48HC
High Efficiency
Gas Heat/Electric Cooling
Packaged Rooftop with EnergyX® System
15 to 25 Nominal Tons

Carrier
turn to the experts

Product Data

WeatherMaster®

ENERGY X

C11481

ENERGY STAR

AHRI CERTIFIED
www.ahridirectory.org

Use of the AHRI Certified TM Mark indicates a manufacturer's participation in the program For verification of certification for individual products, go to www.ahridirectory.org.

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ASHRAE 90.1 COMPLIANT

Puron™
the environmentally sound refrigerant

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Carrier
turn to the experts

Your new 15 to 25 Ton WeatherMaster Carrier rooftop unit (RTU) with EnergyX was designed to provide optimum comfort and control from a packaged rooftop.

The system uses the same base WeatherMaster rooftop but integrates the EnergyX System.

The EnergyX System is factory installed Energy Recovery Ventilator (ERV) module. It is fully integrated with the WeatherMaster rooftop structurally, and electronically for optimum performance and installation.

Easy to install:

These new WeatherMaster units are designed for dedicated factory-supplied vertical air flow duct configurations. This new cabinet design also integrates a large control box that gives you room to work and room to mount Carrier accessory controls.

Further ease of installation is achieved with the factory installed and tested EnergyX System. This allows for more reliable start-ups and operation leading to less time on the job site.

Easy to maintain:

Easy access handles by Carrier provide quick and easy access to all normally serviced components. Our “no-strip” screw system has superior holding power and guides screws into position while preventing the screw from stripping the unit’s metal. Take accurate pressure readings by reading system pressures with panels in place as compressors are strategically located to eliminate any air bypass.

Easy to use:

The newly designed, central terminal board by Carrier puts all your connections and troubleshooting points in one convenient place, standard. Most low voltage connections are made to the same board and make it easy to find what you’re looking for and easy to access it.

Reliable:

Each unit comes with precision sized and tested scroll compressor that is internally protected from over temperature and pressures. In addition, each refrigerant circuit is further protected with a high pressure and low pressure switch as well as containing a liquid line filter drier. Each unit is factory tested prior to shipment to help ensure unit operation once properly installed.

ENERGY X

FEATURES AND BENEFITS

- Integrated EnergyX System with Energy Recovery Ventilator (ERV).
- Two stage cooling capability with independent circuits and control.
- High performance copper tube / aluminum plate (RTPF) fin condenser and evaporator coils with optional coating.
- EER's up to 12.0
- IEER's up to 13.2
- Gas heating efficiencies up to 81% thermal efficiency.
- Dedicated vertical air flow duct configuration models. Field installed Horizontal Curb available for horizontal air flow applications.
- Utility connections through the side or bottom. Bottom connections are also in an enclosed environment to help prevent water entry.
- Standardized components and layout. Standardized components and controls make service and stocking parts easier.
- Scroll compressors on all units. This makes service, stocking parts, replacement, and trouble-shooting easier.
- Precision sized TXV metering device on each refrigerant circuit.
- Easy-adjust, belt-drive motor available. Carrier provides a factory solution for most points in the fan performance table. Motor assembly also contains a fan belt break protection system on all models and reliable pillow block bearing system that allows lubrication thru front of the unit.
- Single-point gas / electrical connection.
- Sloped, composite drain pan sheds water; and won't rust.
- Standardized controls and control box layout. Standardized components and controls make stocking parts and service easier.
- Clean, easy to use control box.
- Color-coded wiring.
- Large, laminated wiring and power wiring drawings which are affixed to unit make troubleshooting easy.
- Single, central terminal board for test and wiring connections.
- Fast-access, handled, panels for easy access on normally accessed service panels.
- "No-strip" screw system guides screws into the panel and captures them tightly without stripping the screw, the panel, or the unit.
- Mechanical cooling (125°F to 35°F / 52°C to -2°C) standard on all models. Low ambient controller allows operation down to -20°F / -29°C
- Redundant gas valve for two stage gas heating capacity control with induced-draft flue exhaust design to help ensure no flue gas can escape into the indoor air stream.
- Exclusive IGC solid state gas controller for on board diagnostics with LED error code designation, burner control logic and energy saving indoor fan motor delay.
- 2-in (51mm) disposable filters on all units, with 4-in (102mm) filter track field-installed.
- Refrigerant filter-drier on each circuit.
- High and low pressure switches. Added reliability with high pressure switch and low pressure switch.
- Many factory-installed options ranging from air management economizers, convenience outlets, disconnect switch and smoke detectors.
- Units use standard roofcurbs that require no field modifications such as support rails or stiffening brackets.
- Standard Parts Warranty: 10 year aluminized heat exchanger, 5 year compressor, 5 year energy wheel, 1 year others.

MODEL NUMBER NOMENCLATURE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	8	H	C	D	D	2	4	A	2	A	6	A	0	A	0	A	0

Product Type
48 – Gas Heat Pkg. Rooftop

Product Series
HC – High Efficiency

Heat Options
D – Low Gas Heat
E – Medium Gas Heat
F – High Gas Heat
S – Low Heat w/Stainless Steel Exchanger
R – Med Heat w/Stainless Steel Exchanger
T – High Heat w/Stainless Steel Exchanger

Refrigerant & System Options
D – 2 Stage Cooling w/Round Tube/Plate Fin

Nominal Cooling Capacity (Tons)
17 – 15 Tons
20 – 17.5 Tons
24 – 20 Tons
28 – 25 Tons

Sensor Options
A – None
B – RA Smoke Detector
C – SA Smoke Detector
D – RA + SA Smoke Detector
E – CO_2 Sensor
F – RA Smoke Detector + CO_2
G – SA Smoke Detector + CO_2
H – RA + SA Smoke Detector + CO_2

Indoor Fan Options
1 – Standard Static/Vertical Supply, Return Air Flow
2 – Medium Static/Vertical Supply, Return Air Flow
3 – High Static/Vertical Supply, Return Air Flow
B – Med. Static High Eff. Motor/Vertical Supply, Return Air Flow
C – High Static High Eff. Motor/Vertical Supply, Return Air Flow

Coil Options (RTPF) (Outdoor–Indoor–Hail Guard)
A – Al/Cu – Al/Cu
B – Pre–coat Al/Cu – Al/Cu
C – E–coat Al/Cu – Al/Cu
D – E–coat AL/Cu – E–coat AL/Cu
E – Cu/Cu – Al/Cu
F – Cu/Cu – Cu/Cu
M – Al/Cu – Al/Cu – Louvered Hail Guard
N – Pre–Coat Al/Cu – Al/Cu – Louvered Hail Guard
P – E–Coat Al/Cu – Al/Cu Louvered Hail Guard
Q – E–Coat Al/Cu – E–coat Al/Cu – Louvered Hail Guard
R – Cu/Cu – Al/Cu – Louvered Hail Guard
S – Cu/Cu – Cu/Cu – Louvered Hail Guard

Voltage
1 – 575–3–60
5 – 208/230–3–60
6 – 460–3–60

Factory Design Revision –
– Factory Design Revision

Base Unit Controls
D – ComfortLink (Standard with EnergyX)

Intake / Exhaust Options
Q – EnergyX only
R – EnergyX + Economizer only
S – EnergyX + Frost Protection only
T – EnergyX + Economizer + Frost Protection

Service Options
0 – None
1 – Non–Powered Convenience Outlet
2 – Powered Convenience Outlet
3 – Hinged Panels
4 – Hinged Panels & Non–Powered C.O.
5 – Hinged Panels & Powered C.O.

Electrical Options
A – None
C – Non–Fused Disconnect
D – Through–the–base Connections
F – Non–Fused Disconnect & Through–the–base Connections

Packaging
0 – Standard

Table 1 – FACTORY-INSTALLED OPTIONS AND FIELD-INSTALLED ACCESSORIES

CATEGORY	ITEM	FACTORY INSTALLED OPTION	FIELD INSTALLED ACCESSORY
EnergyX System	EnergyX	X	
	EnergyX with Economizer	X	
	EnergyX with Frost Protection	X	
	EnergyX with Frost Protection and Economizer	X	
	Filter Maintenance Sensor		X
	Motor Status Sensor		X
Cabinet	Dedicated Vertical Air Flow Duct Configuration	X	
	Thru–the–base electrical or gas–line connections	X	
	Hinged Access Panels	X	
Coil Options	Cu/Cu (indoor) coils	X	
	E–coated (outdoor & indoor) coils	X	
	Pre–coated outdoor coils	X	
Condenser Protection	Condenser coil hail guard (louvered design)	X	X
Controls	Thermostats, temperature sensors, and subbases		X
	Smoke detector (supply and/or return air)	X	X (supply only)
	Time Guard II compressor delay control circuit		X
	Phase Monitor		X
Economizer Sensors & IAQ Devices	Single enthalpy sensors[2]	X	
	Differential enthalpy sensors[2]		X
	Wall or duct mounted CO_2 sensor[2]		X
	Unit mounted CO_2 sensor[2, 5]	X	
	4–in Filter Track Assembly		X
Gas Heat	Propane conversion kit		X
	Stainless steel heat exchanger	X	
	High altitude conversion kit		X
	Flue Discharge Deflector		X
Indoor Motor & Drive	Multiple motor and drive packages	X	
Low Ambient Control	Winter start kit[3]		X
	Motormaster head pressure controller[3]		X
Power Options	Convenience outlet (powered)	X	
	Convenience outlet (unpowered)	X	
	Non–fused disconnect[4]	X	
Roof Curbs	Roof curb 14–in (356mm)		X
	Roof curb 24–in (610mm)		X
	Horizontal Curb Adapter (Vertical to horizontal airflow)		X

NOTES:

1. Included with economizer.
2. Sensors used to optimize economizer performance, standard on all EnergyX economizers.
3. See application data for assistance.
4. Non–fused disconnect switch cannot be used when MOCP electrical rating exceeds 70 amps at 460/575 volt and 150 amps at 208/230 volt. Carrier Packaged RTUBuilder selects this automatically.
5. Requires factory installed economizer.

FACTORY OPTIONS AND/OR ACCESSORIES

EnergyX® Energy Recovery

The EnergyX System is a factory installed Energy Recovery Ventilator (ERV) module on a Carrier packaged rooftop unit. It is integrated with the base rooftop unit structurally, electrically and with regard to controls operation.

Economizer

Economizers save money. They bring in fresh, outside air for ventilation; and provide cool, outside air to cool your building. This is the preferred method of low-ambient cooling. When coupled to CO_2 sensors, economizers can provide even more savings by coupling the ventilation air to only that amount required.

Economizers are available, installed and tested by the factory, with either enthalpy or dry-bulb temperature inputs. Additional sensors are available as accessories to optimize the economizers.

Economizers include a powered exhaust system to help equalize building pressures.

CO_2 Sensor

Improves productivity and saves money by working with the economizer to intake only the correct amount of outside air for ventilation. As occupants fill your building, the CO_2 sensor detects their presence through increasing CO_2 levels, and modulates the intake fan appropriately.

When the occupants leave, the CO_2 levels decrease, and the sensor appropriately reduces the outside air brought in the building. This intelligent control of the ventilation air, called Demand Control Ventilation (DCV) reduces the overall load on the rooftop, saving money.

Smoke Detectors

Trust the experts. Smoke detectors make your application safer and your job easier. Carrier smoke detectors immediately shut down the rooftop unit when smoke is detected. They are available, installed by the factory, for supply air, return air, or both.

Louvered Hail Guards

Sleek, louvered panels protect the condenser coil from hail damage, foreign objects, and incidental contact.

Convenience Outlet (powered or un-powered)

Reduce service and/or installation costs by including a convenience outlet in your specification. Carrier will install this service feature at our factory. Provides a convenient, 15 amp, 115v GFCI receptacle with “Wet in Use” cover. The “powered” option allows the installer to power the outlet from the line side of the disconnect side as required by code. The “unpowered” option is to be powered from a separate 115/120v power source.

Non-Fused Disconnect

This OSHA-compliant, factory-installed, safety switch allows a service technician to locally secure power to the rooftop.

Time Guard II Control Circuit

This accessory protects your compressor by preventing short-cycling in the event of some other failure, prevents the compressor from restarting for 30 seconds after stopping. Not required with authorized commercial thermostats.

Filter or Fan Status Switches

Use these differential pressure switches to detect a filter clog or indoor fan motor failure. When used in conjunction with a compatible unit controller/thermostat, the switches will activate an alarm to warn the appropriate personnel.

Motormaster Head Pressure Controller

The Motormaster motor controller is a low ambient, head pressure controller kit that is designed to maintain the unit’s condenser head pressure during periods of low ambient cooling operation. This device should be used as an alternative to economizer free cooling not when economizer usage is either not appropriate or desired. The Motormaster will either cycle the outdoor-fan motors or operate them at reduced speed to maintain the unit operation, depending on the model.

Winter Start Kit

The winter start kit by Carrier extends the low ambient limit of your rooftop to 25°F (-4°C). The kit bypasses the low pressure switch, preventing nuisance tripping of the low pressure switch. Other low ambient precautions may still be prudent.

Propane Heating

Convert your gas heat rooftop from standard natural gas operation to Propane using this field-installed kit.

High Altitude Heating

High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion at altitudes above 2000 ft (610m). Kits may not be required in all areas.

FACTORY OPTIONS AND/OR ACCESSORIES (cont.)

Optional Stainless Steel Heat Exchanger

The stainless steel heat exchanger option provides the tubular heat exchanger be made out of a minimum 20 gauge type 409 stainless steel for applications where the mixed air to the heat exchanger is expected to drop below 45°F (7°C). Stainless steel may be specified on applications where the presence of airborne contaminants require its use (applications such as paper mills) or in area with very high outdoor humidity that may result in severe condensation in the heat exchanger during cooling operation.

Flue Discharge Deflector

The flue discharge deflector is a useful accessory when flue gas recirculation is a concern. By venting the flue discharge upwards, the deflector minimizes the chance for a neighboring unit to intake the flue exhaust.

Motor Status Indicator Switch

Monitors the EnergyX wheel/motor and supply and exhaust fan motors to provide indication of operation.

Alternate Motors and Drives

Some applications need larger horsepower motors, some need more airflow, and some need both. Regardless of the case, your Carrier expert has a factory installed combination to meet your application. A wide selection of motors and pulleys (drives) are available, factory installed, to handle nearly any application.

Thru-the-Base Connections

Thru-the-base connections, available as a factory option, are necessary to ensure proper connection and seal when routing wire and piping through the rooftop's basepan and curb. These couplings eliminate roof penetration and should be considered for gas lines, main power lines, as well as control power.

Hinged Access Panels

Allows access to unit's major components with specifically designed hinged access panels. Panels are filter, control box, indoor fan motor and ERV access.

Filter Status Indicator Switch

Monitors the EnergyX wheel/motor and supply and exhaust fan motors to provide indication of operation.

Table 2 – COOLING RATING TABLE 2-STAGE COOLING

					Atlanta		Miami		Phoenix		Montreal		Detroit	
UNIT	AHRI EER	ERV WHEEL	RTU AIR-FLOW (CFM)	ERV AIR-FLOW (CFM)	ERV RER	CEF	ERV RER	CEF	ERV RER	CEF	ERV RER	CEF	ERV RER	CEF
17	12.0	ERC–3628	5250	3800	68.67	16.60	80.82	17.59	61.82	16.05	43.08	14.52	55.58	15.54
20	12.0	ERC–3628	5950	3800	68.67	16.01	80.82	16.87	61.82	15.52	43.08	14.2	55.58	15.08
24	12.0	ERC–4646C	7000	5500	76.27	17.19	89.95	18.29	68.73	16.58	47.97	14.9	61.80	16.02
28	11.2	ERC–4646C	8750	5500	76.27	15.38	89.95	16.25	68.73	14.89	47.97	13.56	61.80	14.45

Energy recovery systems transfer heat from exhaust to intake air thus transferring up to 70% of the exhaust heat in the building. Evaluate heating needs and total EnergyX system heating capability using Carrier System Software.

Performance of areas shown above simulated with Carrier System Software. For CEF calculations for your application, use Carrier Software System Programs.

AHRI CEF = Combined Efficiency factor. As described in AHRI Guideline V, the CEF is the efficiency of a system incorporating an ERV component with a unitary packaged air conditioner, heat pump, etc. Units vary according to the application. CEF is a dimensionless value as it may be expressed in Btu/(W@h) or in W/W. CEF is calculated per ARI Guideline V calculations using nominal flow rates and temperatures. CEF is analogous to a “system EER” where the system consists of the RTU + ERV. Actual CEF value will vary based on actual location, airflows and temperatures. Contact your Carrier Sales Engineer for additional information.
RER = Net Conditioning recovered by ERV divided by total electrical power consumed by ERV.

Table 3 – HEATING RATING TABLE - NATURAL GAS & PROPANE

MODEL SIZE	HEAT SIZE	AL/SS HEAT EXCHANGER		TEMP RISE (DEG F)	THERMAL EFFICIENCY (%)
		INPUT / OUTPUT STAGE 1 (MBH)	INPUT / OUTPUT STAGE 2 (MBH)		
17	LOW	176 / 142	220 / 178	20 – 55	81%
	MED	248 / 200	310 / 251	30 – 60	81%
	HIGH	320 / 260	400 / 324	35 – 65	81%
20	LOW	176 / 142	220 / 178	15 – 55	81%
	MED	248 / 200	310 / 251	25 – 60	81%
	HIGH	320 / 260	400 / 324	30– 65	81%
24	LOW	176 / 142	220 / 178	15 – 55	81%
	MED	248 / 200	310 / 251	20 – 60	81%
	HIGH	320 / 260	400 / 324	30– 65	81%
28	LOW	176 / 142	220 / 178	10 – 55	81%
	MED	248 / 200	310 / 251	15 – 60	81%
	HIGH	320 / 260	400 / 324	20 – 65	81%

NOTES:

Heat ratings are for natural gas heat exchangers operated at or below 2000 ft (610 m). For information on Propane or altitudes above 2000 ft (610 m), see the Application Data section of this book. Accessory Propane/High Altitude kits are also available.

In the USA the input rating for altitudes above 2000 ft (610m) must be derated by 4% for each 1000 ft (305 m) above sea level. In Canada, the input rating must be derated by 10% for altitudes of 2000 ft (610 m) to 4500 ft (1372 m) above sea level.

Table 4 – SOUND PERFORMANCE TABLE

MODEL SIZE	COOLING STAGES	Outdoor Sound (dB)									
		A–Wtg.	AHRI 370 Rating	63	125	250	500	1000	2000	4000	8000
17	2	84.1	84	92.2	83.9	80.4	81.8	78.7	76.5	72.2	65.4
20	2	84.1	84	92.2	83.9	80.4	81.8	78.7	76.5	72.2	65.4
24	2	86.5	87	95.6	87.5	84.2	84.2	81.7	77.9	73.2	66.3
28	2	85.9	86	97.1	88.3	84.4	83.3	80.7	77.4	73.4	67.3

LEGEND

dB – Decibel

NOTES:

1. Outdoor sound data is measure in accordance with AHRI standard 270–2008.
2. Measurements are expressed in terms of sound power. Do not compare these values to sound pressure values because sound pressure depends on specific environmental factors which normally do not match individual applications. Sound power values are independent of the environment and therefore more accurate.
3. A–weighted sound ratings filter out very high and very low frequencies, to better approximate the response of "average" human ear. A–weighted measurements for Carrier units are taken in accordance with AHRI standard 270–2008.

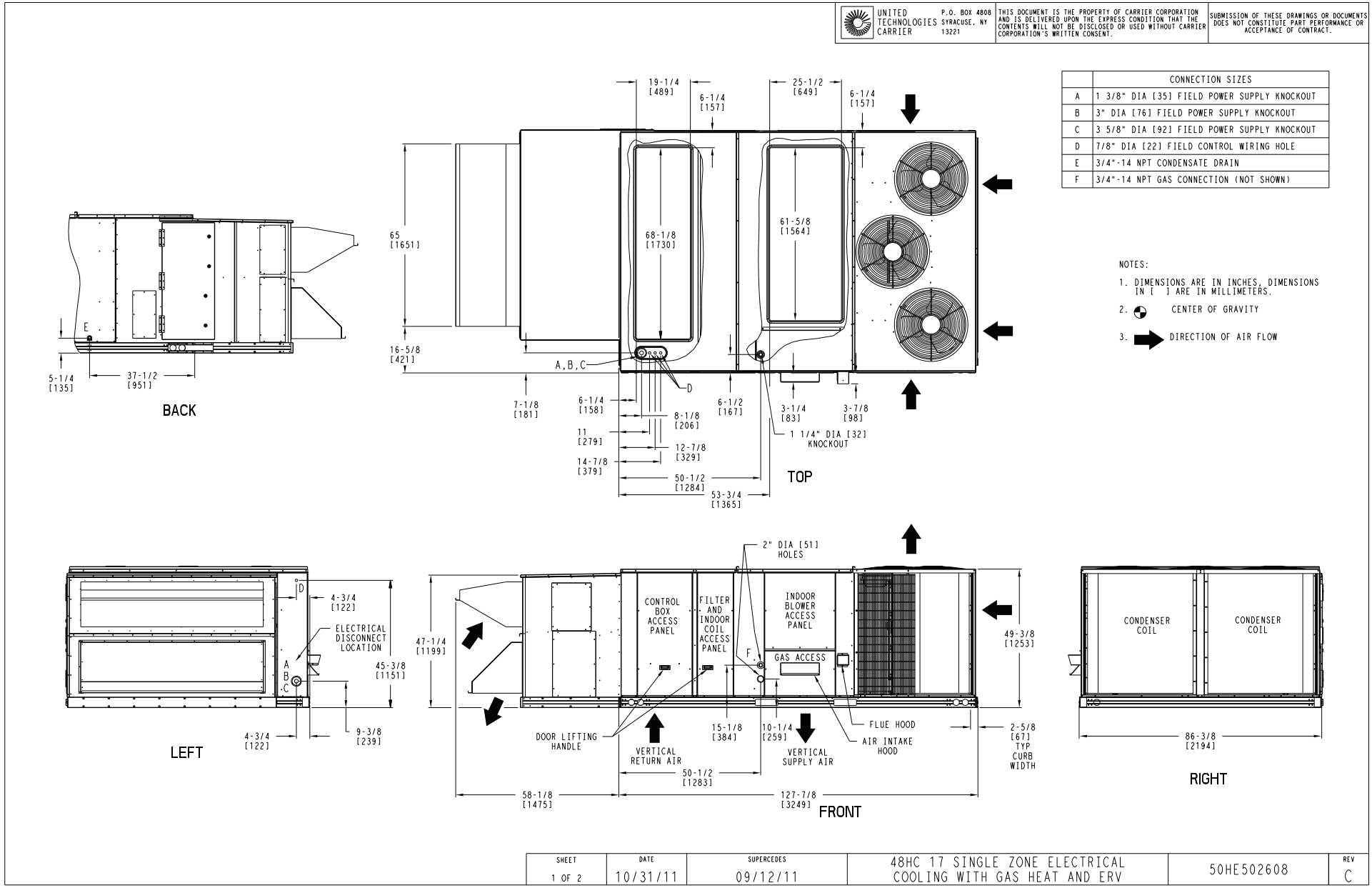
Table 5 – MINIMUM - MAXIMUM AIRFLOW RATINGS - NATURAL GAS & Propane

MODEL SIZE	HEAT SIZE	COOLING		AL HX HEATING		SS HX HEATING	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
17	LOW	4500	7500	3000	8250	3000	8250
	MED			3880	7750	3880	7750
	HIGH			4620	8570	4620	8570
20	LOW	5250	9000	3000	11000	2960	11000
	MED			3880	9300	3880	9300
	HIGH			4620	10000	4620	10000
24	LOW	6000	10000	3000	11000	3000	11000
	MED			3880	11630	3880	11630
	HIGH			4620	10000	4620	10000
28	LOW	7500	12500	3000	16500	2960	16500
	MED			3880	15500	3880	15500
	HIGH			4620	15000	4620	15000

