoints of any controller on your communications loop.

If using the Modular Service Tool or System Manager TS with your system, refer to the *VCB-X Operator Interface SD Technical Guide* and the *System Manager Touch Screen II Technical Guide* for complete VCB-X Controller programming instructions.

If using a Notebook or Desktop computer and the Prism Computer Front End Software, refer to the *Prism 2 Computer Front-End Technical Guide*.

No matter which operator interface you use, we recommend that you proceed with the programming and setup of the VCB-X Controller in the order that follows:

1. Configure the Controller for your application.
2. Program the Controller setpoints.
3. Program the Controller operation schedules.
4. Set the Controller current time and date.
5. Review Controller status screens to verify system operation and correct Controller configuration.

NOTE: For BACnet® Configuration, see Appendices B & C.

Figure 41: Modular Service Tool SD, System Manager TS II, and Prism 2 Graphical Software Operator Interfaces

VCB-X Controller and Expansion Module Input/Output Maps

Input/Output Map

See **Table 2** for the VCB-X Controller's Input/Outputs, **Table 3** for the VCB-X EM1 Expansion Module's Inputs/Outputs, and **Table 4** for the VCB-X EM2 Expansion Module's Inputs/Outputs.

VCB-X CONTROLLER	
Analog Inputs	
1	Space Temperature (AI1)
2	Supply Air Temperature (AI2)
3	Outside Air Temperature (AI3)
4	Discharge Temperature (For Digital Compressor) (AI4)
5	Space Slide Offset (AI5)
Binary Inputs	
1	Emergency Shutdown (BI1)
2	Proof of Flow (BI2)
3	Dirty Filter (BI3)
4	Defrost Coil Temperature Switch (BI4)
Analog Outputs (0-10 VDC)	
1	Fan VFD (AOUT1)
2	Economizer (Outdoor Air Damper) (AOUT2)
3	Modulating Heating (Hot Water, Steam, or SCR) (AOUT3)
Binary Outputs (24 VAC)	
1	Fan Relay (R1)
2	Configurable Relay (R2)
3	Configurable Relay (R3)
4	Configurable Relay (R4)
5	Configurable Relay (R5)
6	Configurable Relay (R6)
7	Digital Compressor Unloader Triac (TR1)

The following E-BUS sensors and modules are available to connect to the VCB-X Controller via E-BUS ports or E-BUS Expansion Modules:

1. E-BUS Digital Room Sensor - LCD Display - Temp Only or Temp & Humidity
2. E-BUS Digital Room Sensor - No LCD Display - Temp & Humidity
3. E-BUS Space and Return Air CO_2 Sensors
4. E-BUS connection to EBTRON, GreenTrol and Paragon Air Flow Stations
5. E-BUS Outside Air Temperature & Humidity Sensor
6. Suction Pressure Transducer with E-BUS Adapter Board

Table 2: VCB-X Controller Inputs & Outputs

VCB-X EM1 EXPANSION MODULE	
Analog Inputs	
1	Static Pressure (AI1)
2	Return Air Temperature (T1)
3	Leaving Water Temperature (T2)
4	Head Pressure 2 (T3)
5	Building Pressure (SIG1)
6	Head Pressure 1 (SIG2)
Binary Inputs	
1	Hood On/Off (BIN1)
2	Remote Forced Occupied (BIN2)
3	Proof of Water Flow (BIN3)
Analog Outputs (0-10 VDC)	
1	Exhaust Fan VFD (AOUT1)
2	Chilled Water (AOUT2)
3	Condenser 2 (AOUT3)
4	Condenser 1 (AOUT4)
PWM+/- Output	
1	Condenser Fan
Binary Outputs (24 VAC)	
1	Configurable Relay (R1)
2	Configurable Relay (R2)
3	Configurable Relay (R3)
4	Configurable Relay (R4)
5	Configurable Relay (R5)

Table 3: VCB-X EM1 Inputs & Outputs

VCB-X EM2 EXPANSION MODULE	
Analog Input (Configurable 0-10 VDC)	
1	Economizer Feedback/Remote SAT Reset (AIN1)
Binary Inputs	
1	Remote Forced Cooling (BIN1)
2	Remote Forced Heating (BIN2)
3	Remote Forced Dehumidification (BIN3)
Analog Outputs (0-10 VDC)	
1	Return Air Damper (AOUT1)
2	Return Air Bypass Damper (AOUT2)

Table 4: VCB-X EM2 Inputs & Outputs

VCB-X Controller Inputs

AI1 - Space Temperature Sensor Input

The Space Temperature Sensor will initiate Occupied Heating and Cooling modes if the unit is configured for Space Temperature control. It is always the sensor used to initiate Unoccupied Heating and Cooling modes. If the Space Temperature Sensor used is equipped with the optional Push-Button Override feature, this input will detect user overrides and switch the unit from the Unoccupied Mode back to the Occupied Mode operation for a user-adjustable amount of time. The Space Temperature can also be configured to reset the Supply Air Temperature Setpoint.

AI2 - Supply Air Temperature Sensor Input

Once the unit is in the Heating or Cooling Mode (based on the temperature at the mode enable sensor), the unit will control the staging or modulation of the heating or cooling sources to maintain a Heating or Cooling Supply Air Setpoint. The HVAC unit must always have a Supply Air Temperature Sensor installed.

AI3 - Outdoor Air Temperature Sensor Input

The Outdoor Air Temperature is used to lock out Heating or Cooling to conserve energy at whatever temperature you deem appropriate for each Mode of Operation. This sensor is also used to initiate Heating and Cooling modes on a Make Up Air unit. The Outdoor Air Temperature Sensor can also be used for Pre-Heater operation and for Low Ambient Protection operation.

NOTE: For AI1 through AI3, all Temperature Sensors must be Thermistor Type III which provide 77.0°F @ 10K Ohms Resistance.

AI4 - Digital Compressor Discharge Temperature Sensor Input

The Digital Compressor Discharge Temperature Sensor monitors the discharge temperature from the Digital Compressor to protect against overheating.

AI5 - Space Temperature Sensor Slide Adjust

If the Space Temperature Sensor being used has the optional Slide Adjust feature, its AUX output is connected to this input. The Slide Adjust control is used to vary the HVAC Mode Heating and Cooling Setpoints by a user-configured maximum amount.

If the Space Temperature is configured as the SAT Reset Source, the Slide Adjustment adjusts both the HVAC Mode Enable Heating and Cooling setpoints and the SAT Reset Source Heating and Cooling setpoints simultaneously by a user-configurable maximum amount.

BI1 - Emergency Shutdown Input

This wet contact input is used to initiate shutdown of the HVAC unit when a N.C. Smoke Detector (by others), Firestat (by others), or other shutdown condition (by others) contact is opened. The controller remains active and can initiate alarm relays.

BI2 - Proof of Flow Input

A Proof of Flow Switch (by others) that provides a wet contact closure whenever the HVAC unit Supply Fan is operating can be connected to this input. If the Proof of Flow Switch contact opens while the Supply Fan is operating, all Heating and Cooling is suspended or disabled.

BI3 - Dirty Filter Contact Closure Input

This wet contact input is required for Filter Status Indication and requires a Differential Pressure Switch to initiate a Dirty Filter alarm.

BI4 - Defrost Coil Temperature Switch Input

This wet contact input monitors a Defrost Coil Temperature Switch on air to air heat pump units. If the compressors are operating in the Heating Mode and this switch closes, it will initiate a Defrost Mode.

NOTE: The Binary Inputs require wet contacts (24 VAC only) to recognize an active input. If you provide dry contacts, the contact closure will not be recognized. All Binary Inputs are optional. This means that you must configure the VCB-X Controller to recognize these input signals.

VCB-X Controller Outputs

AOUT1 - Supply Fan VFD Control Signal

This user-adjustable voltage signal is used to modulate the Supply Fan VFD in VAV, Single Zone VAV, or Filter Loading applications.

AOUT2 - Economizer (Outdoor Air Damper) Control Signal

This user-adjustable voltage signal is used to control the Outdoor Air Damper during Economizer operation. It is also used to maintain the Outdoor Air Damper at its Minimum Position during the Occupied Mode when the Outdoor Air Temperature is not suitable for Economizer Cooling purposes. This minimum position can be reset based on CO_2 override conditions.

This output is also used to control the Outdoor Air Damper based on an Outdoor Air Flow Setpoint if using an Outdoor Airflow Monitoring station. This position can be overridden during Economizer Control.

Finally, this output can be used to control the Outdoor Air Damper during Reverse Acting Building Pressure Control to maintain a Building Pressure Setpoint.

AOUT3 - Modulating Heat Control Signal

This output can be configured with a user-adjustable voltage range of operation which can be set up to provide either a direct or reverse acting operation. This output is used to operate a modulating heating device to maintain the Heating Supply Air Setpoint during the Heat Mode of operation.

TR1 - Digital Compressor Unloader

The unloader solenoid is energized in an on/off pattern to deliver the capacity needed by (1) digital compressor to achieve setpoint.

R1 - Supply Fan (Enable)

This is a non-configurable output.

R2-R6 - User-Configurable Relays

These relays are configurable by the user. For all the available configuration options, see **Table 5**.

No.	Relay Description	Details
1	Digital Compressor	Configured for a Digital Compressor.
2	Cooling Stage	Configured for each fixed stage of cooling (except heat pump compressor).
3	Heating Stage	Configured for each fixed stage of heating.
4-5	Condenser #1 Condenser #2	Configured for Condenser Fan/Valve operation. This relay(s) will be active anytime the respective compressors are active, except if the unit is in Heat Pump Defrost Mode.
6	Heat Pump Water Valve	On a Water Source Heat Pump, this relay will be active anytime compressors are active.
7	Heat Pump Compressor	Configured for a Fixed Heat Pump Compressor stage.
8	Reversing Valve	Configured for the Reversing Valve of a heat pump unit.
9	Aux Heat	Configured for a fixed stage of Aux Heat in a heat pump unit.
10	Emergency Heat	Configured for a fixed stage Emergency Heat in a heat pump unit.
11	Mod Heat Enable	Configure if a 0-10 VDC Modulating Heat source needs a relay to enable it.
12	Mod Cool Enable	Configure if a 0-10 VDC Modulating Cool source needs a relay to enable it.
13	Morning Warm-Up/ Cool-Down (VAV Boxes)	Configure (1) Relay for Morning Warm-Up/Cool-Down when Non-Orion VAV/Zone Controllers are used.
14	Reheat	Configure (1) Relay for On/Off Reheat when used.
15	Pre-Heat	Configure for Pre-Heat operation.
16	Low Ambient	Configure for Low Ambient operation.
17	Exhaust Fan	Configure (1) Relay for enabling exhaust fan when Building Pressure Control is used.
18	Economizer Active	If configured, this relay will energize if unit is in Economizer mode and the damper has moved 5% above its Economizer Minimum Setpoint position.
19	Heat Wheel	Configure (1) Relay that turns heat wheel on when in Occupied operation and turns heat wheel off when in Economizer Mode.
20	Occupied Active	If configured, this relay will energize whenever the unit is in the Occupied Mode.
21	Override Active	If configured, this relay will energize anytime the space sensor Push-button override is active.
22	Alarm Active	If configured, this relay will energize anytime a VCB-X alarm is active.

Table 5: User-Configurable Relay Outputs

VCB-X EM1 Expansion Module

AI1 - Duct Static Pressure Sensor Input

This phone jack-style input connection accepts a Duct Static Pressure Sensor modular cable input. The Duct Static Pressure Sensor reading is used to determine current Duct Static Pressure. This Static Pressure reading is used to control the output signal supplied to the Supply Fan VFD or Zoning Bypass Damper Actuator. If you have configured the HVAC unit for Constant Volume operation, this Sensor is optional. If it is installed on a Constant Volume unit, it will not affect operation, but rather will be used as a status-only reading.

T1 - Return Air Temperature Sensor Input

If you want to generate occupied Heating and Cooling demands based on Return Air Temperature, select this Sensor as the HVAC Mode Enable Sensor. The Return Air Temperature Sensor is also used to initiate or cancel the Morning Warm-up Period on VAV-configured units. If the Return Air Temperature Sensor is connected, the Outdoor Air Temperature must be at least 5°F below the Return Air Temperature to allow Economizer Cooling operation.

T2 - Leaving Water Temperature Sensor Input

This input monitors the Condenser Leaving Water Temperature and determines if the water source condenser is operating in a safe water temperature range.

T3 - Head Pressure 2 Transducer Input

The Head Pressure 2 Transducer is connected to this input when Head Pressure Control is required.

+5V VDC Power

This output is a 5 VDC output that supplies power to the Head Pressure Transducer.

SIG1 - Building Static Pressure Sensor Input

This Sensor is only required if you wish to configure the VCB-X Controller for Building Pressure Control. Building Pressure Control can be accomplished by using one of two main control methods. One control method uses the 0-10 VDC signal to control an Exhaust Fan VFD or an Exhaust Damper Actuator for Direct Acting Pressure Control applications. In addition, for Reverse Acting Pressure Control applications, it can control an Outdoor Air Damper Actuator. The other available control method is to configure one of the Output Relays as an Exhaust Fan output that will activate the Exhaust Fan any time the Building Pressure is above the Building Pressure Setpoint.

SIG2 - Head Pressure 1 Transducer Input

The Head Pressure 1 Transducer is connected to this input when Head Pressure Control is required.

BIN1 - Hood On Input

When this wet contact input closes (Hood On), the VCB-X Controller switches from Indoor Air Control to Outdoor Air Control. This is typically used on CAV applications requiring CAV/MUA Dual Damper (Hood On/Off) Modes.

BIN2 - Remote Forced Occupied Mode Input

When this wet contact input closes, it will force the VCB-X Controller into the Occupied Mode. When the Remote Forced Occupied Signal is removed, the controller will revert to the Unoccupied Mode of operation if no internal or external schedule has been configured or is in effect when this occurs.

BIN3 - Water Proof of Flow Input

This wet contact input is for the Water Proof of Flow Switch. If the Water Proof of Flow Switch contact opens while the Condenser Valve is operating, the controller will react to protect the system depending on the current mode of operation.

NOTE: The Binary Inputs require wet contacts (24 VAC only) to recognize an active input. If you provide dry contacts, the contact closure will not be recognized. All Binary Inputs are optional. This means that you must configure the VCB-X Controller to recognize these input signals.

VCB-X EM1 & EM2 Expansion Module Inputs & Outputs

AOUT1 - Building Pressure Control Signal

This user-adjustable voltage signal is used to provide Direct Acting Building Pressure Control using an Exhaust Fan VFD or a modulating Exhaust Damper.

NOTE: For Reverse Acting Building Pressure Control using the Outdoor Air Damper or Supply Fan VFD, the VCB-X Controller will use the outputs specific to those devices. On the main VCB-X Controller, AOUT2 would control the Outdoor Air Damper and AOUT1 would control the Supply Fan VFD to maintain the Building Pressure Setpoint.

AOUT2 - Modulating Chilled Water Signal

This output is used to control a Modulating Chilled Water Valve to maintain the Cooling Supply Air Temperature Setpoint. This output can be configured with a user-adjustable voltage range of operation which can be set up to provide either direct or reverse acting operation.

AOUT3 - Condenser 2 Fan VFD or Condenser Water Valve Signal

This is a direct acting output signal that is used to modulate the Condenser Fan VFD (0-10 VDC signal) on an Air Cooled unit. It will control a Condenser Water Valve Actuator (2-10 VDC Signal) on a unit configured as a Water Source Heat Pump.

AOUT4 - Condenser 1 Fan VFD or Condenser Water Valve Signal

This is a direct acting output signal that is used to modulate the Condenser Fan VFD (0-10 VDC signal) on an Air Cooled unit. It will control a Condenser Water Valve Actuator (2-10 VDC Signal) on a unit configured as a Water Source Heat Pump.

PWM+

This output connects to the plus (+) input on an ECM motor for Condenser Fan control.

PWM-

This output connects to the minus (-) input on an ECM motor for Condenser Fan control.

R1-R5 - User-Configurable Relays

These relays are configurable by the user. For all the available configuration options, see **Table 5**.

VCB-X EM2 Expansion Module

AIN1 - Economizer Feedback/Remote SAT Reset Signal

If Title 24 Economizer operation has been configured, this input will be used for the 0-10 VDC Feedback Signal from the Economizer actuator. Otherwise, if a Remote SAT Reset Signal is configured as the Reset Source, this input can be used to accept a configurable voltage input between 0-10 VDC (Direct or Reverse Acting) to reset the Supply Air Temperature Setpoint. See the Supply Air Temperature Reset section in the Sequence of Operations for more details.

BIN1 - Remote Forced Cooling Mode Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the unit into Cooling Mode.

BIN2 - Remote Forced Heating Mode Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the unit into Heating Mode.

BIN3 - Remote Forced Dehumidification Input

A wet contact closure on this input is used to provide a means for another BAS or control device (by others) to force the VCB-X Controller into Dehumidification Mode.

AOUT1 - Return Air Damper Actuator Signal

This output signal is a Direct Acting 0-10 VDC output signal that is used to modulate a Return Air Damper Actuator in concert with a Return Air Bypass Damper Actuator for AAON® PAC or DPAC control schemes.

AOUT2 - Return Air Bypass Damper Actuator Signal

This output signal is a Direct Acting 0-10 VDC output signal that is used to modulate a Return Air Bypass Damper Actuator in concert with a Return Air Damper Actuator for AAON® PAC or DPAC control schemes.

E-BUS 12-Relay Expansion Module

Please refer to the user-configurable relays in **Table 5** for relay definitions.

Supply Fan Operation

Anytime the Supply Fan is requested to start, a 1 minute minimum off timer must be satisfied. If the timer is satisfied, the Supply Fan relay is activated while all other outputs are held off until their minimum off timers have been met.

Upon going into the Occupied Mode or upon power-up, the controller will initiate a user-adjustable Fan Starting Delay to provide a staggered start for systems with several HVAC units.

In Fan Cycle Mode or when going unoccupied, the Supply Fan is held on for 2 minutes after the last stage of Heating or Cooling stages off.

Purge Mode

When going into Occupied Mode, an optional "Purge Mode" is initiated. The fan runs with the Economizer closed, and all Cooling and Heating is de-energized. The length of the Purge Mode is user-adjustable.

Occupied Mode

The Supply Fan can be configured to run continuously (default) or to cycle with Heating, Cooling, or Dehumidification.

Unoccupied Mode

The Supply Fan will cycle on a call for Heating, Cooling, or Dehumidification.

HVAC Source Configuration Options

The VCB-X Controller can be configured to have various HVAC Source options that will determine the mode of operation (Heating, Cooling, or Vent Mode) of the unit. The following are descriptions of those options.

Space Temperature—Typical selection for CAV recirculating units.

Return Air Temperature—Optional selection for CAV recirculating units.

Single Zone VAV—Selected for a Space Temperature controlled Single Zone VAV application.

Outdoor Air Temperature—Typical selection for 100% Outdoor Air (MUA) or High Percentage Outdoor Air units.

Supply Air Temperature—Selected for Cooling Only VAV units with optional Morning Warm-Up.

Supply Air Tempering—Selected for Cooling Only VAV units with optional Morning Warm-Up.

Space Temperature with High Outdoor Air %— Provides Space Temperature (instead of Outdoor Air Temperature) control of 100% or high percentage Outdoor Air units by tempering the air during the Space Vent Mode of operation to prevent dumping of hot or cold air into the space.

HVAC Mode Set by Remote Contact Input— Provides for wet contact closures to force the unit into Heating, Cooling, and Dehumidification modes. If this option is selected, it applies to all three modes, and all three modes will only be initiated by these contact closures.

Occupied/Unoccupied Mode of Operation

The VCB-X Controller can utilize several methods for determining the Occupied Mode of Operation. These are as follows:

Forced Schedule
Remote Forced Occupied Signal
Internal Week Schedule
Push-Button Override Signal

Forced Schedule

The VCB-X Controller can be forced into the Occupied Mode by inputting a Forced Schedule from any operator interface.

Remote Forced Occupied Signal

This Forced Occupied input can be used in place of, or in conjunction with, the internal VCB-X Schedule. When this wet contact input closes, it will force the VCB-X Controller into the Occupied Mode. When the Remote Forced Occupied Signal is removed, the controller will revert to the Unoccupied Mode of operation, or if an internal VCB-X schedule is also being used, it will revert back to the current scheduled mode.

Setting the Internal Week Schedule to '0' will cause the controller to only look for the Remote Forced Occupied Signal for Occupied/Unoccupied commands.

Internal Week Schedule

An Internal Week Schedule, which supports up to two start/stop events per day and allows scheduling of up to 14 holiday periods per year is available for determining Occupied and Unoccupied Schedules. It also allows for daylight savings configuration.

Unoccupied Operation

Uses Unoccupied Setback Offset Setpoints for heating and cooling calls. If Unoccupied Setback Setpoints are left at the default 30°F, no Unoccupied Setback operation will occur and the unit will be off.

The Outdoor Air Damper will be closed except if the unit is in unoccupied Economizer Free Cooling mode.

If there is no call for Heating or Cooling, the unit will be off.

Cooling Mode & Economizer

HVAC Modes of Operation

There are 7 possible HVAC Modes of Operation. They are as follows:

- Cooling Mode
- Heating Mode
- Vent Mode
- Dehumidification Mode
- Heat Pump
- Warm-Up Mode / Cool-Down Mode
- Off Mode

Cooling Mode

Occupied Cooling is enabled when the temperature at the Mode Enable Sensor rises one deadband above the Cooling Setpoint. Cooling is disabled when the Mode Enable temperature falls one deadband below the Cooling Setpoint. The setpoint and deadband are user-adjustable.

Unoccupied Cooling operation is enabled when the Space Temperature rises above the Cooling Mode Enable Setpoint plus the Unoccupied Cooling Offset.

Mechanical cooling is disabled if the Outdoor Air Temperature (OAT) falls 1° below the Cooling Lockout Setpoint and will remain disabled until the OAT rises 1° above the Cooling Lockout Setpoint. If the OAT disables mechanical cooling while it is currently operating, mechanical cooling will stage off as minimum run times and stage down delays are satisfied.

If the economizer is enabled, it will function as the first stage of cooling (see Economizer section).

Cooling without Digital Scroll Compressor

Available cooling options are staged DX, Modulating Chilled Water, and On/Off Chilled Water.

In the Cooling Mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), cooling will begin to stage on or to modulate. Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize, and successive stages are subject to a Cooling Stage Up Delay (adj).

Cooling stages will continue to run until the SAT falls below the Active Supply Air Temperature Setpoint minus the Cooling Stage Control Window at which point the cooling will begin to stage off. Each stage must meet its Minimum Run Time (adj.) before it is allowed to stage off and successive stages are subject to a Cooling Stage Down Delay (adj.).

Cooling with Digital Scroll Compressor

In the Cooling Mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the Digital Compressor will stage on and modulate to control to the Active Supply Air Cooling Setpoint. One Digital Compressor can be controlled with the VCB-X Controller.

If additional cooling is required, fixed compressor stages can be staged on while the Digital Compressor continues to modulate.

To stage up the extra compressor(s), the SAT needs to be above the Active Supply Air Cooling Setpoint and the Digital Compressor needs to be at 100% for a period of time equal to the Stage Up Delay. Once a fixed compressor is enabled, the digital compressor signal will go to 50% and modulate up as needed. This will repeat as additional fixed compressors are staged up. For compressors to stage on, Minimum Off Times (adj.) must be satisfied as well as Stage Up Delays (adj.).

To stage down the extra compressor(s), the SAT needs to be below the Active Supply Air Cooling Setpoint minus the Cooling Stage Control Window, the Digital Compressor needs to be below 30%, and the Stage Down Delay requirement met. Once a fixed compressor stages off, the digital compressor will go to 50% and modulate down as needed. This will repeat as additional fixed compressors stage off.

For compressors to stage down, Minimum Run Times (adj.) must be satisfied as well as Stage Down Delays (adj.). The digital compressor is always the last compressor to be deactivated.

Modulating Cooling Signal Control

If Modulating Chilled Water or a Digital Scroll Compressor is being used, the Modulating Cooling Proportional Window is used to determine the signal to the Modulating Cooling Source and is user-adjustable. The Modulating Cooling signal is calculated based on the differential between the Supply Air Temperature and the Active Supply Air Temperature Setpoint based on the Modulating Cooling Proportional Window.

