

ASHRAE 90.1 COMPLIANT PACKAGED ROOFTOP ELECTRIC COOLING UNITS, R-410A, 17.5 – 25 TONS

BUILT TO LAST, EASY TO INSTALL AND SERVICE

- One-piece, high efficiency electric cooling with a low profile, prewired, tested, and charged at the factory
- Dedicated vertical or horizontal air flow duct configuration models. No field kits required.
- Full perimeter base rail with built-in rigging adapters and fork truck slots
- Pre-painted exterior panels and primer-coated interior panels tested to 500 hours salt spray protection
- Fully insulated cabinet
- Two-stage cooling with independent circuits and control on all models
- Scroll compressors with internal line-break connections on all models
- All units have high and low pressure switches
- Two inch disposable fiberglass type return air filters in dedicated rack with tool-less filter access door
- Refrigerant circuits contain a liquid line filter drier to trap dirt and moisture
- Round tube plate fin evaporator and condenser coil design
- Exclusive non-corrosive composite condensate pan in accordance with ASHRAE 62 Standard, sloping design; end drain
- Belt drive evaporator-fan motor and pulley combinations available to meet most applications
- Access panels with easy grip handles provide quick and easy access to the blower and blower motor, control box, and compressors.
- "No-strip" screw system has superior holding power and guides screws into position while preventing the screw from stripping the unit's metal.
- Newly designed terminal board facilitates simple safety circuit troubleshooting and simplified control box arrangement
- Standard outdoor temperature cooling operation range up to 115°F (46°C) and down to 30°F (-1°C)
- Fixed orifice metering devices on all models to precisely control refrigerant flow
- Large, laminated control wiring and power wiring drawings are affixed to unit to make troubleshooting easy
- Single point electrical connections

WARRANTY

- 5 Year compressor limited warranty
- 1 Year parts limited warranty



17.5 Ton



20 & 25 Ton



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.ahrirectory.org.



UNIT PERFORMANCE DATA – Two Stage Cooling							
UNIT	Dedicated Airflow	Nominal Tons	COOLING		Total Power (kW)	Unit Dimensions H x W x L	Unit Weight lb. [kg]
			Net Cap. (Btuh)	EER			
RAS210*0AA0AAA	Vertical	17.5	208,000	11.0	18.9	49-3/8" x 86-5/8" x 127-7/8"	2159 [979]
RAS213*0AA0AAA	Horizontal	17.5	208,000	11.0	18.9	49-3/8" x 86-5/8" x 127-7/8"	2159 [979]
RAS240*0AA0AAA	Vertical	20	242,000	10.0	24.2	49-3/8" x 86-5/8" x 141-1/2"	2197 [997]
RAS243*0AA0AAA	Horizontal	20	242,000	10.0	24.2	49-3/8" x 86-5/8" x 141-1/2"	2197 [997]
RAS300*0AA0AAA	Vertical	25	282,000	10.0	28.2	57-3/8" x 86-5/8" x 141-1/2"	2434 [1104]
RAS303*0AA0AAA	Horizontal	25	282,000	10.0	28.2	57-3/8" x 86-5/8" x 141-1/2"	2434 [1104]

* Indicates Unit voltage: H = 208/230-3-60, L = 460-3-60, S = 575-3-60

NOTE: BASE MODEL NUMBERS LISTED. SEE MODEL NOMENCLATURE LISTING FOR ADDITIONAL OPTIONS

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MODEL NOMENCLATURE

MODEL SERIES	R	A	S	2	1	0	H	0	A	B	0	A	A	A
Position Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
R = Rooftop														
A = Air Conditioning (Cooling Only) G = Gas/Electric														
Type														
S = Standard ASHRAE 90.1-2010 Efficiency														
Efficiency														
210 = 210,000 = 17.5 Tons Dedicated Vertical SA/RA = Supply Air, RA = Return Air)														
213 = 210,000 = 17.5 Tons Dedicated Horizontal SA/RA														
240 = 240,000 = 20 Tons Dedicated Vertical SA/RA														
243 = 240,000 = 20 Tons Dedicated Horizontal SA/RA														
300 = 300,000 = 25 Tons Dedicated Vertical SA/RA														
303 = 300,000 = 25 Tons Dedicated Horizontal SA/RA														
Nominal Cooling Capacity														
H = 208/230-3-60														
L = 460-3-60														
S = 575-3-60														
Voltage														
0 = No Heat														
Heating Capacity														
A = Standard Static Option (All models)														
C = Medium Static Option (17.5 Ton Only)														
F = Medium Static High Efficiency Option (20 & 25 Ton Only)														
E = High Static High Efficiency Option (All Models)														
Motor Option														
A = None														
B = Economizer w/Bara-relief, OA Temp sensor														
E = Economizer w/Bara-relief + CO ₂ sensor, OA Temp sensor														
H = Economizer w/Bara-relief, Enthalpy sensor														
L = Economizer w/Bara-relief + CO ₂ sensor, Enthalpy sensor														
P = 2-Position damper w/Baro-relief														
Outdoor Air Options / Control														
0A = No Options														
4B = Non-fused Disconnect														
AT = Non-powered 115v Convenience Outlet.														
BR = Supply Air Smoke Detector														
7C = Non-fused Disconnect + Non-powered 115v Convenience Outlet.														
7K = Non-fused Disconnect + Non-powered 115v Convenience Outlet. + Supply Air Smoke Detector														
BA = Non-fused Disconnect + Supply Air Smoke Detector														
Factory Installed Options														
A = Alum / Cu Cond & Alum / Cu Evap														
B = Pre coated Alum / Cu Cond & Alum / Cu Evap														
C = E-coated Alum / Cu Cond & Alum / Cu Evap														
D = E-coated Alum / Cu Cond & E-coated Alum / Cu Evap														
E = Cu / Cu Cond & Alum / Cu Evap														
F = Cu / Cu Cond, Cu / Cu Evap														
Condenser / Evaporator Coil Configuration														
A = Original Design														
Sales Digit														

Table 1 – FACTORY INSTALLED OPTIONS AND FIELD INSTALLED ACCESSORIES

CATEGORY	ITEM	FACTORY INSTALLED OPTION	FIELD INSTALLED ACCESSORY
Cabinet	Dedicated Vertical Air Flow Duct Configuration	X	
	Dedicated Horizontal Air Flow Duct Configuration	X	
Coil Options	Cu/Cu (indoor) Coils	X	
	Pre-Coat (outdoor) Coils	X	
	E-coated (outdoor & indoor) coils	X	
Condenser Protection	Condenser coil hail guard (louvered design)		X
Controls	Smoke detector (supply air)	X	X
	Time Guard II compressor delay control circuit		X
	Phase Monitor		X
Economizers & Outdoor Air Dampers	Economizer	X	X
	Motorized 2 position outdoor-air damper	X	X
	Manual outdoor-air damper (25%)		X
	Barometric relief ¹	X	X
	Barometric hood (Horizontal economizer)		X
	Power exhaust-centrifugal blower		X
Economizer Sensors & IAQ Devices	Single dry bulb temperature sensors ²	X	X
	Single enthalpy sensors ²	X	X
	Differential enthalpy sensors ²		X
	Duct mounted CO ₂ sensor ²		X
	4-in Filter Track Assembly		X
Heat	Electric Heat (Vertical or Horizontal Duct Configuration)		X
	Single Point Kit		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 (unpowered)	X	
	Non-fused disconnect ⁴	X	
Roof Curbs	Roof curb 14-in (356mm)		X
	Roof curb 24-in (610mm)		X

NOTES:

1. Included with economizer.
2. Sensors used to optimize economizer performance.
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.

FACTORY OPTIONS AND/OR ACCESSORIES

Economizer (dry–bulb or enthalpy)

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 CO₂ 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 gravity controlled, barometric relief equalizes building pressure and ambient air pressures. This can be a cast effective solution to prevent building pressurization. If further control of exhaust air is required, a dual centrifugal fan power exhaust system is also available.

CO₂ 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 CO₂ sensor detects their presence through increasing CO₂ levels, and opens the economizer appropriately.

When the occupants leave, the CO₂ levels decrease, and the sensor appropriately closes the economizer. This intelligent control of the ventilation air, called Demand Control Ventilation (DCV) reduces the overall load on the rooftop.

Smoke Detector

Smoke detectors make your application safer and your job easier. Smoke detectors immediately shut down the rooftop unit when smoke is detected. It is available for supply air.

Louvered Hail Guards (accessory only)

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

Convenience Outlet (un–powered)

Reduce service and/or installation costs by including a convenience outlet in your specification. The convenience outlet provides a 15 amp, 115v GFCI receptacle with “Wet in Use” cover. This 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 capable of providing protection to a MOCP maximum of 200A.

Power Exhaust with Barometric Relief

Superior internal building pressure control. This field–installed accessory may eliminate the need for costly, external pressure control fans.

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.

Motorized 2–Position Damper

The new 2–position, motorized outdoor air damper admits up to 100% outside air. Using reliable, gear–driven technology, the 2–position damper opens to allow ventilation air and closes when the rooftop stops, stopping unwanted infiltration.