Table 6 – PHYSICAL DATA **15 - 25 TONS**

MODEL	HC 15 –17.5 Ton		HC 20 – 25 Ton	
EnergyX Size	NON ECONO CFM	ECONO CFM	NON ECONO CFM	ECONO CFM
EnergyX Unit Type	Modulating Air Flow Capability		Modulating Air Flow Capability	
ERV WHEEL OA (CFM) Range	682 – 3675		1076 – 6000	
ERV WHEEL EA (CFM) Range	682 – 3675		1076 – 6000	
MAX ECONOMIZER OA (CFM)	N/A	6000/7000	N/A	8000/10000
MAX ECONOMIZER EA (CFM)		6000/7000		8000/10000
ENERGY RECOVERY WHEEL				
TYPE	Enthalpy Lightweight Polymer with Silica Gel Desiccant Coating		Enthalpy Lightweight Polymer with Silica Gel Desiccant Coating	
MODEL (AirXchange)	ERC–3628		ERC–4646C	
SIZE (Diameter X Depth) (in.)	36–in x 3–in		46–in x 3–in	
NOMINAL DRIVE MOTOR HP	1/20		1/6	
SUPPLY FAN #1				
QTY – TYPE	1 – Backward Curved		1 – Backward Curved	
DRIVE TYPE	Direct		Direct	
BLOWER SIZE (Diameter) (in.)	15.75–in		19.68–in	
NOMINAL MOTOR HP	1.2		3.6	
SUPPLY FAN #2				
QTY – TYPE	1 – Backward Curved		1 – Backward Curved	
DRIVE TYPE	Direct		Direct	
BLOWER SIZE (Diameter) (in.)	15.75–in		19.68–in	
NOMINAL MOTOR HP	1.2		3.6	
EXHAUST FAN #1				
QTY – TYPE	1 – Backward Curved		1 – Backward Curved	
DRIVE TYPE	Direct		Direct	
BLOWER SIZE (Diameter) (in.)	19.68–in		19.68–in	
NOMINAL MOTOR HP	3.6		3.6	
EXHAUST FAN #2				
QTY – TYPE	1 – Backward Curved		1 – Backward Curved	
DRIVE TYPE	Direct		Direct	
BLOWER SIZE (Diameter) (in.)	19.68–in		19.68–in	
NOMINAL MOTOR HP	3.6		3.6	
FILTERS				
TYPE	2–in. Pleated, 30% Efficiency		2–in. Pleated, 30% Efficiency	
SUPPLY AIR (QTY) – SIZE (in.)	(2) 20–in x 16–in x 2–in		(2) 16–in x 25–in x 2–in	
EXHAUST AIR (QTY) – SIZE (in.)	(2) 20–in x 16–in x 2–in		(2) 16–in x 25–in x 2–in	
TYPE	Aluminum Water Filter		Aluminum Water Filter	
Water Entrapment (QTY) – SIZE (in.)	(2) 34.375–in x 17.25–in x 1–in		(2) 34.375–in x 24.5–in x 1–in	

DIMENSIONS



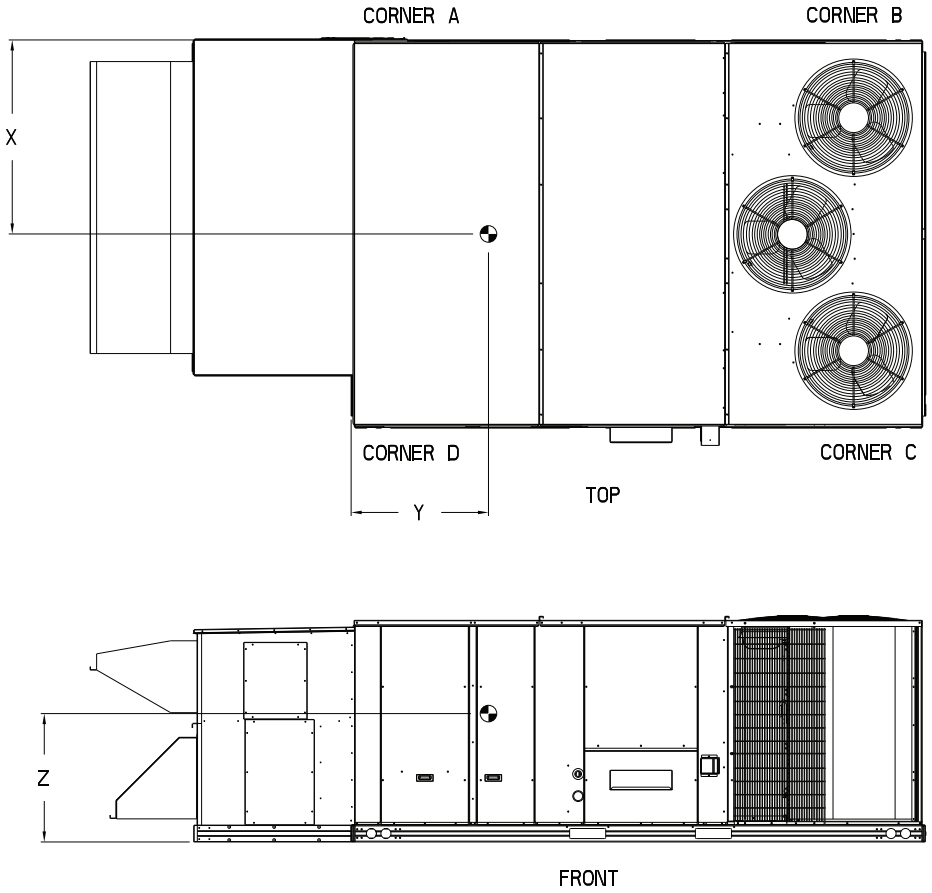
C11416

Fig. 1 - 48HC-17 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 1 of 2)

DIMENSIONS (cont.)

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC17	3358	1526	1178	535	499	227	500	227	1180	537	43 1/8 [1095]	38 [965]	16 1/2 [419]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.

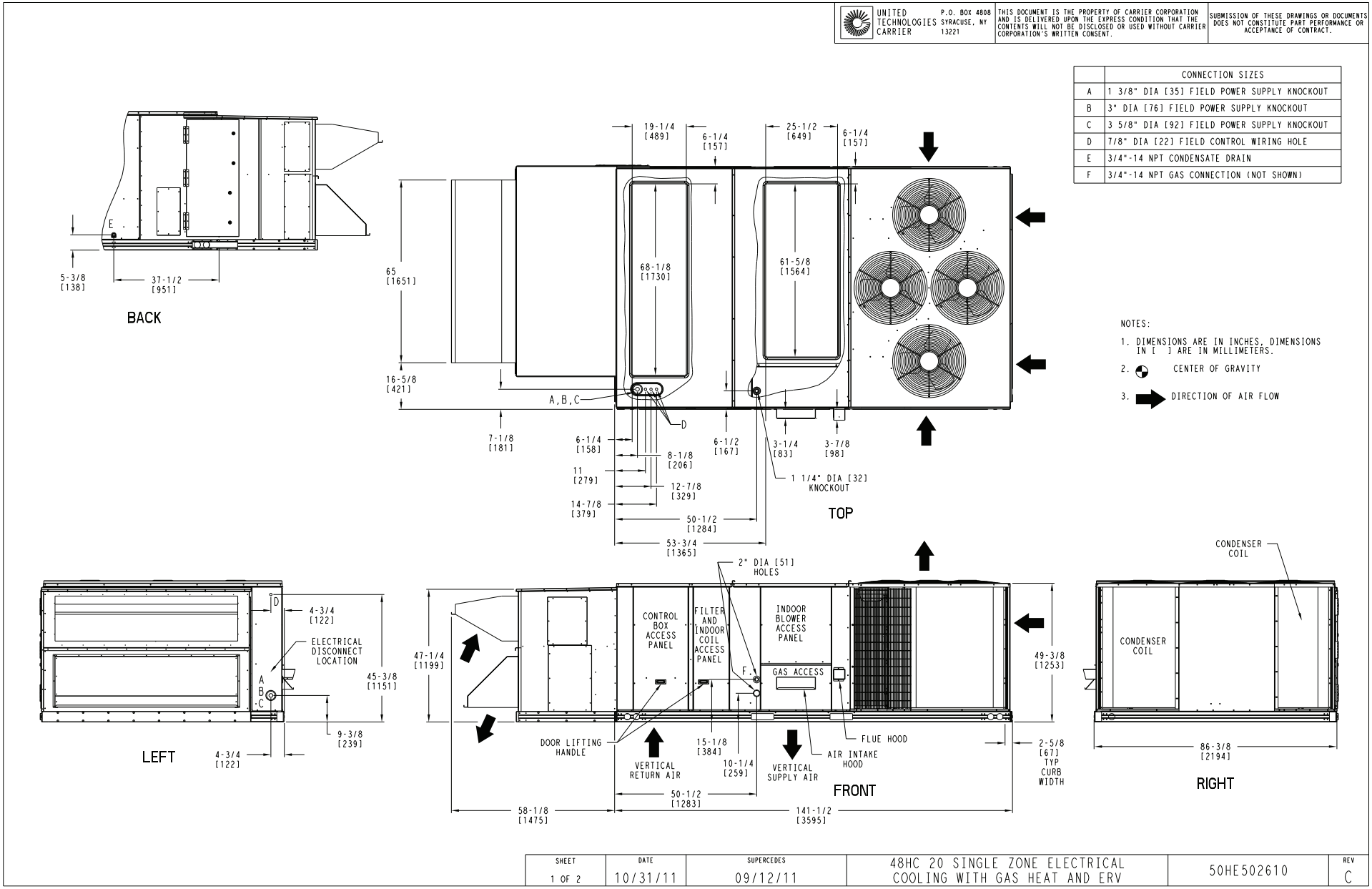


SHEET	DATE	SUPERCEDES			REV
2 OF 2	10/31/11	09/12/11	48HC 17 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502608	C

C11417

Fig. 2 - 48HC-17 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 2 of 2)

DIMENSIONS (cont.)



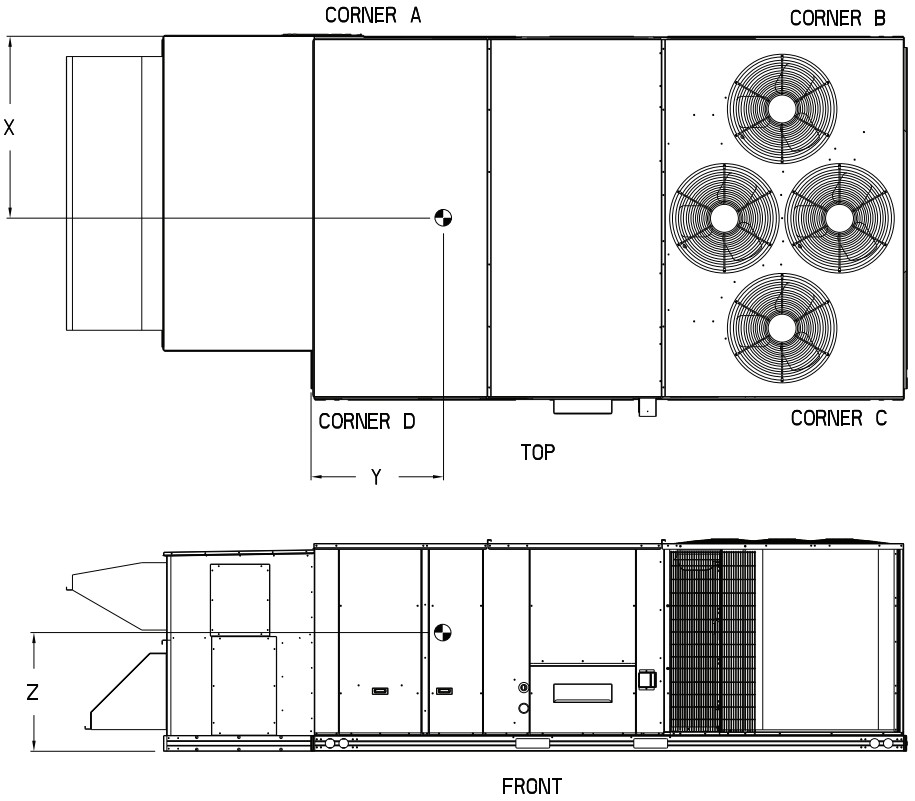
C11418

Fig. 3 - 48HC-20 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 1 of 2)

DIMENSIONS (cont.)

UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC20	3568	1622	1184	538	451	205	608	276	1150	523	42 1/2 [1079]	49 [1241]	16 1/2 [419]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.

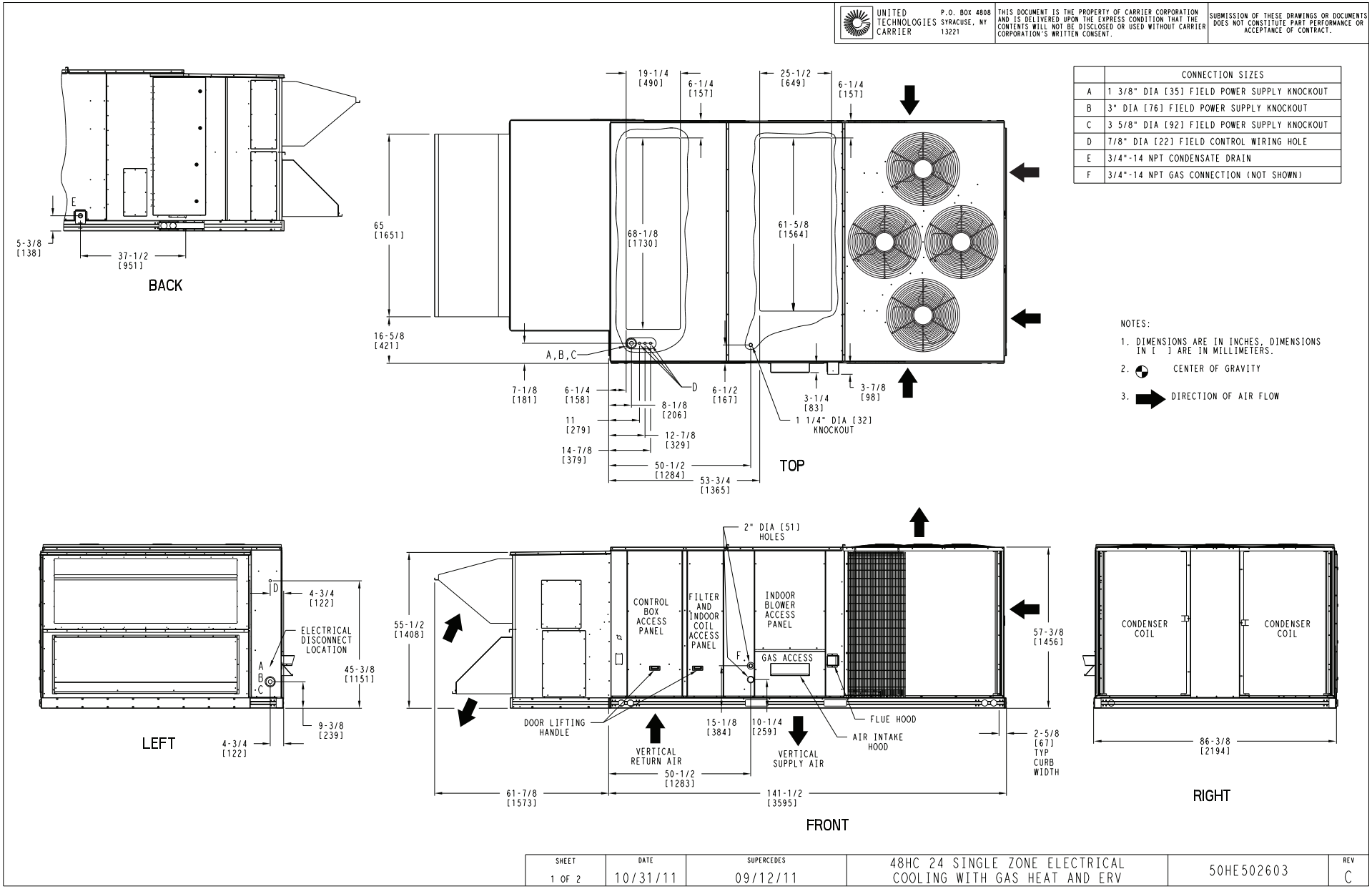


SHEET	DATE	SUPERCEDES			REV
2 OF 2	10/31/11	09/12/11	48HC 20 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502610	C

C11419

Fig. 4 - 48HC-20 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 2 of 2)

DIMENSIONS (cont.)



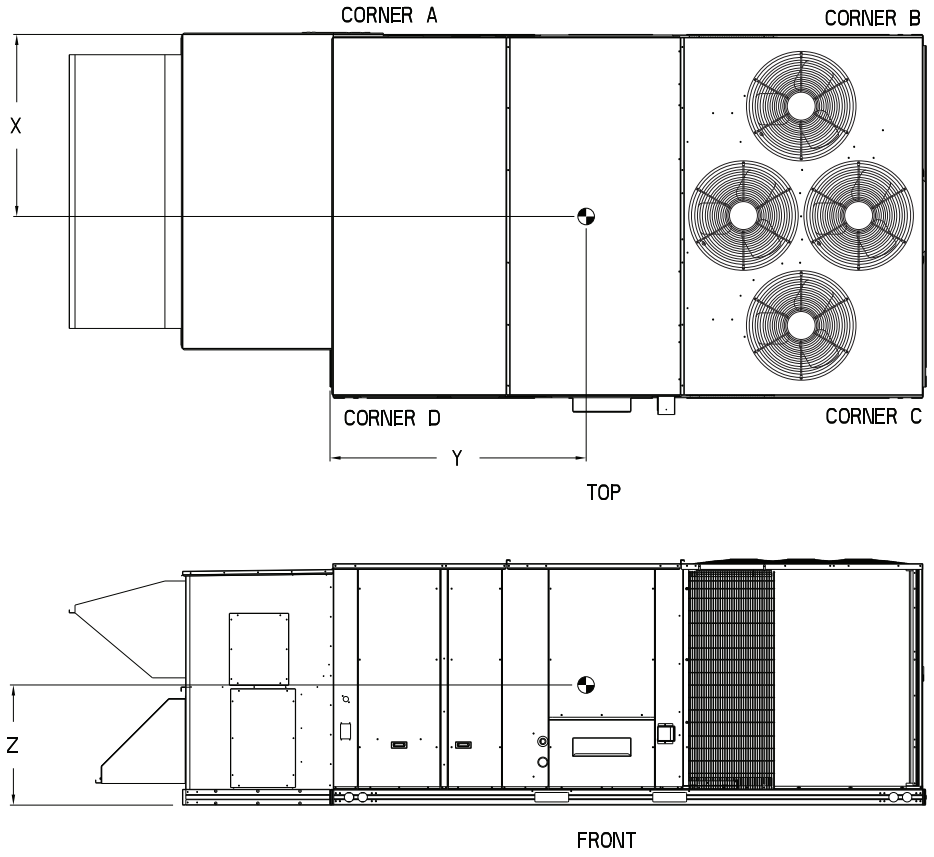
C11420

Fig. 5 - 48HC-24 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 1 of 2)

DIMENSIONS (cont.)

UNIT	STD. UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC24	3923	1783	1368	622	586	266	591	268	1379	627	43 1/4 [1099]	42 3/8 [1076]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.

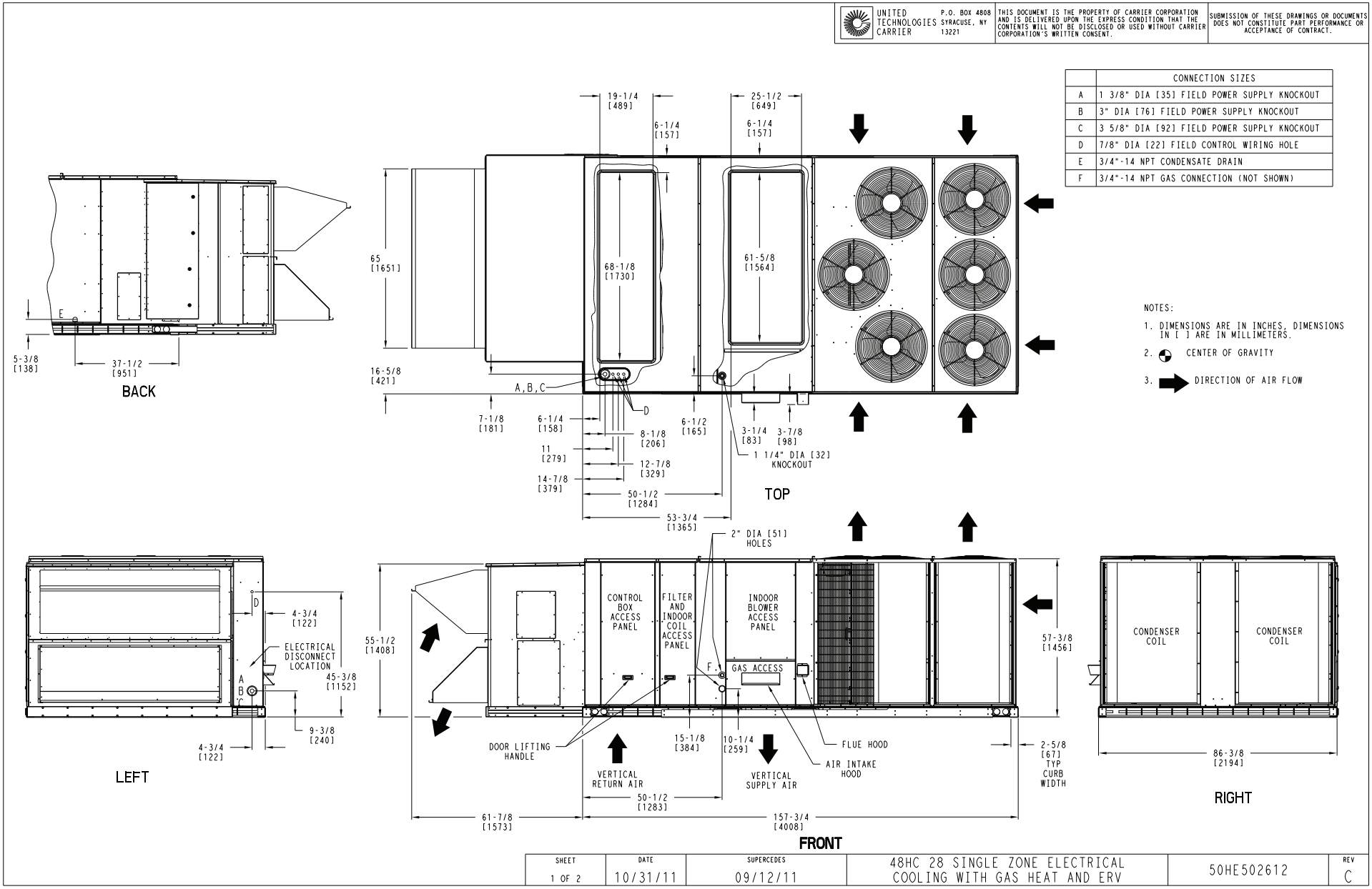


SHEET	DATE	SUPERCEDES			REV
2 OF 2	10/31/11	09/12/11	48HC 24 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502603	C

C11421

Fig. 6 - 48HC-24 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 2 of 2)

DIMENSIONS (cont.)



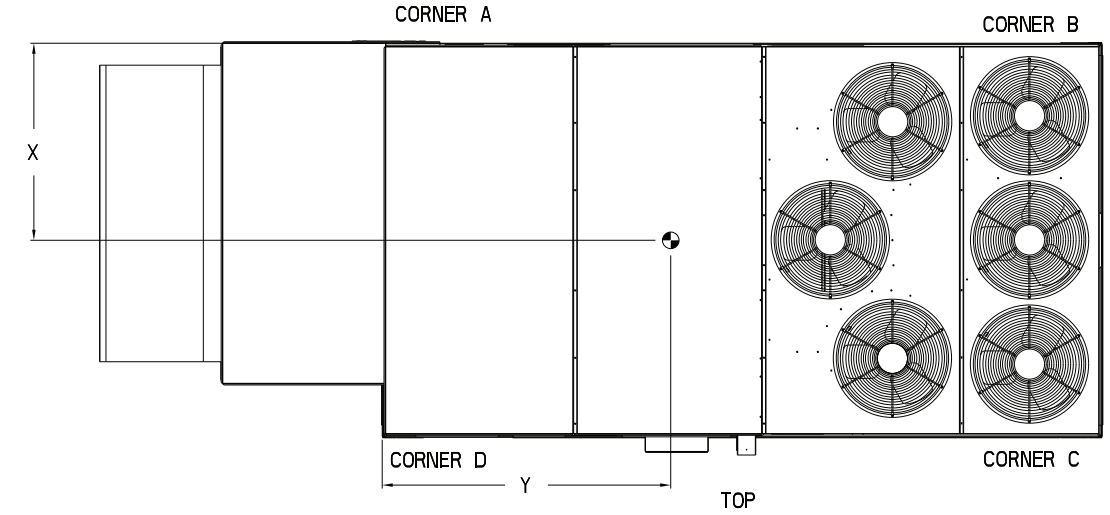
C11422

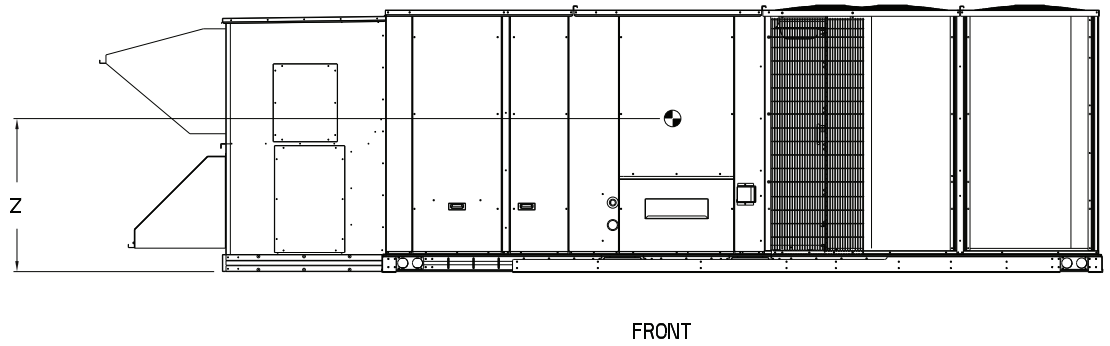
Fig. 7 - 48HC-28 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 1 of 2)

DIMENSIONS (cont.)