The Maximum Signal Adjustment per Time Period is 10% and is not user-adjustable. The Minimum Signal Adjustment per Time Period is based on the Modulating Cooling Proportional Window. The larger the Modulating Cooling Proportional Window, the smaller the signal adjustment will be per Time Period. The Time Period is the delay between another increase or decrease in the Modulating Cooling Source Signal and is user-adjustable. For example, if the Modulating Cooling Proportional Window is 5°F, the signal would adjust 2% per °F each Time Period above or below the Active Supply Air Temperature Setpoint. When the Supply Air Temperature is above or below the Active Supply Air Temperature Setpoint by 5°F or more, the signal would adjust 10% each Time Period.

Economizer Operation

Economizer operation is enabled when the Outdoor Air (OA) drybulb, wetbulb, or dewpoint temperature falls below the Economizer Enable Setpoint by 1°F and if the Outdoor Temperature is at least 5°F below the Return Air Temperature (if that value is available). Economizer operation is disabled when the OA temperature rises 1°F above the Economizer Enable Setpoint.

The Economizer acts as the 1st stage of cooling and controls to the Active Supply Air Cooling Setpoint. An Economizer Minimum Position can be programmed into the controller. During Economizer Operation, the economizer will modulate between this minimum position and 100%. If the economizer reaches 100% and the Supply Air Temperature is still above setpoint, mechanical cooling is then allowed to stage up while the economizer is held at the full open position. Any time cooling stages are currently running, and the economizer becomes enabled, it will immediately open to 100%.

During Heat and Vent Modes, the Economizer will remain at its minimum position. The only exception to this can occur during "VAV Operation with Outdoor Air Temperature Control (VAV Tempering)". See that section for more details. During Unoccupied Mode, the Economizer can be used for night setback free cooling; otherwise it will remain closed.

IAQ (CO_2) Override of the Economizer simply resets the Economizer Minimum Position higher. See IAQ (CO_2) Control Operation section for more details.

If utilizing the Title 24 Economizer option, an Economizer feedback signal (0-10 VDC) can be wired into the VCB-X EM2 Expansion Module for status monitoring. Several Title 24 alarm conditions can also be annunciated and are listed in the Alarms section of this manual.

Dehumidification Mode

On VAV, CAV, Single Zone VAV, and High Percentage Outdoor Units with Space Temperature Control, the Dehumidification Mode is initiated when the Indoor Humidity rises above the Low Indoor Humidity Setpoint by 4%. The unit will leave the Dehumidification Mode when the humidity falls 4% below this setpoint.

On 100% Outdoor Air (MUA) units with Outdoor Air Temperature Control, Dehumidification is initiated when the Outdoor Air Dewpoint rises above the Outdoor Air Dewpoint Setpoint by 2°F. The unit will leave the Dehumidification Mode when the humidity falls 2°F below this setpoint. The Outdoor Air Dewpoint is calculated using the Outdoor Air Temperature and the Outdoor Air Humidity.

There are four configuration options for Dehumidification operation.

In Occupied Vent Mode Only—Dehumidification can only be initiated in the Occupied Mode when there is no call for Heating or Cooling. This creates a Vent Dehumidification Mode.

In Both Occupied and Unoccupied Vent Mode—Dehumidification can be initiated in the Occupied and Unoccupied Modes when there is no call for Heating or Cooling. This creates a Vent Dehumidification Mode.

NOTE: Do not use this option on a MUA unit that does not have return air and which is not configured for space controlled Night Setback operation. Damage to the unit could occur since the OA damper remains closed in the Unoccupied Mode.

In All Modes while Occupied—Dehumidification can be initiated anytime in the Occupied Mode during Cooling, Heating, or Vent Mode. This can create a Cooling Dehumidification Mode, a Heating Dehumidification Mode, or a Vent Dehumidification Mode.

In All Modes while Occupied and Unoccupied—Dehumidification can be initiated anytime in the Occupied or Unoccupied Mode during Cooling, Heating, Vent, or Off Mode. This can create a Cooling Dehumidification Mode, a Heating Dehumidification Mode, or a Vent Dehumidification Mode. This configuration should not be used for an MUA unit with no return air, since it could start the unit in the Unoccupied Mode when the Outdoor Air damper is closed. Any calls for Unoccupied Dehumidification use the same Dehumidification Setpoint as during the Occupied Mode since you never want humidity to get out of control.

NOTE: Do not use this option on a MUA unit that does not have return air and which is not configured for space controlled Night Setback operation. Damage to the unit could occur since the OA damper remains closed in the Unoccupied Mode.

There is no Dehumidification allowed during Heat Mode on a Heat Pump unit.

Dehumidification Operation

For DX Cooling Stages, the VCB-X activates the Cooling Stages based on the actual Evaporator Coil Temperature compared to the Evaporator Coil Suction (Saturation) Temperature Setpoint. The Evaporator Coil Suction (Saturation) Temperature is calculated by using the Suction Pressure Sensor and converting the pressure to temperature.

For Copeland Digital Scroll™ Compressor units, the VCB-X will modulate the Copeland Digital Scroll™ Compressor to maintain the Evaporator Coil Suction (Saturation) Temperature Setpoint and activate Fixed Capacity Compressors as necessary.

If the Fixed Capacity Compressor is activated, the Copeland Digital Scroll™ Compressor will only be allowed to modulate within the range of 70% - 100% in order to prevent the loss of reheat capacity during low load conditions. If, with both compressors on, the digital compressor has modulated down to its 70% minimum and the Coil Suction Temperature falls below the Coil Temperature Setpoint minus the Cooling Stage Control Window, then the second compressor will stage off once its Compressor Minimum Run Time and the Stage Down Delay Timers have been met. At that point, the Copeland Digital Scroll™ Compressor can modulate down as needed to maintain the Coil Temperature Setpoint.

Dehumidification and Economizer Operation

SAFETY: If the Coil Suction (Saturation) Temperature drops below 32˚F, any cooling remaining on will be forced to stage off.

For Modulating Chilled Water units, the VCB-X will modulate the Chilled Water Valve to a fixed 100% position during Dehumidification to provide full moisture removal capabilities. With On/Off Chilled Water units, the Cooling Relay will energize to open the valve.

During Dehumidification, the Economizer will be held to its minimum position. If the unit will be using the CAV/MUA Dual Mode (Hood On/Off) Operation, Dehumidification will require the use of an Outdoor and Indoor Humidity Sensor.

Reheat

During the Dehumidification Mode, the VCB-X activates Cooling to extract moisture from the Supply Air and utilizes either Modulating Hot Gas Reheat, On/Off Hot Gas Reheat, or Heating to reheat the Supply Air. Hot Gas Reheat is the standard form of Reheat.

Reheat is always controlled to the Active Supply Air Setpoint (see the Supply Air Temperature Setpoint Reset section for further explanation) which will be different depending on whether the unit is in Cooling Mode Dehumidification, Heating Mode Dehumidification, or Vent Mode Dehumidification.

During Cooling Dehumidification, Reheat is controlled to the Active Cooling Supply Air Setpoint. During Heating Dehumidification, Reheat is controlled to the Active Heating Supply Air Setpoint. During Vent Dehumidification, Reheat is controlled to a calculated setpoint that is halfway between the Heating and Cooling Mode Enable Setpoints.

If the unit is equipped with a Modulating Hot Gas Reheat Controller (MHGRV-X), then during Dehumidification, it will modulate the reheat valve to maintain the Supply Air Temperature at the Active Supply Air Temperature Setpoint.

If the unit is equipped with an On/Off Hot Gas Valve, then one of the relays will be configured for Reheat. The Reheat Relay will be activated if the SAT is less than the SAT Setpoint. The Hot Gas Reheat Relay will remain on during the Dehumidification Mode regardless of the Supply Air Temperature. This is to ensure a steady Supply Air Temperature.

The HVAC unit's Heat Source or a Heat Source located in the Supply Air Duct can be used for Reheat if the unit is not equipped with Hot Gas Reheat or to supplement Hot Gas Reheat. Please read the warning that follows regarding applications that operate Heating and Cooling simultaneously.

WARNING: Simultaneous Heating and Cooling cannot be approved unless the HVAC unit has been specifically designed for this purpose. A Special Price Authorization (SPA) must be obtained from the AAON® factory for these applications to avoid warranty and/or rating problems. WattMaster Controls Inc. assumes no liability for any Simultaneous Heating and Cooling application if a SPA is not obtained from the AAON® Factory at the time the HVAC unit is ordered.

When Heating is used for Reheat instead of Hot Gas Reheat, the VCB-X can activate the Heat Source(s) discussed in the Heating Mode section. When Heating is used to supplement Hot Gas Reheat, the VCB-X restricts the Heating to one form of Modulating Heat or one stage of Gas or Electric Heat.

Coil Suction (Saturation) Temperature Reset

The Indoor Humidity can be used to reset the Coil Suction (Saturation) Temperature Setpoint. A user adjustable range of Indoor Humidity values can be used to reset the Coil Temperature Setpoint between a user adjustable range of values. As the Indoor Humidity rises within its range the Coil Suction (Saturation) Temperature Setpoint will be lowered within its range.

Return Air Bypass Damper Control

The Return Air Bypass (RAB) Damper is only used on constant air volume units with space temperature configured as the HVAC Mode Enable sensor. The RAB Damper is only active during the Dehumidification Mode and is used as the first form of Reheat. If the HVAC unit is equipped with modulating Hot Gas Reheat, the RAB Damper needs to be at 100% before the modulating Hot Gas Reheat can be used. The RAB Damper modulates from 0-100% as the Space Temperature falls below the Cooling Setpoint. When the Space Temperature is equal to the Cooling Setpoint, the RAB Damper will be at 0%. When the Space Temperature falls to halfway between the Cooling and Heating Setpoints, the RAB Damper will be at 100%.

If the HVAC unit is equipped with separate actuators for the Outdoor Air and Return Air Dampers, the Return Air Damper will proportionally close more as the RAB Damper opens. The rate at which the Return Air Damper closes is user-adjustable. The purpose of closing the Return Air Damper more as the RAB Damper opens is to allow more air to bypass the evaporator coil through the RAB Damper. If you want more air to pass through the RAB Damper, enter a larger number in the Return Air Damper Factor setpoint. If you want less air to pass through the RAB Damper, enter a smaller number in the Return Air Damper Factor setpoint.

NOTE: See **page 6** for specific AAON® DPAC and PAC operation.

Heating Mode

Available heating options are Staged Gas, Modulating Gas, Staged Electric, On/Off Hot Water, Modulating Hot Water, and Modulating SCR Electric.

Heating is enabled when the temperature at the Mode Enable Sensor falls one deadband below the Heating Setpoint. Heating is disabled when the Mode Enable temperature raises one deadband above the Heating Setpoint.

In the Heating Mode, as the Supply Air Temperature falls below the Active Supply Air Heating Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the heating will begin to stage on or to modulate. Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize, and successive stages are subject to a Heating Stage Up Delay (adj).

Heating stages will continue to run until the Supply Air Temperature rises above the Active Supply Air Temperature Setpoint plus the Heating Stage Control Window at which point the heating will begin to stage off. Each stage must meet its Minimum Run Time (adj.) before it is allowed to stage off, and successive stages are subject to a Heating Stage Down Delay (adj.).

Mechanical heating is disabled if the Outdoor Air Temperature (OAT) rises 1° above the Heating Lockout Setpoint and will remain disabled until the OAT falls 1° below the Heating Lockout Setpoint. If the OAT disables mechanical heating while it is currently operating, mechanical heating will stage off as minimum run times and stage down delays are satisfied.

Modulating Heating

The VCB-X supports various forms of Modulating Heat such as SCR Electric Heat, Modulating Hot Water Heat, and Modulating Steam Heat. This references Modulating Heat that is controlled from AOUT3 on the VCB-X Controller with a user-adjustable voltage range between 0-10 VDC. Modulating Gas, which is controlled by the ModGas-X Controller, is not included in this section. Whichever form of Modulating Heating is used, the VCB-X will modulate the Heat Source to achieve the Active Supply Air Temperature Setpoint.

The Modulating Heating Proportional Window is used to determine the signal to the Modulating Heating Source and is user-adjustable. The Modulating Heating Signal is calculated by the differential between the Supply Air Temperature and the Active Supply Air Temperature Setpoint based on the Modulating Heating Proportional Window. The maximum signal adjustment per Time Period is 10% and is not user- adjustable. The minimum signal adjustment per Time Period is based on the Modulating Heating Proportional Window. The larger the Modulating Heating Proportional Window, the smaller the signal adjustment will be per Time Period. The Time Period is the delay between another increase or decrease in the Modulating Heating source signal and is user-adjustable.

For example, if the Modulating Heating Proportional Window is 5°F, the signal will be adjusted 2% per °F each Time Period above or below the Active Supply Air Temperature Setpoint. When the Supply Air Temperature is above or below the Active Supply Air Temperature Setpoint by 5°F or more, the signal will adjust 10% each Time Period.

Hot Water Coil Protection

Fan On Mode

If anytime the fan is on, the Supply Air Temperature falls below the user-adjustable Low Supply Air Temperature Cutoff Setpoint for at least one minute, the Hot Water Valve will move to a user-adjustable position configured with the Hot Water Valve Protection Position Setpoint. If the Supply Air Temperature rises back above the Low Supply Air Cutoff by 5°F, the valve will return to its normal position.

If the Supply Air Temperature remains below the Low Supply Air Temperature Cutoff Setpoint for ten minutes, the unit will then shut down and the Low Supply Air Temperature Cutoff Alarm will be generated. If the Supply Air Temperature rises above the Low Supply Air Cutoff by 5°F, the alarm (if generated) will clear and the unit will attempt to restart and resume normal operation.

Fan Off Mode

If anytime the fan is off, the Outdoor Air Temperature falls below the user-adjustable Low Ambient Setpoint, the Hot Water Valve will move to the user-adjustable Hot Water Valve Protection Position Setpoint. If the Outdoor Temperature rises above the Low Ambient Setpoint, the valve will return to its normal position.

If the Hot Water Valve Protection Position setpoint is left at the default of 0%, the controller will not initiate this protection sequence.

Primary and Secondary Heating

The VCB-X can activate two forms of Heating, which are classified as Primary and Secondary Heat Sources. The following section describes that operation.

Primary Modulating Heat with Secondary Staged Heat

The Modulating Heat source can be ModGas, Modulating Hot Water, Modulating Steam, or SCR Electric Heat. In this case the modulating heat will be the first form of heat used and will operate as described above to attempt to achieve the Active Supply Air Heating Setpoint. If the modulating heat reaches 100%, the Heating Stage Up Delay begins. If the Primary Heat Source is still at 100% after the Heating Stage Up Delay expires, the Secondary Heat Source will activate. The Primary Heat Source can then modulate as necessary to achieve the Active Supply Air Heating Setpoint. If there are additional stages of heat, they will stage up as described, with the Primary Heat Source modulating as necessary.

If the Secondary Heat Source is activated and the Primary Heat Source has modulated to 0%, the Heating Stage Down Delay will begin. If the Primary Heat Source is still at 0% after the Heating Stage Down Delay expires, the Secondary Heat Source will deactivate. If there are multiple stages of Secondary Heat, they will stage off in the same manner. Then, if the Supply Air Temperature rises above the Active Supply Air Heating Setpoint plus the Heating Stage Control Window, the Primary Heat Source will modulate to 0% to allow the Supply Air Temperature to cool off.

Ventilation Mode

This mode is only available in the Occupied Mode of operation on units configured for continuous Supply Fan operation and is generated anytime there is no demand for heating or cooling. The fan will operate at the configured Minimum Vent speed.

Off Mode

Off Mode occurs in the Unoccupied Mode when there is no heating or cooling demand. The Supply Fan is off and the outside air damper is closed.

Off Mode can only occur in the Occupied Mode if the fan is configured to cycle with heating and cooling and there is no call for heating or cooling. Space Sensor Operation

Remote Contact Control, Space Sensor Operation, IAQ

VCB-X Remote Contact Control

A Remote Contact Control option can be configured on the VCB-X Controller to initiate the HVAC Modes of operation. If this option is configured, all Heating, Cooling, and Dehumidification modes will only be initiated based on 24 VAC wet contact closures on the Forced Heating, Forced Cooling, and Forced Dehumidification inputs on the EM2 Expansion Module. This is a single configuration option that applies to all three modes. When using this Remote Contact Control, configure the Outdoor Air Sensor as the controlling sensor.

If both the Forced Heating and Forced Cooling inputs are inactive or if both are simultaneously active, then the unit is in a Vent mode (neutral) state. In this condition in the Occupied Mode, only the fan would be on for ventilation. In this condition in the Unoccupied Mode, the unit would just be Off.

If Forced Dehumidification is also being used, it will operate in conjunction with the Forced Heating and Forced Cooling inputs according to which Dehumidification option you have configured. The four configuration options are described in the Dehumidification Mode section on **page 63**.

Space Sensor Operation

Space Sensors are available as a Plain Sensor, Sensor with Override, Sensor with Setpoint Slide Adjust, and Sensor with Override and Setpoint Slide Adjust (this is the version that is factory supplied).

An E-BUS Digital Space Sensor is also available with override and setpoint adjustment capability.

Sensors with Setpoint Slide Adjust can be programmed to allow Space Setpoint adjustment of up to ± 10° F.

If the Space Temperature is the SAT/Reset Source, then the Slide Adjust will adjust the HVAC Mode Enable Setpoints and the SAT/Reset Source Setpoints simultaneously.

During Unoccupied hours, the Override Button can be used to force the unit back into the Occupied Mode (by pressing the button for less than 3 seconds) for a user-defined override duration of up to 8.0 hours. Pressing the button between 3 to 10 seconds cancels the override.

IAQ (CO_2) Control Operation

If you have configured the VCB-X Controller to monitor and control CO_2 levels, the Economizer operation will be modified as follows:

1. If the CO_2 levels remain below the Low CO_2 Level Setpoint, the Economizer Minimum Position will remain at its configured value.

2. As the level of CO_2 increases above the Minimum CO_2 Level Setpoint, the Economizer Minimum Position will begin to be reset higher. The Economizer Minimum Position will be proportionally reset higher as the CO_2 rises within the range set by the Minimum CO_2 Level Setpoint and the Maximum CO_2 Level Setpoint. If the CO_2 level reaches the High CO_2 Level Setpoint, the Economizer Minimum Position will be reset to the Maximum Reset Position.

3. The Maximum Reset Position Setpoint is the highest the Economizer Minimum Position can be reset to during CO_2 Control Operation. This setpoint is user-adjustable and does not keep the Economizer from opening further during Economizer operation.

Morning Warm-Up Mode Operation

NOTE: Morning Warm-Up can now be configured for any application but should not be used on 100% Outdoor Air Units, since the Outdoor Air Damper remains closed during Warm Up.

When the VCB-X Controller is configured for Morning Warm Up and switches to the Occupied Mode of Operation (not Override or Force Mode), the unit compares the Return Air Temperature to a Morning Warm-Up Target Temperature. If the Return Air Temperature is below this Setpoint, the Warm-Up Mode is initiated. Heating will then be controlled to the Warm-Up Supply Air Temperature Setpoint.

This Mode remains in effect until the Return Air Temperature rises above the Target Temperature or a user-adjustable Time Period expires. Warm-Up Mode is not initiated by Push-Button Overrides or Unoccupied Heating demands. The Outdoor Air Damper remains closed during Warm-Up Mode.

Once the Warm-Up Mode has been terminated, it cannot resume until the unit has been through a subsequent Unoccupied Mode. Only one Warm-Up Mode is allowed per Occupied cycle.

If you have stand-alone VAV boxes that need to be forced wide open during the Warm-Up Mode, you can configure one of the relay outputs to be used during this Mode. If the Warm-Up Mode is active, the relay is activated. This relay then becomes the Force Open Command for all VAV boxes to which it is wired.

Morning Cool-Down Mode Operation

When the VCB-X Controller is configured for Morning Cool-Down and switches to the Occupied Mode of Operation (not Override Mode), the unit compares the Return Air Temperature to a Cool-Down Target Temperature. If the Return Air Temperature is above this Setpoint, the Cool-Down Mode is initiated. Cooling will then be controlled to the Cool-Down Supply Air Temperature Setpoint.

This Mode remains in effect until the Return Air Temperature drops below the Target Temperature or a user-adjustable Time Period expires. Cool-Down is not initiated by Push-Button Overrides or Unoccupied Cooling demands. The Outdoor Air Damper remains closed during Cool-Down Mode.

Once the Cool-Down Mode has been terminated, it cannot resume until the unit has been through a subsequent Unoccupied Mode. Only one Cool-Down Mode is allowed per Occupied cycle.

If you have stand-alone VAV boxes that need to be forced wide open during the Cool-Down Mode, you can configure one of the relay outputs to be used during this Mode. If the Cool-Down Mode is active, the relay is activated. This relay then becomes the Force Open Command for all VAV boxes to which it is wired.

Single Zone VAV

Single Zone VAV Operation is a hybrid CAV/VAV application where the Supply Fan VFD is modulated to maintain the Space Temperature Setpoint while heating or cooling is modulated to maintain the Supply Air Setpoint. This application can be configured to use VAV Cooling and either VAV Heating or CAV Heating. There is no Supply Air Setpoint reset function on a Single Zone VAV unit.

VAV Cooling and VAV Heating require modulating cooling and heating sources in order to maintain a constant Supply Air Temperature no matter what the fan speed is. CAV Heating must be configured if using a staged form of heat.

The Space Temperature Sensor determines the heating or cooling mode of operation. Heating and cooling are enabled and disabled as described previously in the Heating and Cooling sections.

In the Cooling Mode, the modulating cooling source will modulate to maintain the Cooling Supply Air Setpoint. The Supply Fan VFD will begin operation at the Minimum VFD Cooling Speed (30% default) and modulate between this setpoint and 100% as needed to maintain the Space Temperature within the Space Cooling Reset Window created by configuring a Space Cooling High and a Space Cooling Low Reset Source Setpoint.

If the unit is configured for VAV Heating, then in the Heating Mode the modulating heating source will modulate to maintain the Heating Supply Air Setpoint. The Supply Fan VFD will begin operation at the Minimum VFD Heating Speed (50% default) and modulate between this setpoint and the Maximum VFD Heating Speed (100% default) as needed to maintain the space temperature within the Space Heating Reset Window created by configuring a Space Heating High and a Space Heating Low Reset Source Setpoint.

If the unit needs to be configured for CAV Heating, set the Minimum VFD Heating Speed to be the same as the Maximum VFD Heating Speed desired during heating. Once the unit enters the Heating Mode, the Supply Fan will run at the set Maximum VFD Heating Speed (100% default) and Heating will occur as described in the Heating Section of this sequence.

In the Vent Mode of operation, the Supply Fan will operate at the VFD Vent Speed (user-adjustable).

During Dehumidification, the fan will operate as described above, depending on if the Space Temperature is calling for Cooling, Heating, or Vent Mode of operation.

Whenever the unit is in CO_2 override operation of the Outdoor Air Damper, the minimum VFD Fan Speed is forced to 75% and can modulate up from there.

If the Hood On/Off operation is used on a SZ VAV unit, then during Hood On, the mode enable will switch to the Outdoor Air Temperature Sensor using Hood On Mode Enable Setpoints and the Outdoor Air Damper will modulate to 100%. The Supply Fan VFD will still control to maintain the Space Temperature Setpoints.

Supply Air Temperature Setpoint Reset

Various sources can be configured to reset the Supply Air Temperature (SAT) Setpoint. Since the Supply Air Temperature Setpoints are not fixed during reset, we refer to them as “Active Supply Air Temperature Setpoints.” The following Reset Source options are available in this release:

1. Space Temperature
2. Outdoor Air Temperature
3. Return Air Temperature
4. Fan VFD Signal
5. Remote SAT Reset Signal

For whatever option is selected, a High and a Low Reset Source Setpoint must be configured that will correspond to configured Low and High SAT Setpoints. This must be done separately for the Cooling Mode Setpoints and for the Heating Mode Setpoints.

When the Reset Source is at its highest configured setpoint, the SAT Setpoint will be reset to its lowest configured setpoint. When the Reset Source is at its lowest configured setpoint, the SAT Setpoint will be reset to its highest configured setpoint.

In all cases, as the Reset Source value moves within its range established by the configured High and Low Reset Setpoints, the Supply Air Setpoint will be proportionally reset within its range established by the configured Low and High SAT Setpoints.