Manual OA Damper (accessory only)

Manual outdoor air dampers are an economical way to bring in ventilation air. The dampers are available in 25% versions.

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 (accessory only)

The winter start kit 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.

High Static Motors and Drives

Some applications need larger horsepower motors, some need more airflow, and some need both. Regardless of the case, your dealer 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.

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.

Electric Heaters / Single Point Kit

A full–line of field–installed accessory heaters and single point kits are available when required. The heaters are very easy to use, install and are all pre–engineered and certified.

Barometric Hood (accessory only)

For Horizontal Economizer applications where relief damper is installed in duct work. This kit provides the needed protection.

ACCESSORIES – RAS210–303

FLAT ROOF CURBS		
Model Number	Description	Use With Model Size
CRRFCURB045A00	14" High Roof Curb – Vertical and Horizontal Economizer IV with solid-state controller, gear-driven, modulating damper, spring return actuator, up to 100% barometric relief, supply and outdoor air sensors and outdoor air hood. CO2 sensor compatible.	210/213
CRRFCURB047A00		240/243 – 300/303
CRRFCURB046A00	24" High Roof Curb – Vertical and Horizontal Economizer IV with solid-state controller, gear-driven, modulating damper, spring return actuator, up to 100% barometric relief, supply and outdoor air sensors and outdoor air hood. CO2 sensor compatible.	210/213
CRRFCURB048A00		240/243 – 300/303

* Includes thru-the-bottom capability

ECONOMIZERS		
Model Number	Description	Use With Model Size
DNECOMZR052A00	Vertical & Horizontal with solid state controller	210/213 – 240/243
DNECOMZR053A00	Vertical & Horizontal with solid state controller	300/303

ECONOMIZER SENSORS		
Model Number	Description	Use With Model Size
DNTEMPSN002A00	Single (dry bulb) Control	ALL Economizers
DNCBDIOX005A00	CO2 Sensor and aspirator box for use in return airstream.	ALL Economizers
DNENTDIF004A00	Return Air Enthalpy Sensor	ALL Economizers
AXB078ENT	Enthalpy Control	ALL

BAROMETRIC RELIEF HOOD		
Model Number	Description	Use With Model Size
CRBARHOD001A00	For horizontal economizer applications where relief damper is installed in duct work, this kit provides needed protection	213 – 243

POWER EXHAUST*		
Model Number	Description	Use With Model Size
CRPWREXH068A00	Vertical and Horizontal, 208/230–3–60	210/213–240/243–300/303
CRPWREXH069A00	Vertical and Horizontal, 460–3–60	210/213–240/243–300/303
CRPWREXH070A00	Vertical and Horizontal, 575–3–60	210/213–240/243–300/303

* When power exhaust is used on horizontal applications, it must be field mounted to the side of the return duct.

MANUAL OUTDOOR AIR DAMPERS		
Model Number	Description	Use With Model Size
CRMANDPR009A00	25% Open Manual Fresh Air Damper	210/213 – 240/243
CRMANDPR010A00	25% Open Manual Fresh Air Damper	300/303

MOTORIZED OUTDOOR AIR DAMPERS		
Model Number	Description	Use With Model Size
CRTWOPOS012A00	Motorized 2 position outdoor air damper	210/213 – 240/243
CRTWOPOS013A00	Motorized 2 position outdoor air damper	300/303

LOW AMBIENT CONTROLS		
Model Number	Description	Use With Model Size
CRLOWAMB041A00 ¹	Motormaster® I –20° Low Ambient Control 208/230–3–60	210/213–240/243–300/303
CRLOWAMB042A00 ¹	Motormaster® I –20° Low Ambient Control 460–3–60, 575–3–60	210/213–240/243–300/303
CRTRXKIT001A00	Motormaster® I –20° Transformer 575–3–60 Must be used in conjunction with Low Ambient Controller if used on 575–3–60 models.	210/213–240/243–300/303

¹ Also requires one DNWINSTR001A00 winter start kit per circuit.

ACCESSORIES – RAS210–303 (cont.)

CONTROL UPGRADE KITS		
Model Number	Description	Use With Model Size
NRTIMEGD001A00	Time Guard II	210 – 303
CRSDTEST001A00	Smoke detector remote Test/Reset/Alarm indicator kit	210 – 303
CRPHASE3001A02	Electronic Phase Monitor – All 208/230/460–3–60 models	210 – 303
CRPHASE3002A00	Electronic Phase Monitor – All 575–3–60 models	210 – 303
CRSTATUS005A00	Fan/filter Status Switch – Indicator light not included	210 – 303
CRSMKSEN002A00	Smoke Detector Control Module	210 – 303
CRSMKKIT002A00	Smoke Detector Control Module (Smoke Detector Sensor with sampling tube & exhaust tube)	210 – 303
DNWINSTR001A00	Winter Start Kit – Contains time delay relay for timed bypass of low pressure switch on startup	210 – 303
4" FILTER TRACK UPGRADE KIT		
Model Number	Description	Use With Model Size
CRFLTTRK001A00	4" Field Conversion Kit	210 – 303
LOUVERED HAIL GUARDS		
Model Number	Description	Use With Model Size
CRLVHLGD017A00	Louvered Condenser Coil Hail Guard	210/213
CRLVHLGD027A00	Louvered Condenser Coil Hail Guard	240/243
CRLVHLGD028A00	Louvered Condenser Coil Hail Guard	300/303
ELECTRIC HEAT – HORIZONTAL DUCT CONFIGURATION		
Model Number	Nominal kW	Use With Model Size
CRHEATER270A00	25.0	All Horizontal Duct 208/230v Models
CRHEATER271A00	50.0	
CRHEATER272A00	75.0	
CRHEATER273A00	25.0	All Horizontal Duct 460v Models
CRHEATER274A00	50.0	
CRHEATER275A00	75.0	
CRHEATER276A00	24.8	All Horizontal Duct 575v Models
CRHEATER277A00	49.6	
CRHEATER278A00	74.4	
ELECTRIC HEAT – VERTICAL DUCT CONFIGURATION		
Model Number	Nominal kW	Use With Model Size
CRHEATER279A00	25.0	All Vertical Duct 208/230v Models
CRHEATER280A00	50.0	
CRHEATER281A00	75.0	
CRHEATER282A00	25.0	All Vertical Duct 460v Models
CRHEATER283A00	50.0	
CRHEATER284A00	75.0	
CRHEATER285A00	24.8	All Vertical Duct 575v Models
CRHEATER286A00	49.6	
CRHEATER287A00	74.4	
SINGLE POINT CONNECTION KIT		
Model Number	Description	Use With Electric Heater
CRSINGLE056A00	Single Point Connection for 208/230V 75kW Heaters	CRHEATER272A00 CRHEATER281A00
CRSINGLE057A00	Single Point Connection for 460V & 575V 75kW Heaters	CRHEATER275A00 CRHEATER278A00 CRHEATER284A00 CRHEATER287A00

Table 2 – AHRI COOLING RATING TABLE

MODEL RAS	COOLING STAGES	NOMINAL CAPACITY (TONS)	NET COOLING CAPACITY (MBH)	TOTAL POWER (kW)	EER	IEER
210 – 213	2	17.5	208.0	18.9	11.0	11.8
240 – 243	2	20	242.0	24.2	10.0	10.8
300 – 303	2	25	282.0	28.2	10.0	10.6

LEGEND

- AHRI – Air-Conditioning, Heating & Refrigeration Institute
- ASHRAE – American Society of Heating, Refrigerating and Air Conditioning, Inc.
- EER – Integrated Energy Efficiency Ratio
- IPLV – Integrated Part Load Value

NOTES:

1. Rated and certified under AHRI Standard 340/360-04, as appropriate.
2. Ratings are based on:
Cooling Standard: 80°F (27°C) db, 67°F (19°C) wb indoor air temp and 95°F (35°C) db outdoor air temp.
IPLV Standard: 80°F (27°C) db, 67°F (19°C) wb indoor air temp and 80°F (27°C) db outdoor air temp.
3. All RAS units comply with ASHRAE 90.1 2001, 2004 Energy Standard for minimum SEER and EER requirements.
4. RAS units comply with US Energy Policy Act (2005). To evaluate code compliance requirements, refer to state and local codes or visit the following website: <http://bcap-energy.org> to determine if compliance with this standard pertains to your state, territory, or municipality.



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Table 3 – MINIMUM AIRFLOWS ELECTRIC HEAT

MODEL RAS	NOMINAL KW	CFM	CFM
		MINIMUM	MAXIMUM
210 – 213	25	5200	9000
	50		
	75		
240 – 243	25	6000	10,000
	50		
	75		
300 – 303	25	7000	12,500
	50		
	75		

Table 4 – SOUND PERFORMANCE TABLE

MODEL RAS	COOLING STAGES	Outdoor Sound (dB)									
		A-Wtg.	AHRI 370 Rating	63	125	250	500	1000	2000	4000	8000
210 – 213	2	84.1	84	92.2	83.9	80.4	81.8	78.7	76.5	72.2	65.4
240 – 243	2	86.5	87	95.6	87.5	84.2	84.2	81.7	77.9	73.2	66.3
300 – 303	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 measured 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 are taken in accordance with AHRI standard 270-2008.