UNIT	STD UNIT WEIGHT *		CORNER WEIGHT (A)		CORNER WEIGHT (B)		CORNER WEIGHT (C)		CORNER WEIGHT (D)		C.G.		
	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	X	Y	Z
48HC28	3968	1804	1447	658	724	329	599	272	1198	544	39 [991]	52 1/2 [1334]	19 [483]

* STANDARD UNIT WEIGHT IS WITH LOW GAS HEAT AND WITHOUT PACKAGING.
FOR OTHER OPTIONS AND ACCESSORIES, REFER TO THE PRODUCT DATA CATALOG.



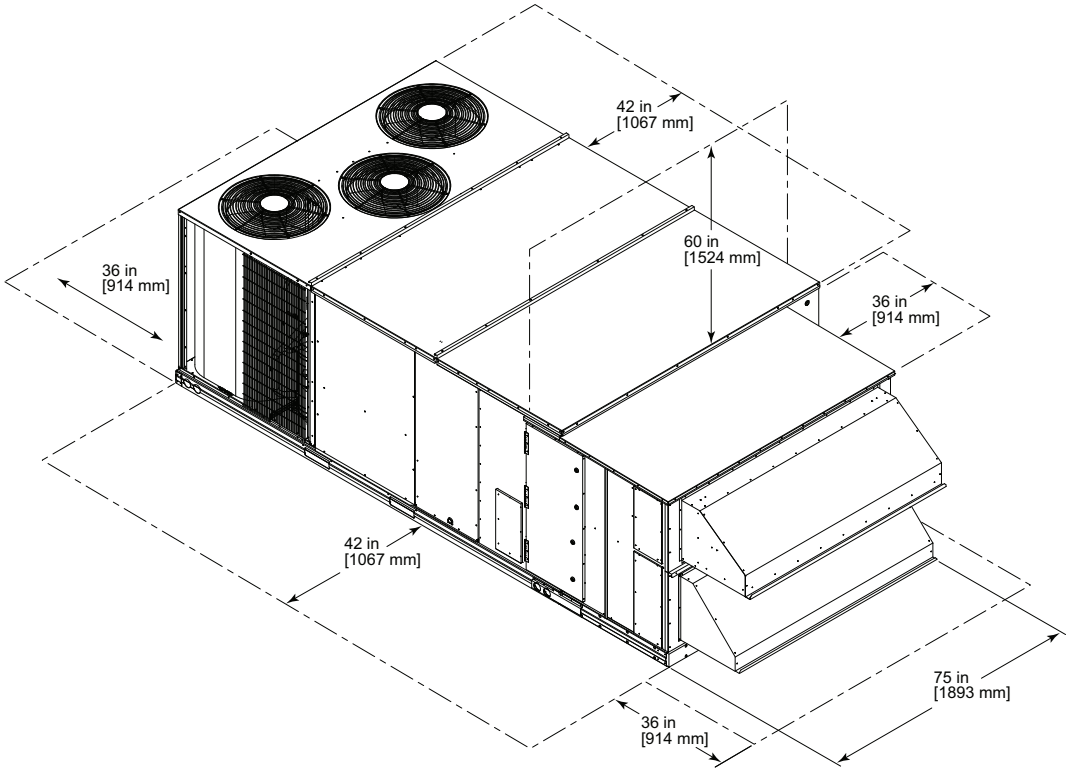


SHEET	DATE	SUPERCEDES			REV
2 OF 2	10/31/11	09/12/11	48HC 28 SINGLE ZONE ELECTRICAL COOLING WITH GAS HEAT AND ERV	50HE502612	C

C11423

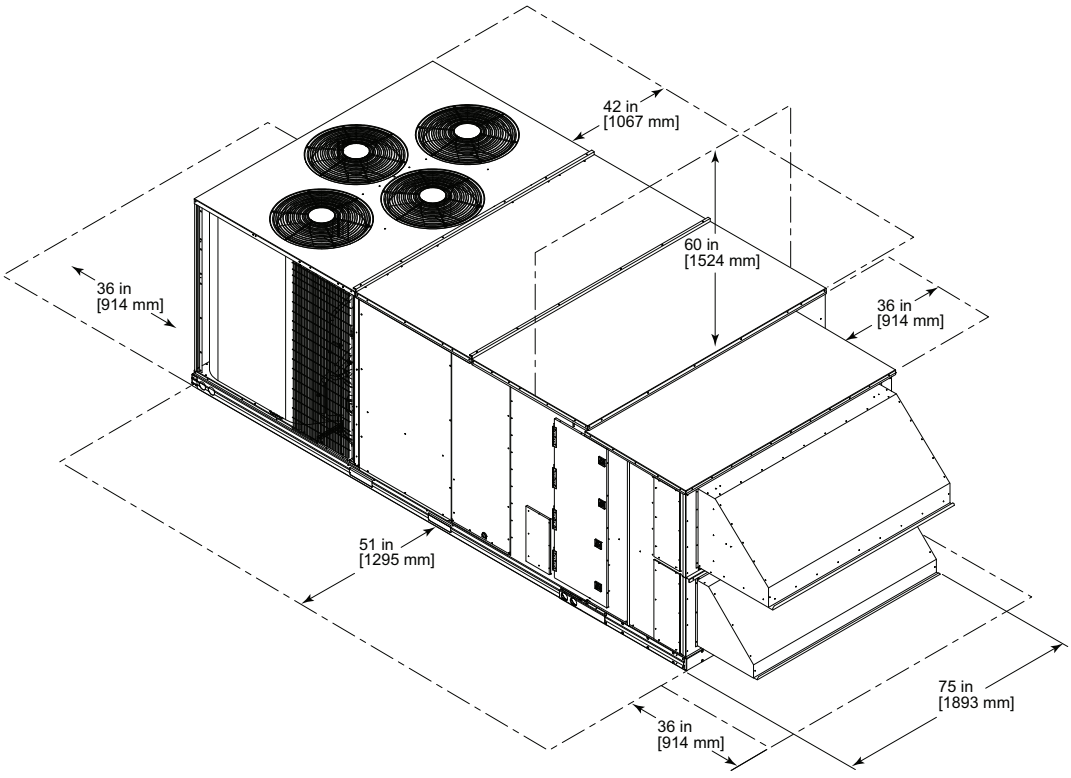
Fig. 8 - 48HC-28 Single Zone Electric Cooling with Gas Heat and ERV (Sheet 2 of 2)

DIMENSIONS (cont.)



C11461

Fig. 9 – Clearances for ERV on Size 17 & 20 HC Base Units

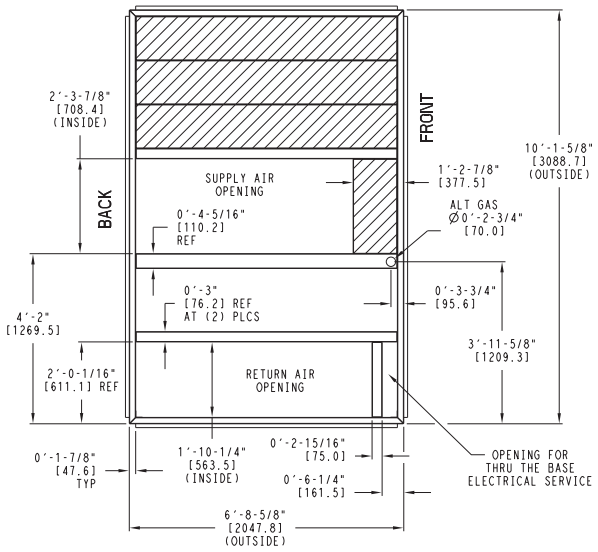


C11462

Fig. 10 – Clearances for ERV on Size 24 & 28 Base Units

DIMENSIONS (cont.)

UNIT SIZE	"A"	ROOF CURB ACCESSORY
17	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB045A00 CRRFCURB046A00



NOTES:

1 ROOF CURB ACCESSORY IS SHIPPED UNASSEMBLED.

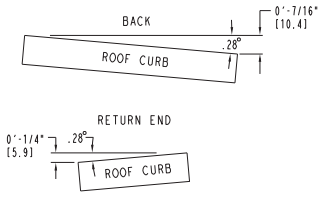
2 DIMENSIONS IN [ ] ARE IN MILLIMETERS.

3 ROOF CURB GALVANIZED STEEL.

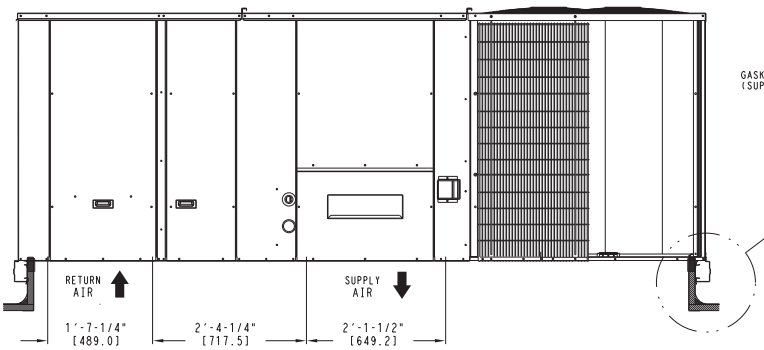
4 ATTACH DUCTWORK TO CURB (FLANGES ON DUCT REST ON CURB)

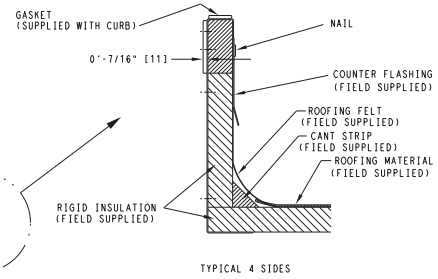
5 SERVICE CLEARANCE 4 ft ON EACH SIDE

DIRECTION OF AIR FLOW

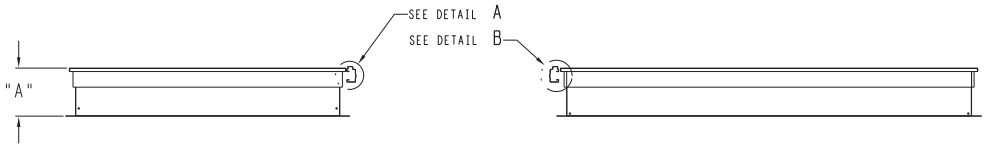


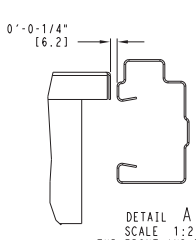
MAX CURB LEVELING TOLERANCES

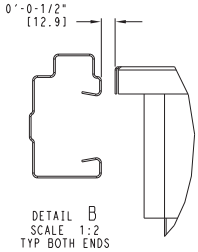


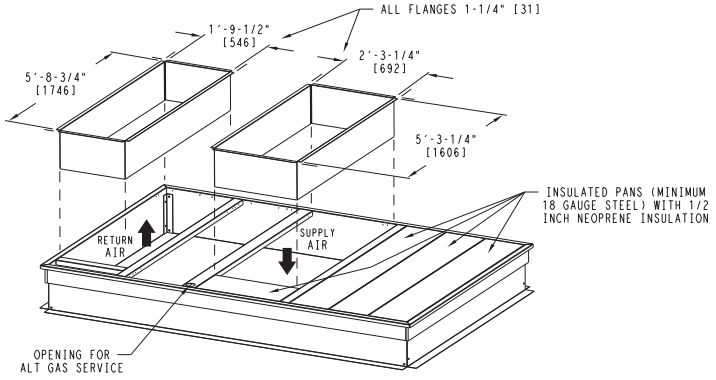


TYPICAL 4 SIDES









C10954

Fig. 11 - Curb Dimensions 48HC*D17

DIMENSIONS (cont.)

UNIT SIZE	"A"	ROOF CURB ACCESSORY
20, 24	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB047A00 CRRFCURB048A00

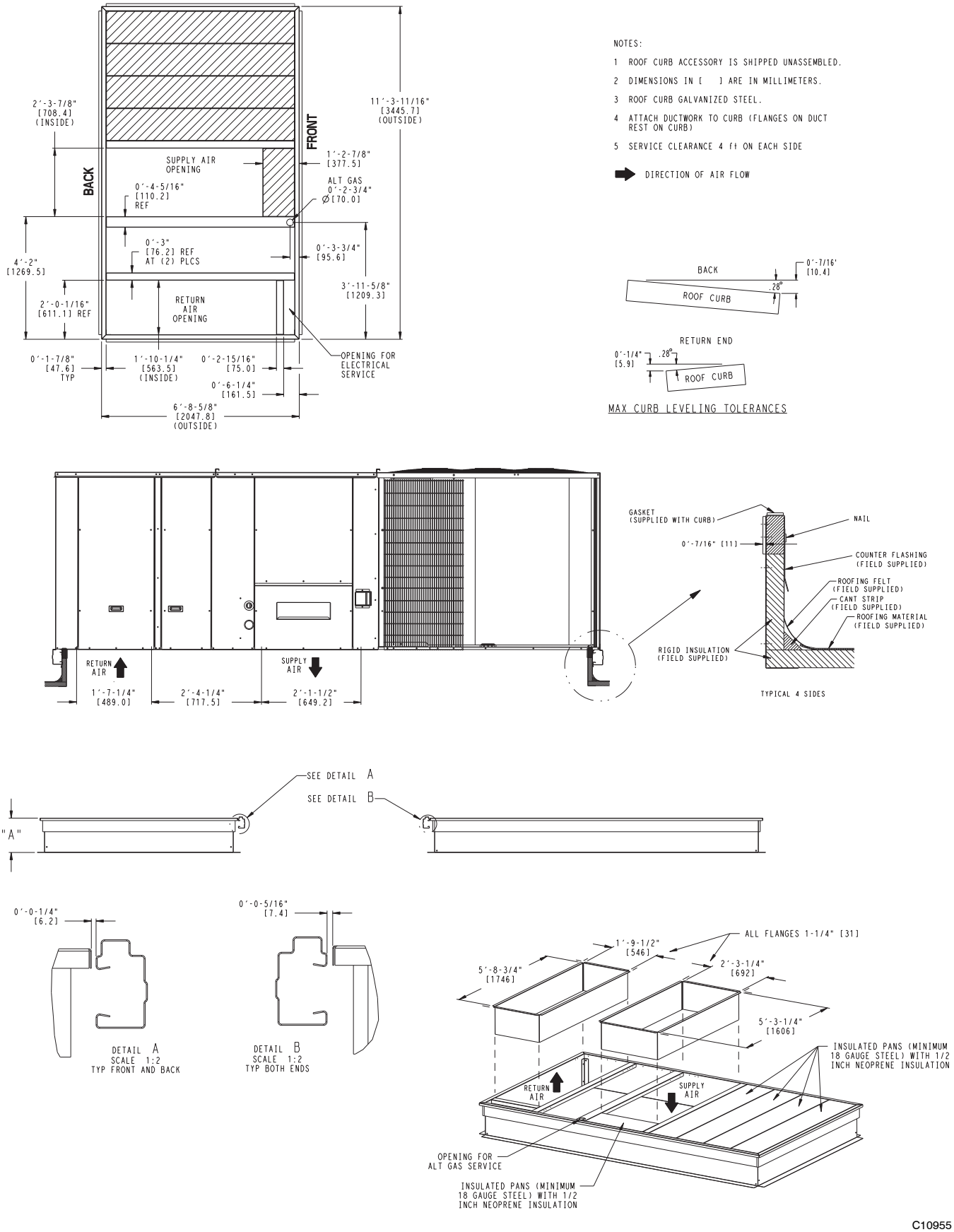
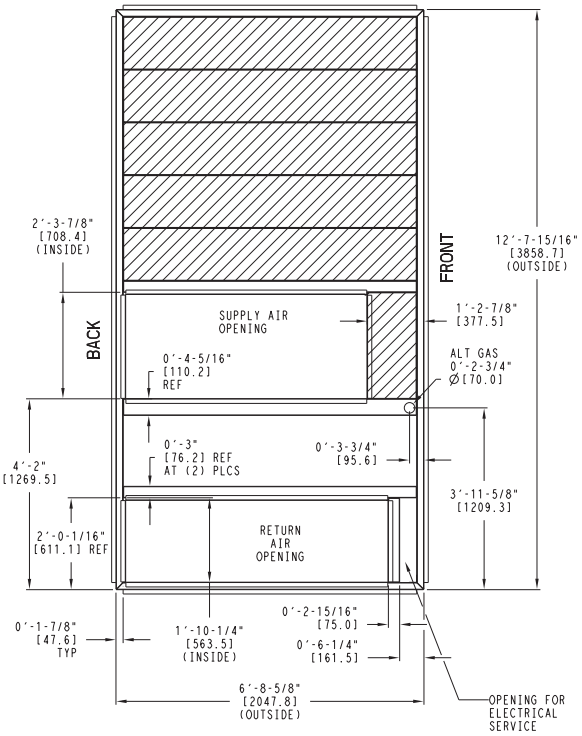


Fig. 12 – Curb Dimensions 48HC*D20 – 24

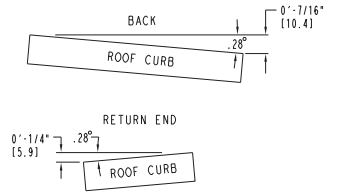
DIMENSIONS (cont.)

UNIT SIZE	"A"	ROOF CURB ACCESSORY
28	1′-2" [356.0] 2′-0" [610.0]	CRRFCURB049A00 CRRFCURB050A00

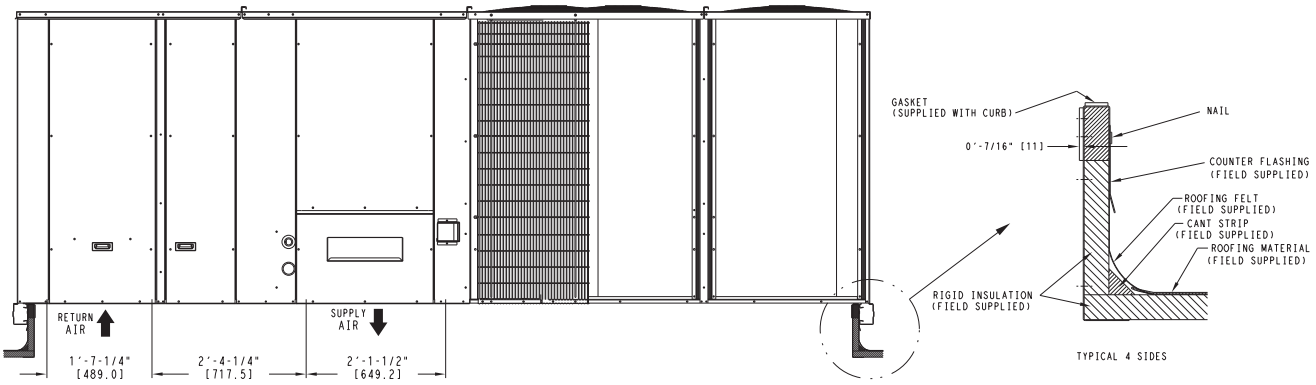


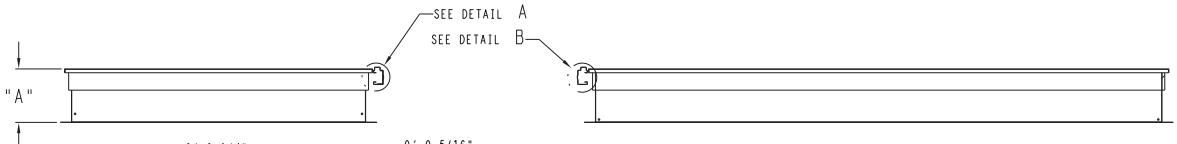
NOTES:
1 ROOF CURB ACCESSORY IS SHIPPED UNASSEMBLED.
2 BOLT HEADS TO BE ON INSIDE OF FLANGE. CLEARANCE IS [11] 0-0-7/16" TYP ALL CORNERS.
3 DIMENSIONS IN [ ] ARE IN MILLIMETERS.
4 ROOF CURB GALVANIZED STEEL.
5 ATTACH DUCTWORK TO CURB (FLANGES ON DUCT REST ON CURB)
6 SERVICE CLEARANCE 4 ft ON EACH SIDE
7 GAS SERVICE PLATE IS PART OF A SEPERATELY SHIPPED ACCESSORY PACKAGE.
8 GAS SERVICE PLATE CAN BE USED WITH EITHER ACCESSORY ROOFCURB.

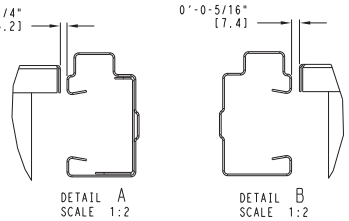
➡ DIRECTION OF AIR FLOW

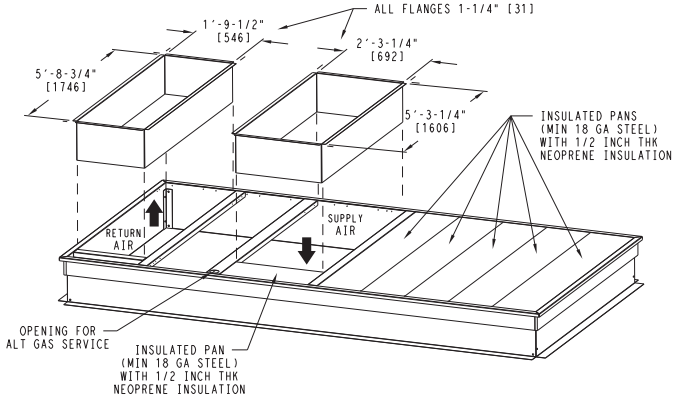


MAX CURB LEVELING TOLERANCES









C10956

Fig. 13 - Curb Dimensions 48HC*D28

OPTIONS WEIGHT ADDERS

BASE UNIT WITH OPTIONS (Weight Adders)	MAX WEIGHT ADD							
	48HC*17		48HC*20		48HC*24		48HC*28	
	lb	kg	lb	kg	lb	kg	lb	kg
Base Unit Operating Weight	3358	1526	3568	1622	3923	1783	3968	1804
Economizer	498	226	498	226	505	229	505	229
Low Gas Heat	85	39	85	39	85	39	85	39
Medium Gas Heat	90	41	90	41	90	41	90	41
High Gas Heat	113	51	113	51	113	51	113	51
Flue Discharge Deflector	7	3	7	3	7	3	7	3
Roof Curb 14–in (356mm)	240	109	255	116	255	116	255	116
Roof Curb 24–in (610mm)	340	154	355	161	355	161	355	161
Louvered Hail Guard	60	27	60	27	120	54	150	68
CO_2 sensor	5	2	5	2	5	2	5	2
Return Smoke Detector	5	2	5	2	5	2	5	2
Supply Smoke Detector	5	2	5	2	5	2	5	2
Fan/Filter Status Switch	2	1	2	1	2	1	2	1
Non–Fused Disconnect	15	7	15	7	15	7	15	7
Powered Convenience Outlet	35	16	35	16	35	16	35	16
Non–Powered Convenience Outlet	5	2	5	2	5	2	5	2
Enthalpy Sensor	2	1	2	1	2	1	2	1
Differential Enthalpy Sensor	3	1	3	1	3	1	3	1
Field Filter Track 4–in (102mm)	22	10	22	10	22	10	22	10
MotorMaster Controller	35	16	35	16	35	16	35	16
Standard Static Motor/Drive	0	0	0	0	0	0	0	0
Medium Static Motor/Drive	5	2	6	3	6	3	6	3
High Static Motor/Drive	11	5	12	5	16	7	16	7
Copper Tube/Fin Condenser Coil	28	13	30	14	34	15	34	15
Copper Tube/Fin Condenser & Evaporator Coil	53	24	56	28	64	29	64	29

APPLICATION/SELECTION DATA

EnergyX

When selecting the WeatherMaster Series Unit and EnergyX system to use on a given application, it is strongly recommended that the Carrier Packaged RTU Builder (PRB) Selection Software be used. This is because there are a number of variables which become complex when manual calculations are performed, but can easily be accounted for in a computer operation. Most specifically, the AHRI certified ratings use Standard CFM values, but due to real world operation, variances in altitude and air density are very important. The Carrier PRB software uses altitude corrected airflows (ACFM).

See Carrier's Packaged Rooftop Builder selection software for automated calculation of unit selection and Combined Efficiency Factor (CEF) values.