If a Remote SAT Reset Signal is configured as the Reset Source, a configurable voltage signal (between 0 and 10 VDC, direct or reverse acting) can be used to reset the Supply Air Temperature Setpoint. You can configure what voltage will correspond to the Low SAT Setpoint and what voltage will correspond to the High SAT Setpoint in both the Heating and the Cooling Modes. The EM2 Expansion Module is required for this option.

Airflow Monitoring and Duct Static Pressure Control

Airflow Monitoring

Outdoor, Supply, Return and Exhaust Airflow can be monitored using the EBTRON® GTC116 series, Paragon MicroTrans^{EQ} series, or GreenTrol GA-200-N Module in conjunction with a GreenTrol GF series of airflow station. Contact WattMaster Controls for information on other airflow station options. The VCB-X will control the Outdoor Air Damper to maintain an Outdoor Air CFM Setpoint. This operation can be overridden higher by normal Economizer control.

Pre-Heater Operation

A Pre-Heat relay can be configured to energize anytime the Supply Fan is operating and the Outdoor Air Temperature is below the Pre-Heat Setpoint. This option allows pre-heating of cold outside air before it reaches the evaporator coils and is useful in Hot Water/ Chilled Water applications or during CO_2 control of the economizer in low temperature conditions. This operation only occurs in the Occupied Mode of Operation.

If using the Preheat-X Controller, an SCR preheater and/or stages of preheat can be controlled. If the Entering Air Temperature (sensor connected to the Preheat-X) falls below the Pre-Heat Setpoint, then preheat will be controlled to either a Cooling, Heating or Vent Mode Preheater Leaving Air Setpoint - depending on if the VCB-X is currently in the Cooling, Heating, or Vent mode of operation. These setpoints are all set in the VCB-X Controller. See the *PREHEAT-X Controller Technical Guide* for more details.

Low Ambient Operation

A Low Ambient Relay can be configured. Whenever the Outdoor Air Temperature falls below the Low Ambient Setpoint, this Low Ambient Relay will energize. This operation occurs in both the Occupied and Unoccupied Modes of Operation.

Heat Wheel

One of the relay outputs can be configured as a Heat Wheel Relay. This relay will enable the Heat Wheel when the unit goes into the Occupied Mode. If the unit is configured for Economizer Operation, this relay will disable the Heat Wheel when the unit goes into Economizer Mode. If the Heat Wheel Relay is active, a Heat Wheel Defrost Cycle will occur that will disable the Heat Wheel Relay for 2 minutes if the Outdoor Air Temperature is below the Heat Wheel Defrost Setpoint and 30 minutes have elapsed since the last Heat Wheel Defrost Cycle.

Duct Static Pressure Control

If the VCB-X Controller has been configured for Duct Static Pressure Control, then anytime the Supply Fan is operating, the unit will be controlling to a Duct Static Pressure Setpoint. The Static Pressure Control Output Signal can be used to control a Supply Fan VFD (Direct Acting Operation) or a Zoning Bypass Damper Actuator (Reverse Acting Operation).

The Duct Static Pressure Setpoint, the Setpoint Deadband, the Static Pressure Control Signal, and the Static Control Rate are all user-adjustable. The Static Control Rate is the amount of time that elapses between each adjustment to the Duct Static Pressure Control Output Signal. The default period is 10 seconds and should not be changed unless close observation reveals that the Supply Fan or Bypass Damper is hunting and not maintaining a stable pressure reading.

For Supply Fan VFD operation, the Output Signal increases (increases the VFD speed) if the Duct Static Pressure is below the Duct Static Pressure Setpoint by the Deadband amount, and the Output Signal decreases (decreases VFD Speed) if the Static Pressure is above the Setpoint by the Deadband amount.

For Bypass Damper operation, the VCB-X will reverse the logic of the Output Signal. The Output Signal decreases (closes the Zoning Bypass Damper) if the Duct Static Pressure is below the Duct Static Pressure Setpoint by the Deadband amount, and the Output Signal increases (opens the Zoning Bypass Damper) if the Duct Static Pressure is above the Duct Static Pressure Setpoint by the Deadband amount.

If the Static Pressure ever rises 0.5” above the Duct Static Pressure Setpoint, the Duct Static Pressure Control Output Signal will be cut in half every control period until the Static Pressure is brought under control. This is to prevent damage to the ductwork if all the VAV boxes are closed or some other blockage occurs in the ductwork.

WARNING: The manufacturer does not assume responsibility for protecting the equipment from over-pressurization! You should always install mechanical high static protection cutoffs to protect your system!

Any time the Supply Fan is off, the Duct Static Pressure Control Output Signal will remain at zero volts. If Duct Static Pressure Control is not configured, the Static Pressure can still be monitored if a Static Sensor is installed, however, no control will occur.

Duct Static Pressure Control for Filter Loading

In order to maintain a constant CFM through the supply air ducts on a mixed air CAV unit, the VCB-X can utilize a Duct Static Pressure Sensor (used to monitor the discharge pressure) in conjunction with a Supply Fan VFD. If the filters are getting dirty, the VCB-X will ramp up the VFD to compensate for the decrease in airflow. To utilize this feature, the unit must be configured to use VFD Fan Control. This feature cannot be used if this is a VAV or Zoning application with typical Duct Static Pressure Control, or if this unit has been configured for Single Zone VAV operation.

Building Pressure Control

The VCB-X can maintain Building Static Pressure anytime the Supply Fan is operating. A Building Pressure Transducer must be connected to the VCB-X EM1 Expansion Module. The following are the available control options.

Direct Acting Building Pressure Control

- **On/Off Exhaust Fan**—If an On/Off Exhaust Fan is being used, a relay output must be configured for "Exhaust Fan". This relay will energize whenever the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount. The relay will de-energize when the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount.

- **Exhaust Fan VFD or Modulating Exhaust Damper**—If configured for Modulating Exhaust, a user-adjustable voltage output (AOUT1 – Building Pressure Output on the VCB-X EM1 Expansion Module) will be used to control this fan or damper. An Exhaust Relay can be configured if necessary to enable the fan or damper. Whenever the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount, the Exhaust Fan Relay will energize and the Modulating Signal will activate to control to the Building Pressure Setpoint. If the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount, the Modulating Signal will modulate towards 0% as it attempts to maintain the Building Pressure Setpoint. The Exhaust Fan Relay is energized whenever the Modulating Signal is above 0%.

Reverse Acting Building Pressure Control

- **Outdoor Air Damper**—If this option is configured, the VCB-X will use the user-adjustable Economizer/ Outdoor Air Damper output signal (AOUT2 – Economizer Control Signal) to maintain the Building Pressure Setpoint. Whenever the Building Pressure falls below the Building Pressure Setpoint by the Deadband amount, the modulating Economizer Output Signal will modulate the damper open to control to the Building Pressure Setpoint. If the Building Pressure rises above the Building Pressure Setpoint by the Deadband amount, the damper will modulate towards closed as it attempts to maintain the Building Pressure Setpoint. When this option is selected, no Economizer free cooling or CO_2 IAQ operation will be available.

- **Supply Fan VFD**—Contact WattMaster regarding this Reverse Acting Building Pressure Control option. It should not be used in most applications. If this option is selected, the user-adjustable Supply Fan VFD Output (AOUT1 on the VCB-X) will be used to control the Supply Fan VFD to maintain the Building Pressure Setpoint in similar fashion to the Outdoor Air Damper control described above.

MUA Operation

- **Occupied Mode—**The VCB-X will use the normal Cooling and Heating Mode Enable Setpoints (not the Hood On Setpoints) in conjunction with the Outdoor Air (OA) temperature sensor to determine the mode of operation. The Outdoor Air Dewpoint Setpoint will initiate the Dehumidification Mode. See the Cooling, Heating and Dehumidification Modes of Operation sections for those details. The Outdoor Air Damper will be modulated to the Economizer Minimum Damper Position (normally set at 100% for a MUA unit).

- **Unoccupied Mode—**Normally, an MUA unit is off during the Unoccupied Mode. However, if the unit has Return Air, it can be configured to operate as a recirculating Night Setback Controlled unit during Unoccupied Hours. This is accomplished by simply configuring Night Setback Temperature Setpoints (anything other than the default 30ºF) on a unit that is also configured for Outdoor Temperature Control (MUA). With this configuration, when the unit goes Unoccupied, it will close the Outdoor Air Damper and begin to use a Space Temperature Sensor in conjunction with the existing Heating and Cooling Setpoints, offset by the Night Setbacks, to make Night Setback calls. If a Space Humidity Sensor is installed, and the unit is configured for Night Humidity control, the VCB-X Controller will use the Space Humidity Setpoint for unoccupied Dehumidification calls.

CAV/MUA and Condenser Fan/Water Valve Operation

CAV/MUA Dual Mode (Hood On/Off Operation)

The VCB-X Controller can be configured as a CAV controller but switch to MUA operation when an exhaust hood is energized. This MUA force mode occurs when a 24 VAC wet contact closure is received on the Hood On binary input on the VCB-X EM1 Expansion Module. Under normal operation (CAV), the unit will operate as a recirculating Space Temperature (and Space Humidity) controlled unit.

When the Hood On contact is made, the unit will open the Outdoor Air Damper to its full open position. The Heating and Cooling Modes will then be determined by the Outdoor Air Temperature Sensor using the Hood On Outdoor Air Heating and Cooling Setpoints which are used only in Hood On operation. Dehumidification would then be initiated by an Outdoor Dewpoint Setpoint.

When the Hood On Force Mode is removed, the unit will revert to CAV operation with the Outdoor Damper returning to its minimum position (unless economizer operation is enabled) and with mode control initiated by the Space Temperature and Humidity Sensors.

Space Temperature Control of High Percentage Outside Air Units

This option allows for Space Temperature control of 100% Outside Air MUA Units or units with a high percentage of Outdoor Air (normally 50% or greater). For this application you would configure "Space Temperature w/High OA %" for the Controlling Sensor option. The intent of this sequence is to allow Space Temperature control of the unit while preventing the dumping of hot or cold outside air into the space during the Space Vent Mode of operation.

Once the Space Temperature is satisfied, before switching to Vent Mode, the controller compares the Outside Air Temperature to the Hood On HVAC Setpoints (Hood On MUA Setpoints) to determine if a continued demand for heating or cooling is required to prevent dumping. If there is no demand, the VCB-X Controller switches to Vent Mode. If the Outside Air Temperature is greater than the Hood On HVAC Cooling Setpoint or less than the Hood On HVAC Heating Setpoint, plus the Occupied Deadband, the VCB-X Controller will continue mechanical cooling or heating operation and stage it as necessary to maintain the Vent Mode Supply Air Setpoint (Calculated to halfway between the Mode Enable Setpoints).

During this Vent Mode Tempering operation, indoor humidity (space or return air) will continue to control the dehumidification operation. So, if dehumidification is configured and the humidity is above setpoint, the unit will be in Vent Mode Dehumidification (see the Dehumidification Mode section for more details). Reheat will be controlled to the calculated Vent Mode Supply Air Setpoint described earlier.

A call for Heating or Cooling from the Space Sensor will cancel the Outdoor Air Tempering operation.

NOTE: All Minimum Run times must be satisfied before mechanical cooling or heating is de-energized.

Supply Air Tempering (VAV Operation with Outdoor Air Temperature Control)

NOTE: This operation is handled differently than what was used in the VCM-X Controller.

On a VAV unit that may need daytime heating in order to maintain the Cooling Supply Air Setpoint, previous controllers used a Supply Air Tempering sequence with the Supply Air Temperature Sensor configured as the Controlling Sensor. The VCB-X Controller accomplishes the same result using the Hood-On Outdoor Air (OA) Setpoints to initiate Cooling and Heating.

To utilize this sequence, the HVAC Mode Enable Source must be configured as Supply Air Tempering. Then, configure the Hood On HVAC Setpoints for the OA temperature values that will enable Cooling and Heating. The Hood On Heating Setpoint should be set at or above the OA Temperature, that when mixed with the Return Air (with the economizer at its minimum position), will require Heating in order to achieve the Heating Supply Air Setpoint. The Hood On Cooling Setpoint would be set above that, which will allow a Vent Mode in between.

Then, configure the Cooling and Heating Supply Air Setpoints. While not set at the same value (see below), those would normally both be set at or near 55°F to allow the box heat to keep spaces comfortable.

With this configuration, as the OA Temperature rises above the Hood On Cooling Setpoint, the unit will be in Cooling Mode, controlling to the Cooling Supply Air Setpoint. The economizer can operate as normal for free cooling to maintain the Cooling Supply Air Setpoint.

During the Vent Mode, when the OA Temperature is between the Hood On Cooling and Heating Setpoints, the economizer can modulate if necessary to maintain the Cooling Supply Air Setpoint.

Whenever the OA Temperature falls below the Hood On Heating Setpoint, the unit will be in Heating Mode controlling to the Heating Supply Air Setpoint. The Heating Supply Air Setpoint should be set at least 2°F below the Cooling Supply Air Setpoint. The economizer can still modulate if necessary to maintain the Cooling Supply Air Setpoint. Configured this way, even if the OA Temperature is below the Hood On Heating Setpoint, if the Supply Air Temperature is too warm (above the Cooling Supply Air Setpoint), the economizer can modulate open to maintain the Cooling Supply Air Setpoint. If the Supply Air Temperature drops below the Cooling Supply Air Setpoint, the economizer will have time to close off before heating is energized below the Heating Supply Air Setpoint.

During Morning Warm-Up, heating will be controlled to the Morning Warm-Up Supply Air Setpoint (see the Morning Warm-Up Mode Operation section for complete details).

In this operation, if Night Setback operation will be initiated by a space sensor connected to the VCB-X Controller, then the Night Setback Cooling and Heating Offsets will be applied to the normal Occupied HVAC Mode Enable Setpoints (not the Hood On Setpoints). During Night Setback operation, Heating will be controlled to the Morning Warm-Up supply Air Setpoint.

Finally, configure the VCB-X for Duct Static Pressure Control (see the Duct Static Pressure Control section for complete details).

Air to Air Heat Pump Operation

Cooling Mode will operate in the same manner as described in the Cooling section.

A reversing valve relay output can be configured to activate with the first compressor stage in the Heating Mode or the Cooling Mode of operation.

In the Heating Mode, Compressor Heat, Auxiliary Heat, and Emergency Heat can be used to achieve the Active Supply Air Heating Setpoint. Auxiliary Heat can be either a modulating or staged form of heat, or it can be a modulating form of heat followed by staged heat.

When Auxiliary Heat comes on in conjunction with a digital compressor heat stage, the digital compressor will be locked at 100% until the Supply Air Temperature (SAT) rises above the SAT Heating Setpoint plus the Heat Staging Window. At that point, the Auxiliary Heat will stage off (after a stage down delay) and the digital compressor heat will be allowed to modulate.

When the Outdoor Air Temperature (OAT) is below the Heating Lockout but above the OAT Compressor Heating Lockout, Compressor Heat will be used and can be supplemented by Auxiliary Heat.

When the OAT is below the OAT Compressor Heating Lockout, Compressor Heat is locked out. Auxiliary Heat will then be the primary heat and can be supplemented with stage(s) of Emergency Heat (if available). Emergency heat is only available when the OAT is below the OAT Compressor Lockout.

For Dehumidification during Heat Mode of an Air to Air Heat Pump Unit, Auxiliary Heat can be used as the Reheat Source or to supplement Modulating Hot Gas Reheat.

NOTE: Any digital compressor stage in a Heat Pump unit must be configured as a “Digital Compressor”. The VCB-X will know it will operate as a heat pump compressor by the unit being configured as having a Reversing Valve. Any fixed Heat Pump compressor stage must be configured as a “Heat Pump Compressor” rather than a “Cooling Stage.”

Heat Pump Standard Defrost Operation

If using the VCB-X Controller with an installed Defrost Coil Temperature Switch, a Defrost Cycle is available.

If the compressor(s) are operating in the Heating Mode and the Defrost Coil Temperature Switch closes, the unit will enter the Defrost Mode, provided the user-adjustable Defrost Interval Timer has elapsed since the last Defrost Cycle.

In the Defrost Cycle, the reversing valve signal is switched to the opposite operation, and the compressors are brought to maximum capacity. Auxiliary Heat will be used to attempt to maintain the Heating SAT Setpoint.

The unit will leave the Defrost Mode after 10 minutes have elapsed or the Defrost Coil Temperature Switch opens.

If the unit leaves the compressor heating mode, the Defrost Interval will restart once the unit re-enters the compressor heating mode.

Heat Pump Adaptive Defrost Operation

The Adaptive Defrost operation adjusts the time interval (Adaptive Defrost Timer) in between Defrost Mode cycles.

As stated above, the unit will leave the Defrost Mode after 10 minutes have elapsed or the Defrost Coil Temperature Switch opens. If the Defrost Cycle is terminated because the 10 minute timer runs out, this could be an indicator that the unit may need more defrost time. To address this issue, the Adaptive Defrost Timer value will be subtracted from the original Defrost Interval.

If the Defrost Cycle is terminated between the 8th and 9th minute, the Defrost Interval will not be changed.

If the Defrost Cycle is terminated before the 8th minute, this could be an indicator that the unit may need less defrost time. To address this issue, the Adaptive Defrost Timer value will be inversely proportionally added to the original Defrost Interval as the termination time moves from 8 minutes to 0 minutes.

Adaptive Defrost can be disabled by setting the Adaptive Defrost Timer Setpoint to 0.

Water Source Heat Pump Operation

Cooling Mode will operate in the same manner as described in the Cooling section.

A reversing valve relay output can be configured to activate with the first compressor stage in the Heating Mode or the Cooling Mode of operation.

In the Heating Mode, Auxiliary Heat can be used with Compressor Heat to achieve the Active Supply Air Heating Setpoint. Auxiliary Heat can be either modulating or staged forms of heat, or it can be a modulating form of heat followed by staged heat.

When Auxiliary Heat comes on in conjunction with a digital compressor heat stage, the digital compressor will be locked at 100% until the Supply Air Temperature (SAT) rises above the SAT Heating Setpoint plus the Heat Staging Window. At that point, the Auxiliary Heat will stage off (after a stage down delay) and the digital compressor heat will be allowed to modulate.

There is no Dehumidification during Heat Mode of a Water Source Heat Pump Unit. There is no Defrost Mode on a Water Source Heat Pump Unit.

NOTE: Any digital compressor stage in a Heat Pump unit must be configured as a “Digital Compressor”. The VCB-X will know it will operate as a heat pump compressor by the unit being configured as having a Reversing Valve. Any fixed Heat Pump compressor stage must be configured as a “Heat Pump Compressor” rather than a “Cooling Stage.”

The unit can be configured for the percentage of glycol it has. The options are 0%-40% in 5% increments.

Safety Monitoring

Proof of Flow

1. If there is a call for a compressor and there is no Proof of Flow (POF) Input enable:
    - Compressors will not be enabled.
    - The VCB-X will wait up to 3 minutes to activate the POF Alarm and the POF LEDs which will blink the code-indicating failure. If POF failure still exists, compressors will remain disabled.

2. If compressors(s) are running and the POF contact opens for 2 seconds during Heat Pump Heating:
    - Compressors will be disabled.
    - POF Alarm will activate and POF LEDs will blink the code-indicating failure.
    - If after a 2 minute delay POF is established, compressors will be enabled.

3. If compressors(s) are running and the POF contact opens for 2 seconds during Cooling:
    - POF input will be ignored.
    - No alarm will be generated.

Low Suction Pressure Detection

1. If the Suction Pressure falls below the Low Suction Temperature Setpoint for longer than a minute, compressors will be disabled for 10 minutes.

2. If after the 10 minutes, the Suction Pressure is still below setpoint, then after one additional minute:
    - A Low Suction Pressure Alarm will be activated and the Status LEDs will blink a code indicating this alarm.
    - The compressors will be locked out until power is cycled.

3. If after the initial 10 minute disable period, the pressure has risen above setpoint, restart compressors and resume testing for a Low Suction Pressure condition.

4. If compressors run then run for 2 hours without falling below the Low Suction Temperature Setpoint, then all counters and timers are cleared.

5. If another Low Suction condition occurs within that 2 hour period:
   - A Low Suction Pressure Alarm will be activated and the Status LEDs will blink a code indicating this alarm.
   - The compressors will be locked out until power is cycled.

6. If multiple compressors are enabled to come back on simultaneously, a 2 second start-up delay is implemented to avoid a power surge.

Unsafe Suction Pressure Detection

If the Suction Pressure falls below the Unsafe Suction Pressure Setpoint for 5 seconds:

- Compressors will be locked out immediately.
- Power will need to be cycled to restart the unit.

Low Leaving Water Temperature

NOTE: This safety is only monitored in the Heat Mode.

1a. If the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint with 2 compressors on:
   - The 2nd compressor will stage off.
   - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
   - Compressor 2 will be locked out until the Leaving Water Temperature is 6˚ above setpoint.

1b. If the Leaving Water Temperature remains below setpoint after a 1 minute stage off delay:
   - The 1st compressor will stage off.
   - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
   - Compressor 1 and 2 will be locked out until the Leaving Water Temperature is 12˚ above setpoint.

2. If the Leaving Water Temperature falls below the Low Leaving Water Setpoint with only 1 compressor on:
   - The 1st compressor will stage off.
   - A Low Leaving Water Temperature Alarm will activate and LEDs will blink the code-indicating failure.
   - Compressor 1 will be locked out until the Leaving Water Temperature is 12˚ above setpoint.

Head Pressure Control and Alarms

Head Pressure Control

The VCB-X EM1 Expansion Module can monitor a Head Pressure Transducer(s) and control a Condenser Fan(s) or a Condenser Water Valve(s) to maintain a Head Pressure Setpoint. The VCB-X Controller can be configured for an Air Cooled Condenser (default) or for a Water Cooled Condenser.

If there are two head pressure transducers being monitored to control one condenser fan/valve, then control will be based on the highest of the two transducer readings. For this operation, one condenser relay should be configured.

If there are two head pressure transducers being monitored to control two condenser fans/valves, then each transducer will control its respective condenser fan/valve. For this operation, two condenser relays should be configured.

A Condenser Relay is commanded on when the first compressor is enabled (except if the unit is in Heat Pump Defrost Mode). On an Air Cooled Unit, the Condenser Fan will be controlled with 0-10 VDC output signal or a PWM output signal. Both outputs operate simultaneously. On a Water Cooled Unit, the Condenser Water Valve will be controlled with a 2-10 VDC output signal.

When the Condenser Signal first activates, it maintains at 50% for 30 seconds on an Air Cooled Unit and at 75% for 3 minutes on a Water Cooled Unit.

In the Cooling Mode, the Condenser Signal will modulate to maintain the Cooling Head Pressure Setpoint. For an Air Cooled Unit, the signal can modulate between 15% and 100%. For a Water Cooled Unit, the signal can modulate between 25% and 100%. If the Head Pressure exceeds 550 PSIG, the condenser control signal will immediately go to 100% and a High Head Pressure Alarm will be generated. The alarm will be deactivated when the Head Pressure drops below 540 PSIG.

In the Dehumidification Mode, the Condenser Output Signal controls to the Reheat Head Pressure Setpoint. High Head Pressure conditions produce the same effects as in the Cooling Mode.

In Heat Pump Heating Mode, the Condenser Output Signal will be 100%. In the Defrost Mode the signal will be 0%. There is no Defrost required in a Water Cooled Unit.

If no Head Pressure Sensor is detected, the Condenser Output Signal will be maintained at 100%. When the unit is off, the Condenser Output Signal will be 0%

Temperature Protection

Temperature Protection is activated when the Supply Air Temperature (SAT) rises above the High Cutoff Temperature (immediate) or drops below the Low Cutoff Temperature (for 10 minutes). In either case, an alarm will be created. Both cutoff setpoints are user-adjustable. This mode shuts off the unit (with a 3 minute fan off delay) until the mode is cancelled.

This mode is cancelled when the SAT drops 5 degrees below the High Cutoff Temperature Setpoint or rises 5 degrees above the Low Temp Cutoff Temperature Setpoint or when the unit changes back into Occupied Operation.

On non-MUA units, if the Supply Air Temperature falls 5º below the Low Supply Air Temperature Cutoff, the Outdoor Air Damper will fully close in an attempt to the Supply Air Temperature up before the 10 minute cutoff occurs.

Outdoor Air Lockouts

The compressors are disabled during Cooling Mode when the Outdoor Air Temperature is below the Compressor Cooling Lockout Setpoint.

Mechanical heating is disabled when the Outdoor Air Temperature is above the Heating Lockout Setpoint.