Table 5 – PHYSICAL DATA (COOLING) 17.5 – 25 TONS

RAS		210	240	300
Refrigeration System				
# Circuits / # Comp. / Type		2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll
R-410a charge A/B (lbs)		9.5/12.0	20.6/14.7	19.8/20.4
Metering device		Fixed	Fixed	Fixed
High–press. Trip / Reset (psig)		630 / 505	630 / 505	630 / 505
Low–press. Trip / Reset (psig)		54 / 117	54 / 117	54 / 117
Compressor Capacity Staging (%)		50 / 100	50 / 100	50 / 100
Evap. Coil				
Material		Cu / Al	Cu / Al	Cu / Al
Tube Diameter		3/8–in	3/8–in	3/8–in
Rows / FPI		4 / 15	4 / 15	4 / 15
Total face area (ft2)		22.00	22.00	23.11
Condensate drain conn. size		3/4–in	3/4–in	3/4–in
Evap. fan and motor				
VERTICAL				
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.3	4.9	4.9
	RPM range	622–822	690–863	717–911
	Motor frame size	56	56	56
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	15 x 15	15 x 15	15 x 15
Medium Static	Motor Qty / Drive type	1 / Belt	n/a	n/a
	Max BHP	4.9	n/a	n/a
	RPM range	713–879	n/a	n/a
	Motor frame size	56	n/a	n/a
	Fan Qty / Type	2 / Centrifugal	n/a	n/a
	Fan Diameter (in)	15 x 15	n/a	n/a
Medium Static High Eff*	Motor Qty / Drive type	n/a	1 / Belt	1 / Belt
	Max BHP	n/a	6.5	6.5
	RPM range	n/a	835–1021	913–1116
	Motor frame size	n/a	184T	184T
	Fan Qty / Type	n/a	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	n/a	15 x 15	15 x 15
High Static High Eff*	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt
	Max BHP	6.5	8.7	8.7
	RPM range	882–1078	941–1176	941–1176
	Motor frame size	184T	213T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	15 x 15	15 x 15	15 x 15

* Section 313 of the Energy Independence and Security Act of 2007 (EISA 2007) mandates that the efficiency of general purpose motors we use in our Light Commercial Rooftops rated at 5.0 HP and larger be increased on or after December 19, 2010. We will offer both medium and standard efficient motors until inventory is depleted and then shift over solely to the high efficient motors only.

Table 6 – PHYSICAL DATA (COOLING) 17.5 – 25 TONS

RAS		213	243	303
HORIZONTAL				
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.3	4.9	4.9
	RPM range	622–822	690–863	647–791
	Motor frame size	56	56	56
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	18 x 15 & 15 X 11	18 x 15 & 15 X 11	18 x 15 & 15 X 11
Medium Static	Motor Qty / Drive type	1 / Belt	n/a	n/a
	Max BHP	4.9	n/a	n/a
	RPM range	713–879	n/a	n/a
	Motor frame size	56	n/a	n/a
	Fan Qty / Type	2 / Centrifugal	n/a	n/a
	Fan Diameter (in)	18 x 15 & 15 X 11	n/a	n/a
Medium Static High Eff*	Motor Qty / Drive type	n/a	1 / Belt	1 / Belt
	Max BHP	n/a	6.5	6.5
	RPM range	n/a	835–1021	755–923
	Motor frame size	n/a	184T	184T
	Fan Qty / Type	n/a	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	n/a	18 x 15/15 x 11	18 x 15/15 x 11
High Static High Eff*	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt
	Max BHP	6.5	8.7	8.7
	RPM range	882–1078	941–1176	827–1010
	Motor frame size	184T	213T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	18 x 15/15 x 11	18 x 15/15 x 11	18 x 15/15 x 11
Cond. Coil (Circuit A)				
	Coil type	RTPF	RTPF	RTPF
	Coil Length (in)	70	82	75
	Coil Height (in)	44	44	52
	Total face area (ft2)	21.4	25.1	27.1
Cond. Coil (Circuit B)				
	Coil type	RTPF	RTPF	RTPF
	Coil Length (in)	70	57	75
	Coil Height (in)	44	44	52
	Total face area (ft2)	21.4	17.4	27.1
Cond. fan / motor				
	Qty / Motor drive type	3 / direct	4 / direct	4 / direct
	Motor HP / RPM	1/4 / 1100	1/4 / 1100	1/4 / 1100
	Fan diameter (in)	22	22	22
Filters				
	RA Filter # / size (in)	6 / 20 x 25 x 2	6 / 20 x 25 x 2	9 / 16 x 25 x 2
	OA inlet screen # / size (in)	4 / 16 x 25 x 1	4 / 16 x 25 x 1	4 / 16 x 25 x 1

* Section 313 of the Energy Independence and Security Act of 2007 (EISA 2007) mandates that the efficiency of general purpose motors we use in our Light Commercial Rooftops rated at 5.0 HP and larger be increased on or after December 19, 2010. We will offer both medium and standard efficient motors until inventory is depleted and then shift over solely to the high efficient motors only.

Table 7 – ELECTRIC HEAT – ELECTRICAL DATA 17.5 – 25 TONS

UNIT RAS	NOM. V-PH-HZ	IFM TYPE	VERTICAL ELECTRIC HEATER PART NUMBER CRHEATER	HORIZONTAL ELECTRIC HEATER PART NUMBER CRHEATER	NOMINAL (kW)	APPLICATION (kW)	APPLICATION OUTPUT (MBH)
210/213	208/230-3-60	STD	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
		MED	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
		HIGH-High Eff	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
	460-3-60	STD	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
		MED	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
		HIGH-High Eff	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
	575-3-60	STD	285A00	276A00	24.8	22.8	77.7
			286A00	277A00	49.6	45.6	155.4
			287A00	278A00	74.4	68.3	233.1
		MED	285A00	276A00	24.8	22.8	77.7
			286A00	277A00	49.6	45.6	155.4
			287A00	278A00	74.4	68.3	233.1
		HIGH-High Eff	285A00	276A00	24.8	22.8	77.7
			286A00	277A00	49.6	45.6	155.4
			287A00	278A00	74.4	68.3	233.1
240/243	208/203-3-60	STD	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
		MED-High Eff	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
		HIGH-High Eff	279A00	270A00	25.0	18.8/23.0	64.1/78.3
			280A00	271A00	50.0	37.6/45.9	128.1/156.7
			281A00	272A00	75.0	56.3/68.9	192.2/235.0
	460-3-60	STD	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
		MED-High Eff	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
		HIGH-High Eff	282A00	273A00	25.0	23.0	78.3
			283A00	274A00	50.0	45.9	156.7
			284A00	275A00	75.0	68.9	235.0
	575-3-60	STD	285A00	276A00	24.8	22.8	77.7
			286A00	277A00	49.6	45.6	155.4
			287A00	278A00	74.4	68.3	233.1
		MED-High Eff	285A00	276A00	24.8	22.8	77.7
			286A00	277A00	49.6	45.6	155.4
			287A00	278A00	74.4	68.3	233.1
		HIGH-High Eff	285A00	276A00	24.8	22.8	77.7
			277A00	277A00	49.6	45.6	155.4
			278A00	278A00	74.4	68.3	233.1

Note:

APP PWR – 208 / 230V / 460V / 575V

NOM PWR – 240V / 480V / 600V

TABLE 6 – ELECTRIC HEAT – ELECTRICAL DATA 17.5 – 25 TONS (Cont.)