Typical Energy Recovery unit selection involves the following steps:

1. Determine the zone cooling and heating requirements at the design conditions.
2. Select Energy Recovery unit based on desired outdoor airflow rate.
   Note: It is recommended that the outdoor airflow and exhaust airflow rates be designed at the same or close to the same value. If the difference between the two airflows becomes large enough, the energy recovery unit's cooling capacity, heating capacity and overall efficiency will be negatively impacted.
3. Calculate the Energy Recovery unit's leaving air conditions and unit capacities based on the outside airflow rate, temperature (dB & wB) and exhaust airflow rate and temperatures (dB and wB) at the design temperatures and maximum ventilation rate.
4. Subtract the Energy Recovery unit's cooling and heating capacities from the design zone requirements. The value that remains is the necessary design size of the rooftop unit.
5. Use the Energy Recovery unit's leaving air temperatures (dB and wB) as the ventilation air temperatures entering the rooftop unit to be mixed with the return air before passing through the rooftop unit's evaporator.
6. After selecting the desired Energy Recovery unit and rooftop unit, use AHRI's Guideline V to calculate the Combine Efficiency Factor (system EER).

Additional information on Energy Recovery capacity calculations and leaving air temperature calculations can be found in the two AHRI documents below:

AHRI Guideline V – CALCULATING THE EFFICIENCY OF ENERGY RECOVERY VENTILATION AND ITS EFFECT ON EFFICIENCY AND SIZING OF BUILDING HVAC SYSTEMS

AHRI Standard 1060 - PERFORMANCE RATING OF AIR-TO-AIR HEAT EXCHANGERS FOR ENERGY RECOVERY VENTILATION EQUIPMENT

Airxchange Energy Recovery Cassette

UL certified, AHRI listed, silica gel enthalpy desiccant, wheels > 25-in diameter are segmented for easy cleaning, washable with detergent and water, 5 year std limited warranty.

Operation

Energy recovery wheels rotate between the incoming outdoor airstream and the building exhaust airstream. As the wheel rotates, it transfers heat and moisture from one airstream to the other. Result = outdoor air is pre-conditioned, significantly reducing the capacity and energy needed from the mechanical HVAC system.

Factory installed accessories

Economizer option – allows true modulating economizer capability when OA is suitable for free cooling

- operates as a true wheel bypass damper
- uses stop/jog operation for wheel
- required when using CO_2 sensor for DCV operation

Frost control option – uses exhaust air to defrost the wheel when necessary.

EnergyX System ComfortLink V5 integrated controls

All ERV configuration, setup and troubleshooting is done via ComfortLink controls.

- Modulating OA ventilation damper
- New "Outside Air Unit" points table
- New control functions for accessory devices:
  Cold air tempering kit
  Exhaust fan building pressure control
  2-position exhaust damper

Field installed accessories

Horizontal roofcurb adaptors – used when horizontal supply &/or return is desired.

Motor status indicator accessory – monitors wheel, supply & exhaust motors and provides indication if not operating.

Filter status indicator accessory – monitors static pressure across supply & exhaust filters and provides indication when filters become clogged.

Motorized exhaust damper accessory – replaces the standard barometric exhaust damper blades with motorized (open/shut) damper.

Min operating ambient temp (cooling):

In mechanical cooling mode, your Carrier rooftop unit can safely operate down to an outdoor ambient temperature of 35°F (2°C). It is possible to provide cooling at lower outdoor ambient temperatures by using less outside air, economizers, and/or accessory low ambient kits.

APPLICATION/SELECTION DATA (cont.)

Max operating ambient temp (cooling):

The maximum operating ambient temperature for cooling mode is 125°F (52°C). While cooling operation above 125°F (52°C) may be possible, it could cause either a reduction in performance, reliability, or a protective action by the unit's internal safety devices.

Min mixed air temp (heating):

Using the factory settings, the minimum temperatures for the mixed air (the combined temperature of the warm return air and the cold outdoor air) entering the dimpled, gas heat exchangers are:

Aluminized	Stainless Steel
50°F (10°C) continuous	40°F (4°C) continuous
45°F (7°C) intermittent	35°F (2°C) intermittent

Operating at lower mixed-air temperatures may be possible, if a field-supplied, outdoor air thermostat initiates both heat stages when the temperature is less than the minimum temperatures listed above. Please contact your local Carrier representative for assistance.

Min and max airflow (heating and cooling):

To maintain safe and reliable operation of your rooftop, operate within the heating airflow limits during heating mode and cooling airflow limits during cooling mode. Operating above the max may cause blow-off, undesired airflow noise, or airflow related problems with the rooftop unit. Operating below the min may cause problems with coil freeze-up and unsafe heating operation. Heating and cooling limitations differ when evaluating operating CFM, the minimum value is the HIGHER of the cooling and heating minimum CFM values published in Table 5 and the maximum value is the LOWER of the cooling and heating minimum values published in Table 5.

Heating-to-cooling changeover:

Your unit will automatically change from heating to cooling mode with ComfortLink controls.

Airflow:

All units are draw-through in cooling mode and blow-through in heating mode.

Outdoor air application strategies:

Economizers reduce operating expenses and compressor run time by providing a free source of cooling and a means of ventilation to match application changing needs. In fact, they should be considered for most applications. Also, consider the various economizer control methods and their benefits, as well as sensors required to accomplish your application goals. Please contact your local Carrier representative for assistance.

Motor limits, break horsepower (BHP):

Due to internal design of Carrier units, the air path, and specially designed motors, the full horsepower (maximum continuous BHP) band, as listed in Physical Data Table Cooling, can be used with the utmost confidence. There is no need for extra safety factors, as Carrier motors are designed and rigorously tested to use the entire, listed BHP range without either nuisance tripping or premature motor failure.

Propane heating:

Propane has different physical qualities than natural gas. As a result, Propane requires different fuel to air mixture. To optimize the fuel/air mixture for Propane, Carrier sells different burner orifices in an easy to install accessory kit. To select the correct burner orifices or determine the heat capacity for an Propane application, use either the selection software, or the unit's service manual.

High altitude heating:

High altitudes have less oxygen, which affects the fuel/air mixture in heat exchangers. In order to maintain a proper fuel/air mixture, heat exchangers operating in altitudes above 2000 ft (610m) require different orifices. To select the correct burner orifices or determine the heat capacity for a high altitude application, use either the selection software, or the unit's service manual.

High altitudes have less oxygen, which means heat exchangers need less fuel. The new gas orifices in this field-installed kit make the necessary adjustment for high altitude applications. They restore the optimal fuel to air mixture and maintain healthy combustion on altitudes above 2000 ft (610m).

NOTE: Typical natural gas heating value ranges from 975 to 1050 Btu/ft^3 at sea level nationally. The heating value goes down approximately 1.7% per every thousand feet elevation. Standard factory orifices can typically be used up to 2000 ft (610m) elevation without any operational issues.

NOTE: For installations in Canada, the input rating should be derated by 10% for altitudes from 2000 ft (610m) to 4500 ft (1372m) above sea level.

APPLICATION/SELECTION DATA (cont.)

Sizing a rooftop

Bigger isn't necessarily better. While an air conditioner needs to have enough capacity to meet the design loads, it doesn't need excess capacity. In fact, excess capacity typically results in very poor part load performance and humidity control.

Using higher design temperatures than ASHRAE recommends for your location, adding "safety factors" to the calculated load, are all signs of oversizing air conditioners. Oversizing the air conditioner leads to poor humidity control, reduced efficiency, higher utility bills, larger indoor temperature swings, excessive noise, and increased wear and tear on the air conditioner.

Rather than oversizing an air conditioner, engineers should "right-size" or even slightly undersize air conditioners. Correctly sizing an air conditioner controls humidity better; promotes efficiency; reduces utility bills; extends equipment life, and maintains even, comfortable temperatures. Please contact your local Carrier representative for assistance.

Low ambient applications

The optional Carrier economizer can adequately cool your space by bringing in fresh, cool outside air. In fact, when so equipped, accessory low-ambient kit may not be necessary. In low ambient conditions, unless the outdoor air is excessively humid or contaminated, economizer-based "free cooling" is the preferred less costly and energy conscious method.

In low ambient applications where outside air might not be desired (such as contaminated or excessively humid outdoor environments), your Carrier rooftop can operate to ambient temperatures down to -20°F (-29°C) using the recommended accessory Motormaster low ambient controller or down to 25°F (-4°C) with the field installed Winter Start Package.

Application/Selection Option

Selection software by Carrier saves time by performing many of the steps above. Contact your Carrier sales representative for assistance.

Table 7 – COOLING CAPACITIES 2-Stage Cooling 15 TONS

48HC*D17				AMBIENT TEMPERATURE													
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
4500 CFM	EAT (wb)	58	TC	158.3	158.3	179.2	152.6	152.6	172.9	146.6	146.6	166.1	140.2	140.2	158.8	133.2	133.2	150.8
			SHC	137.3	158.3	179.2	132.4	152.6	172.9	127.2	146.6	166.1	121.6	140.2	158.8	115.5	133.2	150.8
		62	TC	166.8	166.8	169.0	159.5	159.5	165.6	151.8	151.8	161.9	143.6	143.6	157.9	134.9	134.9	153.4
			SHC	123.1	146.1	169.0	119.7	142.6	165.6	116.1	139.0	161.9	112.3	135.1	157.9	108.2	130.8	153.4
		67	TC	182.9	182.9	182.9	174.9	174.9	174.9	166.3	166.3	166.3	157.2	157.2	157.2	147.6	147.6	147.6
			SHC	100.0	123.1	146.1	96.7	119.8	142.8	93.2	116.3	139.4	89.7	112.7	135.7	85.9	108.9	131.9
		72	TC	200.5	200.5	200.5	191.6	191.6	191.6	182.2	182.2	182.2	172.2	172.2	172.2	161.7	161.7	161.7
			SHC	76.1	99.5	122.8	72.9	96.2	119.5	69.5	92.8	116.1	66.0	89.3	112.5	62.4	85.6	108.8
		76	TC	–	215.4	215.4	–	205.8	205.8	–	195.6	195.6	–	184.8	184.8	–	173.6	173.6
			SHC	–	80.2	105.0	–	77.1	101.7	–	73.7	98.2	–	70.2	94.5	–	66.7	90.7
5250 CFM	EAT (wb)	58	TC	166.7	166.7	188.8	160.6	160.6	181.9	154.0	154.0	174.4	147.0	147.0	166.5	139.5	139.5	157.9
			SHC	144.6	166.7	188.8	139.3	160.6	181.9	133.6	154.0	174.4	127.6	147.0	166.5	121.0	139.5	157.9
		62	TC	172.0	172.0	185.1	164.3	164.3	181.2	156.3	156.3	177.0	147.8	147.8	172.4	139.6	139.6	164.3
			SHC	132.5	158.8	185.1	128.9	155.1	181.2	125.0	151.0	177.0	120.9	146.6	172.4	114.9	139.6	164.3
		67	TC	188.3	188.3	188.3	179.7	179.7	179.7	170.7	170.7	170.7	161.0	161.0	161.0	150.9	150.9	150.9
			SHC	106.1	132.7	159.3	102.8	129.3	155.9	99.3	125.8	152.4	95.6	122.1	148.6	91.7	118.2	144.7
		72	TC	206.1	206.1	206.1	196.7	196.7	196.7	186.7	186.7	186.7	176.2	176.2	176.2	165.3	165.3	165.3
			SHC	78.8	105.6	132.5	75.5	102.3	129.1	72.1	98.8	125.6	68.5	95.2	121.9	64.8	91.4	118.0
		76	TC	–	221.2	221.2	–	211.0	211.0	–	200.3	200.3	–	189.0	189.0	–	177.2	177.2
			SHC	–	83.6	111.7	–	80.3	108.2	–	76.9	104.6	–	73.3	100.9	–	69.7	97.1
6000 CFM	EAT (wb)	58	TC	173.8	173.8	196.8	167.2	167.2	189.4	160.2	160.2	181.4	152.7	152.7	173.0	144.7	144.7	163.8
			SHC	150.8	173.8	196.8	145.1	167.2	189.4	139.0	160.2	181.4	132.5	152.7	173.0	125.5	144.7	163.8
		62	TC	176.3	176.3	199.5	168.5	168.5	194.9	160.5	160.5	188.9	152.9	152.9	179.9	144.8	144.8	170.4
			SHC	140.9	170.2	199.5	136.9	165.9	194.9	132.1	160.5	188.9	125.8	152.9	179.9	119.2	144.8	170.4
		67	TC	192.3	192.3	192.3	183.4	183.4	183.4	173.9	173.9	173.9	164.0	164.0	164.0	153.4	153.4	156.9
			SHC	112.0	142.0	172.0	108.5	138.5	168.5	104.9	134.9	164.8	101.2	131.1	161.0	97.2	127.1	156.9
		72	TC	210.4	210.4	210.4	200.6	200.6	200.6	190.2	190.2	190.2	179.3	179.3	179.3	167.9	167.9	167.9
			SHC	81.2	111.4	141.7	77.9	108.0	138.2	74.4	104.5	134.6	70.7	100.8	130.8	67.0	96.9	126.9
		76	TC	–	225.6	225.6	–	215.0	215.0	–	203.8	203.8	–	192.1	192.1	–	180.0	180.0
			SHC	–	86.7	117.9	–	83.3	114.5	–	79.9	110.8	–	76.3	107.1	–	72.6	103.2
6750 CFM	EAT (wb)	58	TC	179.8	179.8	203.7	172.9	172.9	195.8	165.5	165.5	187.4	157.5	157.5	178.4	149.0	149.0	168.8
			SHC	156.0	179.8	203.7	150.0	172.9	195.8	143.5	165.5	187.4	136.7	157.5	178.4	129.3	149.0	168.8
		62	TC	180.5	180.5	210.7	173.0	173.0	203.6	165.6	165.6	194.9	157.7	157.7	185.5	149.1	149.1	175.5
			SHC	147.6	179.2	210.7	142.4	173.0	203.6	136.3	165.6	194.9	129.8	157.7	185.5	122.8	149.1	175.5
		67	TC	195.6	195.6	195.6	186.2	186.2	186.2	176.5	176.5	176.8	166.2	166.2	172.7	155.4	155.4	168.4
			SHC	117.5	150.8	184.1	114.0	147.3	180.5	110.4	143.6	176.8	106.5	139.6	172.7	102.4	135.4	168.4
		72	TC	213.8	213.8	213.8	203.6	203.6	203.6	192.9	192.9	192.9	181.6	181.6	181.6	169.9	169.9	169.9
			SHC	83.5	117.0	150.5	80.1	113.5	147.0	76.5	109.9	143.3	72.8	106.1	139.4	69.1	102.3	135.5
		76	TC	–	229.1	229.1	–	218.1	218.1	–	206.6	206.6	–	194.6	194.6	–	182.1	182.1
			SHC	–	89.6	124.0	–	86.2	120.5	–	82.7	116.8	–	79.0	113.0	–	75.2	109.0
7500 CFM	EAT (wb)	58	TC	185.1	185.1	209.6	177.7	177.7	201.3	170.0	170.0	192.5	161.6	161.6	183.0	152.8	152.8	173.0
			SHC	160.6	185.1	209.6	154.2	177.7	201.3	147.5	170.0	192.5	140.2	161.6	183.0	132.5	152.8	173.0
		62	TC	185.2	185.2	218.0	177.9	177.9	209.3	170.1	170.1	200.2	161.8	161.8	190.4	152.9	152.9	179.9
			SHC	152.5	185.2	218.0	146.4	177.9	209.3	140.0	170.1	200.2	133.2	161.8	190.4	125.8	152.9	179.9
		67	TC	198.1	198.1	198.1	188.6	188.6	192.1	178.6	178.6	188.1	168.1	168.1	183.8	157.2	157.2	179.1
			SHC	122.8	159.3	195.9	119.2	155.7	192.1	115.5	151.8	188.1	111.5	147.7	183.8	107.3	143.2	179.1
		72	TC	216.6	216.6	216.6	206.1	206.1	206.1	195.1	195.1	195.1	183.5	183.5	183.5	171.6	171.6	171.6
			SHC	85.6	122.3	159.0	82.2	118.8	155.5	78.6	115.2	151.7	74.9	111.3	147.8	71.1	107.4	143.8
		76	TC	–	231.9	231.9	–	220.7	220.7	–	208.9	208.9	–	196.5	196.5	–	183.8	183.8
			SHC	–	92.4	129.9	–	88.9	126.3	–	85.4	122.6	–	81.6	118.7	–	77.8	114.6

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

Table 8 – COOLING CAPACITIES 2-Stage Cooling 17.5 TONS

48HC*D20				AMBIENT TEMPERATURE													
				85			95			105			115			125		
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)		
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85
5250 CFM	EAT (wb)	58	TC	185.1	185.1	209.2	178.7	178.7	201.9	171.8	171.8	194.1	164.5	164.5	185.8	156.7	156.7	177.0
			SHC	161.1	185.1	209.2	155.4	178.7	201.9	149.4	171.8	194.1	143.1	164.5	185.8	136.3	156.7	177.0
		62	TC	193.8	193.8	199.5	185.6	185.6	195.4	176.9	176.9	191.1	167.7	167.7	186.4	158.2	158.2	181.1
			SHC	145.6	172.6	199.5	141.7	168.6	195.4	137.6	164.4	191.1	133.2	159.8	186.4	128.3	154.7	181.1
		67	TC	212.2	212.2	212.2	203.3	203.3	203.3	193.8	193.8	193.8	183.8	183.8	183.8	173.1	173.1	173.1
			SHC	119.0	146.0	173.1	115.3	142.3	169.4	111.4	138.4	165.4	107.3	134.3	161.3	103.0	130.0	157.0
		72	TC	232.3	232.3	232.3	222.7	222.7	222.7	212.4	212.4	212.4	201.6	201.6	201.6	190.1	190.1	190.1
			SHC	91.5	118.8	146.2	87.9	115.2	142.5	84.1	111.4	138.7	80.2	107.4	134.6	76.0	103.2	130.4
		76	TC	–	249.5	249.5	–	239.2	239.2	–	228.2	228.2	–	216.6	216.6	–	204.3	204.3
			SHC	–	96.7	125.3	–	93.2	121.7	–	89.5	117.9	–	85.6	113.8	–	81.5	109.5
6125 CFM	EAT (wb)	58	TC	194.7	194.7	220.0	187.8	187.8	212.2	180.4	180.4	203.8	172.5	172.5	194.9	164.1	164.1	185.5
			SHC	169.4	194.7	220.0	163.3	187.8	212.2	156.9	180.4	203.8	150.1	172.5	194.9	142.8	164.1	185.5
		62	TC	199.6	199.6	218.0	191.1	191.1	213.5	182.1	182.1	208.4	173.0	173.0	201.2	164.3	164.3	192.8
			SHC	156.5	187.2	218.0	152.3	182.9	213.5	147.7	178.0	208.4	141.8	171.5	201.2	135.8	164.3	192.8
		67	TC	218.0	218.0	218.0	208.7	208.7	208.7	198.7	198.7	198.7	188.2	188.2	188.2	177.1	177.1	177.1
			SHC	126.2	157.4	188.6	122.4	153.6	184.7	118.4	149.6	180.7	114.3	145.4	176.5	109.9	141.0	172.1
		72	TC	238.5	238.5	238.5	228.4	228.4	228.4	217.7	217.7	217.7	206.3	206.3	206.3	194.3	194.3	194.3
			SHC	94.7	126.1	157.5	91.0	122.4	153.8	87.2	118.5	149.8	83.1	114.4	145.7	78.9	110.1	141.4
		76	TC	–	255.9	255.9	–	245.1	245.1	–	233.6	233.6	–	221.4	221.4	–	208.5	208.5
			SHC	–	100.7	133.3	–	97.1	129.6	–	93.3	125.6	–	89.3	121.5	–	85.1	117.1
7000 CFM	EAT (wb)	58	TC	202.7	202.7	229.1	195.4	195.4	220.8	187.5	187.5	211.9	179.2	179.2	202.5	170.3	170.3	192.4
			SHC	176.4	202.7	229.1	170.0	195.4	220.8	163.1	187.5	211.9	155.9	179.2	202.5	148.1	170.3	192.4
		62	TC	204.6	204.6	234.4	196.0	196.0	228.0	187.7	187.7	220.3	179.3	179.3	210.5	170.4	170.4	200.0
			SHC	166.0	200.2	234.4	160.8	194.4	228.0	155.1	187.7	220.3	148.2	179.3	210.5	140.8	170.4	200.0
		67	TC	222.5	222.5	222.5	212.8	212.8	212.8	202.4	202.4	202.4	191.5	191.5	191.5	180.0	180.0	186.4
			SHC	133.0	168.2	203.4	129.2	164.3	199.5	125.1	160.3	195.4	120.9	156.0	191.0	116.4	151.4	186.4
		72	TC	243.3	243.3	243.3	232.7	232.7	232.7	221.6	221.6	221.6	209.9	209.9	209.9	197.4	197.4	197.4
			SHC	97.5	132.9	168.3	93.8	129.2	164.5	89.9	125.2	160.5	85.8	121.1	156.3	81.6	116.7	151.9
		76	TC	–	260.8	260.8	–	249.6	249.6	–	237.7	237.7	–	225.1	225.1	–	211.7	211.7
			SHC	–	104.4	140.8	–	100.7	137.0	–	96.9	133.0	–	92.8	128.8	–	88.5	124.4
7875 CFM	EAT (wb)	58	TC	209.6	209.6	236.8	201.8	201.8	228.1	193.6	193.6	218.8	184.8	184.8	208.9	175.5	175.5	198.3
			SHC	182.3	209.6	236.8	175.6	201.8	228.1	168.4	193.6	218.8	160.8	184.8	208.9	152.7	175.5	198.3
		62	TC	209.8	209.8	246.2	202.0	202.0	237.1	193.8	193.8	227.4	185.0	185.0	217.1	175.6	175.6	206.1
			SHC	173.4	209.8	246.2	167.0	202.0	237.1	160.1	193.8	227.4	152.9	185.0	217.1	145.1	175.6	206.1
		67	TC	226.1	226.1	226.1	216.0	216.0	216.0	205.4	205.4	209.4	194.2	194.2	204.8	182.4	182.4	199.9
			SHC	139.6	178.6	217.7	135.6	174.7	213.7	131.5	170.5	209.4	127.1	166.0	204.8	122.5	161.2	199.9
		72	TC	247.0	247.0	247.0	236.2	236.2	236.2	224.7	224.7	224.7	212.7	212.7	212.7	199.9	199.9	199.9
			SHC	100.2	139.5	178.8	96.5	135.7	174.9	92.5	131.7	170.9	88.4	127.5	166.6	84.1	123.1	162.1
		76	TC	–	264.7	264.7	–	253.1	253.1	–	240.9	240.9	–	227.9	227.9	–	–	–
			SHC	–	107.9	148.1	–	104.2	144.3	–	100.2	140.2	–	96.1	135.9	–	–	–
8750 CFM	EAT (wb)	58	TC	215.4	215.4	243.4	207.3	207.3	234.3	198.7	198.7	224.6	189.6	189.6	214.2	179.9	179.9	203.2
			SHC	187.4	215.4	243.4	180.3	207.3	234.3	172.9	198.7	224.6	164.9	189.6	214.2	156.5	179.9	203.2
		62	TC	215.5	215.5	253.0	207.5	207.5	243.5	198.9	198.9	233.4	189.7	189.7	222.7	180.0	180.0	211.2
			SHC	178.1	215.5	253.0	171.5	207.5	243.5	164.4	198.9	233.4	156.8	189.7	222.7	148.8	180.0	211.2
		67	TC	228.9	228.9	231.5	218.7	218.7	227.3	207.8	207.8	222.8	196.4	196.4	217.9	184.5	184.5	212.6
			SHC	145.8	188.6	231.5	141.8	184.5	227.3	137.5	180.1	222.8	133.0	175.5	217.9	128.2	170.4	212.6
		72	TC	250.1	250.1	250.1	239.0	239.0	239.0	227.3	227.3	227.3	214.9	214.9	214.9	201.8	201.8	201.8
			SHC	102.8	145.8	188.9	99.0	142.0	185.0	95.0	137.9	180.9	90.8	133.7	176.5	86.4	129.2	172.0
		76	TC	–	267.8	267.8	–	256.0	256.0	–	243.5	243.5	–	230.2	230.2	–	–	–
			SHC	–	111.2	155.2	–	107.4	151.3	–	103.5	147.1	–	99.3	142.8	–	–	–