For Air to Air Heat Pumps, the compressors are disabled during Heating Mode when the Outdoor Air Temperature is below the Compressor Heating Lockout Setpoint.

System Broadcasts

An Outdoor Air Temperature Sensor reading is broadcast from any one VCB-X Controller to any controller that does not have an Outdoor Air Temperature Sensor.

Alarm Detection and Reporting

The VCB-X Controller continuously performs self diagnostics during normal operation to determine if any operating failures have occurred.

These failures (alarms) can be reported to a Touch Screen System Manager, a Hand Held Modular Service Tool, or to a computer running Prism 2 software.

Diagnostic LEDs on the VCB-X controller will generate “blink codes” for certain alarm conditions.

The following are the available alarm designations for the VCB-X Controller:

Bad SAT Sensor
Bad OAT Sensor
Bad Space Sensor
Missing Main Exp Board
Missing Co2 Sensor
Bad Compressor Discharge Sensor
Missing Suction Pressure Sensor
Missing Outdoor Airflow Sensor
Missing Exhaust Airflow Sensor
Missing Supply Air Airflow Sensor
Missing Return Air Airflow Sensor
Missing MHGRV-X Board
Missing MODGAS-X Board
Missing 12RLY Board

Mech Cooling Failure
Mech Heating Failure
Fan Proving Alarm
Dirty Filter Alarm
Emergency Shutdown
High Supply Air Temperature Cutoff
Low Supply Air Temperature Cutoff
High Control Temp
Low Control Temp
Digital Compressor Cutoff
Digital Compressor Lockout
High Head Pressure
WSHP Proof of Flow Failure
Low Suction Pressure
Unsafe Suction Pressure
WSHP Low Water Temperature

Sensor Failure Alarms

Supply Air Temperature Sensor Failure Alarm

The Supply Air Temperature Sensor Failure Alarm is generated when the controller detects an open or short circuit on the Supply Air Temperature Sensor input. Once the alarm is generated, the unit will be completely shut down. If a sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will restart operations.

Space Temperature Sensor Failure Alarm

If the Space Sensor is configured as the Controlling Sensor (Mode Enable Sensor) or as the Reset Sensor, and if the controller detects an open or short circuit on the Space Sensor input, then a Space Temperature Sensor Failure Alarm is generated. If the Space Sensor is configured as the Controlling Sensor and the Failure Alarm is generated, the unit will shut down. If the Space Sensor is only configured as a Reset Sensor and the Failure Alarm is generated, the Space Temperature will default to a value half way between the Heating and Cooling Mode Enable Setpoints, and the unit will continue to run.

Outdoor Air Temperature Sensor Failure Alarm

The Outdoor Air Temperature Sensor Failure Alarm is generated when the controller detects an open or short circuit on the Outdoor Air Temperature Sensor input. When this occurs, the Outdoor Air reading will be artificially set to the half point between the Cooling and Heating Lockout Setpoints. This will allow the cooling and the heating to continue operating.

CO_2 Sensor Failure Alarm

This alarm is generated if the controller is configured to have a CO_2 sensor, but does not detect it. IAQ Mode is disabled when this occurs. If a sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will be return to CO_2 control

Compressor Discharge Sensor Failure Alarm

This alarm is generated if the unit is configured to have a digital scroll compressor, but the Digital Compressor Discharge Temperature Sensor is not detected or if shorted.

Suction Pressure Sensor Failure Alarm

If the controller detects the Suction Pressure Sensor is missing, this alarm is generated and the unit will shut down. If the sensor is properly detected after the unit has alarmed, the alarm will be cleared and the unit will restart.

Airflow Alarms

Outdoor Airflow Sensor Alarm
Supply Airflow Sensor Alarm
Return Airflow Sensor Alarm
Exhaust Airflow Sensor Alarm

If the controller is configured to have any of the above air flow sensors, but the controller does not detect that the sensor is connected, then the applicable alarm will occur. If the sensor is properly detected after the unit has alarmed, the alarm will be cleared.

Missing Expansion Module Alarm

Main Expansion Missing
EM2 Expansion Missing
Reheat Board Missing
ModGas Board Missing
12 Relay Board Missing
Preheat-X Controller Missing

If the controller is configured to have any of the above Expansion Boards (Modules), but the controller does not detect that board, then the applicable alarm will occur. If the board is properly detected after the unit has alarmed, the alarm will be cleared.

Mechanical Failure Alarms

Mechanical Cooling Failure

The Mechanical Cooling Failure Alarm is generated if the Supply Air Temperature fails to drop 5 degrees (within a user-adjustable time period) from the temperature the supply air was at when the cooling was activated. The alarm will be cleared when the Supply Air Temperature drops the 5 degrees and sets the failure timer back to zero. This alarm does not apply for Modulating Cooling.

Mechanical Heating Failure

The Mechanical Heating Failure Alarm is generated if the Supply Air Temperature fails to rise 5 degrees (within a user-adjustable time period) from the temperature the supply air was at when the heating was activated. The alarm will be cleared when the Supply Air Temperature rises the 5 degrees and sets the failure timer back to zero. This alarm does not apply for Modulating Heating.

Alarms

Proof of Flow Interlock Alarm

A Proof of Flow switch (by others) provides a 24 VAC wet contact closure when the Supply Fan is operating. If this contact opens while the fan is being called to run, all heating and cooling is disabled, the Outdoor Air Damper closes, and a Fan Proving Alarm is generated. Fan Proving needs to be configured for this alarm to occur.

Dirty Filter Alarm

A differential pressure switch (by others) is used to provide a 24 VAC wet contact closure to indicate a dirty filter status. A Dirty Filter Alarm is then generated. Dirty Filter needs to be configured for this alarm to occur.

Emergency Shutdown Alarm

A 24 VAC wet contact input is available to be used when a N.C. Smoke Detector, Firestat, or other shutdown condition occurs. If this contact opens, it will initiate shutdown of the VCB-X and will generate an alarm condition. This contact closure does not produce an instantaneous shutdown. Emergency Shutdown needs to be configured for this alarm to occur.

Failure Mode Alarms

High and Low Supply Temp Alarm

These alarms are activated when the Supply Air Temperature (SAT) rises above the High Cutoff Temperature Setpoint (immediate) or drops below the Low Cutoff Temperature Setpoint (for 10 minutes). Both cutoff setpoints are user-adjustable. This mode shuts off the unit (with a 3 minute fan off delay) until the mode is cancelled.

This mode is cancelled when the SAT drops 5 degrees below the High Cutoff Temperature Setpoint or rises 5 degrees above the Low Temp Cutoff Temperature Setpoint, or when the unit changes back into Occupied Operation.

On non-MUA units, if the Supply Air Temperature falls 5º below the Low Supply Air Temperature Cutoff, the Outdoor Air Damper will fully close in an attempt to the Supply Air Temperature up before the 10 minute cutoff occurs.

High and Low Control Temp Failure

When the Controlling Sensor Temperature rises above the Cooling Mode Enable Setpoint plus the Control Mode High Alarm Offset setpoint, the controller will generate a High Control Temp Failure Alarm.

When the Controlling Sensor Temperature drops below the Heating Mode Enable Setpoint minus the Control Mode Low Alarm Offset setpoint, the controller will generate a Low Control Temp Failure Alarm.

Both offset setpoints are user-adjustable.

Digital Compressor Cutoff Alarm

If the digital compressor discharge temperature rises above 268˚F (131.11˚C) or the sensor is shorted (which will read a temperature of 300˚F (148.88˚C)), this alarm will be generated.

The alarm is removed when the compressor discharge temperature drops below 250˚F (121.11˚C). Once the compressor is shut off, it remains off for 30 minutes.

Digital Compressor Lockout Alarm

If a total of 5 Digital Compressor High Temperature Cutoffs have occurred within four hours, the VCB-X Controller will lock out the digital compressor and this alarm will be generated. The ALERT LED will continually flash 6 times to signal the lockout. The lockout can only be reset by cycling the 24VAC power off and on to the controller.

If the unit runs for 60 minutes without a digital compressor discharge temperature alarm, then the counter is reset to zero.

High Head Pressure Alarm

If the Head Pressure exceeds an acceptable limit, this alarm will be generated. The alarm will be cleared if the Head Pressure falls back within acceptable limits.

WSHP Proof of Flow Alarm

On a Water Source Heat Pump unit, if water flow is not proven within a certain time limit, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Low Suction Pressure Alarm

On a Water Source Heat Pump unit, if the Suction Pressure falls below the Low Suction Pressure Setpoint, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Unsafe Suction Pressure Alarm

On a Water Source Heat Pump unit, if the Suction Pressure falls below the Unsafe Suction Pressure Setpoint, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

WSHP Low Leaving Water Temperature Alarm

On a Water Source Heat Pump unit, if the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint while in the Heating Mode, this alarm will be generated. This alarm condition will disable the compressor(s) or prevent activation of compressor(s).

Title 24 Economizer Alarms

Economizer Temperature Sensor Failure

Outside Air or Supply Air Temperature Sensor is shorted or missing.

Economizer Not Economizing When it Should

Economizer is enabled but not following the desired Economizer position commanded.

Economizer Is Economizing When It Should Not

Economizer is not enabled but the feedback signal indicates a position more open than the minimum.

Economizer Damper Not Modulating

Economizer is enabled but not within 10% of desired position within 150 seconds.

Economizer Excess Outdoor Air Filter

Economizer feedback is lost or Economizer is not following commanded position.

Relay Outputs

There are 5 relay outputs that are configurable for the VCB-X Controller (Relay #1 is reserved for the Supply Fan and is not configurable). See **Table 5** for descriptions of the configuration options.

Trend Logging

The VCB-X Controller continuously maintains an Internal Trend Log in memory which records a fixed set of values at a user-defined interval.

120 log positions (timed retrievals) are available on the controller. Once these positions are full, the controller begins overwriting the oldest data.

Values can be retrieved using the Prism 2 graphical front-end software program. With Prism 2 running continuously, values can be saved to the computer hard drive at regular intervals to keep from losing data.

The following are the fixed items that can be logged:

Date
Time
Mode of Op (Occupied / Override / Unoccupied)
HVAC Mode
Space Temperature
Indoor Humidity
Active Cooling Mode Setpoint
Active Heating Mode Setpoint
Supply Air Temperature
Supply Air Temperature Setpoint
Digital Compressor Discharge Temperature
Return Air Temperature
Leaving Water Temperature
Outdoor Air Temperature
Outdoor Air Humidity
Outdoor Air Dewpoint
IAQ Mode Active (0-No, 1=Yes)
CO_2
Head Pressure 1 Status
Head Pressure 2 Status
Head Pressure Setpoint
Condenser Fan 1 Status
Condenser Fan 2 Status
Outdoor Air CFM
Supply Air CFM
Return Air CFM
Exhaust CFM
Building Pressure
Building Pressure Relief VFD Signal
Duct Static Pressure
Main Fan Speed VFD Signal
Economizer Signal Percentage
Economizer Position
Modulating Cool Signal - (Digital Compressor)
Modulating Heat Signal
Reheat Signal
MODGAS Valve Position
Suction Pressure
Coil Temperature
Coil Temperature Setpoint
Binary Inputs (1=Emergency, 2=Proof of Flow, 4=Dirty Filter, 8=Defrost, 16=Hood On, 32=Remote Occupied, 64=Water POF)
Main Fan Status
Relay Outputs Status

LED Diagnostics

Using VCB-X LEDs To Verify Operation

The VCB-X Controller is equipped with LEDs that can be used to verify operation and perform troubleshooting. There are LEDs for communication, operation modes, and diagnostic codes. The VCB-X Controller has 23 LEDs—11 used for operation & status, and 6 used for relays, 2 used for Digital Compressor operation, and 4 used for binary inputs. See **Figure 42** for the LED locations. The LEDs associated with these inputs and outputs allow you to see what is active without using a voltmeter. The LEDs and their uses are as follows:

① Operation LEDs - Factory Troubleshooting

POWER - This green LED will light up to indicate that 24 VAC power has been applied to the controller.

APP HB - This green LED will light up and blink continuously to indicate the application software is working properly.

OS HB - This green LED will light up and blink continuously to indicate the operating system is working properly.

WDOG - This green LED will light up and stay lit to indicate the operating system is working properly.

② Diagnostic LEDs

ALARM - This red LED is a diagnostic blink code LED. It will light up and stay lit when there is an alarm present. The type of alarm will display on the LCD display.

STATUS 1 - This red LED is a diagnostic blink code LED. It will light up and blink out diagnostic codes. STATUS 1 LED also represents the tens column in the address blink code. See **Table 6** for Status Blink Code code descriptions. The blink code descriptions are also located on the Controller's front cover.

STATUS 2 - This red LED is a diagnostic blink code LED. It will light up and blink out diagnostic codes. STATUS 2 LED also represents the ones column in the address blink code. See **Table 6** for Status Blink Code code descriptions. The blink code descriptions are also located on the Controller's front cover.

③ Communication LEDs

EBUS - This yellow LED will blink to signal E-BUS communications.

LOOP COMM - This yellow LED will light up and blink continuously to indicate the VCB-X Controller is communicating.

BACNET - This yellow LED will light up and blink continuously to indicate BACnet communications.

④ Compressor LEDs

ALERT - This red LED will light up and blink a code to indicate why the digital scroll compressor is not working properly.

UNLOAD - This green LED will light up and blink continuously when the digital scroll compressor is in cooling mode.

⑤ Relay LEDs

RLY1 - This green LED will light up when the Supply Fan is enabled and will stay lit as long as the Supply Fan is active.

RLY2 - This green LED will light up when Relay 2 is enabled and will stay lit as long as Relay 2 is active.

RLY3 - This green LED will light up when Relay 3 is enabled and will stay lit as long as Relay 3 is active.

RLY4 - This green LED will light up when Relay 4 is enabled and will stay lit as long as Relay 4 is active.

RLY5 - This green LED will light up when Relay 5 is enabled and will stay lit as long as Relay 5 is active.

RLY6 - This green LED will light up when Relay 6 is enabled and will stay lit as long as Relay 6 is active.

⑥ Binary Input LEDs

BIN1 - This green LED will light up when the Emergency Shutdown contact is closed.

BIN2 - This green LED will light up when the Proof of Flow switch is closed.

BIN3 - This green LED will light up when the Dirty Filter switch is closed.

BIN4 - This green LED will light up when the Defrost Coil Temperature switch is closed.

VCB-X EM1 Expansion Module LEDs

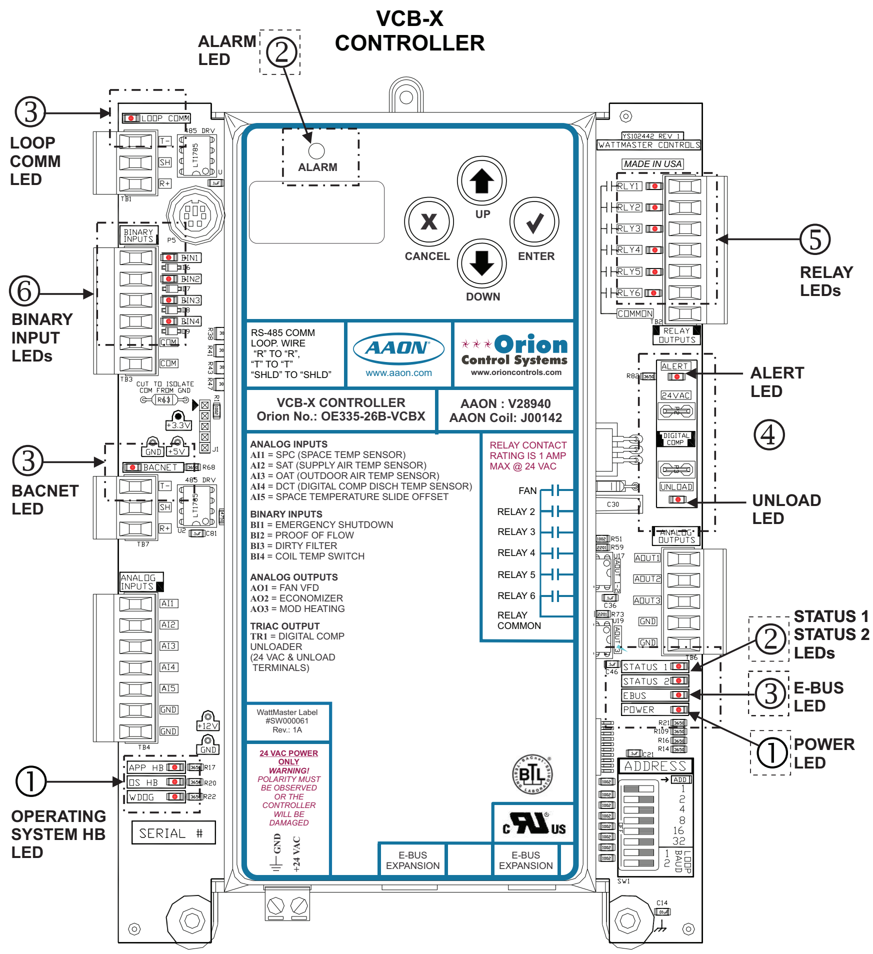
The VCB-X EM1 Expansion Module is equipped with 4 LEDs that can be used as very powerful troubleshooting tools. See **Figure 42** for LED locations. The LEDs and their uses are as follows:

PWR - This LED will light up to indicate that 24 VAC power has been applied to the controller.

ALARM - If the module does not receive communications for more than 1 minute, this LED will light up, the relays will turn off, and the Analog Outputs will go to 0 VDC.

STAT - If the software is running, this LED should blink at a rate of 1 blink per second.

COMM - Every time the module receives a valid E-BUS request from the VCB-X Controller, this LED will blink on and then off, signifying that it received a valid request and responded.



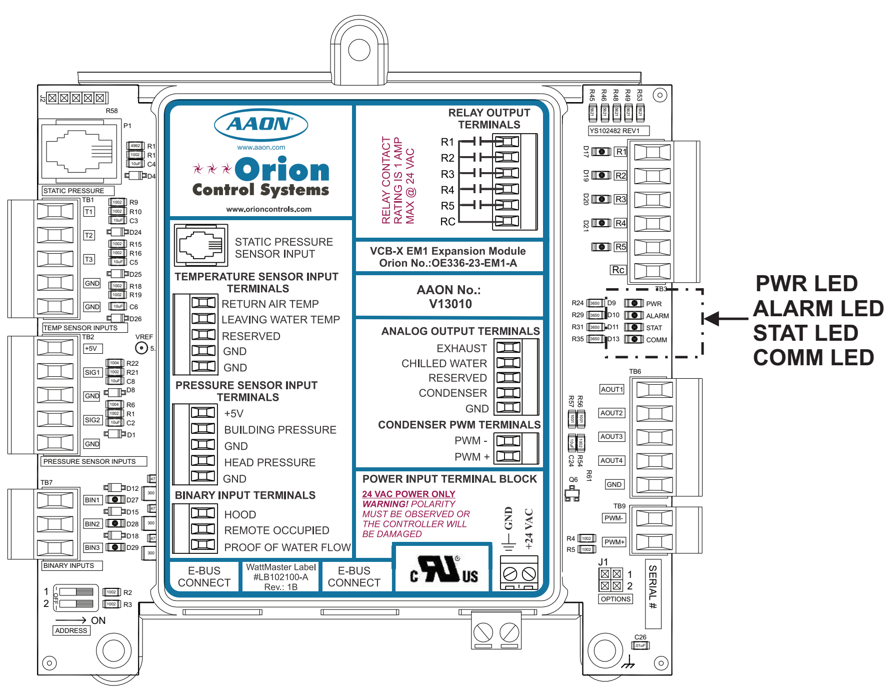


Figure 42: VCB-X Controller & VCB-X EM1 Expansion Module LED Locations

Diagnostic LED Operation

POWER LED Operation

When the VCB-X Controller is first powered up, the POWER LED should light up and stay on continuously. If it does not light up, check to be sure that you have 24 VAC connected to the controller, that the wiring connections are tight, and that they are wired for the correct polarity. The 24 VAC power must be connected so that all ground wires remain common. If after making all these checks, the POWER LED does not light up, please contact WattMaster Controls Technical Support for assistance.

Diagnostic LED Operation

When power is first applied, the STATUS 1 and STATUS 2 LEDs will be off for 1 second. At this time, both LEDs will blink to indicate the setting of the address switch and then will extinguish for 5 seconds. Verify that the address switch setting is correct by counting the number of blinks.

If the address switch is not correct, first remove the communication loop terminal plug from the controller and then from the power terminal plug. Set the address dip switches correctly. See **Figure 41** for correct address switch setting instructions. After you are sure the address switch setting is correct, first reconnect the power connection and then reconnect the communication loop connection to the controller.

NOTE: You must always cycle power to the Controller being addressed after changing address switch settings in order for the changes to take effect.

Reapply power to the controller and observe the blink code to verify the address is set correctly. If the STATUS 1 and STATUS 2 LEDs now blink the correct address, your controller is addressed correctly. If they don't light up at all, the controller is not operating correctly and could be defective. Once the controller is done blinking the address, the LEDs will blink a code every 10 seconds to indicate controller status. If all of these tests are made and the controller still doesn't operate, please contact WattMaster Controls Technical Support at 866-918-1100.

The Blink Code Descriptions in **Table 6** cover multiple alarm conditions. You will need to use one of the Orion Interface Tools to determine the specific alarm condition. See the Alarm descriptions on pages 66 through 68 for further details.

Blink Code Description	STATUS 1 LED Blinks	STATUS 2 LED Blinks
NORMAL OPERATION	0	1
SUPPLY AIR SENSOR FAILURE	1	2
OUTDOOR AIR SENSOR FAILURE	2	2
SPACE SENSOR FAILURE	3	2
MISSING EXPANSION MODULE*	4	2
CO2 SENSOR FAILURE	6	2
AIRFLOW SENSOR FAILURE*	7	2
MECHANICAL COOLING FAILURE	1	3
MECHANICAL HEATING FAILURE	2	3
FAN PROVING FAILURE	3	3
DIRTY FILTER ALARM	4	3
EMERGENCY SHUTDOWN	5	3
ECONOMIZER TITLE 24 ALARM	6	3
LOW SUPPLY TEMP ALARM	1	4
HIGH SUPPLY TEMP ALARM	2	4
CONTROL TEMP HI ALARM	3	4
CONTROL TEMP LOW ALARM	4	4
HIGH HEAD PRESSURE	5	4
WATER PROOF FAILURE	6	4
SUCTION PRESSURE ALARM*	7	4
LOW LEAVING WATER TEMP	8	4
PUSH BUTTON OVERRIDE	1	5
OUTPUT FORCE ACTIVE	0	6
* MISSING EXP. MODULE – INCLUDES MULTIPLE MODULES AIRFLOW SENSOR FAILURE – INCLUDES MULTIPLE AIRFLOW SENSORS SUCTION PRESSURE ALARM – INCLUDES SUCTION PRESSURE SENSOR FAILURE ALARM, LOW SUCTION PRESSURE ALARM, AND UNSAFE SUCTION PRESSURE ALARM		

Table 6: Diagnostic LED Blink Code Interpretation

Digital Compressor LED Operation

UNLOAD LED

Any time there is a signal going to the Digital Compressor Unloader Solenoid Valve the Unload LED will be on.

ALERT LED

The ALERT LED will blink the alarm codes for the digital compressor. See **Table 7**.

Blink Code Description	ALERT LED Blinks
NORMAL OPERATION	0
MISSING DISCHARGE SENSOR	1
HIGH TEMPERATURE CUTOFF TIMEOUT PERIOD (30 MINUTES)	3
HIGH DISCHARGE TEMPERATURE CUTOFF	4
COMPRESSOR LOCKED OUT	6

Table 7: ALERT LED Blink Code Interpretation

System Configuration Options

The VCB-X Controller can be used as a Stand-Alone System (one VCB-X Controller only), connected together on an Interconnected System (multiple VCB-X Controllers only) or connected together on a Network System (multiple VCB-X Controllers, VAV/Zone Controllers, or Add-On Controllers) to form a complete Controls System that can be programmed and monitored with one or more of the available Operator Interfaces.

Operator Interfaces

The Operator Interfaces are designed to provide for programming and monitoring of VCB-X Controller(s) and/or any VAV/Zone or Add-on Controller(s) connected to your System. See **Figure 43**. The available Operator Interfaces are as follows:

- Modular Service Tool SD (OE391-12)
- Modular System Manager SD (OE392-12)
- System Manager Touch Screen II (OE392-10)
- Personal Computer with Prism 2 Computer Front End Software Installed and CommLink 5

You can use any one of these interfaces or all of them on the same VCB-X Control System.