UNIT RAS	NOM. V-PH-HZ	IFM TYPE	VERTICAL ELECTRIC HEATER PART NUMBER CRHEATER	HORIZONTAL ELECTRIC HEATER PART NUMBER CRHEATER	NOMINAL (kW)	APPLICATION (kW)	APPLICATION OUTPUT (MBH)
300/303	208/230-3-60	STD	279/270A00	279/270A00	25.0	18.8/23.0	64.1/78.3
			280/271A00	280/271A00	50.0	37.6/45.9	128.1/156.7
			281/272A00	281/272A00	75.0	56.3/68.9	192.2/235.0
		MED-High Eff	279/270A00	279/270A00	25.0	18.8/23.0	64.1/78.3
			280/271A00	280/271A00	50.0	37.6/45.9	128.1/156.7
			281/272A00	281/272A00	75.0	56.3/68.9	192.2/235.0
		HIGH-High Eff	279/270A00	279/270A00	25.0	18.8/23.0	64.1/78.3
			280/271A00	280/271A00	50.0	37.6/45.9	128.1/156.7
			281/272A00	281/272A00	75.0	56.3/68.9	192.2/235.0
	460-3-60	STD	282/273A00	282/273A00	25.0	23.0	78.3
			283/274A00	283/274A00	50.0	45.9	156.7
			284/275A00	284/275A00	75.0	68.9	235.0
		MED-High Eff	282/273A00	282/273A00	25.0	23.0	78.3
			283/274A00	283/274A00	50.0	45.9	156.7
			284/275A00	284/275A00	75.0	68.9	235.0
		HIGH-High Eff	282/273A00	282/273A00	25.0	23.0	78.3
			283/274A00	283/274A00	50.0	45.9	156.7
			284/275A00	284/275A00	75.0	68.9	235.0
	575-3-60	STD	285/276A00	285/276A00	24.8	22.8	77.7
			286/277A00	286/277A00	49.6	45.6	155.4
			287/278A00	287/278A00	74.4	68.3	233.1
		MED-High Eff	285/276A00	285/276A00	24.8	22.8	77.7
			286/277A00	286/277A00	49.6	45.6	155.4
			287/278A00	287/278A00	74.4	68.3	233.1
		HIGH-High Eff	285/276A00	285/276A00	24.8	22.8	77.7
			286/277A00	286/277A00	49.6	45.6	155.4
			287/278A00	287/278A00	74.4	68.3	233.1

Note:



APP PWR – 208 / 230V / 460V / 575V

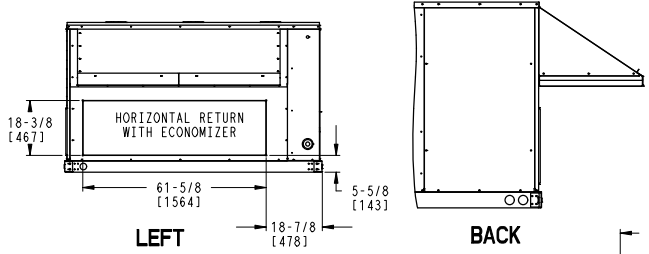
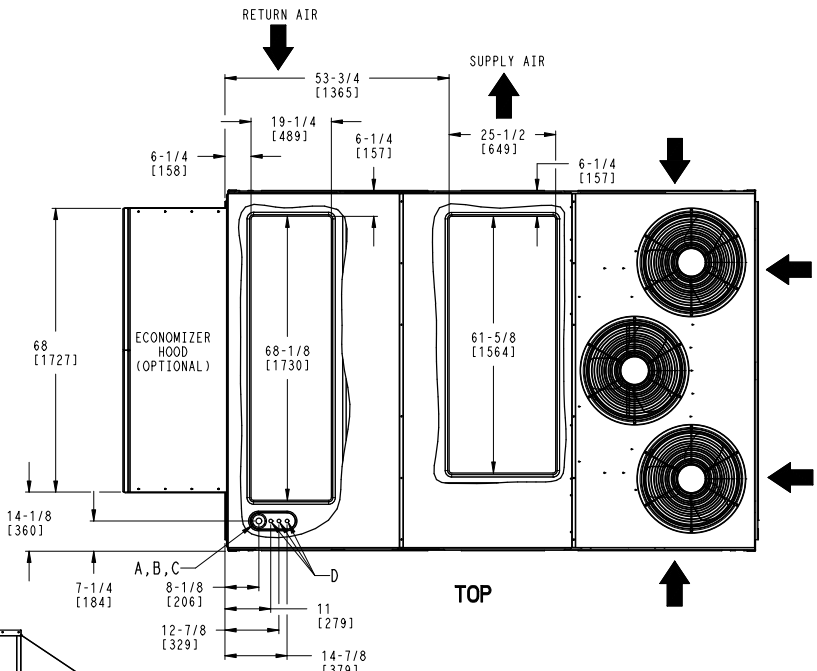
NOM PWR – 240V / 480V / 600V

BASE UNIT DIMENSIONS – RAS210/213

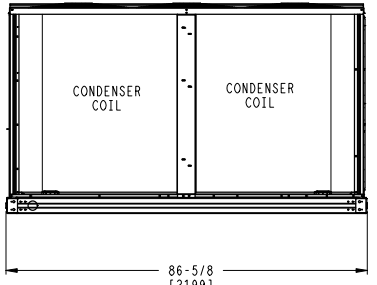
CONNECTION SIZES	
A	1 3/8" DIA [35] FIELD POWER SUPPLY KNOCKOUT
B	3" DIA [76] FIELD POWER SUPPLY KNOCKOUT
C	3 5/8" DIA [92] FIELD POWER SUPPLY KNOCKOUT
D	7/8" DIA [22] FIELD CONTROL WIRING HOLE
E	3/4"-14 NPT CONDENSATE DRAIN

NOTES:

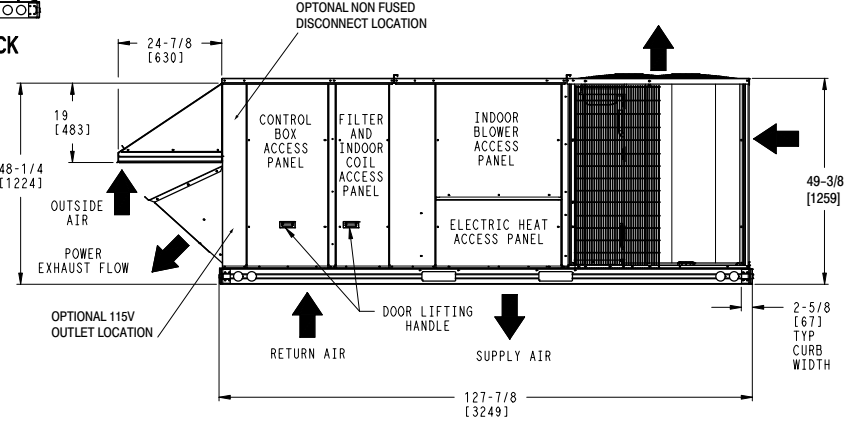
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2.  CENTER OF GRAVITY
3.  DIRECTION OF AIR FLOW



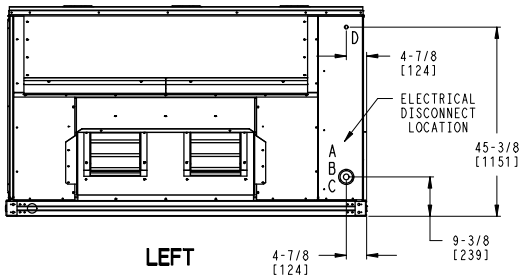
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(HORIZONTAL DISCHARGE W/ ECON)
(WHEN ORDERED)