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

Table 9 – COOLING CAPACITIES 2-Stage Cooling 20 TONS

48HC*D24				AMBIENT TEMPERATURE															
				85			95			105			115			125			
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
6000 CFM	EAT (wb)	58	TC	214.4	214.4	242.5	207.0	207.0	234.2	199	199	225.1	190.2	190.2	215.2	180.6	180.6	204.3	
			SHC	186.3	214.4	242.5	179.9	207.0	234.2	173	199	225.1	165.3	190.2	215.2	157.0	180.6	204.3	
		62	TC	226.8	226.8	227.7	217.3	217.3	223.0	206.9	206.9	218	195.8	195.8	212.5	183.7	183.7	206.4	
			SHC	167.0	197.3	227.7	162.4	192.7	223.0	157.6	187.8	218	152.3	182.4	212.5	146.6	176.5	206.4	
		67	TC	248.4	248.4	248.4	237.9	237.9	237.9	226.6	226.6	226.6	214.3	214.3	214.3	201.0	201.0	201.0	
			SHC	136.5	167.1	197.6	132.2	162.7	193.2	127.5	158	188.4	122.5	152.9	183.4	117.2	147.6	178.0	
		72	TC	271.9	271.9	271.9	260.3	260.3	260.3	247.9	247.9	247.9	234.5	234.5	234.5	220.1	220.1	220.1	
			SHC	105.1	136.0	167.0	100.8	131.7	162.5	96.3	127.1	157.9	91.4	122.1	152.9	86.3	116.9	147.6	
		76	TC	–	291.7	291.7	–	279.2	279.2	–	265.7	265.7	–	251.3	251.3	–	235.8	235.8	
			SHC	–	110.7	143.7	–	106.5	139.5	–	102	134.7	–	97.2	129.7	–	92.1	124.3	
7000 CFM	EAT (wb)	58	TC	225.8	225.8	255.3	217.8	217.8	246.3	209.1	209.1	236.5	199.6	199.6	225.7	189.2	189.2	214.0	
			SHC	196.2	225.8	255.3	189.3	217.8	246.3	181.7	209.1	236.5	173.4	199.6	225.7	164.4	189.2	214.0	
		62	TC	233.9	233.9	248.8	223.8	223.8	243.8	213.1	213.1	238.2	201.4	201.4	231.8	190.0	190.0	221.5	
			SHC	179.4	214.1	248.8	174.6	209.2	243.8	169.4	203.8	238.2	163.7	197.8	231.8	155.9	188.7	221.5	
		67	TC	255.7	255.7	255.7	244.6	244.6	244.6	232.6	232.6	232.6	219.6	219.6	219.6	205.7	205.7	205.7	
			SHC	144.7	179.7	214.8	140.2	175.2	210.2	135.4	170.4	205.4	130.3	165.2	200.2	124.9	159.8	194.7	
		72	TC	279.4	279.4	279.4	267.3	267.3	267.3	254.1	254.1	254.1	240.1	240.1	240.1	224.9	224.9	224.9	
			SHC	108.7	144.1	179.6	104.3	139.7	175.1	99.6	135	170.3	94.7	129.9	165.1	89.5	124.6	159.7	
		76	TC	–	299.4	299.4	–	286.2	286.2	–	272.1	272.1	–	256.9	256.9	–	240.7	240.7	
			SHC	–	115.3	152.9	–	110.9	148.2	–	106.3	143.3	–	101.3	138.0	–	96.1	132.6	
8000 CFM	EAT (wb)	58	TC	235.3	235.3	266.2	226.8	226.8	256.5	217.5	217.5	246	207.4	207.4	234.5	196.3	196.3	222.0	
			SHC	204.5	235.3	266.2	197.1	226.8	256.5	189	217.5	246	180.2	207.4	234.5	170.6	196.3	222.0	
		62	TC	239.7	239.7	268.1	229.4	229.4	262.0	219	219	253.3	208.3	208.3	241.9	196.7	196.7	231.0	
			SHC	190.7	229.4	268.1	185.4	223.7	262.0	178.6	215.9	253.3	170.4	206.2	241.9	162.3	196.7	231.0	
		67	TC	261.3	261.3	261.3	249.6	249.6	249.6	237.1	237.1	237.1	223.6	223.6	223.6	209.2	209.2	210.6	
			SHC	152.3	191.8	231.2	147.7	187.1	226.6	142.9	182.2	221.6	137.7	177.0	216.3	132.2	171.4	210.6	
		72	TC	285.3	285.3	285.3	272.5	272.5	272.5	258.9	258.9	258.9	244.2	244.2	244.2	228.6	228.6	228.6	
			SHC	111.9	151.7	191.5	107.5	147.2	186.9	102.7	142.4	182	97.7	137.2	176.7	92.4	131.8	171.2	
		76	TC	–	305.4	305.4	–	291.6	291.6	–	276.8	276.8	–	261.2	261.2	–	244.4	244.4	
			SHC	–	119.4	161.0	–	114.9	156.2	–	110.1	151.2	–	105.1	146.0	–	99.8	140.4	
9000 CFM	EAT (wb)	58	TC	243.5	243.5	275.4	234.5	234.5	265.2	224.6	224.6	254	213.9	213.9	241.9	202.3	202.3	228.8	
			SHC	211.6	243.5	275.4	203.8	234.5	265.2	195.2	224.6	254	185.9	213.9	241.9	175.8	202.3	228.8	
		62	TC	245.4	245.4	282.9	235.4	235.4	274.6	225	225	264.3	214.4	214.4	251.7	202.5	202.5	237.8	
			SHC	199.7	241.3	282.9	193.2	233.9	274.6	185.6	224.9	264.3	176.8	214.3	251.7	167.1	202.5	237.8	
		67	TC	265.6	265.6	265.6	253.6	253.6	253.6	240.7	240.7	240.7	226.8	226.8	231.8	212.0	212.0	225.8	
			SHC	159.6	203.3	247.1	154.9	198.6	242.3	150	193.6	237.3	144.7	188.3	231.8	139.0	182.4	225.8	
		72	TC	289.9	289.9	289.9	276.7	276.7	276.7	262.6	262.6	262.6	247.5	247.5	247.5	231.4	231.4	231.4	
			SHC	114.9	159.0	203.0	110.4	154.4	198.3	105.6	149.5	193.3	100.5	144.2	188.0	95.2	138.7	182.3	
		76	TC	–	310.1	310.1	–	295.8	295.8	–	280.6	280.6	–	264.4	264.4	–	247.3	247.3	
			SHC	–	123.2	168.9	–	118.6	164.1	–	113.8	159	–	108.7	153.6	–	103.4	147.9	
10,000 CFM	EAT (wb)	58	TC	250.4	250.4	283.2	240.9	240.9	272.5	230.7	230.7	260.9	219.5	219.5	248.2	207.3	207.3	234.5	
			SHC	217.7	250.4	283.2	209.4	240.9	272.5	200.5	230.7	260.9	190.7	219.5	248.2	180.2	207.3	234.5	
		62	TC	250.8	250.8	294.6	241.1	241.1	283.3	231.1	231.1	271.4	219.6	219.6	258.0	207.5	207.5	243.7	
			SHC	207.0	250.8	294.6	199.0	241.1	283.3	190.7	231.1	271.4	181.2	219.6	258.0	171.2	207.5	243.7	
		67	TC	269.2	269.2	269.2	256.8	256.8	257.6	243.5	243.5	252.3	229.4	229.4	246.4	214.3	214.3	240.0	
			SHC	166.6	214.5	262.5	161.9	209.7	257.6	156.8	204.5	252.3	151.3	198.9	246.4	145.5	192.8	240.0	
		72	TC	293.7	293.7	293.7	280.1	280.1	280.1	265.6	265.6	265.6	250.2	250.2	250.2	233.7	233.7	233.7	
			SHC	117.8	166.0	214.2	113.2	161.3	209.3	108.3	156.3	204.3	103.2	151.0	198.8	97.8	145.4	193.1	
		76	TC	–	313.9	313.9	–	299.3	299.3	–	283.7	283.7	–	267.1	267.1	–	249.6	249.6	
			SHC	–	126.8	176.5	–	122.2	171.6	–	117.3	166.5	–	112.1	161.0	–	106.7	155.1	

LEGEND:

– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

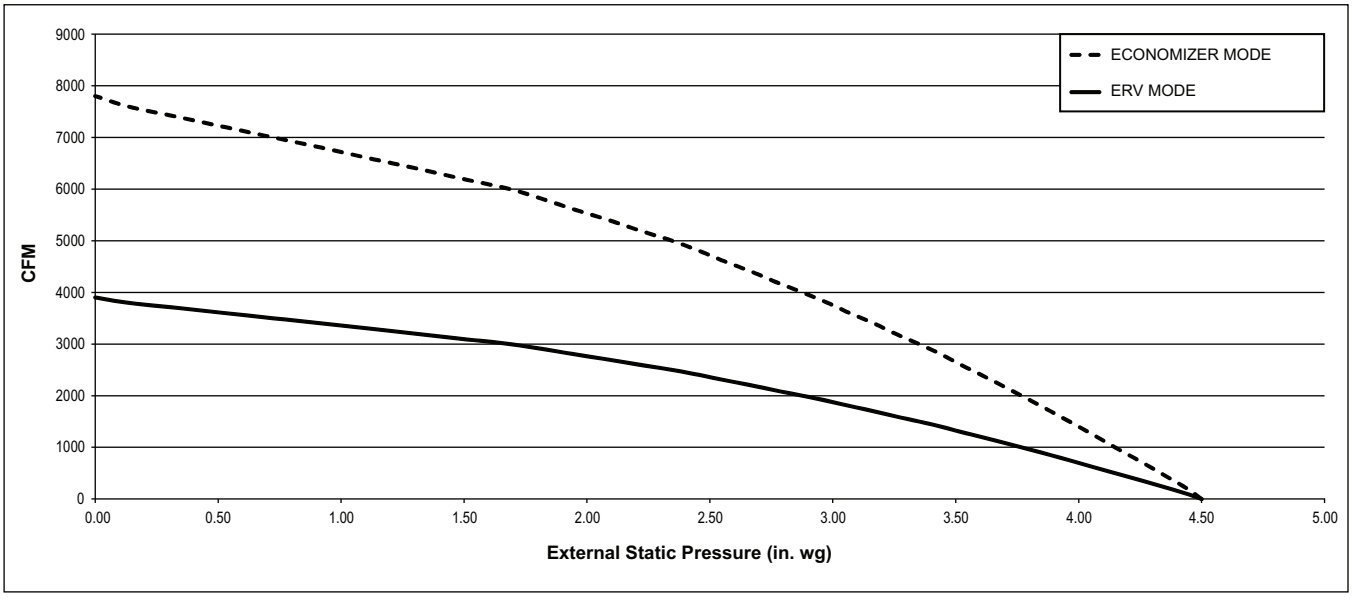
Table 10 – COOLING CAPACITIES 2-Stage Cooling 25 TONS

48HC*D28				AMBIENT TEMPERATURE															
				85			95			105			115			125			
				EA (dB)			EA (dB)			EA (dB)			EA (dB)			EA (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
7,500 CFM	EAT (wb)	58	TC	264.4	264.4	298.9	254.6	254.6	287.9	244.1	244.1	276.0	232.7	232.7	263.1	220.3	220.3	249.1	
			SHC	229.9	264.4	298.9	221.4	254.6	287.9	212.2	244.1	276.0	202.3	232.7	263.1	191.5	220.3	249.1	
		62	TC	278.7	278.7	282.4	266.3	266.3	276.4	252.8	252.8	269.8	238.5	238.5	262.4	223.9	223.9	251.3	
			SHC	206.8	244.6	282.4	200.9	238.7	276.4	194.6	232.2	269.8	187.7	225.0	262.4	178.7	215.0	251.3	
		67	TC	305.3	305.3	305.3	291.9	291.9	291.9	277.3	277.3	277.3	261.5	261.5	261.5	244.5	244.5	244.5	
			SHC	169.0	207.0	245.0	163.4	201.4	239.4	157.4	195.3	233.3	151.0	188.9	226.8	144.2	182.1	219.9	
		72	TC	334.0	334.0	334.0	319.4	319.4	319.4	303.6	303.6	303.6	286.5	286.5	286.5	268.1	268.1	268.1	
			SHC	129.9	168.5	207.1	124.5	163.0	201.5	118.7	157.1	195.5	112.5	150.8	189.2	106.0	144.2	182.3	
		76	TC	–	358.2	358.2	–	342.4	342.4	–	325.4	325.4	–	307.1	307.1	–	287.4	287.4	
			SHC	–	137.0	178.2	–	131.7	172.9	–	126.0	166.9	–	119.9	160.4	–	113.4	153.4	
8,750 CFM	EAT (wb)	58	TC	278.2	278.2	314.5	267.8	267.8	302.8	256.5	256.5	289.9	244.2	244.2	276.1	230.8	230.8	261.0	
			SHC	241.9	278.2	314.5	232.8	267.8	302.8	223.0	256.5	289.9	212.3	244.2	276.1	200.7	230.8	261.0	
		62	TC	287.2	287.2	308.3	274.3	274.3	301.5	260.8	260.8	291.7	247.0	247.0	280.9	232.0	232.0	269.1	
			SHC	222.1	265.2	308.3	215.7	258.6	301.5	207.7	249.7	291.7	199.0	240.0	280.9	189.7	229.4	269.1	
		67	TC	314.0	314.0	314.0	299.8	299.8	299.8	284.4	284.4	284.4	267.8	267.8	267.8	250.0	250.0	250.0	
			SHC	179.1	222.7	266.4	173.3	216.9	260.6	167.2	210.8	254.3	160.7	204.2	247.7	153.7	197.2	240.6	
		72	TC	343.0	343.0	343.0	327.7	327.7	327.7	311.1	311.1	311.1	293.1	293.1	293.1	273.8	273.8	273.8	
			SHC	134.3	178.5	222.6	128.8	172.9	216.9	122.9	166.9	210.8	116.6	160.4	204.3	109.9	153.6	197.3	
		76	TC	–	367.3	367.3	–	350.8	350.8	–	333.0	333.0	–	313.8	313.8	–	293.2	293.2	
			SHC	–	142.6	189.4	–	137.1	183.5	–	131.2	177.3	–	125.0	170.7	–	118.4	163.7	
10,000 CFM	EAT (wb)	58	TC	289.7	289.7	327.5	278.7	278.7	315.0	266.6	266.6	301.4	253.6	253.6	286.7	239.4	239.4	270.7	
			SHC	251.9	289.7	327.5	242.3	278.7	315.0	231.8	266.6	301.4	220.5	253.6	286.7	208.2	239.4	270.7	
		62	TC	294.6	294.6	329.6	282.2	282.2	319.7	268.7	268.7	309.1	254.1	254.1	298.4	239.7	239.7	281.4	
			SHC	234.7	282.1	329.6	226.8	273.3	319.7	218.4	263.7	309.1	209.7	254.1	298.4	197.9	239.7	281.4	
		67	TC	320.6	320.6	320.6	305.9	305.9	305.9	289.9	289.9	289.9	272.7	272.7	272.7	254.3	254.3	260.3	
			SHC	188.6	237.7	286.8	182.7	231.8	280.9	176.5	225.5	274.5	169.8	218.8	267.7	162.8	211.5	260.3	
		72	TC	350.0	350.0	350.0	334.0	334.0	334.0	316.8	316.8	316.8	298.2	298.2	298.2	278.3	278.3	278.3	
			SHC	138.4	187.9	237.5	132.8	182.2	231.7	126.8	176.1	225.5	120.4	169.6	218.8	113.6	162.6	211.7	
		76	TC	–	374.4	374.4	–	357.3	357.3	–	338.7	338.7	–	318.9	318.9	–	297.5	297.5	
			SHC	–	147.7	199.5	–	142.1	193.7	–	136.1	187.4	–	129.7	180.6	–	123.0	173.5	
11,250 CFM	EAT (wb)	58	TC	299.4	299.4	338.4	287.8	287.8	325.4	275.2	275.2	311.1	261.4	261.4	295.6	246.6	246.6	278.8	
			SHC	260.3	299.4	338.4	250.2	287.8	325.4	239.2	275.2	311.1	227.3	261.4	295.6	214.4	246.6	278.8	
		62	TC	302.2	302.2	346.0	289.3	289.3	335.7	275.5	275.5	323.5	262.1	262.1	307.7	246.8	246.8	289.8	
			SHC	244.8	295.4	346.0	236.7	286.2	335.7	227.5	275.5	323.5	216.4	262.1	307.7	203.8	246.8	289.8	
		67	TC	325.9	325.9	325.9	310.7	310.7	310.7	294.2	294.2	294.2	276.6	276.6	286.7	257.7	257.7	278.9	
			SHC	197.6	252.1	306.5	191.7	246.1	300.4	185.3	239.6	293.9	178.5	232.6	286.7	171.2	225.1	278.9	
		72	TC	355.5	355.5	355.5	339.1	339.1	339.1	321.3	321.3	321.3	302.2	302.2	302.2	281.8	281.8	281.8	
			SHC	142.1	197.0	251.8	136.4	191.2	245.9	130.4	185.0	239.6	123.9	178.3	232.8	117.1	171.3	225.5	
		76	TC	–	380.0	380.0	–	362.4	362.4	–	343.3	343.3	–	322.8	322.8	–	300.9	300.9	
			SHC	–	152.4	209.4	–	146.8	203.4	–	140.7	197.0	–	134.2	190.2	–	127.3	182.8	
12,500 CFM	EAT (wb)	58	TC	307.7	307.7	347.9	295.7	295.7	334.2	282.5	282.5	319.3	268.2	268.2	303.2	252.7	252.7	285.7	
			SHC	267.6	307.7	347.9	257.1	295.7	334.2	245.6	282.5	319.3	233.2	268.2	303.2	219.7	252.7	285.7	
		62	TC	308.4	308.4	362.2	295.9	295.9	347.4	283.1	283.1	332.4	268.4	268.4	315.2	252.8	252.8	296.9	
			SHC	254.6	308.4	362.2	244.4	295.9	347.4	233.8	283.1	332.4	221.7	268.4	315.2	208.8	252.8	296.9	
		67	TC	330.2	330.2	330.2	314.6	314.6	319.2	297.8	297.8	312.3	279.8	279.8	304.7	260.6	260.6	295.9	
			SHC	206.3	265.9	325.5	200.3	259.7	319.2	193.8	253.1	312.3	186.7	245.7	304.7	179.0	237.4	295.9	
		72	TC	360.1	360.1	360.1	343.2	343.2	343.2	325.0	325.0	325.0	305.4	305.4	305.4	284.6	284.6	284.6	
			SHC	145.7	205.7	265.7	139.9	199.8	259.7	133.8	193.5	253.3	127.3	186.8	246.3	120.4	179.7	238.9	
		76	TC	–	384.6	384.6	–	366.5	366.5	–	346.9	346.9	–	325.9	325.9	–	303.5	303.5	
			SHC	–	157.0	218.9	–	151.2	212.9	–	145.1	206.3	–	138.5	199.3	–	131.5	191.7	

LEGEND:

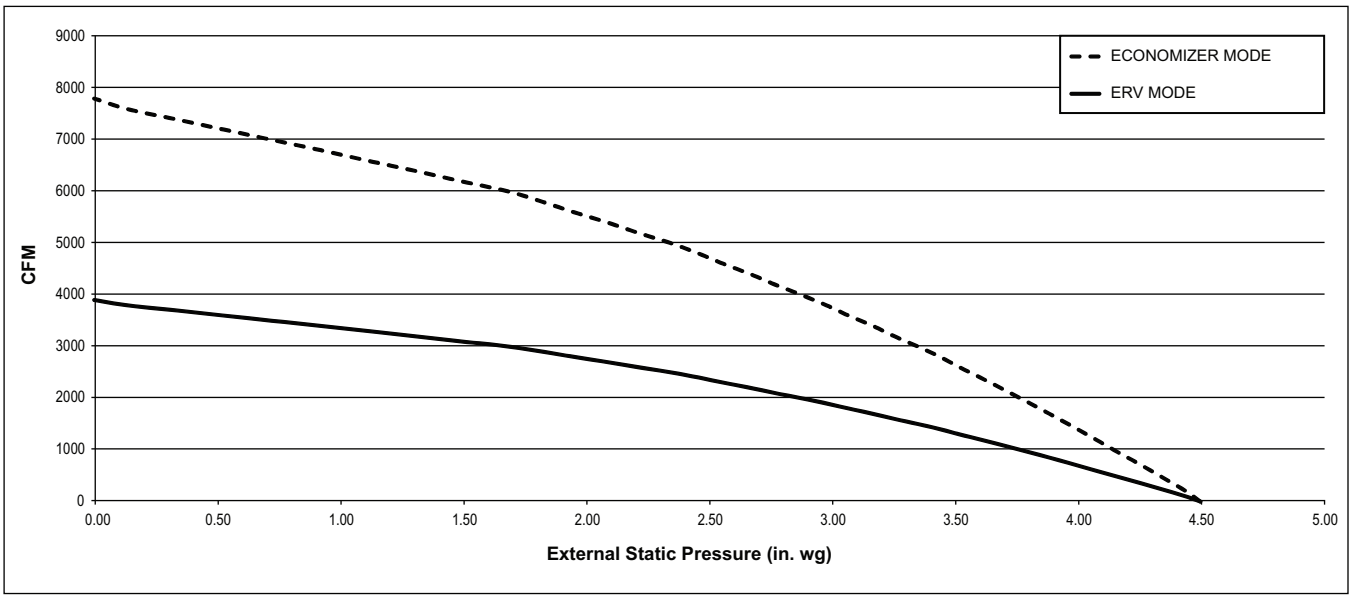
– – Do not operate
Cfm – Cubic feet per minute (supply air)
EAT(db) – Entering air temperature (dry bulb)
EAT(wb) – Entering air temperature (wet bulb)
SHC – Sensible heat capacity
TC – Total capacity

PE PERFORMANCE



C11437

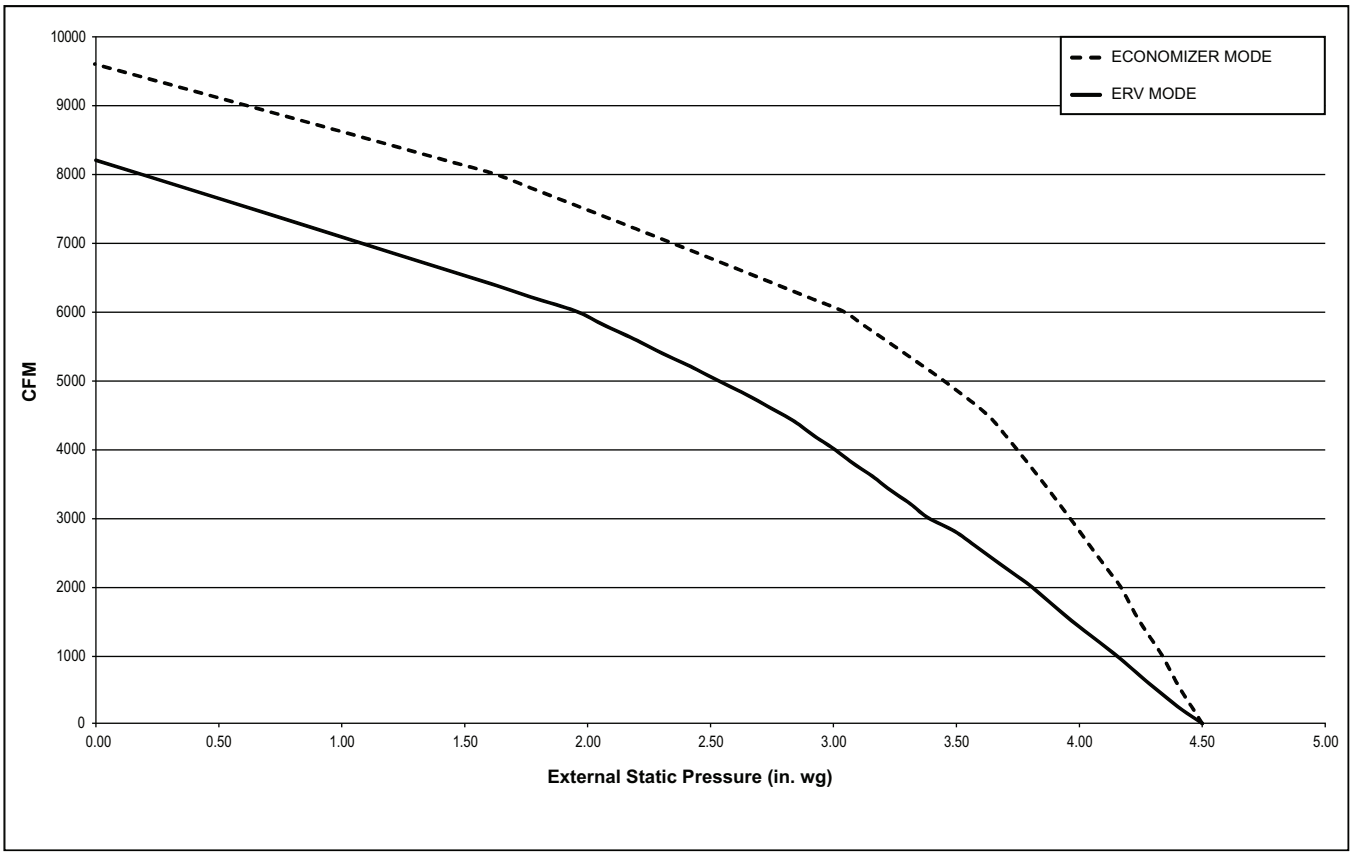
Fig. 14 - 48HC17 Supply and Exhaust Fan Performance Curves**



C11438

Fig. 15 - 48HC20 Supply and Exhaust Fan Performance Curves**

PE PERFORMANCE (cont.)