Stand-Alone System

The Stand-Alone System is used when you have a single VCB-X Controller only. Programming and status monitoring are accomplished by selecting and installing one or more of the Operator Interfaces.

See **Figure 44** for a Typical Stand-Alone System Layout diagram.

Interconnected System

The Interconnected System is used when you have multiple VCB-X Controllers on your job. With this system, you simply connect the controllers together using WattMaster communications wire or 18-gauge, 2-conductor twisted pair with shield wire (Belden #82760 or equivalent). This allows for all controllers that are connected on the communications loop to be programmed and monitored from one or more of the available Operator Interfaces connected on the communications loop.

See **Figure 45** for a Typical Interconnected System Layout diagram.

Networked System

If you have 1 to 59 VCB-X Controllers that require information sharing, simply connect the controllers together using WattMaster communications wire or 18-gauge, 2-conductor twisted pair with shield wire (Belden #82760 or equivalent). The Networked Single Loop System requires that either a MiniLink PD communication interface and/or CommLink communication interface are purchased and wired into the communications loop in a similar manner to the VCB-X Controllers.

The Networked Multiple Loop system is used when you have more than 59 VCB-X Controllers and/or are using multiple VCB-X Controllers that are connected to VAV/Zone controllers. These groups of controllers are broken up into multiple “Local Loops” that connect to each other via the “Network Loop.” Each individual MiniLink PD handles its specific local loop’s communications requirements. The CommLink communications interface handles all the communications between the individual MiniLink PDs to form the network loop. Up to 60 local loops can be connected together with this configuration. This provides the capability for over 3500 controllers to be networked together.

See **Figure 46** for a Typical Networked System Layout diagram.

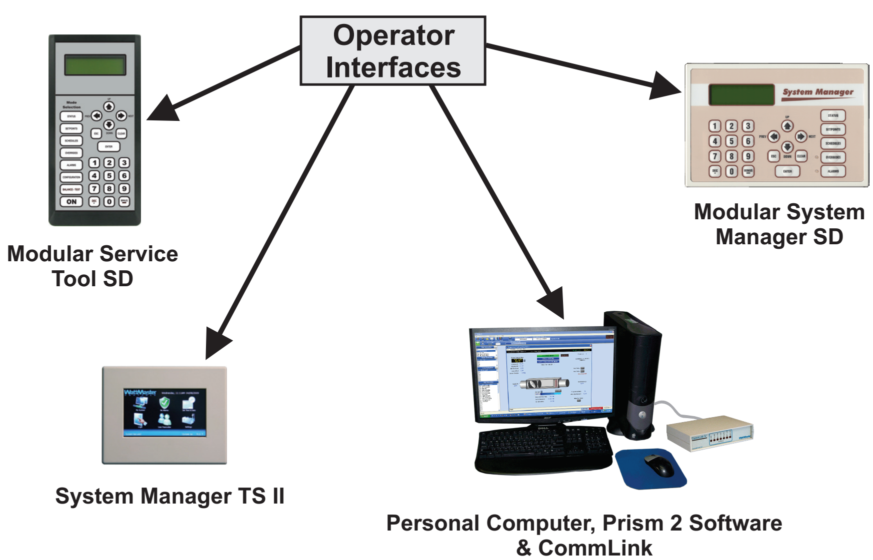


Figure 43: Available Operator Interfaces

Stand-Alone System Layout

Figure 44: Typical Stand-Alone System Layout

Interconnected System Layout

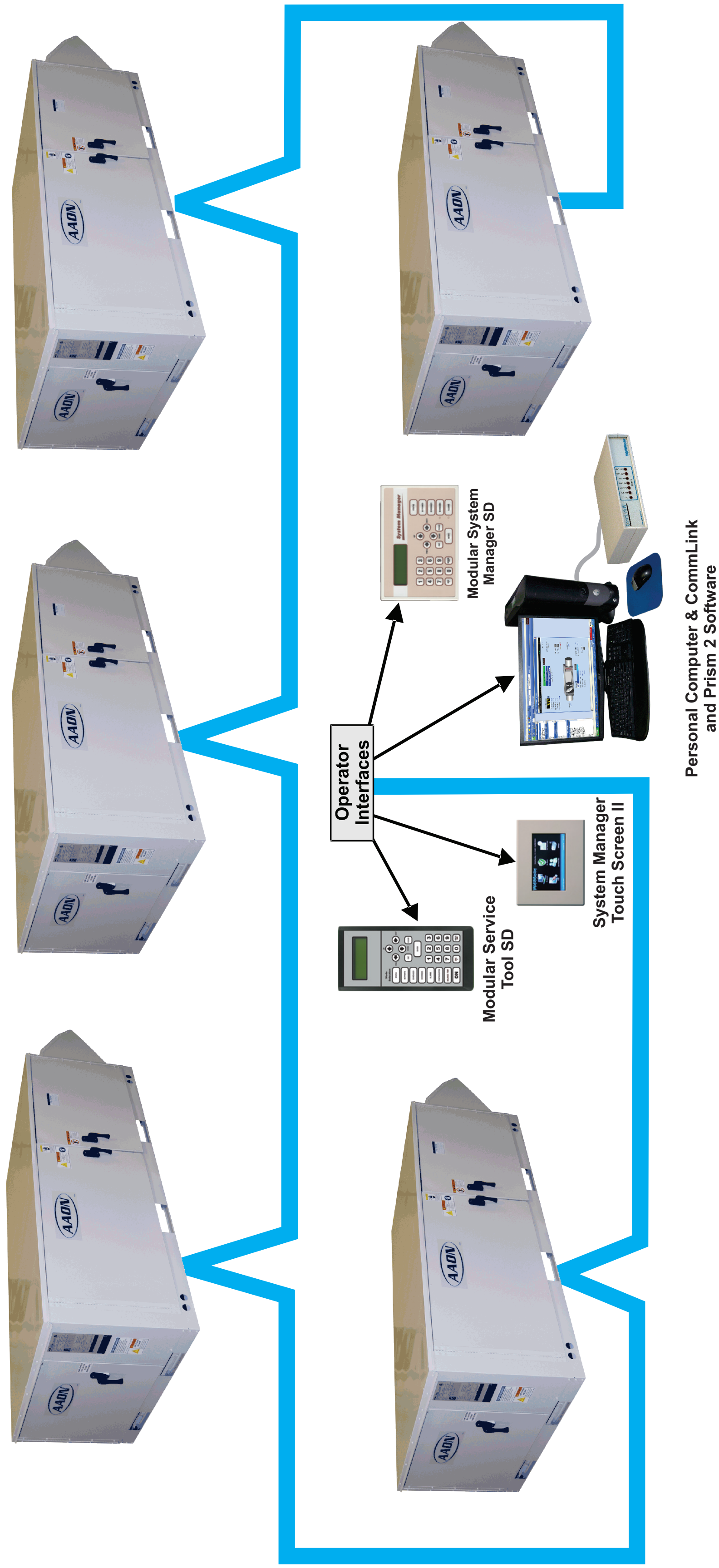


Figure 45: Typical Interconnected System Layout

Networked System Layout

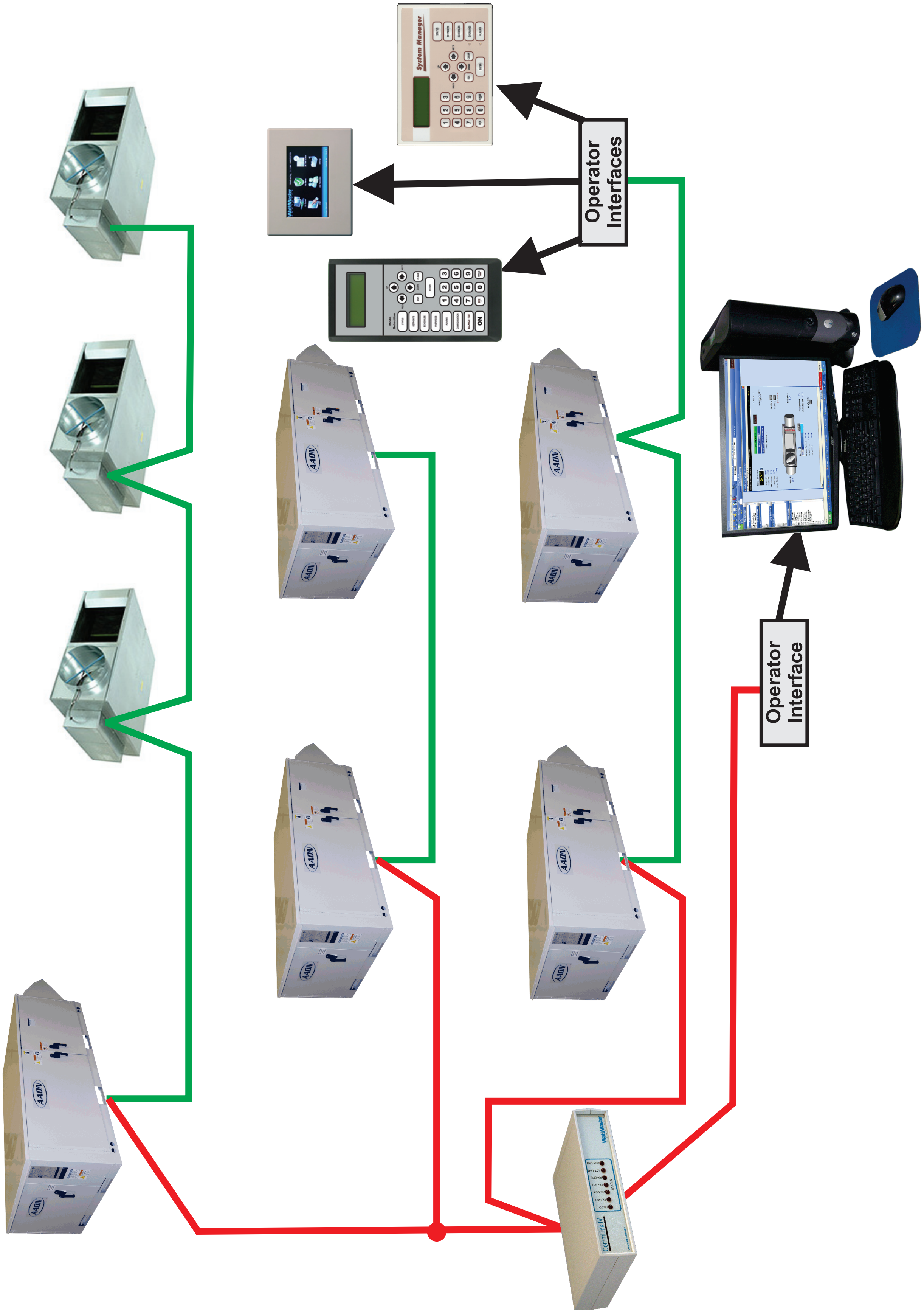


Figure 46: Typical Networked System Layout

Space, Outdoor Air or Return Air Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the tables. Please follow the notes and instructions that appear after the chart when checking sensors.

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51
-5	-20.55	80531	4.45
0	-17.77	69822	4.37
5	-15	60552	4.29
10	-12.22	52500	4.2
15	-9.44	45902	4.1
20	-6.66	40147	4.002
25	-3.88	35165	3.891
30	-1.11	30805	3.773
35	1.66	27140	3.651
40	4.44	23874	3.522
45	7.22	21094	3.39
50	10	18655	3.252
52	11.11	17799	3.199
54	12.22	16956	3.143
56	13.33	16164	3.087
58	14.44	15385	3.029
60	15.55	14681	2.972
62	16.66	14014	2.916
64	17.77	13382	2.861
66	18.88	12758	2.802
68	20	12191	2.746
69	20.55	11906	2.717
70	21.11	11652	2.691
71	21.66	11379	2.661
72	22.22	11136	2.635
73	22.77	10878	2.605

Table 8: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
74	23.33	10625	2.576
75	23.88	10398	2.549
76	24.44	10158	2.52
77	25	10000	2.5
78	25.55	9711	2.464
80	26.66	9302	2.41
82	27.77	8893	2.354
84	28.88	8514	2.3
86	30	8153	2.246
88	31.11	7805	2.192
90	32.22	7472	2.139
95	35	6716	2.009
100	37.77	6047	1.884
105	40.55	5453	1.765
110	43.33	4923	1.65
115	46.11	4449	1.54
120	48.88	4030	1.436
125	51.66	3656	1.339
130	54.44	3317	1.246
135	57.22	3015	1.159
140	60	2743	1.077
145	62.77	2502	1.001
150	65.55	2288	0.931

Table 8, cont.: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.88 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

Copeland® Discharge Thermistor Temperature Sensor Testing

Copeland® Discharge Thermistor Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the table. Please follow the notes and instructions the appear after the chart when checking sensors.

Discharge Thermistor Temperature/ Resistance			
Temp (ºF)	Temp (ºC)	Resistance (K Ohms)	Voltage @ Input (VDC)
-40	-40	2889.60	4.98
-31	-35	2087.22	4.97
-22	-30	1522.20	4.96
-13	-25	1121.44	4.95
-4	-20	834.72	4.94
5	-15	627.28	4.92
14	-10	475.74	4.89
23	-5	363.99	4.86
32	0	280.82	4.82
41	5	218.41	4.77
50	10	171.17	4.72
59	15	135.14	4.65
68	20	107.44	4.57
77	25	86.00	4.47
86	30	69.28	4.36
95	35	56.16	4.24
104	40	45.81	4.10
113	45	37.58	3.94
122	50	30.99	3.77
131	55	25.68	3.59
140	60	21.40	3.40
149	65	17.91	3.20
158	70	15.07	3.00
167	75	12.73	2.80
176	80	10.79	2.59
185	85	9.20	2.39

Table 9: Discharge Thermistor Temperature/ Resistance

Discharge Thermistor Temperature/ Resistance			
Temp (ºF)	Temp (ºC)	Resistance (K Ohms)	Voltage @ Input (VDC)
194	90	7.87	2.19
203	95	6.77	2.01
212	100	5.85	1.84
221	105	5.09	1.68
230	110	4.45	1.53
239	115	3.87	1.39
248	120	3.35	1.25
257	125	2.92	1.12
266	130	2.58	1.02
275	135	2.28	0.92
284	140	2.02	0.83
293	145	1.80	0.76
302	150	1.59	0.68
311	155	1.39	0.61
320	160	1.25	0.55
329	165	1.12	0.50
338	170	1.01	0.45
347	175	0.92	0.42
356	180	0.83	0.38

Table 9, cont.: Discharge Thermistor Temperature/ Resistance

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.98 VDC, then the sensor or wiring is "open." If the voltage is less than 0.38 VDC, then the sensor or wiring is shorted.

OE271 Pressure Sensor Testing

The table below is used to troubleshoot the OE271 Duct Static Pressure Sensors.

OE271 Duct Static Pressure Sensor			
Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)
0.00	0.25	2.60	2.33
0.10	0.33	2.70	2.41
0.20	0.41	2.80	2.49
0.30	0.49	2.90	2.57
0.40	0.57	3.00	2.65
0.50	0.65	3.10	2.73
0.60	0.73	3.20	2.81
0.70	0.81	3.30	2.89
0.80	0.89	3.40	2.97
0.90	0.97	3.50	3.05
1.00	1.05	3.60	3.13
1.10	1.13	3.70	3.21
1.20	1.21	3.80	3.29
1.30	1.29	3.90	3.37
1.40	1.37	4.00	3.45
1.50	1.45	4.10	3.53
1.60	1.53	4.20	3.61
1.70	1.61	4.30	3.69
1.80	1.69	4.40	3.77
1.90	1.77	4.50	3.85
2.00	1.85	4.60	3.93
2.10	1.93	4.70	4.01
2.20	2.01	4.80	4.09
2.30	2.09	4.90	4.17
2.40	2.17	5.00	4.25
2.50	2.25		

Table 10: Duct Static Pressure/Voltage for OE271 Duct Static Pressure Sensors

OE271 Pressure Sensor Testing Instructions

Use the voltage column to check the Duct Static Pressure Sensor while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on the GND terminal and the "+" (plus) lead on the 0-5 pin terminal on (TP) with the jumper removed. Be sure to replace the jumper after checking.

OE258-01 Pressure Sensor Testing

The table below is used to troubleshoot the OE258-01 Building Pressure Sensors.

OE258-01 Building Pressure Sensor			
Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (" W.C.)	Voltage @ Input (VDC)
-0.25	0.00	0.01	2.60
-0.24	0.10	0.02	2.70
-0.23	0.20	0.03	2.80
-0.22	0.30	0.04	2.90
-0.21	0.40	0.05	3.00
-0.20	0.50	0.06	3.10
-0.19	0.60	0.07	3.20
-0.18	0.70	0.08	3.30
-0.17	0.80	0.09	3.40
-0.16	0.90	0.10	3.50
-0.15	1.00	0.11	3.60
-0.14	1.10	0.12	3.70
-0.13	1.20	0.13	3.80
-0.12	1.30	0.14	3.90
-0.11	1.40	0.15	4.00
-0.10	1.50	0.16	4.10
-0.09	1.60	0.17	4.20
-0.08	1.70	0.18	4.30
-0.07	1.80	0.19	4.40
-0.06	1.90	0.20	4.50
-0.05	2.00	0.21	4.60
-0.04	2.10	0.22	4.70
-0.03	2.20	0.23	4.80
-0.02	2.30	0.24	4.90
-0.01	2.40	0.25	5.00
0.00	2.50		

Table 11: Building Static Pressure/Voltage for OE258-01 Building Pressure Sensors

OE258-01 Building Pressure Sensor Testing Instructions

Use the voltage column to check the Building Static Pressure Sensor while connected to a powered expansion module. Read voltage with meter set on DC volts. Place the "-" (minus) lead on terminal labeled GND and the "+" lead on terminal AIN4 on the Analog Input/Output Expansion Module.

OE275-01 Suction Pressure Transducer Testing

OE275-01 Suction Pressure Transducer Testing for R410A Refrigerant

The Evaporator Coil Temperature is calculated by converting the Suction Pressure to Temperature. The Suction Pressure is obtained by using the OE275-01 Suction Pressure Transducer, which is connected into the Suction Line of the Compressor.

Use the voltage column to check the Suction Pressure Transducer while connected to the VCB-X Expansion Module. The VCB-X and the VCB-X Expansion Module must be powered for this test. Read voltage with a meter set on DC volts. Place the positive lead from the meter on the PR OUT terminal located on the VCB-X Expansion Module terminal block. Place the negative lead from the meter on the ground (GND) terminal located adjacent to the PR OUT terminal on the VCB-X Expansion Module terminal block. Use a refrigerant gauge set and/or an accurate electronic thermometer to measure the temperature or suction line pressure near where the Suction Pressure Transducer is connected to the suction line. Measure the Voltage at the terminals PR OUT and GND terminals and compare it to the appropriate chart depending on the refrigerant you are using. If the temperature/voltage or pressure/voltage readings do not align closely with the chart, your Suction Pressure Transducer is probably defective and will need to be replaced.

See the OE275-01 Suction Pressure Transducer, Pressure, Temperature, and Voltage Chart for R410A Refrigerant testing (**Table 12**). The charts show a temperature range from 20°F to 80°F. For troubleshooting purposes, the DC Voltage readings are also listed with their corresponding temperatures and pressures.

OE275-01 Suction Pressure Transducer Coil Pressure – Temperature – Voltage Chart for R410A Refrigerant					
Temperature °F	Pressure PSI	Signal DC Volts	Temperature °F	Pressure PSI	Signal DC Volts
21.19	80.94	1.8	59.03	168.10	3.2
24.49	87.16	1.9	61.17	174.32	3.3
27.80	93.39	2.0	63.19	180.55	3.4
30.99	99.62	2.1	65.21	186.78	3.5
33.89	105.84	2.2	67.23	193.00	3.6
36.80	112.07	2.3	69.24	199.23	3.7
39.71	118.29	2.4	71.15	205.46	3.8
42.30	124.52	2.5	72.95	211.68	3.9
44.85	130.75	2.6	74.76	217.91	4.0
47.39	136.97	2.7	76.57	224.14	4.1
49.94	143.2	2.8	78.37	230.36	4.2
52.23	149.42	2.9	80.18	236.59	4.3
54.50	155.65	3.0			
56.76	161.88	3.1			

Table 12: Coil Pressure/Voltage/Temp for OE275-01 Suction Pressure Transducers - R410A Refrigerant

Head Pressure Transducer Troubleshooting

If you suspect there is a problem related to head pressure transducer measurements, reference **Table 13** below.

Head Pressure Transducer Chart			
Voltage	**Pressure**	**Voltage**	**Pressure**
0.5	0	2.6	350
0.6	17	2.7	367
0.7	33	2.8	384
0.8	50	2.9	400
0.9	67	3.0	417
1.0	83	3.1	434
1.1	100	3.2	450
1.2	117	3.3	467
1.3	133	3.4	484
1.4	150	3.5	500
1.5	167	3.6	517
1.6	183	3.7	534
1.7	200	3.8	550
1.8	217	3.9	567
1.9	233	4.0	584
2.0	250	4.1	600
2.1	267	4.2	617
2.2	283	4.3	634
2.3	300	4.4	650
2.4	317	4.5	667
2.5	334		

Table 13: Head Pressure Transducer Chart

Navigation Keys

LCD Display Screen & Navigation Keys

The LCD display screens and buttons allow you to view status and alarms, enable force modes, and make BACnet® configuration changes. See **Figure 47** and refer to **Table 13** for descriptions.

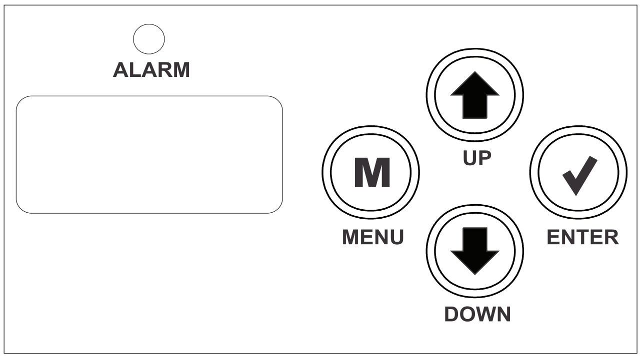


Figure 47: LCD Display and Navigation Keys

NAVIGATION KEY	KEY FUNCTION
MENU	Use the MENU key to move through screens within Main Menu categories and return to the Main Menu while at other screens.
UP	Use this key to adjust setpoints and change configurations.
DOWN	Use this key to adjust setpoints and change configurations.
ENTER	Use the ENTER key to navigate through the Main Menu Screen categories.

Table 14: Navigation Key Functions

Main Screens Map

Refer to the following map when navigating through the LCD Main Screens. The first screen is an initialization screen. To scroll through the rest of the screens, press the **<MENU>** button.

```
VCBX
VER X.XX
```

Press to go to Output Override Screens.

```
Output
Override
```

Press to scroll through the Output Override Screens.

Press to go to the Alarm Screens.

```
Alarms or
No Alarms
```

Press to scroll through the Alarm Screens.

Press to go to the Settings Screens.

```
Settings
```

Press to scroll through the Settings Screens.

Press to go to the Status Screens.

```
Status
```

Press to scroll through Status Screens.

Settings Screens

Refer to the following map when navigating through the Settings Screens. From the Settings Screen, press **<ENTER>** to scroll through the screens.

```
Settings
```

```
MAC Addr
1
```

BACnet® - CURRENT MAC ADDRESS

Valid range is 0 to 254. Default is 1.

```
DEVICEID
#######
```

BACnet® - CURRENT DEVICE ID

A Device ID of up to 7 digits can be entered.

The left and right arrow keys move the cursor between the digit fields. Once the cursor is under a field, use the up and down arrow keys to select a number between 0 and 9.

```
BaudRate
38400
```

BACnet® - CURRENT BAUD RATE

9600, 19200, 38400, 57600, 76800. Default is 38400.

```
EBUS
Hi Speed
```

E-BUS COMMUNICATIONS

Hi Speed or Lo Speed. Default is Hi Speed.