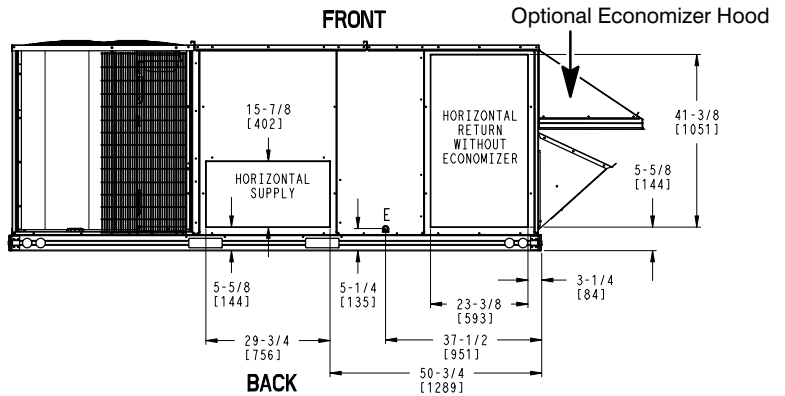
RIGHT



FRONT



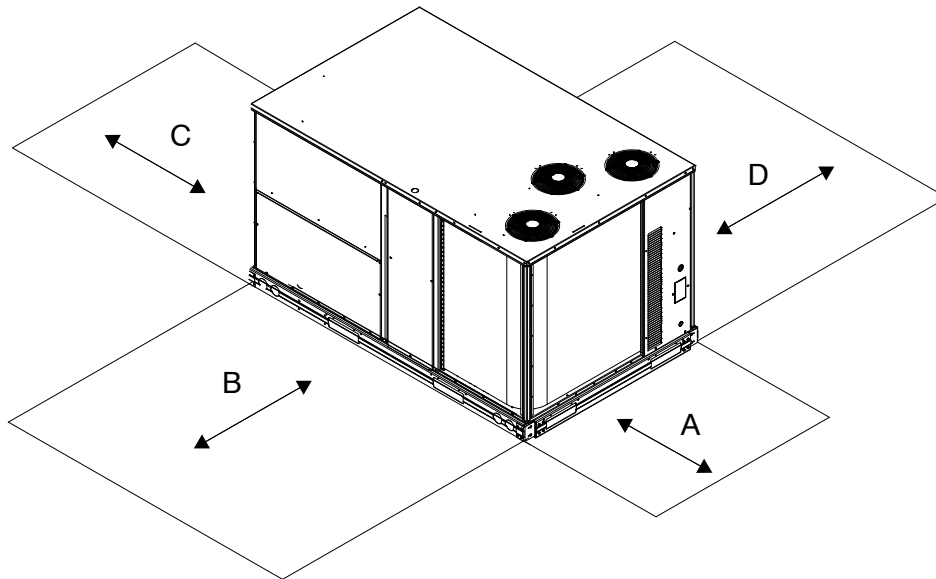
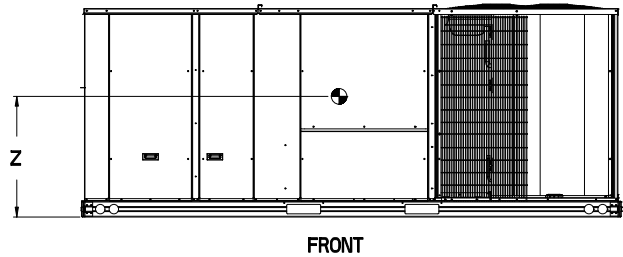
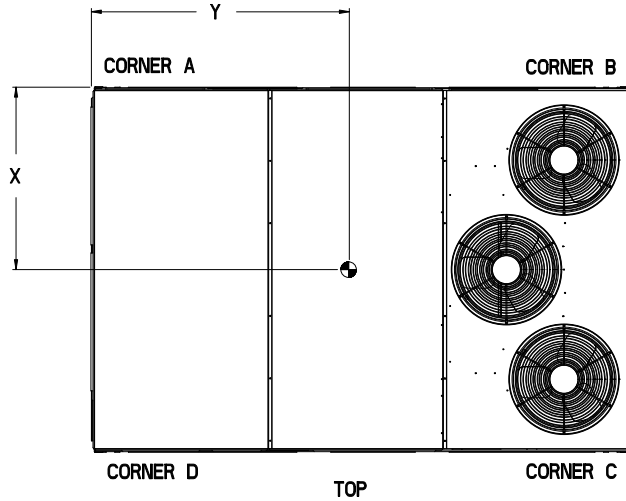
LEFT



BACK
(HORIZONTAL DISCHARGE W/O ECON)
(WHEN ORDERED)

WEIGHT & DIMENSIONS – RAS210/213 (cont.)

UNIT RAS	MAX UNIT WEIGHT		Corner Weight A		Corner Weight B		Corner Weight C		Corner Weight D		Center of Gravity In [mm]		
	LBS	KG	LBS	KG	LBS	KG	LBS	KG	LBS	KG	X	Y	Z
17.5 Ton	2159	979	419	190	496	225	493	224	415	188	42-7/8 [1090]	69-1/4 [1759]	16-1/2 [419]



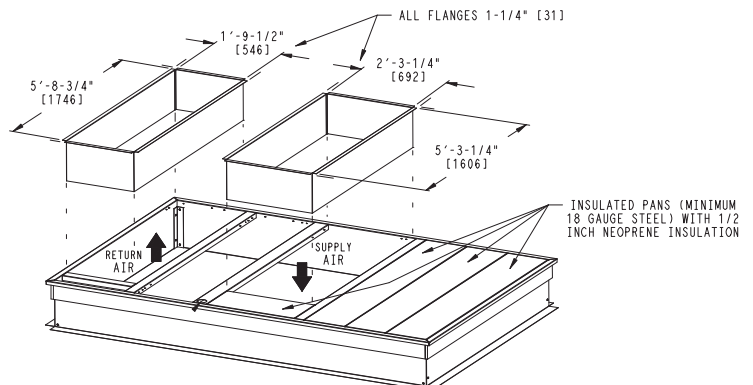
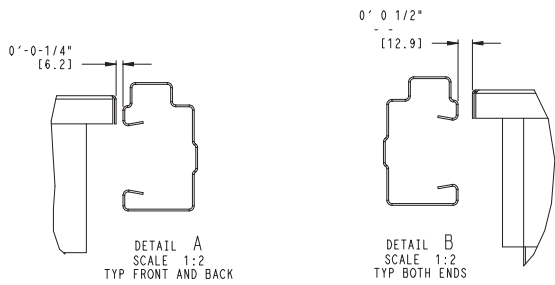
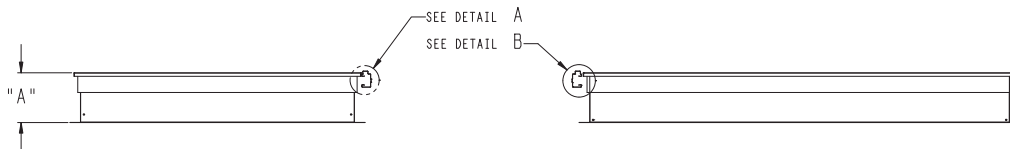
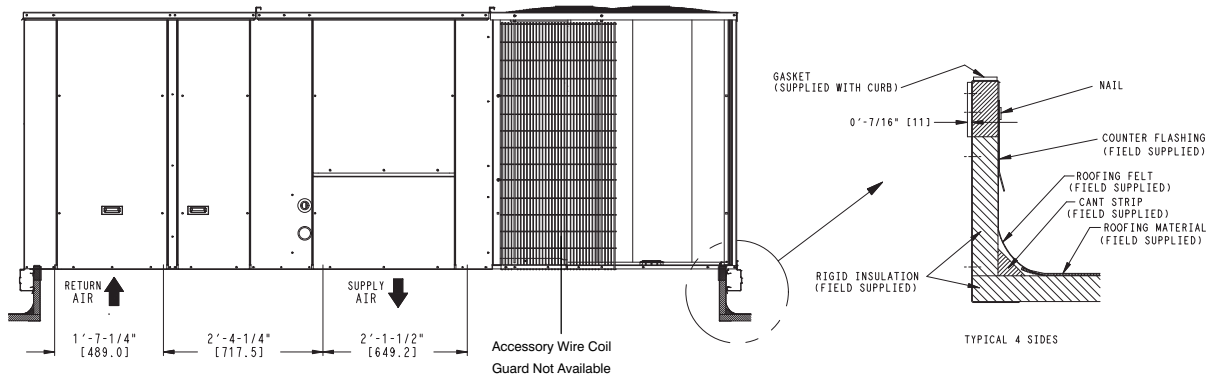
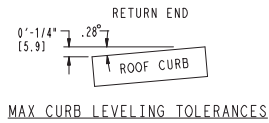
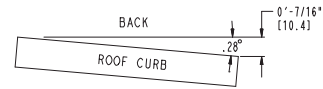
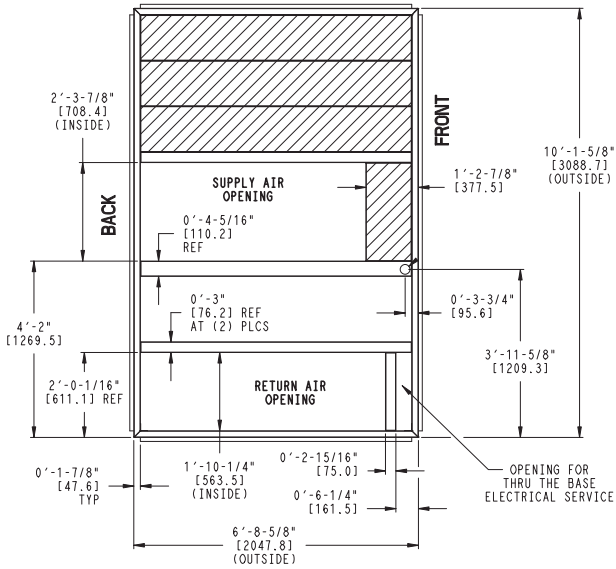
LOC	DIMENSION	CONDITION
A	48 in. (1219 mm) 18 in. (457 mm) 18 in. (457 mm) 12 in. (305 mm)	Unit disconnect is mounted on panel No disconnect, convenience outlet option Recommended service clearance Minimum clearance
B	42 in. (1067 mm) 36 in. (914 mm) Special	Surface behind servicer is grounded (e.g., metal, masonry wall) Surface behind servicer is electrically non-conductive (eg., wood, fiberglass) Check for sources of flue products within 10 ft. of unit fresh air intake hood
C	36 in. (914 mm) 18 in. (457 mm)	Side condensate drain is used Minimum clearance
D	42 in. (1067 mm) 36 in. (914 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit) Surface behind servicer is electrically non-conductive (eg., wood, fiberglass)

ROOF CURB DETAILS – RAS210/213

RoofCurb Accessory	A	Unit Size
CRRFCURB045A01	1' 2" [356]	RAS210/213
CRRFCURB046A01	2' 0" [610]	

NOTES:

1. Roofcurb accessory is shipped disassembled.
 2. Dimensions in. [] in millimeters.
 3. Roofcurb galvanized steel.
 4. Attach ductwork to curb (Flanges of duct rest on curb)
 5. Service clearance 4' on each side.
- ➡ Direction of airflow.