C11439

Fig. 16 - 48HC24 Supply and Exhaust Fan Performance Curves**

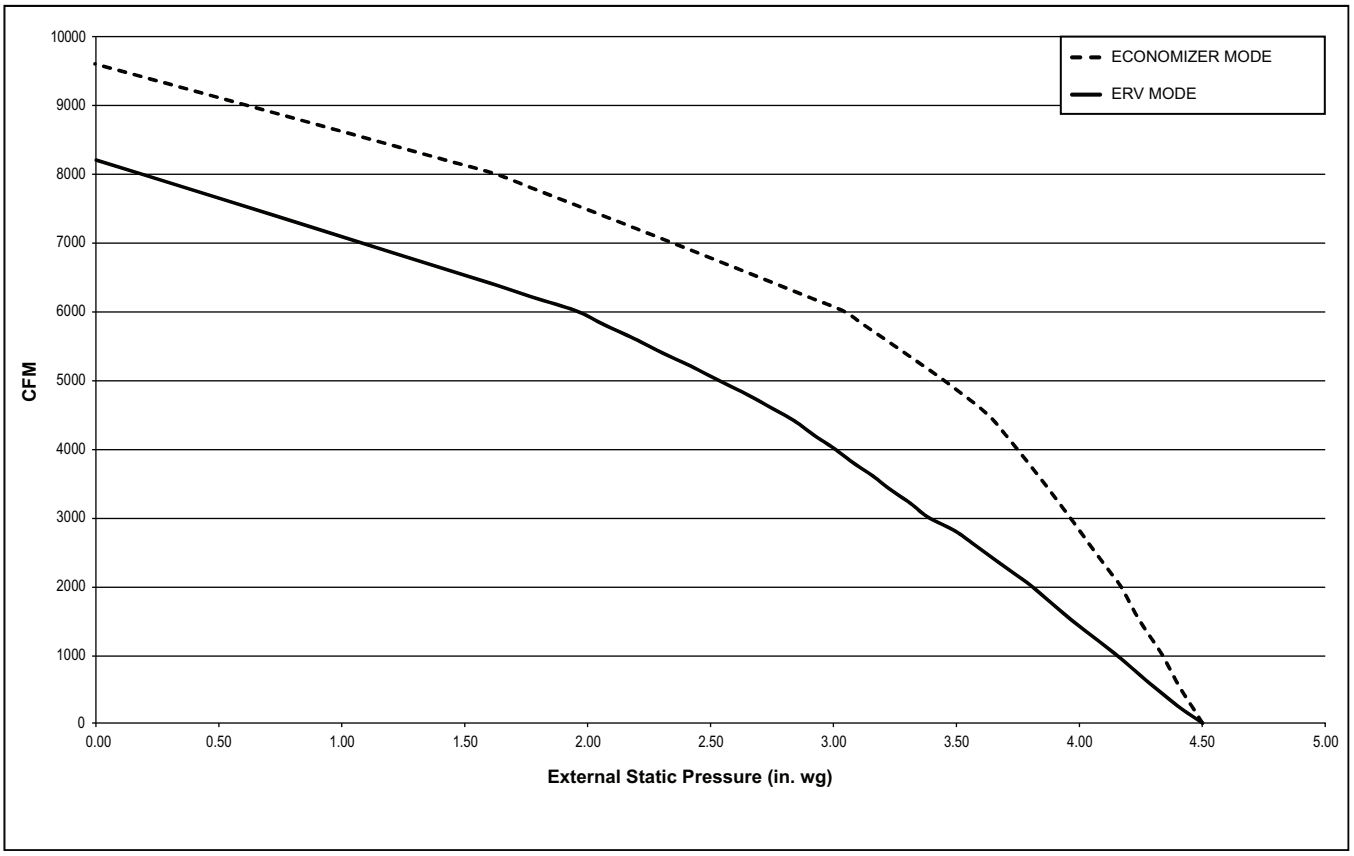


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Fig. 17 - 48HC28 Supply and Exhaust Fan Performance Curves**

GENERAL FAN PERFORMANCE NOTES:

1. Interpolation is permissible. Do not extrapolate.
2. External static pressure is the static pressure difference between the return duct and the supply duct plus the static pressure caused by any FIOPs or accessories.
3. Tabular data accounts for pressure loss due to clean filters, high gas heat, unit casing, and wet coils. Factory options and accessories may add static pressure losses, as shown in the table above. Selection software is available, through your salesperson, to help you select the best motor/drive combination for your application.
4. The Fan Performance tables offer motor/drive recommendations. In cases when two motor/drive combinations would work, Carrier recommended the lower horsepower option.
5. For information on the electrical properties of Carrier motors, please see the Electrical information section of this book.
6. For more information on the performance limits of Carrier motors, see the application data section of this book.

FAN PERFORMANCE

Table 11 – 48HC*D17 **VERTICAL SUPPLY / RETURN** **15 TON**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	**490**	**0.76**	575	1.07	653	1.41	724	1.79	791	2.19
4900	517	0.92	597	1.24	671	1.60	740	1.99	804	2.41
5250	541	1.08	618	1.42	688	1.79	754	2.19	817	2.62
5600	566	1.26	639	1.61	707	2.00	770	2.42	831	2.86
6000	595	1.49	664	1.86	729	2.27	790	2.70	848	3.15
6400	624	1.75	690	2.14	751	2.56	810	3.01	866	3.48
6750	650	2.00	713	2.41	772	2.84	829	3.30	883	3.79
7100	**676**	**2.27**	736	2.70	793	3.15	848	3.63	901	4.13
7500	706	2.62	763	3.06	**819**	**3.54**	871	4.03	922	4.55

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	854	2.63	913	3.09	970	3.57	**1024**	**4.09**	**1077**	**4.62**
4900	**865**	**2.86**	923	3.33	978	3.83	**1031**	**4.35**	**1082**	**4.89**
5250	876	3.08	932	3.56	986	4.07	**1038**	**4.60**	– – – –	– – – –
5600	888	3.33	943	3.82	995	4.34	**1046**	**4.88**	– – – –	– – – –
6000	903	3.64	956	4.14	1008	4.67	– – – –	– – – –	– – – –	– – – –
6400	920	3.98	971	4.50	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
6750	935	4.30	986	4.83	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
7100	952	4.65	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
7500	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –

Std Static Motor and Drive – 514–680 RPM, Max BHP 2.2
Medium Static Motor and Drive – 679–863 RPM, Max BHP 3.3
High Static Motor and Drive – 826–1009 RPM, Max BHP 4.9
– – – – Outside operating range
Boldface – Field–supplied Drive

Table 12 – 48HC*D20 **VERTICAL SUPPLY / RETURN** **17.5 TON**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	**541**	**1.08**	**618**	**1.42**	688	1.79	754	2.19	817	2.62
5700	**573**	**1.31**	645	1.67	712	2.06	775	2.48	835	2.93
6100	**602**	**1.55**	670	1.93	734	2.34	795	2.77	852	3.23
6500	631	1.81	696	2.21	757	2.64	815	3.09	871	3.57
7000	668	2.19	729	2.61	787	3.06	843	3.53	896	4.03
7500	706	2.62	763	3.06	819	3.54	871	4.03	922	4.55
7900	736	3.00	791	3.47	844	3.96	895	4.47	944	5.00
8300	767	3.42	819	3.90	870	4.41	919	4.94	967	5.49
8750	801	3.94	852	4.44	900	4.97	948	5.52	993	6.09

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5250	876	3.08	932	3.56	986	4.07	1038	4.60	**1088**	**5.15**
5700	892	3.40	946	3.90	998	4.42	1049	4.96	**1097**	**5.52**
6100	907	3.72	960	4.23	1011	4.76	1060	5.31	**1107**	**5.89**
6500	924	4.07	975	4.59	1025	5.13	1072	5.70	**1119**	**6.28**
7000	947	4.55	996	5.09	1044	5.65	**1090**	**6.23**	– – – –	– – – –
7500	971	5.08	1019	5.64	1064	6.22	– – – –	– – – –	– – – –	– – – –
7900	992	5.55	1038	6.13	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
8300	1013	6.06	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
8750	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –

Std Static Motor and Drive – 622–822 RPM, Max BHP 3.3
Medium Static Motor and Drive – 713–879 RPM, Max BHP 4.9
High Static Motor and Drive – 882–1078 RPM, Max BHP 6.5
– – – – Outside operating range
Boldface – Field–supplied Drive

FAN PERFORMANCE (cont.)

Table 13 – 48HC*D24 **VERTICAL SUPPLY / RETURN** **20 TON**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6000	**605**	**1.48**	**674**	**1.77**	738	2.08	798	2.41	854	2.74
6500	**644**	**1.82**	709	2.14	770	2.47	827	2.81	881	3.17
7000	**683**	**2.22**	744	2.56	802	2.91	857	3.28	908	3.65
7500	722	2.68	781	3.04	836	3.41	888	3.80	938	4.19
8000	762	3.20	818	3.58	870	3.97	920	4.38	968	4.79
8500	803	3.78	855	4.19	905	4.60	953	5.02	999	5.46
9000	843	4.43	893	4.86	941	5.30	987	5.74	1032	6.19
9500	884	5.15	932	5.61	978	6.06	1022	6.53	1065	7.01
10000	925	5.95	970	6.43	1015	6.91	1057	7.40	1098	7.89

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6000	907	3.10	958	3.46	1006	3.84	1052	4.23	1097	4.63
6500	932	3.54	981	3.92	1027	4.31	1073	4.72	1116	5.14
7000	958	4.04	1005	4.43	1051	4.84	1094	5.27	1137	5.70
7500	985	4.59	1031	5.01	1075	5.44	1118	5.87	1159	6.32
8000	1014	5.21	1058	5.65	1101	6.09	1142	6.55	– – – –	– – – –
8500	1044	5.90	1087	6.35	1128	6.82	1168	7.29	– – – –	– – – –
9000	1075	6.66	1116	7.13	1156	7.61	– – – –	– – – –	– – – –	– – – –
9500	1106	7.49	1146	7.98	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
10000	1139	8.40	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –

Std Static Motor and Drive – 690–863 RPM, Max BHP 4.9
Medium Static Motor and Drive – 835–1021 RPM, Max BHP 6.5
High Static Motor and Drive – 941–1176 RPM, Max BHP 8.7
– – – – Outside operating range
Boldface – Field–supplied Drive

Table 14 – 48HC*D28 **VERTICAL SUPPLY / RETURN** **25 TON**

CFM	Available External Static Pressure (in. wg)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7500	**713**	**2.25**	778	2.61	838	2.97	894	3.36	946	3.76
8000	752	2.68	814	3.06	871	3.44	925	3.85	976	4.26
8500	791	3.17	850	3.56	905	3.97	957	4.39	1006	4.83
9000	831	3.71	887	4.12	939	4.55	989	4.99	1037	5.45
9500	870	4.31	924	4.75	974	5.19	1023	5.66	1069	6.13
10000	910	4.83	961	5.43	1010	5.90	1057	6.38	1102	6.87
10500	950	5.70	999	6.18	1046	6.67	1091	7.17	1135	7.69
11000	990	6.50	1037	7.01	1083	7.52	1126	8.04	1168	8.57
11500	1030	7.38	1076	7.90	1119	8.43	– – – –	– – – –	– – – –	– – – –
12000	1070	8.33	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
12500	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –

CFM	Available External Static Pressure (in. wg)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7500	996	4.17	1044	4.60	1089	5.05	1133	5.51	1175	5.98
8000	1024	4.70	1071	5.14	1115	5.60	1158	6.07	– – – –	– – – –
8500	1053	5.27	1098	5.74	1141	6.21	– – – –	– – – –	– – – –	– – – –
9000	1083	5.91	1127	6.39	1169	6.88	– – – –	– – – –	– – – –	– – – –
9500	1113	6.61	1156	7.11	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
10000	1145	7.38	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
10500	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
11000	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
11500	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
12000	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –
12500	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –	– – – –

Std Static Motor and Drive – 717–911 RPM, Max BHP 4.9
Medium Static Motor and Drive – 913–1116 RPM, Max BHP 6.5
High Static Motor and Drive – 941–1176 RPM, Max BHP 8.7
– – – – Outside operating range
Boldface – Field–supplied Drive

FAN PERFORMANCE (cont.)

Table 15 – PULLEY ADJUSTMENT

MODEL SIZE	MOTOR/DRIVE COMBO	MOTOR PULLEY TURNS OPEN										
		0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
17	Standard Static	680	663	647	630	614	597	580	564	547	531	514
	Medium Static	863	845	826	808	789	771	753	734	716	697	679
	High Static	1009	991	972	954	936	918	899	881	863	844	826
20	Standard Static	822	802	782	762	742	722	702	682	662	642	622
	Medium Static	879	862	846	829	813	796	779	763	746	730	713
	High Static	1078	1058	1039	1019	1000	980	960	941	921	902	882
24	Standard Static	863	846	828	811	794	777	759	742	725	707	690
	Medium Static	1021	1002	984	965	947	928	909	891	872	854	835
	High Static	1176	1153	1129	1106	1082	1059	1035	1012	988	965	941
28	Standard Static	911	892	872	853	833	814	795	775	756	736	717
	Medium Static	1116	1096	1075	1055	1035	1015	994	974	954	933	913
	High Static	1176	1153	1129	1106	1082	1059	1035	1012	988	965	941

NOTE: Do not adjust pulley further than 5 turns open.

– Factory settings

ELECTRICAL DATA

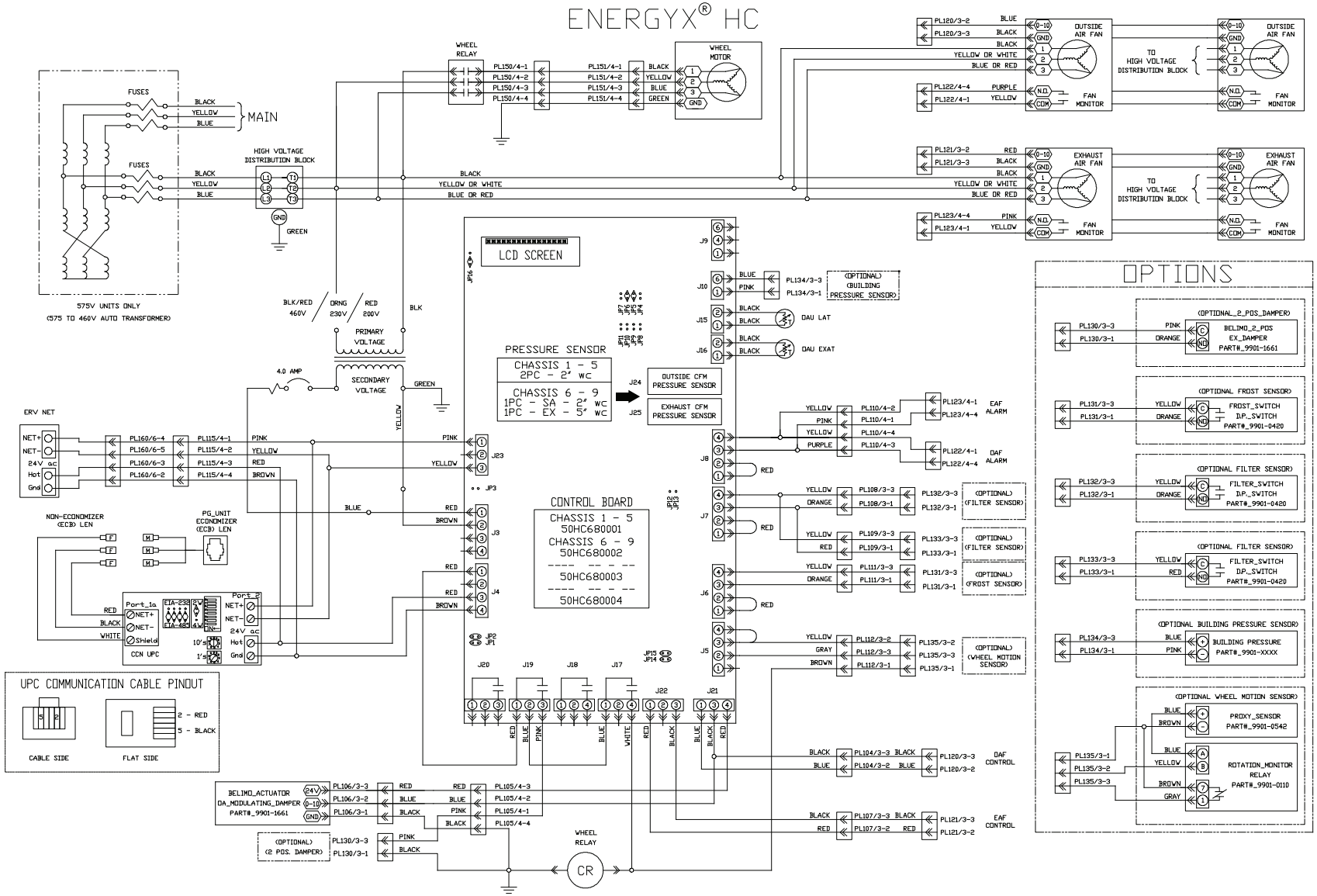

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Fig. 18 - Modulating ERV Wiring Schematic

ELECTRICAL DATA (cont.)

48HC With ERV - Without Economizer

48HC	V–Ph–Hz	UNIT VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM					COMBUSTION FAN MOTOR FLA	ERV Motors *						ERV Total FLA
																Exhaust		Supply		Wheel		
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA		QTY	FLA (ea)	QTY	FLA (ea)	QTY	FLA (ea)	
17	208–3–60	187	253	25.0	164	25.0	164	350	1.5	STD	2278	7.9	81.3%	7.5	0.52	1	7.8	2	3.9	1	0.6	16.2
										MED	2694	10.7	83.8%	10.2							
										HIGH	4559	15.8	83.6%	15.0							
	230–3–60	187	253	25.0	164	25.0	164	350	1.5	STD	2278	7.9	81.3%	7.5	0.52	1	7.8	2	3.9	1	0.6	16.2
										MED	2694	10.7	83.8%	10.2							
										HIGH	4559	15.8	83.6%	15.0							
	460–3–60	414	506	12.8	100	12.8	100	277	0.9	STD	2278	3.6	81.3%	3.4	0.3	1	3.4	2	1.8	1	0.3	7.3
										MED	2694	5.0	83.8%	4.8							
										HIGH	4559	7.8	83.6%	7.4							
	575–3–60	518	633	9.6	78	9.6	78	397	0.6	STD	1870	2.9	81.1%	2.8	0.24	1	3.4	2	1.8	1	0.3	7.3
										MED	1870	2.9	81.1%	2.8							
										HIGH	4470	5.9	83.6%	5.6							
20	208–3–60	187	253	27.6	191	25.0	164	350	1.5	STD	2694	10.7	83.8%	10.2	0.52	1	7.8	2	3.9	1	0.6	16.2
										MED	4559	15.8	83.6%	15.0							
										HIGH	5644	18.0	89.5%	17.1							
	230–3–60	187	253	27.6	191	25.0	164	350	1.5	STD	2694	10.7	83.8%	10.2	0.52	1	7.8	2	3.9	1	0.6	16.2
										MED	4559	15.8	83.6%	15.0							
										HIGH	5644	18.0	89.5%	17.1							
	460–3–60	414	506	12.8	100	12.2	100	277	0.9	STD	2694	5.0	83.8%	4.8	0.3	1	3.4	2	1.8	1	0.3	7.3
										MED	4559	7.8	83.6%	7.4							
										HIGH	5644	9.0	89.5%	8.6							
	575–3–60	518	633	9.6	78	9.0	78	397	0.6	STD	1870	2.9	81.1%	2.8	0.24	1	3.4	2	1.8	1	0.3	7.3
										MED	4470	5.9	83.6%	5.6							
										HIGH	6978	8.0	89.5%	7.6							

* On 575V units, the ERV motors are 460V

ELECTRICAL DATA (cont.)

48HC With ERV - Without Economizer

48HC	V–Ph–Hz	UNIT VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM					COMBUSTION FAN MOTOR FLA	ERV Motors *						ERV Total FLA
																Exhaust		Supply		Wheel		
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA		QTY	FLA (ea)	QTY	FLA (ea)	QTY	FLA (ea)	
24	208–3–60	187	253	30.1	225	30.1	225	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1							
										HIGH	10601	29.9	91.7%	28.5							
	230–3–60	187	253	30.1	225	30.1	225	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1							
										HIGH	10601	29.9	91.7%	28.5							
	460–3–60	414	506	16.7	114	16.7	114	277	0.9	STD	4559	7.8	83.6%	7.4	0.3	2	3.4	2	3.4	1	0.6	14.2
										MED	5644	9.0	89.5%	8.6							
										HIGH	10601	15.0	91.7%	14.3							
	575–3–60	518	633	12.2	80	12.2	80	397	0.6	STD	4470	5.9	83.6%	5.6	0.24	2	3.4	2	3.4	1	0.6	14.2
										MED	6978	8.0	89.5%	7.6							
										HIGH	7341	10.0	91.7%	9.5							
28	208–3–60	187	253	48.1	245	33.3	239	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1							
										HIGH	10601	29.9	91.7%	28.5							
	230–3–60	187	253	48.1	245	33.3	239	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1							
										HIGH	10601	29.9	91.7%	28.5							
	460–3–60	414	506	18.6	125	17.9	125	277	0.9	STD	4559	7.8	83.6%	7.4	0.3	2	3.4	2	3.4	1	0.6	14.2
										MED	5644	9.0	89.5%	8.6							
										HIGH	10601	15.0	91.7%	14.3							
	575–3–60	518	633	14.7	100	12.8	80	397	0.6	STD	4470	5.9	83.6%	5.6	0.24	2	3.4	2	3.4	1	0.6	14.2
										MED	6978	8.0	89.5%	7.6							
										HIGH	7341	10.0	91.7%	9.5							

* On 575V units, the ERV motors are 460V

ELECTRICAL DATA (cont.)

48HC With ERV and Economizer

48HC	V–Ph–Hz	UNIT VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA	COMBUSTION FAN MOTOR FLA	ERV Motors *						ERV Total FLA
																Exhaust		Supply		Wheel		
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA							QTY	FLA (ea)	QTY	FLA (ea)	QTY	FLA (ea)	
17	208–3–60	187	253	25.0	164	25.0	164	350	1.5	STD	2278	7.9	81.3%	7.5	0.52	2	7.8	2	3.9	1	0.6	24.0
										MED	2694	10.7	83.8%	10.2								
										HIGH	4559	15.8	83.6%	15.0								
	230–3–60	187	253	25.0	164	25.0	164	350	1.5	STD	2278	7.9	81.3%	7.5	0.52	2	7.8	2	3.9	1	0.6	24.0
										MED	2694	10.7	83.8%	10.2								
										HIGH	4559	15.8	83.6%	15.0								
	460–3–60	414	506	12.8	100	12.8	100	277	0.9	STD	2278	3.6	81.3%	3.4	0.3	2	3.4	2	1.8	1	0.3	10.7
										MED	2694	5.0	83.8%	4.8								
										HIGH	4559	7.8	83.6%	7.4								
	575–3–60	518	633	9.6	78	9.6	78	397	0.6	STD	1870	2.9	81.1%	2.8	0.24	2	3.4	2	1.8	1	0.3	10.7
										MED	1870	2.9	81.1%	2.8								
										HIGH	4470	5.9	83.6%	5.6								
20	208–3–60	187	253	27.6	191	25.0	164	350	1.5	STD	2694	10.7	83.8%	10.2	0.52	2	7.8	2	3.9	1	0.6	24.0
										MED	4559	15.8	83.6%	15.0								
										HIGH	5644	18.0	89.5%	17.1								
	230–3–60	187	253	27.6	191	25.0	164	350	1.5	STD	2694	10.7	83.8%	10.2	0.52	2	7.8	2	3.9	1	0.6	24.0
										MED	4559	15.8	83.6%	15.0								
										HIGH	5644	18.0	89.5%	17.1								
	460–3–60	414	506	12.8	100	12.2	100	277	0.9	STD	2694	5.0	83.8%	4.8	0.3	2	3.4	2	1.8	1	0.3	10.7
										MED	4559	7.8	83.6%	7.4								
										HIGH	5644	9.0	89.5%	8.6								
	575–3–60	518	633	9.6	78	9.0	78	397	0.6	STD	1870	2.9	81.1%	2.8	0.24	2	3.4	2	1.8	1	0.3	10.7
										MED	4470	5.9	83.6%	5.6								
										HIGH	6978	8.0	89.5%	7.6								

* On 575V units, the ERV motors are 460V

ELECTRICAL DATA (cont.)