Status Screens

Refer to the following map when navigating through the Status Screens. From the Status Screen, press **<ENTER>** to scroll through the screens.

```
Status
```

```
FORCE OCC
OFF   MODE
```

MODE

This screen displays the current mode of operation of the VCB-X Controller. The mode options are:

LINE 1

- UNOCCUPY (Unoccupied)
- OCCUPIED
- OVERRIDE
- HOL UNOC (Holiday Unoccupied)
- HOL OCC (Holiday Occupied)
- FRC OCC (Force Occupied)
- FRC UNOC (Force Unoccupied)
- REM OCC (Remote Occupied)
- ZONE HEAT
- ZONE COOL
- ZONE OVR (Zone Override)

LINE 2

- OFF MODE
- VENT MODE
- COOL MODE
- HEAT MODE
- VENT RH
- COOL RH
- HEAT RH
- WARMUP
- DEFROST
- PURGE

```
Spc Temp
XX.X
```

SPACE TEMPERATURE

40ºF to 200ºF or 5ºC to 93ºC.

```
Spc RH
X.X %
```

SPACE HUMIDITY

```
Sat Temp
XX.X
```

SUPPLY AIR TEMPERATURE

40ºF to 200ºF or 5ºC to 93ºC.

```
Oat Temp
XX.X
```

OUTDOOR AIR TEMPERATURE

40ºF to 200ºF or 5ºC to 93ºC.

```
Oat RH
XX.X
```

OUTDOOR AIR TEMPERATURE HUMIDITY

Alarm Screens

If there are no Alarms, the Alarm Screen will display “No Alarms.” If there are alarms present, the screen will display, “Alarms.” You must press **<ENTER>** to scroll through the alarms. For alarm definitions and troubleshooting, see **pages 74-77**.

```
Alarms
```

Alarms

The screen will display the alarms as follows:

No Alarms

SAT SENSOR	See Supply Air Temperature Sensor Failure Alarm, page 75.
OAT SENSOR	See Outdoor Air Temperature Sensor Failure Alarm, page 75.
SPC SENSOR	See Space Temperature Sensor Failure Alarm, page 75.
MAIN EXP MISSING	See Missing Expansion Module Alarm, page 75.
SUCTION SENSOR	See Low Suction Pressure Sensor Alarm, page 76.
CO2 SENSOR	See CO_2 Sensor Failure Alarm, page 75.
COMP DISCHG	See Compressor Discharge Sensor Failure Alarm, page 75.
OAT CFM SENSOR	See Airflow Alarms, page 75.
EX CFM SENSOR	See Airflow Alarms, page 75.
SA CFM SENSOR	See Airflow Alarms, page 75.
RA CFM SENSOR	See Airflow Alarms, page 75.
REHEAT ALARM	See Missing Expansion Module Alarm - Reheat Board Missing, page 75.
MODGAS ALARM	See Missing Expansion Module Alarm - MODGAS Board Missing, page 75.
RLY EXP ALARM	See Missing Expansion Module Alarm, page 75.
COOLING FAILURE	See Mechanical Cooling Failure Alarm, page 75.
HEATING FAILURE	See Mechanical Heating Failure Alarm, page 75.
FAN POF FAILURE	See Proof of Flow Interlock Alarm, page 76.
DIRTY FILTER	See Dirty Filter Alarm, page 76.
EMERG SHUTDOWN	See Emergency Shutdown Alarm, page 76.
HI SAT ALARM	See High and Low Supply Temp Alarm, page 76.
LO SAT ALARM	See High and Low Supply Temp Alarm, page 76.
CONTROL TEMP HI	See High and Low Control Temp Failure, page 76.
CONTROL TEMP LO	See High and Low Control Temp Failure, page 76.
DIGITAL CUTOFF	See Digital Compressor Cutoff Alarm, page 76.
DIGITAL LOCKOUT	See Digital Compressor Lockout Alarm, page 76.
HIGH HEAD PRESSURE	See High Head Pressure Alarm, page 76.
NO WATER FLOW	See WSHP Proof of Flow Alarm, page 76.
LOW SUCTION	See Low Suction Pressure Alarm, page 76.
UNSAFE SUCTION	See Unsafe Suction Pressure Alarm, page 76.
LOW WATER TEMP	See WSHP Low Leaving Water Temperature Alarm, page 76.
ECONO TITLE 24	See Title 24 Economizer Alarms, pages 76-77.
????? ALARMS	This screen should never display. But if it does, it means the controller doesn’t know what the alarm is.

Output Override Screens

Refer to the following map when navigating through the Output Override Screens. From the *Output Override Screen*, press **<ENTER>**.

```
Output
Override
```

```
Relay #1-6
ON, OFF, AUTO
```

VCB-X CONTROLLER RELAYS 1-6

Press the **<UP>** button to change the value.
Default is AUTO.

```
Unloader
ON, OFF, AUTO
```

Press the **<UP>** button to change the value.
Default is AUTO.

```
ExpRly 1-5
ON, OFF, AUTO
```

VCB-X EM1 EXPANSION RELAYS 1-5

Press the **<UP>** button to change the value.
Default is AUTO.

```
Fan VFD
-1.0, 0.0-10.0
vdc
```

SUPPLY FAN VFD

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

```
Econo
-1.0, 0.0-10.0
vdc
```

ECONOMIZER VFD

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

```
Heating
-1.0, 0.0-10.0
vdc
```

MODULATING HEATING

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

```
Condense
-1.0, 0.0-10.0
vdc
```

MODULATING CONDENSER

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

```
Cooling
-1.0, 0.0-10.0
vdc
```

MODULATING COOLING

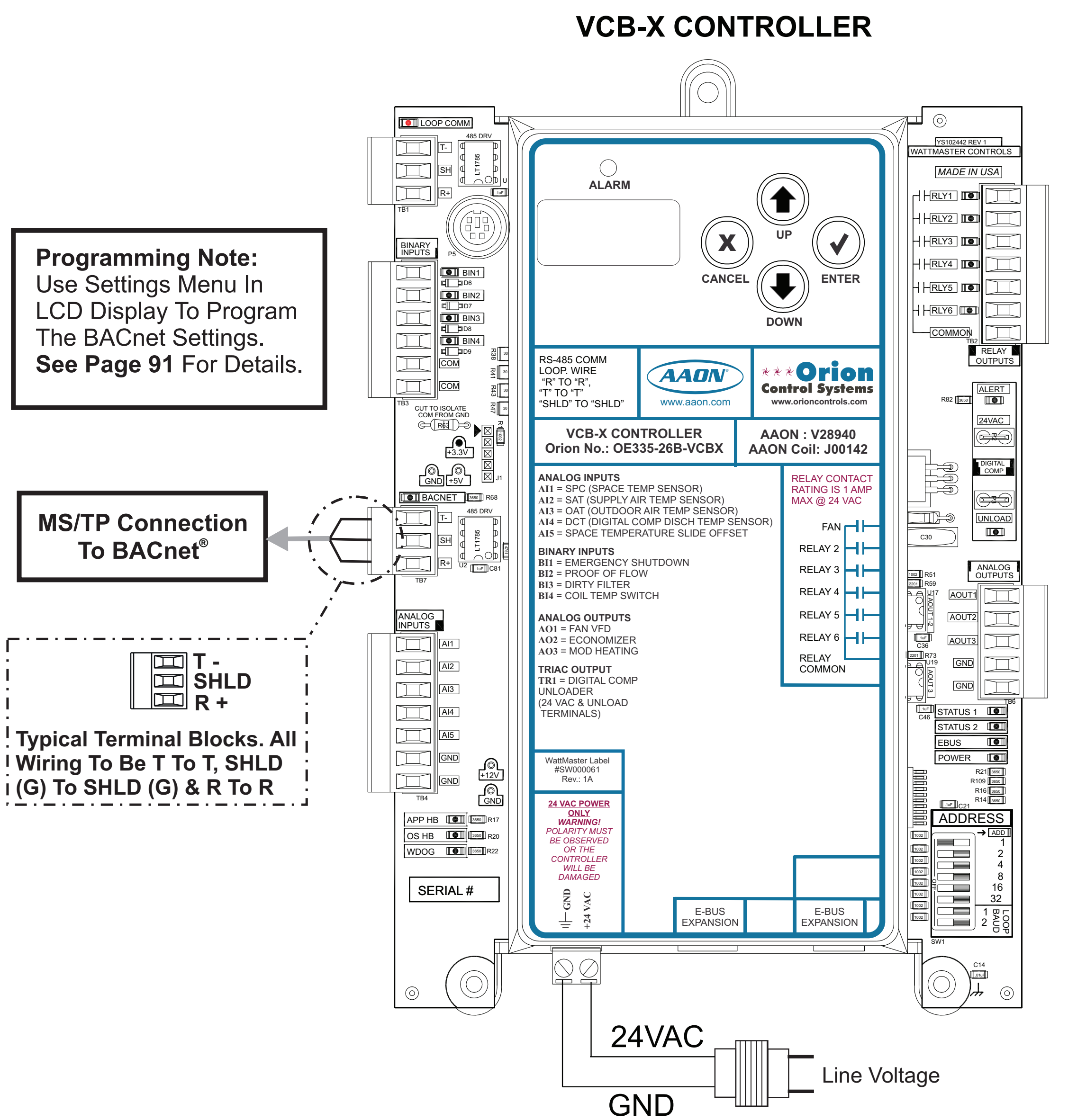
0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

```
Exhaust
-1.0, 0.0-10.0
vdc
```

EXHAUST FAN

0.0 to 10.0 = Active Force Mode.
Press the **<UP>** and **<DOWN>** buttons to increase and decrease the value.
Default is -1.0 = AUTO.

VCB-X BACnet® Connection To MS/TP Network



Size Transformer For Correct Total Load.
VCB-X Controller = 8 VA

Wiring Notes:
1.) All wiring to be in accordance with local and national electrical codes and specifications.

2.) All communication wiring to be 18 gauge minimum, 2 conductor twisted pair with shield. Use Belden #82760 or equivalent.

Figure 48: VCB-X BACnet Connection to MS/TP Network

VCB-X BACnet® Parameters

NOTE: Objects labeled AI and BI are read-only. Objects labeled AV are read/writeable. You cannot write directly to Sensor Inputs.

NOTE: When using Celsius scaling, all temperature values will need to be divided by 10 by the BMS to properly read the status and setpoint values, e.g., a value of 200º C needs to be divided by 10 for an actual value of 20º C.

NOTE: When a new setpoint is received from BACnet, it is maintained and used in temporary memory until the unit reaches midnight. It is then stored in permanent memory and will become the new default setpoint even if power is cycled. Therefore, if power is cycled prior to reaching midnight, the setpoint will not have been stored in permanent memory.

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits
Application Software Version	AI: 1	Current version of the software in the unit.	
Control Mode	AI:2	Configured unit application.	See Control Mode Bits on page 104.
Control Status	AI: 3	Current Occupied/ Unoccupied Status.	See Control Status Bits on page 104.
HVAC Mode	AI: 4	Current operational status.	See HVAC Mode Bits on page 104.
Control Temperature	AI: 5	Current value of the Control Temperature Sensor.	
Space Temperature	AI:6	Current value of the Space Temperature Sensor.	
Supply Air Temperature	AI:7	Current value of the Supply Air Temperature sensor.	
Coil Temperature	AI: 8	Current Coil Temperature value.	
Discharge Temperature	AI:9	Current value of the Digital Compressor Discharge Air Temperature Sensor.	
Outdoor Air Temperature	AI: 10	Current value of the Outdoor Temperature Sensor.	
Return Air Temperature	AI: 11	Current value of the Return Temperature Sensor.	
Leaving Water Temperature	AI:12	Current value of the Leaving Water Temperature Sensor.	

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits
Outdoor Air Wetbulb Temperature	AI:13	Current calculated Outdoor Wetbulb Temperature.	
Outdoor Air Dewpoint Temperature	AI:14	Current Calculated Outdoor Air Dewpoint Temperature.	
Indoor Air Humidity	AI: 15	Current value of the Indoor Humidity Sensor.	
Outdoor Air Humidity	AI:16	Current value of the Outdoor Humidity Sensor.	
Duct Static Pressure	AI:17	Current Duct Static Pressure.	
Building Pressure	AI:18	Current value of the Building Pressure Sensor.	
Suction Pressure	AI: 19	Current Suction Pressure Value.	
Head Pressure 1	AI:20	Current Value of the Head Pressure 1 Reading.	
CO_2	AI:21	Current Indoor CO_2 Level.	
Outdoor Airflow	AI: 22	Current Outdoor Airflow Measurement.	
Exhaust Airflow	AI:23	Current Exhaust Airflow Measurement	
Supply Airflow	AI:24	Current Supply Airflow Measurement.	
Return Airflow	AI:25	Current Return Airflow Measurement.	
Cooling Setpoint	AI:26	Occupied Cooling Mode Enable Setpoint Mirror. Adjusted by Slide Adjust and Night Offsets.	
Heating Setpoint	AI: 27	Occupied Heating Mode Enable Setpoint Mirror. Adjusted by Slide Adjust and Night Offsets.	
Supply Air Setpoint	AI: 28	Current SAT Cooling or Heating Setpoint if there is no reset source; Current calculated SAT setpoint with Reset Source.	
Coil Temperature Setpoint	AI:29	This is the current calculated Coil Suction Temperature target during Dehumidification Mode.	
Head Pressure Setpoint	AI:30	Current Head Pressure Setpoint.	

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits	
Indoor Humidity Setpoint	AI:31	This reflects the value set as the Low Indoor Humidity Reset Limit, which initiates Dehumidification on indoor controlled (non MUA) units.		
Economizer Position	AI: 32	Current signal percentage to the Economizer Damper.		
Fan VFD Signal	AI:33	Current Supply Fan VFD Signal.		
Modulating Heating Position	AI: 34	Current percentage of the Modulating Heating signal (Hot Water or SCR heat).		
Modulating Cooling Position	AI: 35	Current percentage of the Modulating Cooling Signal (Chilled Water or Digital Compressor).		
Building Pressure Exhaust Control Signal	AI: 36	Current Relief VFD Fan/ Damper Signal.		
Reheat Valve Position	AI:37	Current position of MHGRV Modulating Hot Gas Reheat Valve.		
Modulating Gas Valve Position	AI:38	Current position of MODGAS Modulating Gas Valve Control.		
Condenser 1 Control Signal	AI:39	Condenser 1 Fan / Water Valve Signal Status.		
Alarm Status	AI: 40	Indicates an alarm condition.	See Alarm Status Bits on page 104.	
Return Bypass Damper	AI: 41	Position of Return Bypass Damper.		
Return Air Damper	AI: 42	Position of Return Air Damper if using Return Air Bypass Control.		
Superheat #1 Temperature	AI: 43	Not Used.		
Superheat #2 Temperature	AI: 44	Not Used.		
Expansion Valve #1 Position	AI: 45	Not Used.		
Expansion Valve #2 Position	AI: 46	Not Used.		
Return Air Humidity	AI: 47	Return Air Humidity Reading.		
Sensor Slide Adjust Effect	AI: 48	Amount Of Current Sensor Slide Offset		
Title 24 Economizer Feedback	AI: 49	Current position of feedback from Economizer actuator.		
Head Pressure 2	AI: 50	Current Value of the Head Pressure 2 Reading.		
Condenser 2 Control Signal	AI: 51	Condenser 2 Fan/Water Valve Signal.		
Occupied Cooling Setpoint	AV: 1	If the control temperature rises one degree above this setpoint, the control will activate the cooling demand. If the control sensor is the Supply Air Sensor, then the cooling demand is always active.	1	110
Occupied Heating Setpoint	AV: 2	If the control temperature drops one degree below this setpoint, the control will activate the heating demand. If the control sensor is the Supply Air Sensor, then there is no heating demand.	1	110
Hood On Outdoor Air Cooling Setpoint	AV:3	This is the Cooling Mode Enable Setpoint used in Hood On Mode operation, Supply Air Tempering, and during Vent Mode of Space Control of High Percentage Outside Air.	1	110
Hood On Outdoor Air Heating Setpoint	AV:4	This is the Heating Mode Enable Setpoint used used in Hood On Mode operation, Supply Air Tempering, and during Vent Mode of Space Control of High Percentage Outside Air.	1	110
Unoccupied Cooling Offset	AV:5	During the Unoccupied Mode of Operation, this Setpoint offsets the Occupied Cooling Setpoint up by this user-adjustable amount. If you do not want Cooling to operate during the Unoccupied Mode, use the default setting of 30°F for this setpoint.	0	30
Unoccupied Heating Offset	AV:6	During the Unoccupied Mode of Operation, this Setpoint offsets the Occupied Heating Setpoint down by this user-adjustable amount. If you do not want Heating to operate during the Unoccupied Mode, use the default setting of 30°F for this setpoint.	0	30
Mode Select Deadband	AV:7	This value is added to and subtracted from the HVAC Mode Setpoints to create a control deadband range.	0	10

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits	
Max Coil Setpoint Reset Limit	AV:8	This is the highest that the Coil Temperature will be reset to during Space Humidity Reset of the Coil Suction Temperature Setpoint. If no coil temperature reset is required, this value should be set the same as the Min Coil Setpoint Reset Limit.	35	70
Min Coil Setpoint Reset Limit	AV:9	This is the lowest that the Coil Temperature will be reset to during Space Humidity Reset of the Coil Suction Temperature Setpoint. If no coil temperature reset is required, this value should be set the same as the Max Coil Setpoint Reset Limit.	35	70
Supply Air Cooling Setpoint	AV:10	Supply Air Cooling Setpoint. If Supply Air Reset is configured this is the Low SAT Cooling Reset Value.	30	80
Supply Air Heating Setpoint	AV:11	Supply Air Heating Setpoint. If Supply Air Reset is configured this is the Low SAT Heating Reset Value.	40	240
Max SAT Cooling Setpoint Reset Limit	AV: 12	If Supply Air Reset is configured this is the High SAT Cooling Reset Value.	0	100
Max SAT Heating Setpoint Reset Limit	AV: 13	If Supply Air Reset is configured this is the High SAT Heating Reset Value.	0	250
Supply Air Cooling Staging Window	AV: 14	In Cooling Mode, if the Supply Air Temperature drops below the Active Supply Air Cooling Setpoint minus this Staging Window, a Cooling Stage will be deactivated after its Minimum Run Time.	1	30
Supply Air Heating Staging Window	AV: 15	In Heating Mode, if the Supply Air Temperature rises above the Active Supply Air Heating Setpoint plus this Staging Window, a Heating Stage will be deactivated after its Minimum Run Time.	1	50
Morning Warm-Up Target Temperature	AV:16	If Morning Warm-Up is configured, upon entering the occupied mode, the Warm-up Mode will be activated if the return air temperature falls one degree below this setpoint.	50	90
Mechanical Cooling Outdoor Air Lockout	AV:17	The VCB-X will Lockout Mechanical Cooling when the Outdoor Air Temperature is below this Setpoint.	-30	100
Mechanical Heating Outdoor Air Lockout	AV:18	The VCB-X will Lockout Mechanical Heating when the Outdoor Air Temperature is above this Setpoint.	-30	150
Low Supply Air Temperature Cutoff	AV:19	Cooling will be disabled if the Supply Air Temperature falls below this value. See sequence for more details.	0	100
High Supply Air Temperature Cutoff	AV:20	Heating will be disabled if the Supply Air Temperature rises above this value. See sequence for more details.	0	250
Outdoor Air Dewpoint Setpoint	AV:21	On an MUA unit, if the OA dewpoint rises above this setpoint, Dehumidification is initiated.	35	80
Economizer Enable Setpoint	AV:22	The economizer is enabled if the outdoor drybulb, dewpoint, or wetbulb temperature falls below this setpoint.	-30	80
Heat Wheel Defrost Enable Setpoint	AV:23	The unit will go into Heat Wheel Defrost if the Outdoor Air is below this setpoint.	0	50
Preheat Setpoint	AV:24	If the Supply Fan is energized this is the temperature at which the Preheat Relay or the PREHEAT-X Controller will activate. Operates only in the Occupied Mode.	-30	70
Space Sensor Calibration Offset	AV:25	If the Space Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Supply Air Sensor Calibration Offset	AV:26	If the Supply Air Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits	
Return Air Sensor Calibration Offset	AV: 27	If the Return Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Outdoor Air Sensor Calibration Offset	AV: 28	If the Outdoor Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
Coil Temperature Calibration Offset	AV:29	If the Coil Temperature value is reading incorrectly, you can use this option to enter an offset temperature to adjust the Coil Temperature Value.	-100	100
Leaving Water Sensor Calibration Offset	AV:30	If the Leaving Water Temperature Sensor is reading incorrectly, you can use this option to enter an offset temperature to adjust the Sensor's Temperature.	-100	100
CO2 Sensor Calibration Offset	AV:31	If the CO_2 Sensor is reading incorrectly, you can use this option to enter an offset value to adjust the Sensor's CO_2 reading.	-500	500
Low Ambient Protection Setpoint	AV:32	Temperature at which the Low Ambient Relay will activate in the Occupied or Unoccupied Mode.	-30	70
SAT Cool Setpoint Reset Source Low Limit	AV: 33	If doing Supply Air Setpoint Reset, this is the Low Reset Source value in Cooling that will correspond to the Supply Air Cool High Reset Setpoint.	-30	150
SAT Cool Setpoint Reset Source High Limit	AV: 34	If doing Supply Air Setpoint Reset, this is the High Reset Source value in Cooling that will correspond to the Supply Air Cooling Setpoint (Low Reset).	1	150
SAT Heat Setpoint Reset Source Low Limit	AV: 35	If doing Supply Air Setpoint Reset, this is the Low Reset Source value in Heating that will correspond to the Supply Air Heating High Reset Setpoint.	-30	150
SAT Heat Setpoint Reset Source High Limit	AV: 36	If doing Supply Air Setpoint Reset, this is the High Reset Source value in Heating that will correspond to the Supply Air Heating Setpoint (Low Reset).	1	150
Control Temperature High Alarm Offset	AV:37	If the temperature of the controlling sensor rises above the Occupied Cooling Setpoint by this value, a High Control Temp Alarm will occur. Only applies if configured for Space or Return Air Temp Control, or as Single Zone VAV.	0	50
Control Temperature Low Alarm Offset	AV:38	If the temperature of the controlling sensor falls below the Occupied Heating Setpoint by this value, a Low Control Temp Alarm will occur. Only applies if configured for Space or Return Air Temp Control, or as Single Zone VAV.	0	50
Heat Pump Compressor Heat Lockout	AV:39	Compressor Heat will be locked out below this setpoint.	-30	100
Minimum Main Fan VFD in Cooling Mode	AV:40	In Single Zone VAV configuration, this is the fan speed at which the VFD will start when Cooling is initiated. In a VAV configuration this is the lowest fan speed allowed in the Cooling Mode. In CAV and MUA configurations this should be set to 100%.	0	100
Minimum Main Fan VFD in Heating Mode	AV:41	In Single Zone VAV configuration, this is the fan speed at which the VFD will start when Heating is initiated. In a VAV configuration this is the lowest fan speed allowed in the Heating Mode. In CAV and MUA configurations this should be set to 100%.	0	100
Minimum Main Fan VFD in Vent Mode	AV:42	Speed at which the VFD will operate in the Vent Mode in Single Zone VAV.	0	100
Maximum Economizer in Heating Mode	AV:43	Max position the Economizer Damper can open in the Heating Mode. Takes priority over Max Position in High CO2.	0	100
Minimum Economizer Position	AV:44	The minimum position of the Outdoor Air damper in the Occupied Mode. This can be reset upwards based on indoor CO2 levels.	0	100

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	**Object**	**Description**	**Limits**	
Maximum Economizer CO2 Reset Limit	AV:45	The maximum value the Economizer Minimum Position can be reset up to during CO2 override.	0	100
Maximum Main Fan VFD in Heat Mode	AV:46	In Single Zone VAV configuration, this is the max fan speed the VFD can modulate up to in Heat Mode.	0	100
Heat Pump Defrost Minimum Interval	AV:47	The interval that must be met between Defrost Modes.	0 Min. .	120 Min
Heat Pump Adaptive Defrost Increment	AV:48	Value added to or subtracted from the Defrost Interval depending on how long the unit remains in defrost. See sequence for details.	0	30
CO_2 Minimum Setpoint	AV:49	This is the threshold CO_2 level at which the Economizer Min Damper Position Setpoint will begin to be reset higher.	0	2000
CO_2 Maximum Setpoint	AV:50	This is the CO_2 level at which the Economizer Min Damper Position will be reset to the Economizer Max Position in High CO_2. In between the Min and Max CO_2 levels the Economizer Min Damper Position will be proportionally reset between the configured Min Damper Position and the Max Position in High CO_2.	0	2000
Indoor Humidity Setpoint Low Reset Limit	AV: 51	On indoor controlled (non MUA) units, this is the Humidity setpoint that initiates Dehumidification. During Coil Temp Reset, this is the lowest Space RH value that corresponds to the High Coil Temp Setpoint.	0	100
Indoor Humidity Setpoint High Reset Limit	AV:52	During Coil Temp Reset, this is the highest Space RH value that corresponds to the Low Coil Temp Setpoint.	0	100
Duct Static Pressure Setpoint	AV:53	Current Static Pressure Setpoint.	.10	3.0