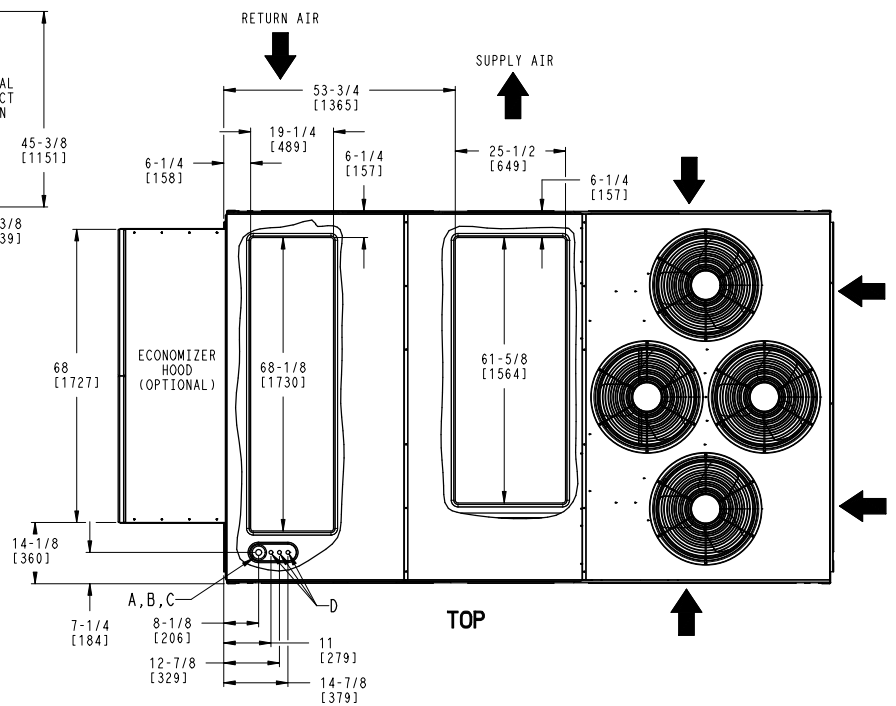
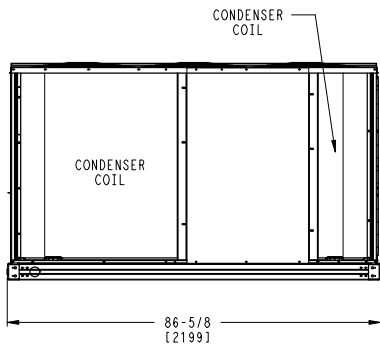
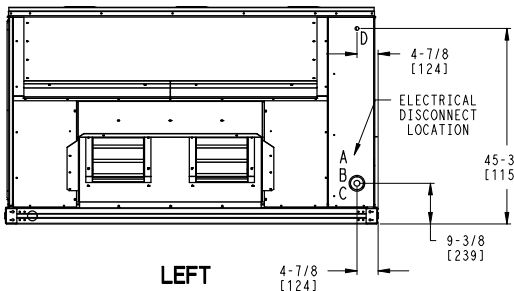
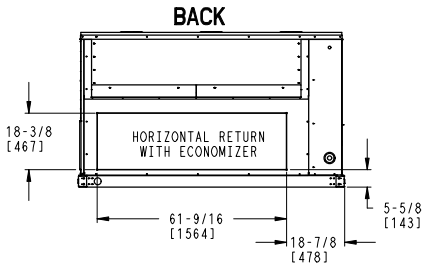
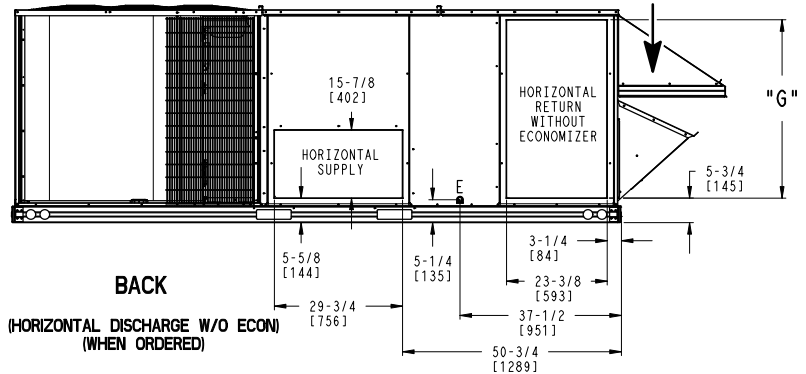
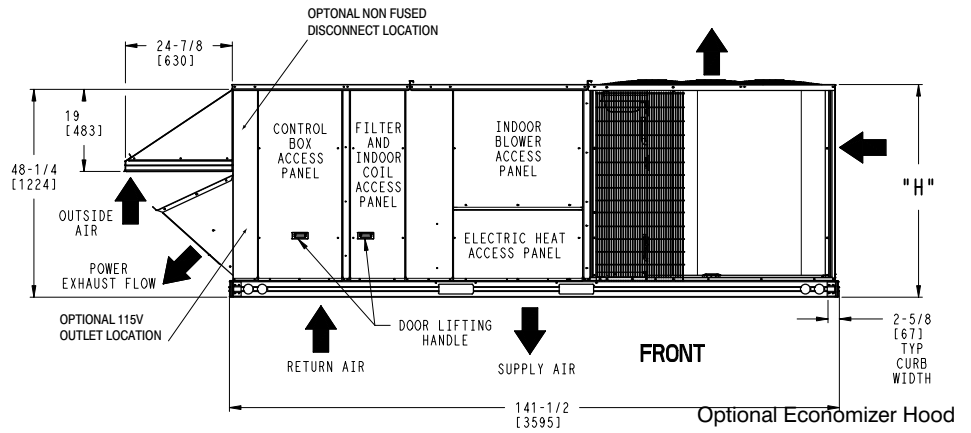
BASE UNIT DIMENSIONS - RAS240/243 - 300/303

CONNECTION SIZES	
A	1 3/8" DIA [35] FIELD POWER SUPPLY KNOCKOUT
B	3" DIA [76] FIELD POWER SUPPLY KNOCKOUT
C	3 5/8" DIA [92] FIELD POWER SUPPLY KNOCKOUT
D	7/8" DIA [22] FIELD CONTROL WIRING HOLE
E	3/4"-14 NPT CONDENSATE DRAIN

UNIT	G	H
240/243	41-3/8 [1051]	49-3/8 [1253]
300/303	49-3/8 [1253]	57-3/8 [1456]

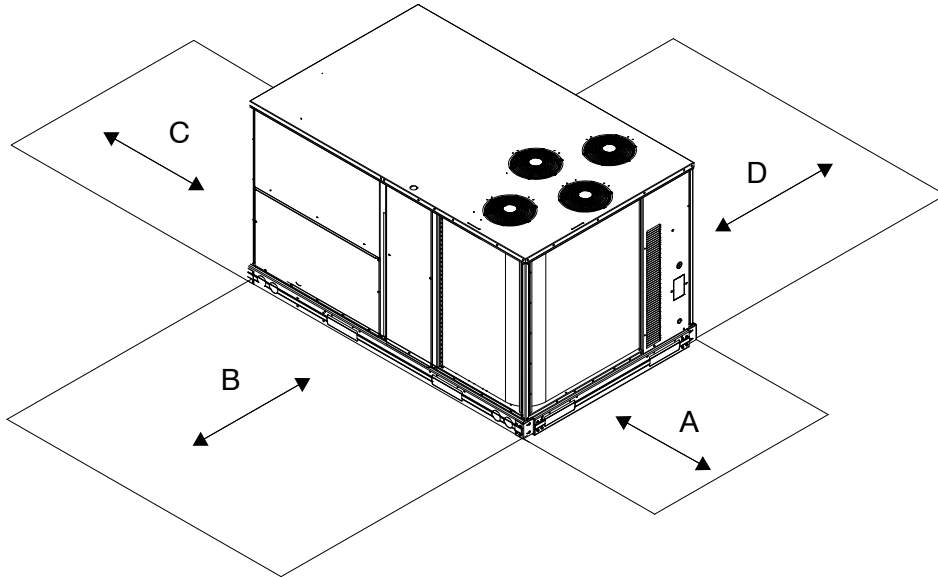
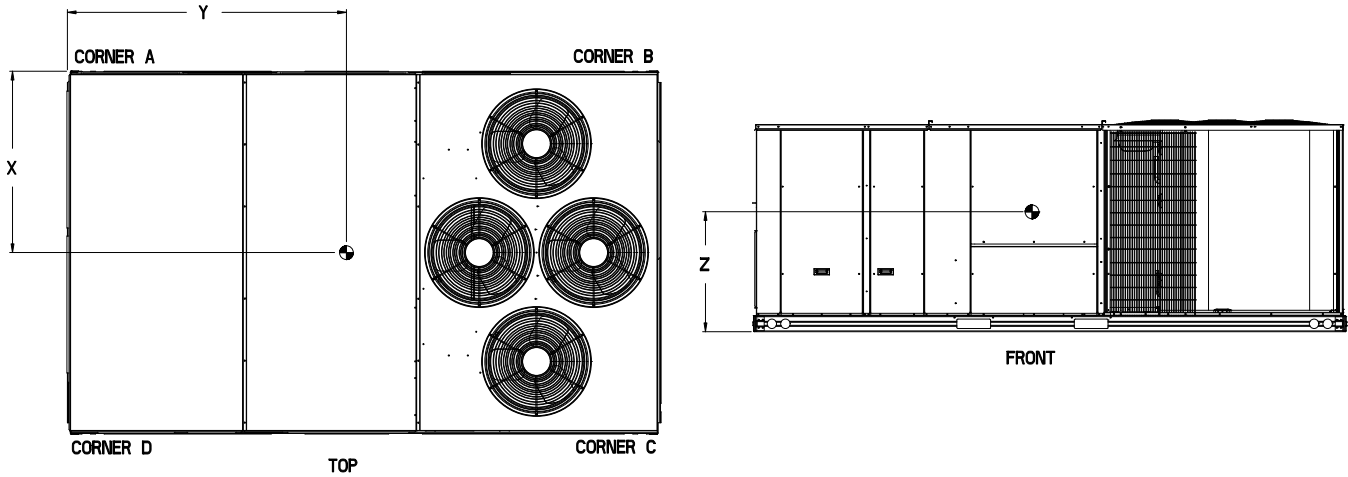
NOTES:

1. DIMENSIONS ARE IN INCHES, DIMENSIONS IN [] ARE IN MILLIMETERS.
2. CENTER OF GRAVITY
3. DIRECTION OF AIR FLOW



WEIGHT & CLEARANCE DIMENSIONS – RAS240/243–300/303 (cont.)

UNIT	Max Unit Weight		Corner Weight (A)		Corner Weight (B)		Corner Weight (C)		Corner Weight (D)		Center of Gravity In [mm]		
	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg	X	Y	Z
20 Ton	2197	997	532	241	522	237	456	207	464	210	40-1/8 [1020]	70 [1778]	16-1/2 [419]
25 Ton	2434	1104	545	247	539	245	504	229	510	231	41-5/8 [1058]	70-1/4 [1784]	19 [483]

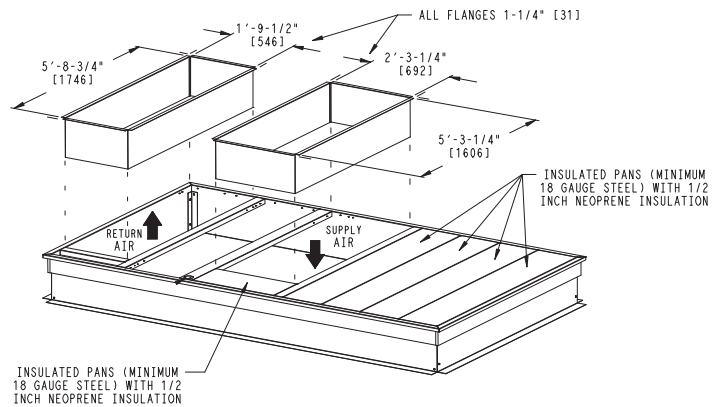
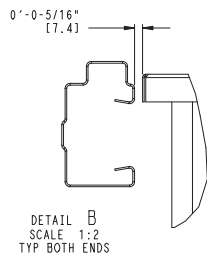
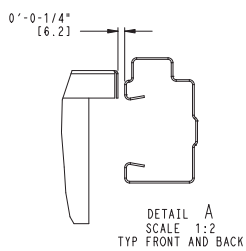
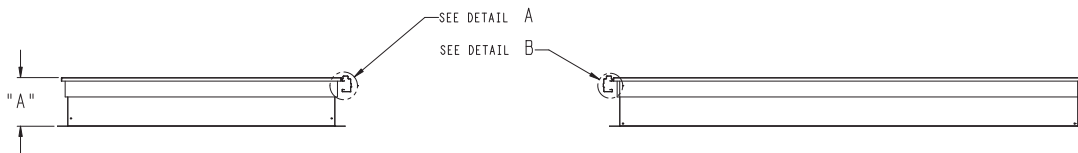
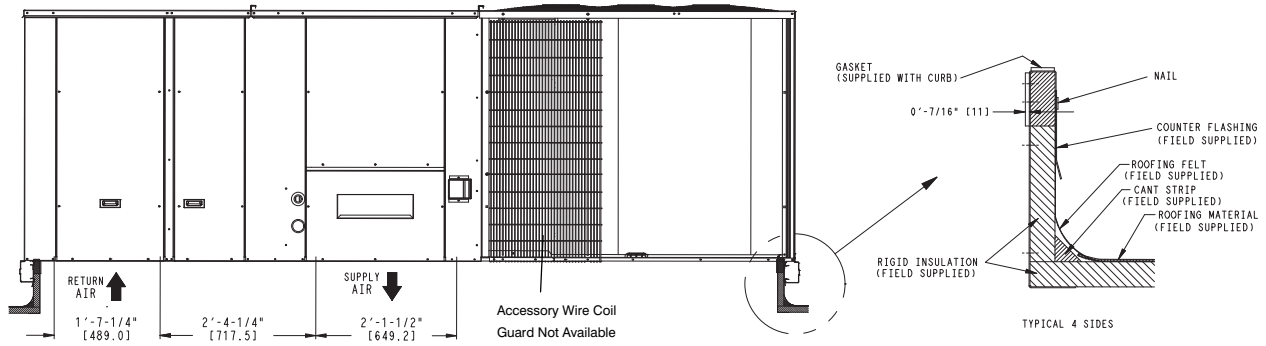
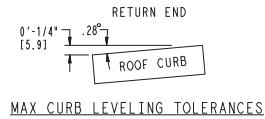
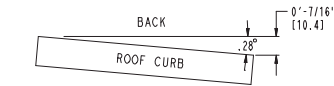
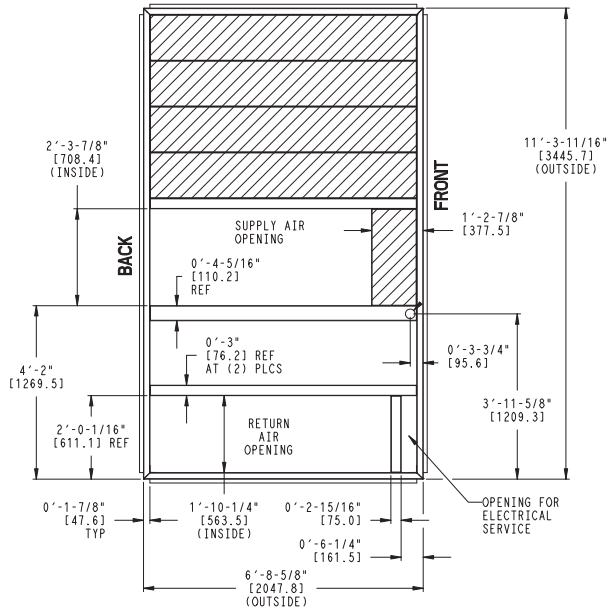


LOC	DIMENSION	CONDITION
A	48 in. (1219 mm) 18 in. (457 mm) 18 in. (457 mm) 12 in. (305 mm)	Unit disconnect is mounted on panel No disconnect, convenience outlet option Recommended service clearance Minimum clearance
B	42 in. (1067 mm) 36 in. (914 mm) Special	Surface behind servicer is grounded (e.g., metal, masonry wall) Surface behind servicer is electrically non-conductive (eg., wood, fiberglass) Check for sources of flue products within 10 ft. of unit fresh air intake hood
C	36 in. (914 mm) 18 in. (457 mm)	Side condensate drain is used Minimum clearance
D	42 in. (1067 mm) 36 in. (914 mm)	Surface behind servicer is grounded (e.g., metal, masonry wall, another unit) Surface behind servicer is electrically non-conductive (eg., wood, fiberglass)

ROOF CURB DETAILS – RAS240/243 – 300/303

RoofCurb Accessory	A	Unit Size
CRRFCURB047A01	1' 2" [356]	RAS240/243
CRRFCURB048A01	2' 0" [610]	RAS300/303

- NOTES:
1. Roofcurb accessory is shipped disassembled.
 2. Dimensions in. [] in millimeters.
 3. Roofcurb galvanized steel.
 4. Attach ductwork to curb (Flanges of duct rest on curb)
 5. Service clearance 4' on each side.
- ➡ Direction of airflow.