48HC With ERV and Economizer

48HC	V–Ph–Hz	UNIT VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)		IFM TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA	COMBUSTION FAN MOTOR FLA	ERV Motors *						ERV Total FLA
																Exhaust		Supply		Wheel		
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA							QTY	FLA (ea)	QTY	FLA (ea)	QTY	FLA (ea)	
24	208–3–60	187	253	30.1	225	30.1	225	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1								
										HIGH	10601	29.9	91.7%	28.5								
	230–3–60	187	253	30.1	225	30.1	225	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1								
										HIGH	10601	29.9	91.7%	28.5								
	460–3–60	414	506	16.7	114	16.7	114	277	0.9	STD	4559	7.8	83.6%	7.4	0.3	2	3.4	2	3.4	1	0.6	14.2
										MED	5644	9.0	89.5%	8.6								
										HIGH	10601	15.0	91.7%	14.3								
	575–3–60	518	633	12.2	80	12.2	80	397	0.6	STD	4470	5.9	83.6%	5.6	0.24	2	3.4	2	3.4	1	0.6	14.2
										MED	6978	8.0	89.5%	7.6								
										HIGH	7341	10.0	91.7%	9.5								
28	208–3–60	187	253	48.1	245	33.3	239	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1								
										HIGH	10601	29.9	91.7%	28.5								
	230–3–60	187	253	48.1	245	33.3	239	350	1.5	STD	4559	15.8	83.6%	15.0	0.52	2	7.8	2	7.8	1	1.2	32.4
										MED	5644	18.0	89.5%	17.1								
										HIGH	10601	29.9	91.7%	28.5								
	460–3–60	414	506	18.6	125	17.9	125	277	0.9	STD	4559	7.8	83.6%	7.4	0.3	2	3.4	2	3.4	1	0.6	14.2
										MED	5644	9.0	89.5%	8.6								
										HIGH	10601	15.0	91.7%	14.3								
	575–3–60	518	633	14.7	100	12.8	80	397	0.6	STD	4470	5.9	83.6%	5.6	0.24	2	3.4	2	3.4	1	0.6	14.2
										MED	6978	8.0	89.5%	7.6								
										HIGH	7341	10.0	91.7%	9.5								

* On 575Vunits, the ERV motors are 460V

ELECTRICAL DATA (cont.)

48HC - WITH ERV

48HC SIZE	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			w/ERV w/o Economizer				w/ERV w/Economizer				w/ERV w/o Economizer				w/ERV w/Economizer			
			MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
17	208/230–3–60	STD	84.4	100	90	409	92.2	100	99	417	89.2	100	95	414	97.0	110	104	422
		MED	87.1	100	93	426	94.9	110	102	434	91.9	100	99	431	99.7	110	107	439
		HIGH	91.9	100	99	435	99.7	110	107	443	96.7	110	104	440	104.5	125	113	448
	460–3–60	STD	42.1	50	45	241	45.5	50	49	245	44.3	50	47	243	47.7	60	51	247
		MED	43.5	50	46	250	46.9	60	50	254	45.7	50	49	252	49.1	60	53	256
		HIGH	46.1	50	49	254	49.5	60	53	258	48.3	60	52	256	51.7	60	56	260
	575–3–60	STD	33.4	40	36	191	36.8	45	40	195	35.1	40	38	193	38.5	45	41	197
		MED	33.4	40	36	191	36.8	45	40	195	35.1	40	38	193	38.5	45	41	197
		HIGH	36.2	45	39	205	39.6	45	43	209	37.9	45	41	207	41.3	50	45	211
20	208/230–3–60	STD	91.9	100	98	456	99.6	125	107	464	96.7	110	103	461	104.4	125	112	469
		MED	96.7	110	103	465	104.4	125	112	473	101.5	125	109	470	109.2	125	118	478
		HIGH	98.8	125	106	467	106.5	125	115	475	103.6	125	111	472	111.3	125	120	480
	460–3–60	STD	43.8	50	47	252	47.2	60	51	256	46.0	50	49	254	49.4	60	53	258
		MED	46.4	50	50	256	49.8	60	54	260	48.6	60	52	258	52.0	60	56	262
		HIGH	47.6	60	51	257	51.0	60	55	261	49.8	60	54	259	53.2	60	57	263
	575–3–60	STD	33.4	40	36	193	36.8	45	40	197	35.1	40	38	195	38.5	45	41	199
		MED	36.2	45	39	207	39.6	45	43	211	37.9	45	41	209	41.3	50	45	213
		HIGH	38.2	45	41	205	41.6	50	45	209	39.9	45	43	207	43.3	50	47	211

ELECTRICAL DATA (cont.)

48HC - WITH ERV

48HC SIZE	NOM. V–Ph–Hz	IFM TYPE	NO C.O. or UNPWR C.O.								w/ PWRD C.O.							
			w/ERV w/o Economizer				w/ERV w/Economizer				w/ERV w/o Economizer				w/ERV w/Economizer			
			MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
					FLA	LRA			FLA	LRA			FLA	LRA			FLA	LRA
24	208/230–3–60	STD	121.0	150	131	577	121.0	150	131	577	125.8	150	136	582	125.8	150	136	582
		MED	123.1	150	133	579	123.1	150	133	579	127.9	150	138	584	127.9	150	138	584
		HIGH	134.5	150	146	658	134.5	150	146	658	139.3	150	152	663	139.3	150	152	663
	460–3–60	STD	62.7	70	67	292	62.7	70	67	292	64.9	80	70	294	64.9	80	70	294
		MED	63.9	80	69	293	63.9	80	69	293	66.1	80	71	295	66.1	80	71	295
		HIGH	69.6	80	75	333	69.6	80	75	333	71.8	80	78	335	71.8	80	78	335
	575–3–60	STD	49.6	60	54	219	49.6	60	54	219	51.3	60	55	221	51.3	60	55	221
		MED	51.6	60	56	217	51.6	60	56	217	53.3	60	58	219	53.3	60	58	219
		HIGH	53.5	60	58	244	53.5	60	58	244	55.2	60	60	246	55.2	60	60	246
28	208/230–3–60	STD	149.7	175	158	617	149.7	175	158	617	154.5	200	164	622	154.5	200	164	622
		MED	151.8	175	161	619	151.8	175	161	619	156.6	200	166	624	156.6	200	166	624
		HIGH	163.2	200	174	698	163.2	200	174	698	168.0	200	179	703	168.0	200	179	703
	460–3–60	STD	68.1	80	73	318	68.1	80	73	318	70.3	80	76	320	70.3	80	76	320
		MED	69.3	80	74	319	69.3	80	74	319	71.5	90	77	321	71.5	90	77	321
		HIGH	75.0	90	81	359	75.0	90	81	359	77.2	90	83	361	77.2	90	83	361
	575–3–60	STD	54.5	60	58	243	54.5	60	58	243	56.2	60	60	245	56.2	60	60	245
		MED	56.5	70	61	241	56.5	70	61	241	58.2	70	63	243	58.2	70	63	243
		HIGH	58.4	70	63	268	58.4	70	63	268	60.1	70	65	270	60.1	70	65	270

SEQUENCE OF OPERATION

CONTROLS

The EnergyX Energy Recovery Ventilator (ERV) module is controlled by a digital controller located inside the EnergyX chassis. It communicates with the WeatherMaster ComfortLink controller via a UPC translator module which connects to the WeatherMaster rooftop unit's ComfortLink controller via a LEN cable. All controller settings and configuration are input via the ComfortLink scrolling marquee display.

All control points, including outdoor airflow, exhaust airflow and CO_2 setpoints are configured via the ComfortLink scrolling marquee interface. (Note: CO_2 sensor requires a factory installed economizer.)

The EnergyX energy recovery unit pre-conditions the outdoor air before it mixes with the return air and enters the rooftop unit evaporator coil. As a result, the EnergyX operation is mostly independent of the rooftop unit operation except to allow the space conditioning needs to be met without RTU compressor operation or RTU heat operation for a significantly wider range of ambient temperatures (than a unit without an energy recovery module). This is achieved either by the pre-conditioning of the EnergyX wheel or the economizer (if equipped). The EnergyX will pre-condition the outside air in the cooling and heating modes of operation.

For more information regarding controller operation, see the EnergyX controls, Start-Up, Operations, and Troubleshooting supplement manual.

General

The sequence below describes the sequence of operation for a WeatherMaster unit with ComfortLink controls and an EnergyX. For more information regarding controller operation, see the EnergyX Start-Up, Operations, and Troubleshooting supplement manual.

The EnergyX module will not activate unless the RTU fan is on. The EnergyX default condition is to remain off in the unoccupied mode, however, this can be over-ridden via the control setpoints.

Cooling Operation

When the ComfortLink controller recognizes that the conditioned zone requires cooling (via the space temperature sensor or space thermostat) the EnergyX module is activated. The EnergyX control module follows the sequence of operation logic as listed below.

Step 1 — Economizer Operation

First, the EnergyX module checks if the outside air is suitable for free cooling via the outside air enthalpy sensor. If the outside air is suitable for free cooling and the unit has an economizer, the EnergyX will operate in "ventilation mode" where the wheel will remain off but the ERV economizer will modulate in free-cooling. If the unit is in Unoccupied mode, then the unit will not operate in economizer mode and will proceed to Step 2.

Step 2 — Wheel Operation

If the outside air is not suitable for free cooling, then the EnergyX will operate in either cooling or heating mode as called for by the rooftop unit ComfortLink controller. Note: if the unit is in Unoccupied mode, the default configuration is that the EnergyX module will not operate. This can be over-ridden by an adjustable setpoint in the ERV controller.

Cooling Operation

If the outside air is not suitable for free cooling then the EnergyX wheel will activate and the supply fan will activate per the CFM setpoint.

Modulating EnergyX Units Only - If a CO_2 sensor is used (connected to the RTU ComfortLink controller) the supply fan will modulate between the DCV minimum and DCV maximum setpoints. The exhaust fan will modulate to follow the supply fan operation per the Exhaust CFM-offset value. If the economizer opens more than 5%, the wheel utilizes a "stop-jog" operation to periodically rotate the wheel and minimize potential dirt build-up and excess wear on one section of the wheel. (Note: CO_2 sensor requires a factory installed economizer).

Heating Operation

When the ComfortLink controller sees that the space requires heating via the space temperature sensor or when the thermostat or calls for heating, the EnergyX module is activated. The ERV wheel will rotate and the supply fan will activate per the CFM setpoint. Modulating EnergyX Units Only - If a CO_2 sensor is used (connected to the RTU ComfortLink controller) the supply fan will modulate between the DCV minimum and DCV maximum setpoints. The exhaust fan will modulate to follow the supply fan operation per the Exhaust CFM-offset value, via the Economizer Control Board (ECB).

Supply and Exhaust Air Frost Control Operation

When the factory installed frost protection option is used, the EnergyX module will sense pressure differential across the energy recovery cassette. The supply blower will be shut-off if the pressure differential across the energy recovery cassette exceeds the adjustable setpoint value. The blower will remain off for 5 minutes. The exhaust blower and wheel will remain on, in order to remove any frost build-up on the wheel.

EnergyX Wheel Maintenance and Blower Indicator Operation

When the optional factory installed wheel maintenance indicator is used, a proxy sensor monitors the EnergyX wheel and sends a corresponding alarm signal when appropriate. Pressure switches are used to detect and activate the unit alarm when blowers are not running.

EnergyX Filter Maintenance Indicator Operation

When the optional factory installed filter maintenance indicator is used, a factory--installed differential pressure switch measures pressure drop across the outside air filter and activates a field--supplied dry contact indicator when the pressure differential exceeds the adjustable switch setpoint. EnergyX operation is not interrupted.

APPLICATION DATA

Energy Recovery

Energy recovery devices such as the EnergyX typically result in substantial energy savings over other outdoor air devices. Specifically, the EnergyX adds sensible and latent capacity as well as additional stages of cooling and heating operation to the Rooftop Unit. Due to the EnergyX's significantly lower input watts than the corresponding RTU compressor(s), proper control strategies for this device maximize its operation to reduce the run time of the RTU compressor(s). This results in a much higher system efficiency than can typically be achieved by using a rooftop unit of the same total capacity.

The EnergyX with its modulating airflow capability allows a designer to increase the amount of outside air significantly more than normal with the following benefits:

- Reduced rooftop unit sizing - The more air that passes through the energy recovery device reduces the load (and potential unit size) on the rooftop unit's compressors and heating system
- Higher system cooling and heating efficiencies - Since the EnergyX uses the power of 'rotary enthalpy transfer' as opposed to mechanical compression conditioning of the ventilation air resulting in a much higher operating efficiency (RER) of the energy recovery unit and system Combined Efficiency Factor (CEF). The higher the airflow through the EnergyX, the higher the system efficiency (CEF) value. Since the EnergyX also conditions ventilation air in the heating mode, the necessary amount and/or operation of the rooftop unit heat system is reduced.
- Better part-load conditioning – as the EnergyX is able to modulate its airflow, the ability to match the changing zone part-load capacity (in cooling and in heating) is greatly increased.
- Higher air change rates – Larger amounts of ventilation air allows the zone air to be flushed out more often. This can contribute significantly to reduced sickness and more productive operating environments.

All ventilated spaces are good candidates for energy recovery systems. The applications that benefit most are those that require a large amount of outside air for a space that has a low internal load. This is true because most outside air loads are latent which requires a larger rooftop unit to accommodate both internal and ventilation loads. Advantages of the ERV unit include the ability to reduce the size of the rooftop unit, provide better humidity levels and provide a stable, tempered space.

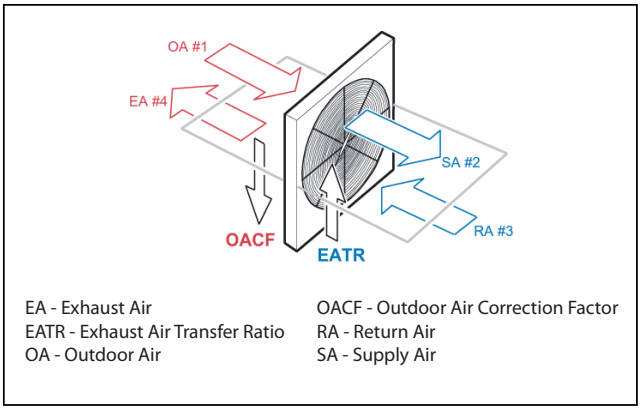

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Fig. 19 - Air-to-Air Energy Recover Ventilation - Airflow Convention

Examples of ERV applications are classrooms, churches, conference rooms, game rooms, auditoriums, movie theaters, day care centers, nursing homes, funeral homes, dormitories, and clinics. Retrofits of existing systems to handle outside air without modifying the rooftop unit are excellent applications. Other examples are bars, restaurants, casino/game rooms, barber/beauty shops, bingo halls, locker rooms, recreational facilities and health clubs. Animal shelters such as veterinary clinics and kennels have been very successful implementations. Retail spaces and manufacturing facilities are also good applications.

If the outside air requirement is greater than 10% of a rooftop unit's supply air rating the EnergyX unit should be considered to enhance the comfort of the occupants and reduce the tonnage of the rooftop unit. Carrier's Packaged RTU Builder selection software program offers a quick, simple look at the advantages and payback of the EnergyX system.

SEQUENCE OF OPERATION (cont.)

ASHRAE 62.1 Air Classification Requirements

The EnergyX allows for easy compliance with the current ASHRAE Standard 62.1 Air Classification Requirements. Pollutant transfer via Desiccant is a 'non issue' since by virtue of the ASHRAE "classes of air" the main determinant is EATR or cross transfer of air by leakage from exhaust to supply. Since the EATR is an AHRI Certified measurement of an AHRI certified wheel device, the user can be assured of meeting the air dilution requirements of ASHRAE 62.1 and therefore the air classification requirements.

Industrial Applications are by definition those that are Class 4 air (or worse). Most wheel manufacturers do not encourage application of wheels to these types of applications. When required, many wheel manufacturers make specialty wheels with specific mechanical purge construction for industrial applications, that can be used to field-replace the factory provided wheels. Contact the applicable wheel manufacture for specific application details.

Choosing the proper airflow is essential. Unit selection guidance for the EnergyX is in definite contrast to typical unit sizing and selections. Typical unit sizing methods are to select the energy recovery device per the desired amount of outdoor air and then calculate the total capacity of the resulting energy recovery unit. This capacity is then subtracted from the desired total capacity for the conditioned zone. The remaining value is the necessary capacity of the rooftop unit. By conventional cooling & heating capacity guidance, the effort is to reduce the amount of outside (ventilation air) as much as possible since this additional ventilation air results in increased load on the rooftop unit compressor and heating sections.

Note that all units can be used in applications that require more or less airflow than the published CFM operating range as long as the airflow range is within the capabilities of the EnergyX fan system. This option can be used for high-static applications. Although performance is optimized at equal exhaust and supply airflow rates, the selection program and the EnergyX unit can be used with unequal airflow amounts. The unit must be sized for the largest airflow amount. The smaller airflow used cannot be less than 50% of the larger airflow in the published range.

Energy recovery wheels

Carrier's EnergyX energy recovery wheels consist of a welded stainless steel hub, spoke and rim assembly, which is independent of the heat transfer matrix. The heat transfer matrix is contained in patented energy transfer segments, removable from the wheel without requiring tools. The energy wheel uses a unique parallel plate geometry and polymer film substrate to provide an optimized heat exchanger design. The polymer film construction is not subject to corrosion in coastal locations or swimming pool areas.

Silica gel technology

The EnergyX energy recovery wheels use the desiccant material known as silica gel, which is a highly porous solid adsorbent material that structurally resembles a rigid sponge. It has a very large internal surface composed of myriad microscopic cavities and a vast system of capillary channels that provide pathways connecting the internal microscopic cavities to the outside surface of the sponge. Silica gel enthalpy wheels transfer water by rotating between two air streams of different vapor pressures. The vapor pressure differential drives molecules into/from these cavities to transfer moisture from the more humid airstream to the drier airstream.

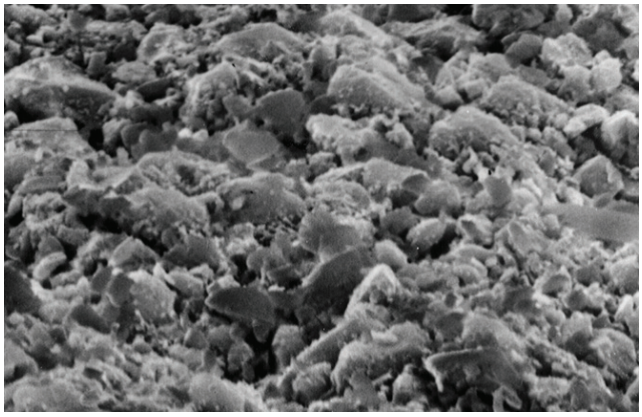

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Fig. 20 - Microscopic Image of Silica Gel

Adsorption: silica gel vs. molecular sieve

The graph below shows the effect of Relative Humidity on Desiccant Capacity characteristic curve for adsorption of water on silica gel. It shows the percent weight adsorbed versus relative humidity of the airstream in contact with the silica gel. The amount of water adsorbed rises linearly with increasing relative humidity (RH) until RH reaches near 60%. It then plateaus at above 40% adsorbed as relative humidity approaches 100%. For contrast, the curve for molecular sieves rises rapidly to plateau at about 20% absorbed at 20% RH.

The Effect of Relative Humidity on Desiccant Capacity graph explains the following application considerations:

- Molecular sieves are preferred for regenerated applications such as desiccant cooling and dehumidification systems that must reduce the processed air streams to very low relative humidities.
- Silica gel has superior characteristics for recovering space conditioning energy from exhaust air and handling high relative humidity outside conditions.

The transfer of water by adsorption/desorption is not dependent on temperature. Therefore, the silica gel enthalpy wheel works to reduce latent load at difficult part-load conditions.

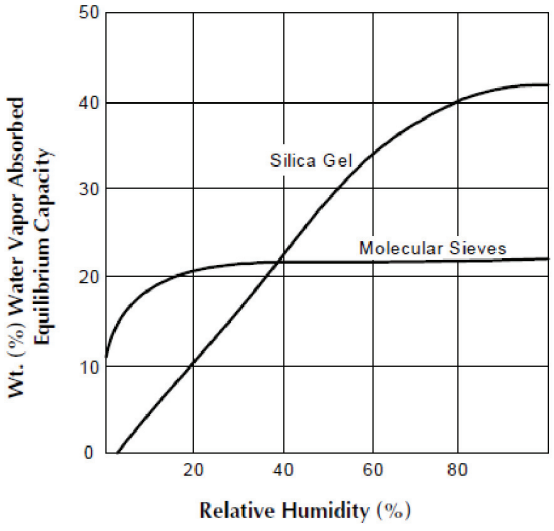

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Fig. 21 - Effect of Relative Humidity on Desiccant Capacity

Fungal growth and moisture transfer

Carrier EnergyX units have silica gel-based desiccant wheels. The water molecules are individually transferred by desorption/adsorption to and from the silica gel surfaces. Water is present on the wheel in a molecular layer only, and condensation does not occur. Therefore, Carrier's energy recovery wheels experience dry moisture transfer; there is no bulk liquid water present that could support fungal growth. Water transfer to and from the wheel's desiccant surfaces occurs in the vapor phase; there are no wet surfaces and liquid water does not enter the airstream. Silica gel is also highly selective for water, based on the strong preference of the gel surface for the dipolar water molecule over other compounds.

Frost control requirements

Energy recovery systems require frost protection or a means of defrosting in climates that experience severe winter conditions. Frost formation results in a reduction and eventual blockage of airflow through the energy wheel.

Frost formation causes reduced airflow through the heat exchanger. Without frost control, energy recovery and airflow may be significantly reduced. The frost threshold temperature is the point at which frost begins to accumulate on heat exchanger surfaces. It is a function of both outside temperature and indoor relative humidity.

The Frost Threshold Comparison figures compares the frost threshold of a plate-type sensible heat exchanger with that of an enthalpy wheel. Note that frost forms at temperatures between 22 F and 30 F in a plate-type heat exchanger, frost threshold temperatures for enthalpy wheels are generally 20 to 30 degrees lower, approximately 0° F to 20 F. This is because the enthalpy wheel removes water from the exhaust airstream, effectively lowering the exhaust's dew point. The water removed is subsequently picked up through desorption by the entering outdoor air. Depending on the indoor relative humidity in areas where winter outside temperatures are between –5 F and 22 F, enthalpy wheel based recovery systems have a significant advantage over sensible plate type units because there is no additional cost for frost control. Even in cold areas, in most cases, enthalpy wheel based systems for schools and office buildings can be designed without frost control because most of the frosting hours are at night when the building is unoccupied. Consult bin data, such as that provided by ASHRAE, to qualify daytime applications in cold climates for frost-free operation.

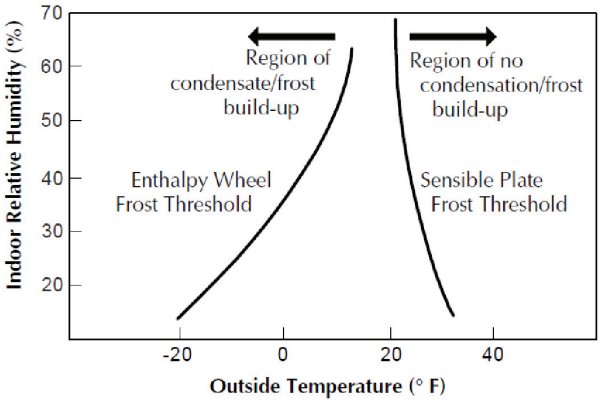

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Fig. 22 - Frost Threshold comparison

The Frost Thresholds Temperatures table below lists typical frost threshold temperatures for Carrier's EnergyX energy recovery wheels over a wide range of indoor-air temperatures and relative humidity. Frost control is not required until outdoor air temperatures are below the threshold.

INDOOR AIR RH (%)	INDOOR AIR DRY BULB TEMPERATURE			
	70 F	72 F	75 F	80 F
20	–14	–13	–11	–8
30	–3	–2	–1	3
40	5	7	9	11
50	12	13	15	18
60	18	19	21	26

In regions where winter temperatures are extreme, Carrier's energy recovery wheels can be used effectively with the Frost Protection Factory Installed Option (FIOP).

NOTE: Refer to ASHRAE for bin data in cold climates where the threat of wheel frosting is frequent. Consult this information to ensure appropriate preheat techniques are used during occupied times.

SEQUENCE OF OPERATION (cont.)

Frost prevention for frost control is required in extremely cold climates to preserve performance and assure the continuous supply of outdoor air. Enthalpy wheel frost control strategies take advantage of inherently low frosting thresholds. This results in minimized energy use and maximized design load reductions. In regions that experience extreme winter conditions, the Frost Protection FIOP allows the exhaust fan to operate below the frost threshold temperature; however, a temperature sensor would disable the supply fan when the outdoor-air temperatures reach the frost control setpoint. The outdoor-air temperature sensor is located in the outdoor air intake of the ERV section. To avoid depressurization of the space, fresh air dampers may be required as part of the building's ventilation system.