BACnet® Properties for the VCB-X Controller				
Parameter	**Object**	**Description**	**Limits**	
Duct Static Pressure Control Deadband	AV:54	Value above and below the Duct Static Pressure Setpoint where no control change occurs.	.01	.5
Building Pressure Control Setpoint	AV:55	Building Pressure Setpoint.	-.20	.20
Building Pressure Control Deadband	AV:56	Value above and below the Building Pressure Setpoint where no control change occurs.	.01	.1
Head Pressure Setpoint in Cooling Mode	AV:57	This is the Head Pressure Setpoint the unit will control to in the Cooling Mode.	240 PSI	420 PSI
Head Pressure Setpoint in Reheat Mode	AV:58	This is the Head Pressure Setpoint the unit will control to in the Dehumidification Reheat Mode.	240 PSI	420 PSI
Minimum Outdoor Air CFM	AV:59	Minimum Outdoor Airflow CFM Setpoint	.10K	200K
Outdoor Air CFM Proportional Window	AV:60	Controls rate of change for damper signal. As OA CFM moves further from setpoint within this window, the damper makes a larger change.	10	9999
SZ VAV Fan Speed Integral	AV:61	The Integral Constant for Single Zone VAV Fan Control.	0	10
Schedule Force	AV: 62	0 = Auto (uses controller's schedule) 1 = Forced Occupied 2 = Forced Unoccupied	0	2
HVAC Mode Override	AV: 63	Overrides normal controller operation in order to force the unit into this desired mode. Configuring for "Auto" will restore normal unit control of the mode of operation.	0=Auto 1=Vent 2=Cool 3=Heat 4=Vent Dehum. 5=Cool Dehum. 6=Heat Dehum.	
Fan VFD Override	AV: 64	Override to force the VFD to this percentage speed. Configuring "Auto" will restore normal unit control of the VFD speed.	0% Auto=65535	100%

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller				
Parameter	**Object**	**Description**	**Limits**	
Outdoor Air Damper Override	AV: 65	Overrides all other Outdoor Air Damper position commands so as to maintain this fixed position. Configuring for "Auto" will restore normal unit control of the Outdoor Air Damper/ Economizer operation.	0% Auto=65535	100%
Warm-Up Supply Air Temperature Setpoint	AV: 66	Heating will be controlled to this Supply Air Setpoint during Warm-Up.	40	240
Cool-Down Supply Air Temperature Setpoint	AV: 67	Cooling will be controlled to this Supply Air Setpoint during Cool-Down.	30	80
Minimum Condenser Position	AV: 69	If using Head Pressure control and have the EM1 Expansion Module installed and configured, this is the minimum condenser signal percentage.	0	100
Maximum Condenser Position	AV: 70	If using Head Pressure control and have the EM1 Expansion Module installed and configured, this is the maximum condenser signal percentage.	0	100
Preheat Cooling Setpoint	AV: 71	If the Preheater is enabled, and the unit is in the Cooling Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Preheat Heating Setpoint	AV: 72	If the Preheater is enabled, and the unit is in the Heating Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Preheat Venting Setpoint	AV: 73	If the Preheater is enabled, and the unit is in the Vent Mode, this setpoint will be sent to the Preheat-X Controller to control Leaving Air Temperature.	35	90
Push-Button Override Duration	AV: 74	The Push-Button Override Duration Setpoint allows you to adjust the amount of time the Override will remain in effect when the Override Button is pressed.	0	8
Cooling Enabled Status	BI: 1	Status that indicates Mechanical Cooling is enabled based on the Cooling Lockout.		

BACnet® Properties for the VCB-X Controller			
Parameter	**Object**	**Description**	**Limits**
Heating Enabled Status	BI: 2	Status that indicates that Mechanical Heating is enabled based on the Heating Lockout.	
Economizer Enabled Status	BI: 3	Status that indicates the Economizer is enabled based on the Economizer Enable Setpoint.	
Reheat Enabled Status	BI:4	Modulating Hotgas Reheat Enabled.	
Emergency Heat Enabled Status	BI:5	Shows the Emergency Heat is enabled based on the Compressor Heating Lockout.	
Bad Supply Air Sensor	BI: 6	Alarm that indicates a failure of the Supply Air Sensor.	
Reserved For Bad RAT Sensor	BI: 7	Not Currently Used.	
Bad Outdoor Air Sensor	BI: 8	Failure of the Outdoor Air Temperature Sensor.	
Bad Space Temp Sensor	BI: 9	Failure of the Space Temperature Sensor. If Space is the controlling sensor, the unit will shut down.	
Missing EM1 Expansion Module	BI: 10	EM1 Module is configured but not detected.	
Bad Coil Pressure Sensor	BI: 11	Failure of the Coil Pressure Sensor. Will shut unit down.	
Bad CO2 Sensor	BI: 12	Failure of the CO2 Sensor.	
Bad Discharge Sensor	BI: 13	Failure of the Digital Compressor Discharge Temperature Sensor.	
Bad Outdoor Airflow Sensor	BI: 14	An Outdoor Airflow Sensor is configured, but not detected.	
Bad Exhaust Airflow Sensor	BI: 15	An Exhaust Airflow Sensor is configured, but not detected.	
Bad Supply Airflow Sensor	BI: 16	A Supply Airflow Sensor is configured, but not detected.	
Bad Return Airflow Sensor	BI: 17	A Return Airflow Sensor is configured, but not detected.	
Bad or Missing Reheat Board	BI: 18	The MHGR board is configured but not detected.	

VCB-X BACnet® Parameters

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Bad or Missing MODGAS Board	BI: 19	The MODGAS board is configured but not detected.	
Bad or Missing 12 Relay Expansion Board.	BI: 20	The 12 Relay Expansion Board is configured but not detected.	
Mechanical Cooling Alarm	BI: 21	Compressor Relays are enabled but the Supply Air Temperature has not fallen 5°F w/in a user-adjustable time period. This does not apply for Modulating Cooling.	
Mechanical Heating Alarm	BI: 22	Heating Mode has been initiated but the Supply Air Temperature has not risen 5°F w/in a user-adjustable time period. This does not apply for Modulating Heating.	
Fan Proving Alarm	BI: 23	Alarm that indicates an Airflow failure from the Main Fan. Heating and Cooling will be disabled.	
Dirty Filter Alarm	BI: 24	Alarm that indicates the filters are dirty.	
Emergency Shutdown Alarm	BI: 25	Alarm that indicates that Emergency Shutdown has been activated. Will shut the unit down.	
High Supply Temp Cutoff Alarm	BI: 26	The Supply Air has risen above the Hi SAT Cutoff Setpoint. Heating stages begin to deactivate and the fan continues to run.	
Low Supply Temp Cutoff Alarm	BI: 27	The Supply Air has fallen below the Low SAT Cutoff Setpoint and cooling stages will begin to deactivate. If the unit is in Economizer, Vent, or Heating Mode the Supply Fan will shut off.	
High Control Mode Alarm	BI: 28	Occurs when the Controlling Sensor Temperature rises above the Cooling Mode Enable Setpoint plus the Control Mode High Alarm Offset. Applies only to Space or Return Air Temperature controlled units.	

BACnet® Properties for the VCB-X Controller			
Parameter	Object	Description	Limits
Low Control Mode Alarm	BI: 29	Occurs when the Controlling Sensor Temperature falls below the Heating Mode Enable Setpoint minus the Control Mode Low Alarm Offset. Applies only to Space or Return Air Temperature controlled units.	
Digital Compressor Cutoff Alarm	BI: 30	Occurs if the digital compressor discharge temperature rises above 268°F or the sensor is shorted. The compressor is disabled.	
Digital Compressor Lockout Alarm	BI: 31	Occurs if five Digital Compressor Cutoffs occur within four hours. The compressor will be locked out.	
High Head Pressure Alarm	BI: 32	Occurs if the Head Pressure exceeds the acceptable limit.	
Loop Water Proof of Flow Alarm	BI: 33	On a WSHP unit, occurs if water flow is not proven within a certain time limit. Compressors disabled or prevented from activating.	
Low Suction Pressure Alarm	BI: 34	On a WSHP unit, occurs if the Suction Pressure falls below the Low Suction Pressure Setpoint. Compressors disabled or prevented from activating.	
Unsafe Suction Pressure Alarm	BI: 35	On a WSHP unit, occurs if the Suction Pressure falls below the Unsafe Suction Pressure Setpoint. Compressors disabled or prevented from activating.	
Low Leaving Water Temperature Alarm	BI: 36	On a WSHP unit, occurs if the Leaving Water Temperature falls below the Low Leaving Water Temperature Setpoint while in the Heating Mode. Compressors disabled or prevented from activating.	
On Board Relay 1 Main Fan	BI: 37	Current status of Relay 1 on VCB-X Main Board.	
On Board Relay 2	BI: 38	Current status of Relay 2 on VCB-X Main Board.	
On Board Relay 3	BI:39	Current status of Relay 3 on VCB-X Main Board.	

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits
On Board Relay 4	BI: 40	Current status of Relay 4 on VCB-X Main Board.	
On Board Relay 5	BI: 41	Current status of Relay 5 on VCB-X Main Board.	
On Board Relay 6	BI: 42	Current status of Relay 6 on VCB-X Main Board.	
Expansion Module Relay 1	BI:43	Current status of Relay 1 on the EM1 Expansion Module.	
Expansion Module Relay 2	BI:44	Current status of Relay 2 on the EM1 Expansion Module.	
Expansion Module Relay 3	BI:45	Current status of Relay 3 on the EM1 Expansion Module.	
Expansion Module Relay 4	BI:46	Current status of Relay 4 on the EM1 Expansion Module.	
Expansion Module Relay 5	BI:47	Current status of Relay 5 on the EM1 Expansion Module.	
12 Relay Expansion Module Relay 1	BI:48	Current status of Relay 1 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 2	BI:49	Current status of Relay 2 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 3	BI:50	Current status of Relay 3 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 4	BI:51	Current status of Relay 4 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 5	BI:52	Current status of Relay 5 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 6	BI:53	Current status of Relay 6 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 7	BI:54	Current status of Relay 7 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 8	BI:55	Current status of Relay 8 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 9	BI:56	Current status of Relay 9 on the 12 Relay Expansion Module.	

BACnet® Properties for the VCB-X Controller

Parameter	Object	Description	Limits
12 Relay Expansion Module Relay 10	BI:57	Current status of Relay 10 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 11	BI:58	Current status of Relay 11 on the 12 Relay Expansion Module.	
12 Relay Expansion Module Relay 12	BI:59	Current status of Relay 12 on the 12 Relay Expansion Module.	
Reheat Expansion Board FAN Relay	BI:60	Current status of Reheat Board Relay 1.	
Reheat Expansion Board COMP Relay	BI:61	Current status of Reheat Board Relay 2.	
Reheat Expansion Board VALVE Relay	BI:62	Current status of Reheat Board Relay 3.	
Reheat Expansion Board AUX Relay	BI:63	Current status of Reheat Board Relay 4.	
MODGAS-X Controller Fan Relay	BI:64	Current Status of the Fan Relay on the MODGAS-X Controller.	
MODGAS-X Controller Low Speed Relay	BI:65	Current Status of the Low Speed Relay on the MODGAS-X Controller.	
MODGAS-X Controller AUX 1 Relay	BI:66	Current Status of the AUX 1 Relay on the MODGAS-X Controller.	
MODGAS-X Controller AUX 2 Relay	BI:67	Current Status of the AUX 2 Relay on the MODGAS-X Controller.	
Title 24 Sensor Alarm	BI:68	Outside Air or Supply Air Temperature Sensor is shorted or missing.	
Title 24 Not Economiz-ing When It Should	BI:69	Economizer is enabled but not following the desired Economizer position commanded.	
Title 24 Economiz-ing When It Should Not	BI:70	Economizer is not enabled but the feedback signal indicates a position more open than the minimum.	
Title 24 Damper Failure	BI:71	Economizer is enabled but not within 10% of desired position within 150 seconds.	
Title 24 Excess Outdoor Air	BI:72	Economizer feedback is lost or Economizer is not following commanded position.	

VCB-X BACnet® Parameters

VCB-X BACnet® Property Identifier:

BACNETPropertyIdentifier :

VcbxControlModeBits ::= ENUMERATED {

Constant Volume Mode	(1),
Supply Air Cooling Only	(2),
Outdoor Temperature Control	(3),
Single Zone VAV	(4),
Supply Air Tempering	(5),
Space Temperature Control w/ High OA Content	(6),

}

VcbxControlStatusBits ::= ENUMERATED {

Unoccupied	(0)
Occupied	(1),
Override Mode	(2),
Holiday Unoccupied	(3),
Holiday Occupied	(4),
Forced Occupied	(5),
Forced Unoccupied	(6),
Remote Contact Occupied	(7),
Zone Heat Demand (Not applicable on BACnet system)	(8),
Zone Cool Demand (Not applicable on BACnet system)	(9),
Zone Override (Not applicable on BACnet system)	(10),
Hot Water Lockout (May only be available on custom code)	(11)

}

VcbxHVACModeStatusBits ::= ENUMERATED {

Off	(0),
Vent Mode	(1),
Cooling Mode	(2),
Heating Mode	(3),
Vent RH Mode	(4),
Cooling RH Mode	(5),
Heating RH Mode	(6),
Warm Up Mode	(7),
Defrost Mode	(8),
Purge Mode	(9),
Cool Down Mode	(10),
Remote Cooling Mode	(11),
Remote Heating Mode	(12),
Remote Vent Dehum	(13),
Remote Cool Dehum	(14),
Remote Heat Dehum	(15)

}

VcbxAlarmStatusBits ::= BIT STRING {

Bad Supply Air Sensor	(0),
Bad Return Air Sensor	(1),
Bad Outside Air Sensor	(2),
Bad Space Sensor	(3),
Missing EM1 Module	(4),
Bad Coil Temp Sensor	(5),
Bad Co2 Sensor	(6),
Bad Discharge Sensor	(7),
Bad OA CFM Sensor	(8),
Bad Exhaust CFM Sensor	(9),
Bad Supply CFM Sensor	(10),
Bad Return CFM Sensor	(11),
Bad or Missing Reheat Module	(12),
Bad or Missing ModGas Module	(13),
Bad or Missing 12 Relay Expansion Module	(14)
Mechanical Cooling Failure	(15),
Mechanical Heating Failure	(16),
Fan Proving Alarm	(17),
Dirty Filter Alarm	(18),
Emergency Shutdown Alarm	(19)
High Supply Air Temp Cutoff	(20),
Low Supply Air Temp Cutoff	(21),
High Control Mode Signal Alarm	(22),
Low Control Mode Signal Alarm	(23),
Digital Compressor Cutoff Alarm	(24),
Digital Compressor Lockout Alarm	(25),
High Head Pressure	(26)
Loop Water Proof of Flow Alarm	(27)
Low Suction Pressure Alarm	(28)
Unsafe Suction Pressure Alarm	(29)
Low Leaving Water Temperature Alarm	(30)

}

BACnet® Protocol Implementation Conformance Statement

Vendor		Listing Status
WattMaster Controls, Inc. 8500 NW River Park Drive, Suite 108A Parkville, MO 64152 USA		Listed Product
Test Requirements	**BACnet® Protocol Revision**	**Date Tested**
Requirements as of December 2011	Revision 12 (135-2010)	April 2013

Product Name	Model Number	Software Version
VCB-X Controller	OE335-26B-VCBX	2.13

BACnet® Standardized Device Profile (Annex L)
BACnet Application Specific Controller (B-ASC)

BIBBs Supported		
Data Sharing	ReadProperty-B	DS-RP-B
	ReadPropertyMultiple-B	DS-RPM-B
	WriteProperty-B	DS-WP-B
Device and Network Management	Dynamic Device Binding-B	DM-DDB-B
	Dynamic Object Binding-B	DM-DOB-B
	DeviceCommunication Control-B	DM-DCC-B

Object Type Support		
Device	Analog Input	Analog Value
Binary Input	Binary Value	
Device does not support CreateObject, DeleteObject, and there are no Proprietary Properties.		

Data Link Layer Options	
Media	**Options**
MS/TP Master	9600,19200, 38400, 57600, 76800

Character Set Support
ANSI X3.4

A-B

C

D

D-F

E

F

G

H

I

K

L

M

N

O

P

R

U

V

W

Z

Form: OR-VCBX-FIELD-TGD-01W Printed in the USA March 2017

WattMaster Controls Inc. • 8500 NW River Park Drive • Parkville, MO • 64152
Phone: 866-918-1100 www.orioncontrols.com Fax (816) 505-1101

Startup Documents

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

RN Series Startup Form

Date:_______________
Job Name: PHASE II FOUR MILE CREEK WQRF COW
Address:______________________________
Model Number: RN-013-3-A-CA12-000
Serial Number: ANCK14460 Tag: 110-AHU/AC-001
Startup Contractor: Building Controls & Services
Address: 1730 E Douglas, Wichita, KS 67214 Phone: 316-267-5814

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size____________________ VAV Controls________________

VFD Frequency_______________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐		Check Rotation ☐		FLA_____________
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐		Check Rotation ☐		Nameplate Amps_________
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature
Ambient Dry Bulb Temperature _________°F Ambient Wet Bulb Temperature _________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow _________GPM	
Water Inlet Temperature _________°F	
Water Outlet Temperature _________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ___________________________________		

Gas Heating

Natural Gas ☐ Propane ☐ Purge Air from Lines ☐ Verify Pilot Spark ☐

Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating

Stages___________

Limit Lockout ☐ Aux. Limit Lockout ☐

Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	Action Taken	Name/Tel.

RN Series Startup Form

Date:________________
Job Name: PHASE II FOUR MILE CREEK WQRF COW
Address:________________

Model Number: RN-007-3-A-FA19-000
Serial Number: ANCG14462 Tag: 210-AHU/AC-001
Startup Contractor: Building Controls & Services
Address: 1730 E Douglas, Wichita, KS 67214 Phone: 316-267-5814

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size______________________ VAV Controls__________________

VFD Frequency_________________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐		Check Rotation ☐		FLA____________
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐		Check Rotation ☐		Nameplate Amps________
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature	
Ambient Dry Bulb Temperature ________°F	Ambient Wet Bulb Temperature ________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow ________GPM	
Water Inlet Temperature ________°F	
Water Outlet Temperature ________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ___________________________________		

Gas Heating			
Natural Gas ☐	Propane ☐	Purge Air from Lines ☐	Verify Pilot Spark ☐
Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating			
Stages___________			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	**Action Taken**	**Name/Tel.**

RN Series Startup Form

Date:________________
Job Name: PHASE II FOUR MILE CREEK WQRF COW
Address:______________________________
____
Model Number: RN-026-3-A-0000-3E9
Serial Number: BNGS70076 Tag: 110-MAU-001
Startup Contractor: Building Controls & Services
Address: 1730 E Douglas, Wichita, KS 67214 Phone: 316-267-5814
____

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size______________________ VAV Controls__________________

VFD Frequency_________________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐		Check Rotation ☐		FLA_____________
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐		Check Rotation ☐		Nameplate Amps_________
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature	
Ambient Dry Bulb Temperature _________°F	Ambient Wet Bulb Temperature _________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow _________GPM	
Water Inlet Temperature _________°F	
Water Outlet Temperature _________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ___________________________________		

Gas Heating			
Natural Gas ☐	Propane ☐	Purge Air from Lines ☐	Verify Pilot Spark ☐
Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating			
Stages___________			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	**Action Taken**	**Name/Tel.**

RN Series Startup Form

Date:________________
Job Name: PHASE II FOUR MILE CREEK WQRF COW
Address:______________________________
____
Model Number: RN-006-3-A-0000-3L9
Serial Number: ANGF70050 Tag: 210-MAU-001
Startup Contractor: Building Controls & Services
Address: 1730 E Douglas, Wichita, KS 67214 Phone: 316-267-5814
____

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size______________________ VAV Controls__________________

VFD Frequency_________________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐		Check Rotation ☐		FLA____________
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐		Check Rotation ☐		Nameplate Amps________
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature
Ambient Dry Bulb Temperature ________°F Ambient Wet Bulb Temperature ________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow ________GPM	
Water Inlet Temperature ________°F	
Water Outlet Temperature ________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ___________________________________		

Gas Heating			
Natural Gas ☐	Propane ☐	Purge Air from Lines ☐	Verify Pilot Spark ☐
Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating			
Stages___________			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	Action Taken	Name/Tel.

RN Series Startup Form

Date:________________
Job Name: PHASE II FOUR MILE CREEK WQRF COW
Address:________________

____
Model Number: RN-026-3-A-0000-3D9
Serial Number: BNGS70077 Tag: 350-MAU-001
Startup Contractor: Building Controls & Services
Address: 1730 E Douglas, Wichita, KS 67214 Phone: 316-267-5814

____

Pre Startup Checklist		
Installing contractor should verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
6. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
7. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
8. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
9. Have all set screws on the fans been tightened?	Yes ☐	No ☐
10. Do all fans rotate freely?	Yes ☐	No ☐
11. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐
12. Has outside air rain hood been opened?	Yes ☐	No ☐
13. Have the damper assemblies been inspected?	Yes ☐	No ☐
14. Are the air filters installed with proper orientation?	Yes ☐	No ☐
15. Have condensate drain and p-trap been connected?	Yes ☐	No ☐

Supply Fan Assembly

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1	L2	L3
1				
2				

Band Size______________________ VAV Controls__________________

VFD Frequency_________________

Energy Recovery Wheel Assembly				
Wheel(s) Spin Freely ☐		Check Rotation ☐		FLA____________
Number	hp	L1	L2	L3
1				
2				

Power Return/Exhaust Assembly				
Alignment ☐		Check Rotation ☐		Nameplate Amps________
Number	hp	L1	L2	L3
1				
2				

Outside Air/Economizer Dampers
Operation Check ☐
Damper Actuator Type:
Economizer Changeover Type and Operations:
Damper Wiring Check ☐
Gears Check ☐

Ambient Temperature	
Ambient Dry Bulb Temperature ________°F	Ambient Wet Bulb Temperature ________°F

Unit Configuration	
Water-Cooled Condenser ☐	Air-Cooled Condenser ☐
No Water Leaks ☐	
Condenser Safety Check ☐	
Water Flow ________GPM	
Water Inlet Temperature ________°F	
Water Outlet Temperature ________°F	

Compressors / DX Cooling						
Number/stage	L1	L2	L3	Head Pressure PSIG	Suction Pressure PSIG	Crankcase Heater Amps
1						
2						
3						
4						

Refrigeration System 1 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 4 – Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 1 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 2 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A
Refrigeration System 3 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 – Heating Mode (Heat Pump only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Air-Cooled Condenser				
Alignment ☐	Check Rotation ☐	Nameplate Amps________		
Number	hp	L1	L2	L3
1				
2				
3				
4				
5				
6				

Water/Glycol System		
1. Has the entire system been flushed and pressure checked?	Yes ☐	No ☐
2. Has the entire system been filled with fluid?	Yes ☐	No ☐
3. Has air been bled from the heat exchangers and piping?	Yes ☐	No ☐
4. Is the glycol the proper type and concentration (N/A if water)?	Yes ☐	No ☐
5. Is there a minimum load of 50% of the design load?	Yes ☐	No ☐
6. Has the water piping been insulated?	Yes ☐	No ☐
7. What is the freeze point of the glycol (N/A if water)? ________________________________		

Gas Heating			
Natural Gas ☐	Propane ☐	Purge Air from Lines ☐	Verify Pilot Spark ☐
Stage	Manifold Pressure (w.c.)	Stage	Manifold Pressure (w.c.)
1		3	
2		4	

Electric Heating			
Stages___________			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Electric Preheating			
Limit Lockout ☐		Aux. Limit Lockout ☐	
Outside Air Temperature Setpoint ________°F			
Preheat Leaving Air Temperature Setpoint ________°F			
Stage	Amps	Stage	Amps
1		5	
2		6	
3		7	
4		8	

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	**Action Taken**	**Name/Tel.**

Warranty Certificates

Limited Warranty Certificate

GENERAL CONDITIONS

AAON, Inc. (hereinafter referred to as "AAON") warrants this AAON equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty shall be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. AAON is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this AAON equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE AAON UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS OR WH/WV); OPTIONAL ON OTHER EQUIPMENT

For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchaser-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF WH/WV PRODUCTS

The WH/WV limited warranty is effective five (5) years from date of original **manufacture** at the factory and covers all parts and components, including compressors, in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF RQ PRODUCTS

The RQ limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TWO YEAR EXTENDED LIMITED WARRANTY OF RN PRODUCTS

The limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective five (5) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TEN YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective ten (10) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF GAS FIRED HEAT EXCHANGERS

FOR STANDARD RQ or RN ALUMINIZED STEEL HEAT EXCHANGERS

For the second through the fifteenth year from date of **shipment**, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

FOR OPTIONAL RQ or RN STAINLESS STEEL HEAT EXCHANGERS

For the second through the twenty-fifth year from date of **shipment**, we further warrant the stainless steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

EXTENDED LIMITED WARRANTY OF RL SERIES GAS FIRED HEAT EXHANGERS

For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

OTHER CONDITIONS

This warranty **does not cover** any AAON unit or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, **or which has been tampered with or altered in any way**, or which has **not** been installed operated serviced and maintained in accordance with our instructions, or which has been installed outside of the Continental United States or Canada, or on which the serial number or identification number has been altered defaced, or removed. AAON will not be responsible for failure of the unit to start due to voltage conditions, blown fuses, open circuit breakers, or other damages due to the inadequacy or interruption of electric service.