Economizers

As promulgated by ASHRAE, economizers reduce operating expenses and compressor run time by providing a source of free cooling and a means of ventilation to match changing application needs. When properly designed (per ASHRAE standards), the economizer will control the amount of outdoor air allowed into the building and is integrated with the operation of the compressors. Carrier economizers are properly designed and allow free cooling to occur when the outdoor air is suitable depending upon the control strategy chosen.

It has also been proven (by multiple independent sources) that using a Demand Control Ventilation (CO_2) strategy will result in considerable energy savings over a constant outdoor air volume strategy. This is because air to be brought in at a fixed rate has no variability as the outside air conditions change. Modulating EnergyX systems with DCV control allows the outside ventilation air to be reduced to the minimum building ventilation requirements as required by the actual occupancy load, which in term reduces the load on the unit compressors or heating system.

It is recommended that an economizer option always be used with the EnergyX. This allows for true free cooling operation when the outside air conditions allow for it.

Wheel Cleaning

The EnergyX includes a 5 year wheel warranty as a standard product feature. Wheels are self cleaning from dry dust and dirt due to laminar airflow through the wheel. If volatile organic compounds (VOC's) are present present, wheels need to be 'deep' cleaned just like evaporator coils must be in order to maintain latent recovery performance. Since it is easier and less risky to clean a wheel outside of the HVAC unit than within, EnergyX unit construction allows for easy wheel segment removal.

It is recommended that a different wheel segment be cleaned each time the unit air filters are changed in order to ensure periodic entire wheel cleaning. Wheel cleaning can be done simply and easily by hand. Proper wheel cleaning does not remove wheel desiccant. See the EnergyX Controls & Troubleshooting Supplement Instructions for additional wheel cleaning and service information.

EXHAUST FAN PERFORMANCE

Many applications that utilize energy recovery incorporate ducted return/exhaust air paths. In these applications, it is important to consider the duct pressure of the return/exhaust just as a designer would consider the effects of the supply duct static pressure on the airflow of the rooftop unit itself.

EnergyX Modulating Volume 15-25 ton Units – The exhaust fan in the Modulating Volume EnergyX unit will assist the rooftop unit fan in pulling air through the exhaust/return duct. These exhaust fans are backwards curved impeller designs which are capable of significant more static pressure operation than typical forward curved fan designs. The following exhaust fan performance curves are provided for additional guidance when considering return/exhaust duct design.

NOTE: If application designs require two separate ducts (one for exhaust air, one for return air) contact your Carrier Sales Engineer for additional guidance prior to specification or ordering.

General

The sequence below describes the sequence of operation for an electro-mechanical unit with and without a factory installed EconoMi$er™ IV (called "economizer" in this sequence). For information regarding a direct digital controller, see the start-up, operations, and troubleshooting manual for the applicable controller.

Note about this specification:

These specifications are written in "Masterformat" as published by the Construction Specification Institute. Please feel free to copy this specification directly into your building spec.

Gas Heat/Electric Cooling Packaged Rooftop

HVAC Guide Specifications

Size Range: **15 to 25 Nominal Tons**

Section **Description**

23 06 80 Schedules for Decentralized HVAC Equipment

23 06 80.13 Decentralized Unitary HVAC Equipment Schedule

23 06 80.13.A. Rooftop unit schedule

1. Schedule is per the project specification requirements.

23 07 16 HVAC Equipment Insulation

23 07 16.13 Decentralized, Rooftop Units:

23 07 16.13.A. Evaporator fan compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1/2-in thick, minimum 1 1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

23 07 16.13.B. Gas heat compartment:

1. Aluminum foil-faced fiberglass insulation shall be used.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

23 09 13 Instrumentation and Control Devices for HVAC

23 09 13.23 Sensors and Transmitters

23 09 13.23.A. Thermostats

1. Thermostat must
   a. energize both "W" and "G" when calling for heat.
   b. have capability to energize 2 different stages of cooling, and 2 different stages of heating.
   c. include capability for occupancy scheduling.

23 09 23 Direct-digital Control system for HVAC

23 09 23.13 Decentralized, Rooftop Units:

23 09 23.13.A. Controls and Safeties

1. Unit ComfortLink Controls:
   a. Scrolling Marquee display.
   b. CCN (Carrier Comfort Network™) capable.
   c. Unit control with standard suction pressure transducers and condensing temperature thermistors.
   d. Shall provide a 5°F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
   e. Shall provide and display a current alarm list and an alarm history list.
   f. Automatic compressor redundancy on units without Humidi-MiZer system.
   g. Service run test capability.
   h. Shall accept input from a CO_2 sensor (both indoor and outdoor).
   i. Configurable alarm light shall be provided which activates when certain types of alarms occur.
   j. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
   k. Service diagnostic mode.
   l. Economizer control (optional).
   m. Multiple capacity stages.
   n. Unit shall be complete with self-contained low-voltage control circuit.
   o. Unit shall have 0°F low ambient cooling operation.
2. Safeties:
   a. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:

(1.) Compressor lockout protection provided for either internal or external overload.
(2.) Low-pressure protection.
(3.) Freeze protection (evaporator coil).
(4.) High-pressure protection (high pressure switch or internal).
(5.) Compressor reverse rotation protection (ComfortLink units only).
(6.) Loss of charge protection.
(7.) Start assist on singe-phase units.

b. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
c. Induced draft heating section shall be provided with the following minimum protections:
(1.) High-temperature limit switch.
(2.) Induced-draft motor speed sensor.
(3.) Flame rollout switch.
(4.) Flame proving controls.
(5.) Redundant gas valve.

23 09 23.13.B. N/A

23 09 33 Electric and Electronic Control System for HVAC

23 09 33.13 Decentralized, Rooftop Units:

23 09 33.13.A. General:

1. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
2. Shall utilize color-coded wiring.
3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches.
4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
5. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

23 09 33.23.B. Safeties:

1. Compressor over-temperature, over-current. High internal pressure differential.
2. Low-pressure switch.
   a. Units shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
3. High-pressure switch.
   a. Units shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   b. High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
4. Automatic reset, motor thermal overload protector.
5. Heating section shall be provided with the following minimum protections:
   a. High-temperature limit switches.
   b. Induced draft motor speed sensor.
   c. Flame rollout switch.
   d. Flame proving controls.

23 09 93 Sequence of Operations for HVAC Controls

23 09 93.13 Decentralized, Rooftop Units:

23 09 93.13 INSERT SEQUENCE OF OPERATION

23 40 13 Panel Air Filters

23 40 13.13 Decentralized, Rooftop Units:

23 40 13.13.A. Standard filter section

1. Shall consist of factory-installed, low velocity, disposable 2-in thick fiberglass filters of commercially available sizes.
2. Unit shall use only one filter size. Multiple sizes are not acceptable.

3. Filters shall be accessible through a dedicated, weather tight access panel.
4. 4-in (102mm) filter capabilities shall be capable with pre-engineered and approved Carrier filter track field installed accessory. This kit requires field furnished filters.

23 81 19 Self-Contained Air Conditioners

23 81 19.13 Medium-Capacity Self-Contained Air Conditioners (48HC*D17-28)

23 81 19.13.A. General

1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
3. Unit shall use environmentally sound, Puron refrigerant.
4. Unit shall be installed in accordance with the manufacturer's instructions.
5. Unit must be selected and installed in compliance with local, state, and federal codes.

23 81 19.13.B. Quality Assurance

1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
2. Units are Energy Star certified where sizes are required.
3. Unit shall be rated in accordance with AHRI Standard 340/360.
4. Unit shall be designed to conform to ASHRAE 15.
5. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.
6. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
7. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
8. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
9. Unit shall be designed and manufactured in accordance with ISO 9001.
10. Roof curb shall be designed to conform to NRCA Standards.
11. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
12. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
13. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
14. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
15. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

23 81 19.13.C. Delivery, Storage, and Handling

1. Unit shall be stored and handled per manufacturer's recommendations.
2. Lifted by crane requires either shipping top panel or spreader bars.
3. Unit shall only be stored or positioned in the upright position.

23 81 19.13.E. Project Conditions

1. As specified in the contract.

23 81 19.13.F. Operating Characteristics

1. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 340/360 at ± 10% voltage.
2. Compressor with standard controls shall be capable of operation down to 35°F (2°C), ambient outdoor temperatures. Accessory winter start kit is necessary if mechanically cooling at ambient temperatures below 35°F (2°C).
3. Unit shall discharge supply air vertically as shown on contract drawings.
4. Unit shall be factory configured and ordered for vertical supply & return configurations.
5. Unit shall be factory furnished in vertical configuration.

23 81 19.13.G. Electrical Requirements

1. Main power supply voltage, phase, and frequency must match those required by the manufacturer.

23 81 19.13.H. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F / 16°C): 60, Hardness: H-2H Pencil hardness.

3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standard 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the gas heat compartment.
4. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections standard. Both gas and electric connections shall be internal to the cabinet to protect from environmental issues.
5. Base Rail
   a. Unit shall have base rails on a minimum of 2 sides.
   b. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
   c. Holes shall be provided in the base rail for moving the rooftop by fork truck.
   d. Base rail shall be a minimum of 16 gauge thickness.
6. Condensate pan and connections:
   a. Shall be a sloped condensate drain pan made of a non-corrosive material.
   b. Shall comply with ASHRAE Standard 62.
   c. Shall use a 3/4-in (102mm) -14 NPT drain connection, through the side of the drain pan. Connection shall be made per manufacturer's recommendations.
7. Top panel:
   a. Shall be a multi-piece top panel linked with water tight flanges and locking systems.
8. Gas Connections:
   a. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).
   b. Thru-the-base capability
      (1.) Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
      (2.) Optional, factory-approved, water-tight connection method must be used for thru-the-base gas connections.
      (3.) No basepan penetration, other than those authorized by the manufacturer, is permitted.
9. Electrical Connections
   a. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
   b. Thru-the-base capability.
      (1.) Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
      (2.) Optional, factory-approved, water-tight connection method must be used for thru-the-base electrical connections.
      (3.) No basepan penetration, other than those authorized by the manufacturer, is permitted.
10. Component access panels (standard)
   a. Cabinet panels shall be easily removable for servicing.
   b. Unit shall have one factory installed, tool-less, removable, filter access panel.
   c. Panels covering control box and filter shall have molded composite handles while the blower access door shall have an integrated flange for easy removal.
   d. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.
   e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
   f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

23 81 19.13.I. Gas Heat

1. General
   a. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
   b. Shall incorporate a direct-spark ignition system and redundant main gas valve.
   c. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
   a. IGC board shall notify users of fault using an LED (light-emitting diode).
   b. The LED shall be visible without removing the control box access panel.
   c. IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.

d. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

3. Standard Heat Exchanger construction
   a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.
   b. Burners shall be of the in-shot type constructed of aluminum-coated steel.
   c. Burners shall incorporate orifices for rated heat output up to 2000 ft (610m) elevation. Additional accessory kits may be required for applications above 2000 ft (610m) elevation, depending on local gas supply conditions.
   d. Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.
4. Optional Stainless Steel Heat Exchanger construction
   a. Use energy saving, direct-spark ignition system.
   b. Use a redundant main gas valve.
   c. Burners shall be of the in-shot type constructed of aluminum-coated steel.
   d. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
   e. The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.
   f. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
   g. Complete stainless steel heat exchanger allows for greater application flexibility.
5. Induced draft combustion motor and blower
   a. Shall be a direct-drive, single inlet, forward-curved centrifugal type.
   b. Shall be made from steel with a corrosion-resistant finish.
   c. Shall have permanently lubricated sealed bearings.
   d. Shall have inherent thermal overload protection.
   e. Shall have an automatic reset feature.

23 81 19.13.J. Coils

1. Standard Aluminum Fin/Copper Tube Coils:
   a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
   b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
   c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.
2. Optional Pre-coated aluminum-fin condenser coils:
   a. Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments.
   b. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube.
   c. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.
3. Optional Copper-fin evaporator and condenser coils:
   a. Shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets.
   b. Galvanized steel tube sheets shall not be acceptable.
   c. A polymer strip shall prevent coil assembly from contacting the sheet metal coil pan to minimize potential for galvanic corrosion between coil and pan.
4. Optional E-coated aluminum-fin evaporator and condenser coils:
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.
   b. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.
   c. Color shall be high gloss black with gloss per ASTM D523-89.
   d. Uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges.
   e. Superior hardness characteristics of 2H per ASTM D3363-92A and cross-hatch adhesion of 4B-5B per ASTM D3359-93.
   f. Impact resistance shall be up to 160 in-lb (ASTM D2794-93).
   g. Humidity and water immersion resistance shall be up to minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92).

h. Corrosion durability shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.

5. Optional E-coated aluminum-fin, aluminum tube condenser coils:
   a. Shall have a flexible epoxy polymer coating uniformly applied to all coil external surface areas without material bridging between fins or louvers.
   b. Coating process shall ensure complete coil encapsulation, including all exposed fin edges.
   c. E-coat thickness of 0.8 to 1.2 mil with top coat having a uniform dry film thickness from 1.0 to 2.0 mil on all external coil surface areas, including fin edges, shall be provided.
   d. Shall have superior hardness characteristics of 2H per ASTM D3363-00 and cross-hatch adhesion of 4B-5B per ASTM D3359-02.
   e. Shall have superior impact resistance with no cracking, chipping or peeling per NSF/ANSI 51-2002 Method 10.2.

23 81 19.13.K. Refrigerant Components

1. Refrigerant circuit shall include the following control, safety, and maintenance features:
   a. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
   b. Refrigerant filter drier - Solid core design.
   c. Service gauge connections on suction and discharge lines.
   d. Pressure gauge access through a specially designed access screen on the side of the unit.
2. Compressors
   a. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
   b. Models shall be available with 2 compressor/2 stage cooling.
   c. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
   d. Compressors shall be internally protected from high discharge temperature conditions.
   e. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
   f. Compressor shall be factory mounted on rubber grommets.
   g. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
   h. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

23 81 19.13.L. Filter Section

1. Filters access is specified in the unit cabinet section of this specification.
2. Filters shall be held in place by a preformed, slide-out filter tray, facilitating easy removal and installation.
3. Shall consist of factory-installed, low velocity, throw-away 2-in thick fiberglass filters.
4. Filters shall be standard, commercially available sizes.
5. Only one size filter per unit is allowed.
6. 4-in (102mm) filter capability is possible with a field installed pre engineered slide out filter track accessory. 4-in (102mm) filters are field furnished.

23 81 19.13.M. Evaporator Fan and Motor

1. Evaporator fan motor:
   a. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
   b. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
2. Belt-driven Evaporator Fan:
   a. Belt drive shall include an adjustable-pitch motor pulley and belt break protection system.
   b. Shall use rigid pillow block bearing system with lubricant fittings at accessible bearing or lubrication line.
   c. Blower fan shall be double-inlet type with forward-curved blades.
   d. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

23 81 19.13.N. Condenser Fans and Motors

1. Condenser fan motors:
   a. Shall be a totally enclosed motor.
   b. Shall use permanently lubricated bearings.
   c. Shall have inherent thermal overload protection with an automatic reset feature.
   d. Shall use a shaft-down design.

2. Condenser Fans:
   a. Shall be a direct-driven propeller type fan.
   b. Shall have aluminum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

23 81 19.13.O. Special Features Options and Accessories

1. EnergyX and Economizer
   a. System Description
      One-piece EnergyX (Energy Recovery Ventilation) unit is an electrically controlled ventilation air pre-conditioner utilizing an ARI 1060 certified Energy Recovery Cassette to reduce the cooling and heating loads placed on the primary HVAC unit by untreated outdoor air. Building exhaust air shall be introduced to the EnergyX unit through ductwork. Unit shall be designed as a factory-installed option to be used with WeatherMaster 48HC units for use in vertical return applications only.
   b. Quality Assurance
      (1.) Unit shall be designed in accordance with UL Standard 1995
      (2.) Energy Recovery unit shall be ETL tested and certified.
      (3.) Rooftop unit and Energy Recovery unit shall be ETL certified as one single system.
      (4.) Roof curb or curb extension shall be designed to conform to NRCA Standards.
      (5.) Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
      (6.) Unit casing shall be capable of withstanding ASTM No. 141 (Method 6061) 500-hour salt spray test.
      (7.) Unit shall contain ARI 1060 certified Energy Recovery Cassette.
      (8.) Unit shall leakage rates shall be capable of meeting ASHRAE Standard 62.1 requirements for use of class-2 exhaust with class-1 ventilation air.
2. Products
   a. Equipment (Standard)
      (1.) General
         The EnergyX unit shall be a factory assembled, single piece unit. Contained within the unit enclosure shall be all factory wiring with a single, pre-determined point of power input and a single point of 24-volt control wiring.
   b. Unit Cabinet
      (1.) Unit cabinet shall be constructed of galvanized steel coated with a pre-painted baked enamel finish.
      (2.) All models shall have hoods installed over outside air intake and exhaust openings. Outside air hood shall have aluminum water entrainment filters.
      (3.) All models have 1-in., 2 pound density fiberglass insulation.
      (4.) Hinged access doors with compression latches shall be provided on all units for access to fans and filters. Hinged doors shall be provided with at least one handle capable of being locked.
      (5.) Exhaust air stream shall have back-draft dampers to prevent air penetration during off cycles.
      (6.) Holes shall be provided in the base rails for rigging shackles to facilitate overhead rigging.
   c. Blowers
      (1.) Blowers shall be direct drive with variable speed motors.
      (2.) Blower wheel shall be made of steel with a corrosion resistant finish. It shall be dynamically balanced, double-inlet type with backward-curved blades.
      (3.) Blower shall be mounted on neoprene vibration isolation pads.
      (4.) Motor shall be high efficiency and have thermal overload protection.
   d. Filter Section
      (1.) Standard filter section shall accept commercially available, 2-in. pleated filter(s).
   e. Controls and Safeties
      (1.) The EnergyX unit shall operate in conjunction with rooftop unit fan.
   f. Electrical Requirements
      (1.) All unit power wiring shall enter unit cabinet at a single location.
   g. Energy Recovery Cassette
      (1.) The energy recovery media shall have a minimum of 70% effectiveness at nominal unit airflow.
      (2.) Energy wheel performance shall be ARI Standard 1060 Certified and bear the ARI Certified Product Seal.
      (3.) The energy recovery cassette shall be an UL Recognized component for electrical and fire safety.
      (4.) The wheel shall be coated with silica gel desiccant, permanently bonded without the use of binders or adhesives.
      (5.) Coated wheels shall be washable with detergent or alkaline coil cleaner and water.

(6.) The silica gel shall not dissolve or deliquesce in the presence of water or high humidity.

(7.) The substrate shall be made of a lightweight polymer and shall not degrade or require additional coatings for application in coastal environments.

(8.) The wheel polymer layers shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop.

(9.) The polymer layers shall be captured in a stainless steel wheel frame or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.

(10.) Energy recovery wheels greater than 19 inches in diameter shall be provided with removable wheel segments.

(11.) Wheel frame shall be a welded hub, spoke and rim assembly of stainless, plated, and or coated steel and shall be self supporting without the wheel segments in place.

(12.) Wheel segments shall be removable without the use of tools to facilitate maintenance and cleaning.

(13.) Wheel rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

(14.) Wheel bearings shall provide an L-10 life of 400,000 hours.

(15.) Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

3. Special Features (Options and Accessories)

a. Supply and exhaust air frost control option

(1.) Factory-installed frost protection module shall sense pressure differential across the energy recovery cassette.

(2.) Supply blower shall be shut-off if the pressure differential across the energy recovery cassette exceeds an adjustable set point. Blower shall remain off for an adjustable time period.

(3.) Exhaust blower and wheel shall remain in operation in order to remove any frost build-up on the wheel.

b. EnergyX maintenance indicator package
A factory-installed switch shall monitor EnergyX blowers and wheel motor amp draw and send a signal to field-supplied 24-v indicator upon amperage surge that maintenance required.

c. Filter maintenance indicator
A factory-installed differential pressure switch shall measure pressure drop across the outside air filter and activate a field-supplied 24-v indicator when airflow is restricted. It shall not interrupt EnergyX operation. Switch set point shall be adjustable.

d. EnergyX free cooling with enthalpy and stop/jog control

(1.) An enthalpy sensor shall prevent the wheel from rotating if the outside air conditions are acceptable for free cooling. Both exhaust and supply blowers will remain on.

(2.) Stop-Jog-Control shall energize the wheel periodically during the free cooling operation of the EnergyX to prevent dirt build-up on the wheel.

e. Economizer Option

(1.) The economizer shall be integrated in the energy recovery module and shall allow air to bypass the energy recovery wheel for free cooling and fail safe operation. Tilting wheel mechanisms shall not be allowed.

(2.) The economizer damper shall be motorized with factory installed, 24-volt Belimo actuator.

(3.) The EnergyX shall be capable of using the economizer in a free cooling operation.

(4.) The economizer shall utilize enthalpy sensor controls when in the economizer mode.

f. CO2 Sensor

(1.) The modulating airflow energy recovery unit shall be capable of incorporating a CO_2 sensor for use with Demand Control Ventilation.

(2.) The CO_2 sensor shall connect to the base rooftop unit's digital controller.

(3.) The modulating airflow energy recovery unit shall use at a minimum, a high & low CFM airflow set point when a CO_2 sensor is used.

g. Roof Curb Extension (PM16-28 sizes with EnergyX) Accessory for use with EnergyX units

(1.) The energy recovery module shall us the standard rooftop unit rooftop curb.

(2.) Rooftop extensions, support rails or other devices that come in contact with the roof surface to support the energy recovery module shall not be allowed.

(3.) A horizontal adapter curb shall be used to convert vertical return air applications into horizontal return air applications. The supply airflow shall be convertible via the base rooftop unit operation and restrictions.

4. Head Pressure Control Package
   a. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
   b. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to -20°F (-29°C).
5. Propane Conversion Kit
   a. Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit for use with liquefied propane. Kits shall be available for elevations from 0 up to 14,000 ft (4,276m).
6. Condenser Coil Hail Guard Assembly
   a. Shall protect against damage from hail.
   b. Shall be louvered style design.
7. Unit-Mounted, Non-Fused Disconnect Switch:
   a. Switch shall be factory-installed, internally mounted.
   b. National Electric Code (NEC) and UL approved non-fused switch shall provide unit power shutoff.
   c. Shall be accessible from outside the unit.
   d. Shall provide local shutdown and lockout capability.
8. Convenience Outlet:
   a. Powered convenience outlet.
      (1.) Outlet shall be powered from main line power to the rooftop unit.
      (2.) Outlet shall be powered from line side of disconnect by installing contractor, as required by code. If outlet is powered from load side of disconnect, unit electrical ratings shall be UL certified and rated for additional outlet amperage.
      (3.) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
      (4.) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
      (5.) Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer.
      (6.) Outlet shall be accessible from outside the unit.
   b. Non-Powered convenience outlet.
      (1.) Outlet shall be powered from a separate 115/120v power source.
      (2.) A transformer shall not be included.
      (3.) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
      (4.) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
      (5.) Outlet shall be accessible from outside the unit.
9. Flue Discharge Deflector:
   a. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.
   b. Deflector shall be defined as a “natural draft” device by the National Fuel and Gas (NFG) code.
10. Roof Curbs (Vertical):
   a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
   b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
   c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
11. High Altitude Gas Conversion Kit:
   a. Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 3,000-10,000 ft (914 to 3048m) elevation and 10,001-14,000 ft (3049-4267m) elevation.
12. Indoor Air Quality (CO_2) Sensor (field or factory installed):
   a. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
   b. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.
13. Smoke detectors: SA/RA Factory Option Field Installed SA Only
   a. Shall be a Four-Wire Controller and Detector.
   b. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
   c. Shall use magnet-activated test/reset sensor switches.
   d. Shall have tool-less connection terminal access.
   e. Shall have a recessed momentary switch for testing and resetting the detector.

f. Controller shall include:
(1.) One set of normally open alarm initiation contacts for connection to an initiating device circuit on a fire alarm control panel.
(2.) Two Form-C auxiliary alarm relays for interface with rooftop unit or other equipment.
(3.) One Form-C supervision (trouble) relay to control the operation of the Trouble LED on a remote test/reset station.
(4.) Capable of direct connection to two individual detector modules.
(5.) Can be wired to up to 14 other duct smoke detectors for multiple fan shutdown applications

14. Winter start kit
a. Shall contain a bypass device around the low pressure switch.
b. Shall be required when mechanical cooling is required down to 25°F (-4°C).
c. Shall not be required to operate on an economizer when below an outdoor ambient of 40°F (4°C).

15. Time Guard
a. Shall prevent compressor short cycling by providing a 5-minute delay (±2 minutes) before restarting a compressor after shutdown for any reason.
b. One device shall be required per compressor.

16. Hinged Access Panels
a. Shall provide easy access through integrated quarter turn latches.
b. Shall be on major panels of – filter, control box, and fan motor.

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