This warranty **does not cover** equipment containing a water-to-refrigerant heat exchanger for any damage resulting from freezing, fouling, corrosion or clogging.

AAON shall not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lightning strikes, or any other acts of God.

DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH SHALL CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT AAON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. AAON SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF AAON WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF AAON WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY AAON NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION SHALL FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY SHALL NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name:	PHASE II FOUR MILE CREEK WQRF COW	**Sales Order Number:**	798189	**Unit Tag:**	110-AHU/AC-001	Date of Shipment:	7/31/2018
Serial Number:	ANCK14460	**Unit Model Number:**	RN-013-3-A-CA12-000:500000BNBD0000EQAH0E0000C0000VX				

Limited Warranty Certificate

GENERAL CONDITIONS
AAON, Inc. (hereinafter referred to as "AAON") warrants this AAON equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty shall be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. AAON is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this AAON equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE AAON UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS OR WH/WV); OPTIONAL ON OTHER EQUIPMENT
For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchase-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF WH/WV PRODUCTS
The WH/WV limited warranty is effective five (5) years from date of original **manufacture** at the factory and covers all parts and components, including compressors, in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF RQ PRODUCTS
The RQ limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TWO YEAR EXTENDED LIMITED WARRANTY OF RN PRODUCTS
The limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS
The limited warranty is effective five (5) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TEN YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS
The limited warranty is effective ten (10) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF GAS FIRED HEAT EXCHANGERS

FOR STANDARD RQ or RN ALUMINIZED STEEL HEAT EXCHANGERS
For the second through the fifteenth year from date of **shipment**, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

FOR OPTIONAL RQ or RN STAINLESS STEEL HEAT EXCHANGERS
For the second through the twenty-fifth year from date of **shipment**, we further warrant the stainless steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

EXTENDED LIMITED WARRANTY OF RL SERIES GAS FIRED HEAT EXHANGERS
For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

OTHER CONDITIONS
This warranty **does not cover** any AAON unit or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, **or which has been tampered with or altered in any way**, or which has **not** been installed operated serviced and maintained in accordance with our instructions, or which has been installed outside of the Continental United States or Canada, or on which the serial number or identification number has been altered defaced, or removed. AAON will not be responsible for failure of the unit to start due to voltage conditions, blown fuses, open circuit breakers, or other damages due to the inadequacy or interruption of electric service.

This warranty **does not cover** equipment containing a water-to-refrigerant heat exchanger for any damage resulting from freezing, fouling, corrosion or clogging.

AAON shall not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lightning strikes, or any other acts of God.

DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH SHALL CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT AAON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. AAON SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF AAON WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF AAON WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY AAON NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION SHALL FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY SHALL NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name:	PHASE II FOUR MILE CREEK WQRF COW	**Sales Order Number:**	798189	**Unit Tag:**	210-AHU/AC-001	Date of Shipment:	7/31/2018

Serial Number: ANCG14462 **Unit Model Number:** RN-007-3-A-FA19-000:500000BNMC0000EMAH0E0000C0000VX

Limited Warranty Certificate

GENERAL CONDITIONS

AAON, Inc. (hereinafter referred to as "AAON") warrants this AAON equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty shall be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. AAON is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this AAON equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE AAON UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS OR WH/WV); OPTIONAL ON OTHER EQUIPMENT

For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchase-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF WH/WV PRODUCTS

The WH/WV limited warranty is effective five (5) years from date of original **manufacture** at the factory and covers all parts and components, including compressors, in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF RQ PRODUCTS

The RQ limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TWO YEAR EXTENDED LIMITED WARRANTY OF RN PRODUCTS

The limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective five (5) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TEN YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective ten (10) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF GAS FIRED HEAT EXCHANGERS

FOR STANDARD RQ or RN ALUMINIZED STEEL HEAT EXCHANGERS

For the second through the fifteenth year from date of **shipment**, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

FOR OPTIONAL RQ or RN STAINLESS STEEL HEAT EXCHANGERS

For the second through the twenty-fifth year from date of **shipment**, we further warrant the stainless steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

EXTENDED LIMITED WARRANTY OF RL SERIES GAS FIRED HEAT EXHANGERS

For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

OTHER CONDITIONS

This warranty **does not cover** any AAON unit or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, **or which has been tampered with or altered in any way**, or which has **not** been installed operated serviced and maintained in accordance with our instructions, or which has been installed outside of the Continental United States or Canada, or on which the serial number or identification number has been altered defaced, or removed. AAON will not be responsible for failure of the unit to start due to voltage conditions, blown fuses, open circuit breakers, or other damages due to the inadequacy or interruption of electric service.

This warranty **does not cover** equipment containing a water-to-refrigerant heat exchanger for any damage resulting from freezing, fouling, corrosion or clogging.

AAON shall not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lightning strikes, or any other acts of God.

DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH SHALL CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT AAON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. AAON SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF AAON WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF AAON WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY AAON NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION SHALL FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY SHALL NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name:	PHASE II FOUR MILE CREEK WQRF COW	**Sales Order Number:**	798189	**Unit Tag:**	110-MAU-001	Date of Shipment:	7/31/2018
Serial Number:	BNGS70076	**Unit Model Number:**	RN-026-3-A-0000-3E9:K00000BNDF000000AH0F000000000VX				

Limited Warranty Certificate

GENERAL CONDITIONS
AAON, Inc. (hereinafter referred to as "AAON") warrants this AAON equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty shall be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. AAON is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this AAON equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE AAON UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS OR WH/WV); OPTIONAL ON OTHER EQUIPMENT
For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchase-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF WH/WV PRODUCTS
The WH/WV limited warranty is effective five (5) years from date of original **manufacture** at the factory and covers all parts and components, including compressors, in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF RQ PRODUCTS
The RQ limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TWO YEAR EXTENDED LIMITED WARRANTY OF RN PRODUCTS
The limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS
The limited warranty is effective five (5) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TEN YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS
The limited warranty is effective ten (10) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF GAS FIRED HEAT EXCHANGERS

FOR STANDARD RQ or RN ALUMINIZED STEEL HEAT EXCHANGERS
For the second through the fifteenth year from date of **shipment**, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

FOR OPTIONAL RQ or RN STAINLESS STEEL HEAT EXCHANGERS
For the second through the twenty-fifth year from date of **shipment**, we further warrant the stainless steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

EXTENDED LIMITED WARRANTY OF RL SERIES GAS FIRED HEAT EXHANGERS
For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

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DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH SHALL CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT AAON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. AAON SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF AAON WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF AAON WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY AAON NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION SHALL FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY SHALL NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name:	PHASE II FOUR MILE CREEK WQRF COW	**Sales Order Number:**	798189	**Unit Tag:**	210-MAU-001	Date of Shipment:	7/31/2018
Serial Number:	ANGF70050	**Unit Model Number:**	RN-006-3-A-0000-3L9:K00000BNBC000000AH0F000000000VX				

Limited Warranty Certificate

GENERAL CONDITIONS

AAON, Inc. (hereinafter referred to as "AAON") warrants this AAON equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty shall be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. AAON is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this AAON equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE AAON UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS OR WH/WV); OPTIONAL ON OTHER EQUIPMENT

For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchase-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF WH/WV PRODUCTS

The WH/WV limited warranty is effective five (5) years from date of original **manufacture** at the factory and covers all parts and components, including compressors, in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF RQ PRODUCTS

The RQ limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TWO YEAR EXTENDED LIMITED WARRANTY OF RN PRODUCTS

The limited warranty is effective two (2) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective five (5) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

FOR OPTIONAL TEN YEAR EXTENDED LIMITED WARRANTY OF RN or RQ PRODUCTS

The limited warranty is effective ten (10) years from date of original **shipment** from the factory and covers all parts and components in this AAON equipment except those excluded in the general conditions.

EXTENDED LIMITED WARRANTY OF GAS FIRED HEAT EXCHANGERS

FOR STANDARD RQ or RN ALUMINIZED STEEL HEAT EXCHANGERS

For the second through the fifteenth year from date of **shipment**, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

FOR OPTIONAL RQ or RN STAINLESS STEEL HEAT EXCHANGERS

For the second through the twenty-fifth year from date of **shipment**, we further warrant the stainless steel heat exchanger against failure due to defects in materials and workmanship for the **original purchaser-user only**.

EXTENDED LIMITED WARRANTY OF RL SERIES GAS FIRED HEAT EXHANGERS

For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

OTHER CONDITIONS

This warranty **does not cover** any AAON unit or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, **or which has been tampered with or altered in any way**, or which has **not** been installed operated serviced and maintained in accordance with our instructions, or which has been installed outside of the Continental United States or Canada, or on which the serial number or identification number has been altered defaced, or removed. AAON will not be responsible for failure of the unit to start due to voltage conditions, blown fuses, open circuit breakers, or other damages due to the inadequacy or interruption of electric service.

This warranty **does not cover** equipment containing a water-to-refrigerant heat exchanger for any damage resulting from freezing, fouling, corrosion or clogging.

AAON shall not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lightning strikes, or any other acts of God.

DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH SHALL CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT AAON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. AAON SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF AAON WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF AAON WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY AAON NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION SHALL FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY SHALL NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name:	PHASE II FOUR MILE CREEK WQRF COW	**Sales Order Number:**	798189	**Unit Tag:**	350-MAU-001	Date of Shipment:	7/31/2018
Serial Number:	BNGS70077	**Unit Model Number:**	RN-026-3-A-0000-3D9:K00000BNDQ000000AH0F000000000VX				

BCS Warranty Letter

BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com

1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

RE: Phase II, MGD Expansion Four Mile Creek
WQRF COW AAON Warranty
15760 E Harry St
Wichita, KS 67230

To whom it may concern,

Thank you for purchasing AAON products from BCS. The units purchased carry a standard manufacturer's warranty. We ask that if there is an issue with the units you contact Kruse Corporation. As the Mechanical Contractor, Kruse will then determine what steps need to be followed in order to repair any issues. By contacting the Mechanical Contractor first, it will help prevent any unnecessary billing for troubleshooting, parts, material, etc. to you directly.

Listed below is the contact information for the Mechanical Contractor:

Kruse Corporation
3636 N Topeka
Wichita, KS 67219
(316) 838-7885
krusecorp.com

Per the specifications stated, BCS will cover the warranty period beyond the current manufacturer's warranty pertaining to the items listed below. All warranty items are parts only unless otherwise stated. The warranty begins after the units have been commissioned.

Below is an equipment list that BCS has provided as well as the specified warranty end dates.

AAON

- AAON Equipment (110, 210, 350-MAU-001; 110, 210-AHU/AC-001)
    - Stainless Steel Heat Exchanger – 25 year End Date 7/31/2043
    - Evaporator Coil (AHU/ACs ONLY) – 5 year End Date 7/31/2023
    - Condenser Coil (AHU/ACs ONLY) – 5 year End Date 7/31/2023
    - Compressors (AHU/ACs ONLY) – 5 year End Date 7/31/2023
    - General Parts – 18 months End Date 1/31/2020

As the owner of the equipment, we would like you to be aware of the required maintenance. Performing, regular, scheduled, Preventative Maintenance will ensure your equipment experiences a long life, with minimal downtime due to mechanical failure. We have provided Preventative Maintenance worksheets for your use, detailing the maintenance required at monthly, quarterly, semi-annual, and annual intervals. These steps will help you, the equipment owner, avoid warranty, and eventually non-warranty, part failures. Please provide completed Preventative Maintenance worksheets when requesting warranty on a particular unit. Any lack of maintenance on the equipment will potentially void the warranty. If warranty is requested, and Preventative Maintenance has not been completed, we cannot process warranty claims.

Whether it's done internally, by your current service provider, or the installing contractor, it's important that regular maintenance is performed. It is vital to the efficiency, longevity, and performance of this equipment that it is properly maintained. Should warranty work need to be performed, and it be discovered that proper preventative maintenance has not been performed, we will notify you with the options to complete it at that time, schedule it to be done, or have whoever is on site do it then. Should that be BCS, we can complete the maintenance, at current prevailing wages, and then proceed with warranty diagnosis and repairs. Should your maintenance provider be scheduled to complete the maintenance, it's likely that we will have to return to complete warranty. In that case, you would be charged for both the initial trip and the return trip, at our current prevailing wages, plus mileage. Just like you, we want this equipment to last, and the number one indicator of whether or not it will, is to ensure that proper Preventative Maintenance is regularly completed.

The Owner assumes responsibility for all maintenance of the equipment. BCS assumes no responsibility for repairs made on AAON equipment unless done by BCS's authorized personnel or the installing contractor. This warranty does not cover any AAON units, or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, or which has been tampered with or altered in any way, or which has not been installed, operated, serviced, and maintained in accordance with our instructions, or on which the serial number or identification number has been altered defaced, or removed. BCS will not be responsible for failure of the unit to start due to voltage condition, blown fuses, open circuit breakers, or other damage due to the inadequacy or interruption of electric services.

BCS shall not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lighting strikes or any other acts of God.

OWNER:	BCS:
Signature: ______________________	Signature: ______________________
Name: ______________________	Name: ______________________
Title: ______________________	Title: ______________________
Date: ______________________	Date: ______________________

Filter List

1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

Four Mile Creek			
AAON Equipment Filter List			
Unit Tag	Type	Size	Qty.
110-MAU-001	Unit Filter	24X24X2m8	8
210-MAU-001	Unit Filter	16X20X2m8	4
350-MAU-001	Unit Filter	24X24X2m8	8
110-AHU/AC-001	Unit Filter	20X25X2m10	4
210-AHU/AC-001	Unit Filter	16X20X2m8	4

Total	
Size	Qty.
24X24X2m8	16
16X20X2m8	12
20X25X2m10	4

Preventative Maintenance Schedules

BCS
BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: PHASE II FOUR MILE CREEK WQRF COW ______
Location: ______ Unit #: 110-AHU/AC-001 ______
Manufacturer: AAON ______
Model #: RN-013-3-A-CA12-000 ______
Serial #: ANCK14460 ______
Serviced By: ______ Date: ______

☐ **Pre-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ______ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Replace blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ______ Return Air Temp______ ☐
19. Record pressure drop across coils Before______ After______ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

NOTES:______

BUILDING CONTROLS AND SERVICES, INC. 1730 E. DOUGLAS WICHITA, KS 67214
BLDGCONTROLS.com O: 316.267.5814 F: 316.267.2988

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ______________________ Unit #: ____________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: ____________________

☐ **Mid-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Check blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ________ Return Air Temp________ ☐
19. Record pressure drop across coils Before_____ After________ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: _______________________ Unit #: _____________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: ______________________

☐ **Pre-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
6. Check heating valve operation (if applicable) ☐
7. Check steam trap operation (if applicable) ☐
8. Check blower wheel (clean as required) ☐
9. Check and lubricate blower bearings ☐
10. Check blower shaft alignment ☐
11. Check and pulleys and sheaves for wear ☐
12. Check and adjust blower belt tension ☐
13. Check blower belt ☐
14. Visually check for excessive vibration ☐
15. Check damper operation on all dampers ☐
16. Lubricate and adjust dampers/linkage ☐
17. Record Discharge Air Temp ________ Return Air Temp________ ☐
18. Record pressure drop across coils Before_____ After________ ☐
19. Change air filters with high efficiency pleated filter ☐
20. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ______________________ Unit #: ____________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: _____________________

☐ **Mid-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
6. Check heating valve operation (if applicable) ☐
7. Check steam trap operation (if applicable) ☐
8. Check blower wheel (clean as required) ☐
9. Check and lubricate blower bearings ☐
10. Check blower shaft alignment ☐
11. Check and pulleys and sheaves for wear ☐
12. Check and adjust blower belt tension ☐
13. Check blower belt ☐
14. Visually check for excessive vibration ☐
15. Check damper operation on all dampers ☐
16. Lubricate and adjust dampers/linkage ☐
17. Record Discharge Air Temp ________ Return Air Temp________ ☐
18. Record pressure drop across coils Before_____ After________ ☐
19. Change air filters with high efficiency pleated filter ☐
20. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: PHASE II FOUR MILE CREEK WQRF COW ____________________

Location: ____________________ Unit #: 210-AHU/AC-001 ____________________

Manufacturer: AAON ____________________

Model #: RN-007-3-A-FA19-000 ____________________

Serial #: ANCG14462 ____________________

Serviced By: ____________________ Date: ____________________

☐ **Pre-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ___________ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Replace blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp _________ Return Air Temp_________ ☐
19. Record pressure drop across coils Before______ After_________ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

NOTES:____

BUILDING CONTROLS AND SERVICES, INC. 1730 E. DOUGLAS WICHITA, KS 67214
BLDGCONTROLS.com O: 316.267.5814 F: 316.267.2988

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ______________________ Unit #: ____________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: ____________________

☐ **Mid-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Check blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ________ Return Air Temp________ ☐
19. Record pressure drop across coils Before_____ After________ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.
BLDGCONTROLS.com
1730 E. DOUGLAS WICHITA, KS 67214
O: 316.267.5814 F: 316.267.2988

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____
Location: ______________________________ Unit #: ___________________________
Manufacturer: ____
Model #: ____
Serial #: ____
Serviced By: ____________________________ Date: ____________________________

☐ **Pre-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw __________ ☐
6. Check heating valve operation (if applicable) ☐
7. Check steam trap operation (if applicable) ☐
8. Check blower wheel (clean as required) ☐
9. Check and lubricate blower bearings ☐
10. Check blower shaft alignment ☐
11. Check and pulleys and sheaves for wear ☐
12. Check and adjust blower belt tension ☐
13. Check blower belt ☐
14. Visually check for excessive vibration ☐
15. Check damper operation on all dampers ☐
16. Lubricate and adjust dampers/linkage ☐
17. Record Discharge Air Temp ________ Return Air Temp________ ☐
18. Record pressure drop across coils Before_____ After________ ☐
19. Change air filters with high efficiency pleated filter ☐
20. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ___________________________ Unit #: ________________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _________________________ Date: _________________________

☐ **Mid-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw __________ ☐
6. Check heating valve operation (if applicable) ☐
7. Check steam trap operation (if applicable) ☐
8. Check blower wheel (clean as required) ☐
9. Check and lubricate blower bearings ☐
10. Check blower shaft alignment ☐
11. Check and pulleys and sheaves for wear ☐
12. Check and adjust blower belt tension ☐
13. Check blower belt ☐
14. Visually check for excessive vibration ☐
15. Check damper operation on all dampers ☐
16. Lubricate and adjust dampers/linkage ☐
17. Record Discharge Air Temp ________ Return Air Temp________ ☐
18. Record pressure drop across coils Before_____ After________ ☐
19. Change air filters with high efficiency pleated filter ☐
20. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: PHASE II FOUR MILE CREEK WQRF COW ______

Location: ______ Unit #: 110-MAU-001 ______

Manufacturer: AAON ______

Model #: RN-026-3-A-0000-3E9 ______

Serial #: BNGS70076 ______

Serviced By: ______ Date: ______

☐ **Pre-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ______ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Replace blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ______ Return Air Temp______ ☐
19. Record pressure drop across coils Before______ After______ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

NOTES:______

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ___________________________ Unit #: ________________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _________________________ Date: _________________________

☐ **Mid-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw __________ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
9. Check blower wheel (clean as required) ☐
10. Check and lubricate blower bearings ☐
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15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ________ Return Air Temp________ ☐
19. Record pressure drop across coils Before_____ After________ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

NOTES:____

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____
Location: ______________________________ Unit #: ___________________________
Manufacturer: ____
Model #: ____
Serial #: ____
Serviced By: ____________________________ Date: ____________________________

☐ **Pre-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ___________ ☐
6. Check heating valve operation (if applicable) ☐
7. Check steam trap operation (if applicable) ☐
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17. Record Discharge Air Temp _________ Return Air Temp_________ ☐
18. Record pressure drop across coils Before_____ After_________ ☐
19. Change air filters with high efficiency pleated filter ☐
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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____
Location: ______________________ Unit #: ____________________
Manufacturer: ____
Model #: ____
Serial #: ____
Serviced By: _____________________ Date: ____________________

☐ **Mid-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
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17. Record Discharge Air Temp ________ Return Air Temp________ ☐
18. Record pressure drop across coils Before_____ After________ ☐
19. Change air filters with high efficiency pleated filter ☐
20. **Clean up area & notify owner of any issues** ☐

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: PHASE II FOUR MILE CREEK WQRF COW
Location: ______________________ Unit #: 210-MAU-001
Manufacturer: AAON
Model #: RN-006-3-A-0000-3L9
Serial #: ANGF70050
Serviced By: ______________________ Date: ______________________

☐ **Pre-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw __________ ☐
6. Check operation of cooling valve (if applicable) ☐
7. Check evaporator coil (clean as required) ☐
8. Check and clean condensate drain pan and drain line ☐
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11. Check blower shaft alignment ☐
12. Check and pulleys and sheaves for wear ☐
13. Check and adjust blower belt tension ☐
14. Replace blower belt ☐
15. Visually check for excessive vibration ☐
16. Check damper operation on all dampers ☐
17. Lubricate and adjust dampers/linkage ☐
18. Record Discharge Air Temp ________ Return Air Temp________ ☐
19. Record pressure drop across coils Before_____ After________ ☐
20. Change air filters with high efficiency pleated filter ☐
21. **Clean up area & notify owner of any issues** ☐

NOTES:____

BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____
Location: ______________________ Unit #: ____________________
Manufacturer: ____
Model #: ____
Serial #: ____
Serviced By: _____________________ Date: ____________________

☐ **Mid-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: _______________________ Unit #: ____________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: _____________________

☐ **Pre-Season Heating Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw ________ ☐
6. Check heating valve operation (if applicable) ☐
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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: __________________________ Unit #: _______________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: ________________________ Date: ________________________

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: PHASE II FOUR MILE CREEK WQRF COW

Location: ______________________________ Unit #: 350-MAU-001

Manufacturer: AAON

Model #: RN-026-3-A-0000-3D9

Serial #: BNGS70077

Serviced By: ____________________________ Date: ____________________________

☐ **Pre-Season Cooling Inspection**

1. Inspect and tighten all electrical connections ☐
2. Check operation of controls ☐
3. Check operation of safety controls ☐
4. Visually check for leaks (water, refrigerant, air) ☐
5. Check and record blower motor starting amp draw __________ ☐
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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ______________________________ Unit #: ___________________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: ____________________________ Date: _____________________________

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

Location: ______________________________ Unit #: ___________________________

Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: ____________________________ Date: ____________________________

☐ **Pre-Season Heating Inspection**

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BUILDING CONTROLS AND SERVICES, INC.

Air Handling Units

Company: ____

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Manufacturer: ____

Model #: ____

Serial #: ____

Serviced By: _____________________ Date: _____________________

☐ **Mid-Season Heating Inspection**

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