OPTIONS AND ACCESSORIES WEIGHT ADDERS

BASE UNIT WITH OPTIONS AND ACCESSORIES (Weight Adders)	WEIGHT ADD					
	RAS210/213		RAS240/243		RAS300/303	
	lb	kg	lb	kg	lb	kg
Base Unit (RTPF Coils)	1823	827	1973	895	2098	952
Power Exhaust	125	57	125	57	125	57
Economizer	170	77	170	77	195	88
Copper Tube/Fin Evaporator Coil	110	50	135	61	161	73
Electric Heater	85	39	85	39	85	39
Single Point Kit	15	7	15	7	15	7
Roof Curb 14-in (356mm)	240	109	240	109	255	116
Roof Curb 24-in (610mm)	340	154	340	154	355	161
Louvered Hail Guard	60	27	120	54	150	68
CO ₂ sensor	5	2	5	2	5	2
Supply Smoke Detector	5	2	5	2	5	2
Fan/Filter Status Switch	2	1	2	1	2	1
Non-Fused Disconnect	15	7	15	7	15	7
Enthalpy Sensor	2	1	2	1	2	1
Differential Enthalpy Sensor	3	1	3	1	3	1
Two Position Motorized Damper	50	23	50	23	65	29
Manual Damper	35	16	35	16	40	18
Field Filter Track 4-in (102mm)	12	5	12	5	18	8
MotorMaster Controller	35	16	35	16	35	16
Standard Static Motor/Drive	0	0	0	0	0	0
Medium Static Motor/Drive	6	3	6	3	6	3
High Static Motor/Drive	12	5	16	7	16	7
Barometric Relief Hood (Horz)	25	11	25	11	25	11

APPLICATION DATA

Min operating ambient temp (cooling):

In mechanical cooling mode, your rooftop unit can safely operate down to an outdoor ambient temperature of 30°F (-1°C). It is possible to provide cooling at lower outdoor ambient temperatures by using less outside air, economizers, and/or accessory low ambient kits.

Max operating ambient temp (cooling):

The maximum operating ambient temperature for cooling mode is 115°F (46°C). While cooling operation above 115°F (46°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 and max airflow (cooling):

To maintain safe and reliable operation of your rooftop, operate within the cooling airflow limits. 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.

Airflow:

All units are draw-through in cooling 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.

Motor limits, break horsepower (BHP):

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

Sizing a rooftop

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.

Low ambient applications

The optional 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 rooftop can operate to ambient temperatures down to -20°F (-29°C) using the recommended accessory Motormaster low ambient controller.

Winter start

The winter start kit 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.

Table 8 – COOLING CAPACITIES 17.5 TONS (2 Stage Cooling)

RAS210/213			AMBIENT TEMPERATURE												
			85			95			105			115			
			EAT (DB)			EAT (DB)			EAT (DB)			EAT (DB)			
			75	80	85	75	80	85	75	80	85	75	80	85	
5250 Cfm	EAT (wb)	58	THC	180.4	185.6	196.3	167.7	176.1	186.9	154.7	165.3	176.6	142.2	153.6	164.9
		SHC	166.5	185.6	196.3	160.6	176.1	186.9	152.7	165.3	176.6	142.2	153.6	164.9	
		62	THC	196.2	195.5	196.9	183.6	182.9	187.2	169.3	168.7	176.9	153.4	154.1	165.2
		SHC	146.8	172.1	194.7	141.4	166.6	187.2	135.4	160.5	176.9	128.6	152.5	165.2	
		67	THC	216.7	215.9	215.2	204.9	204.1	203.1	190.6	189.7	189.0	174.8	174.0	173.3
	SHC	120.0	146.1	171.8	115.4	141.5	167.1	109.8	136.1	161.7	103.8	130.2	155.6		
	72	THC	237.4	236.8	236.0	226.0	225.1	224.2	212.8	211.9	211.0	197.3	196.4	195.5	
	SHC	92.0	118.3	144.3	87.8	114.3	140.4	83.0	109.6	135.8	77.6	104.2	130.6		
	76	THC	--	252.9	253.0	--	242.5	241.6	--	229.1	228.2	--	214.1	213.1	
	SHC	--	95.1	121.4	--	91.7	118.0	--	87.3	113.8	--	82.5	107.1		
6125 Cfm	EAT (wb)	58	THC	188.8	198.5	209.3	176.5	188.2	200.2	164.5	176.7	189.0	151.9	164.2	176.7
		SHC	180.4	198.5	209.3	174.4	188.2	200.2	164.5	176.7	189.0	151.9	164.2	176.7	
		62	THC	205.2	204.6	209.6	191.8	191.5	200.4	176.6	177.6	189.2	159.9	164.2	176.9
		SHC	159.9	188.7	209.6	154.2	183.0	200.4	147.9	174.8	189.2	141.0	164.2	176.9	
		67	THC	225.5	224.5	223.5	213.5	212.5	211.7	199.1	198.3	197.4	182.3	181.4	180.9
	SHC	128.3	158.4	187.8	123.8	154.1	183.5	118.4	148.9	178.1	112.2	142.7	171.6		
	72	THC	245.6	245.3	244.6	234.7	233.6	232.6	220.9	219.9	218.8	205.5	204.4	203.4	
	SHC	95.4	125.9	155.7	91.7	122.2	152.4	86.9	117.7	148.1	81.7	112.5	143.1		
	76	THC	--	262.0	261.2	--	250.7	250.1	--	237.3	236.2	--	221.6	220.6	
	SHC	--	99.5	129.4	--	95.9	126.2	--	91.8	122.4	--	87.0	117.8		
7000 Cfm	EAT (wb)	58	THC	197.4	209.8	221.3	186.1	199.1	211.7	173.8	186.9	200.1	160.3	173.5	186.9
		SHC	196.8	209.8	221.3	186.1	199.1	211.7	173.8	186.9	200.1	160.3	173.5	186.9	
		62	THC	212.7	212.4	221.5	198.4	199.8	212.0	182.3	186.9	200.3	164.7	173.8	187.1
		SHC	173.4	205.1	221.5	167.4	197.4	212.0	160.8	186.8	200.3	153.4	173.8	187.1	
		67	THC	233.7	232.5	231.4	220.8	219.8	218.9	205.6	204.5	204.1	187.8	186.8	188.0
	SHC	138.0	172.0	205.0	133.4	167.6	200.4	127.8	162.0	194.4	121.3	155.6	185.6		
	72	THC	254.3	253.3	252.8	242.7	241.5	240.3	228.0	226.8	225.7	211.8	210.6	209.3	
	SHC	101.3	135.4	169.2	97.3	131.8	165.9	92.3	127.2	161.5	86.9	121.8	156.3		
	76	THC	--	270.7	269.9	--	259.0	258.1	--	245.0	243.6	--	228.5	227.1	
	SHC	--	106.1	140.0	--	102.4	136.5	--	98.2	132.7	--	93.2	127.9		
7875 Cfm	EAT (wb)	58	THC	205.0	217.2	229.1	193.4	206.9	219.3	180.6	194.3	207.9	166.6	180.5	194.5
		SHC	205.0	217.2	229.1	193.4	206.9	219.3	180.6	194.3	207.9	166.6	180.5	194.5	
		62	THC	216.7	217.4	229.4	202.5	207.1	219.6	185.9	194.5	208.4	168.4	180.7	194.7
		SHC	183.9	217.4	229.4	178.2	207.1	219.6	171.5	194.5	208.4	141.2	180.7	194.7	
		67	THC	237.8	236.7	235.7	224.7	223.5	223.0	209.5	208.3	209.2	191.5	190.3	195.0
	SHC	144.6	182.4	219.3	140.3	178.2	213.7	134.9	172.7	205.9	113.6	166.2	195.0		
	72	THC	258.6	257.5	256.5	246.8	245.7	244.3	231.8	230.5	229.2	215.3	213.9	212.5	
	SHC	103.9	141.8	179.2	100.0	138.3	176.1	95.1	133.9	172.1	89.7	128.6	142.0		
	76	THC	--	275.4	274.2	--	262.7	261.8	--	248.7	247.6	--	231.9	230.5	
	SHC	--	109.5	147.0	--	105.7	143.6	--	101.5	139.9	--	96.6	135.4		
8750 Cfm	EAT (wb)	58	THC	211.3	223.6	235.9	199.7	213.4	225.7	186.4	200.7	214.3	172.1	186.5	200.9
		SHC	211.3	223.6	235.9	199.7	213.4	225.7	186.4	200.7	214.3	172.1	186.5	200.9	
		62	THC	220.0	223.7	236.3	206.0	213.6	226.1	189.3	200.9	214.5	172.2	186.7	201.2
		SHC	194.0	223.7	236.3	188.5	213.6	226.1	181.3	200.9	214.5	172.2	186.7	201.2	
		67	THC	241.1	240.1	239.7	227.9	226.6	226.9	212.7	211.4	214.9	194.4	193.0	201.4
	SHC	151.0	192.1	230.2	146.9	188.3	225.2	141.6	182.9	214.8	135.3	176.3	201.4		
	72	THC	262.2	261.0	259.7	250.0	248.8	247.7	235.0	233.5	232.1	218.1	216.6	215.2	
	SHC	106.5	148.1	189.0	102.5	144.5	186.0	97.8	140.4	182.1	92.4	135.3	177.1		
	76	THC	--	278.9	277.4	--	266.0	264.8	--	251.5	250.6	--	234.7	233.0	
	SHC	--	112.7	153.7	--	108.9	150.4	--	104.7	146.7	--	100.0	142.4		

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 20 TONS (2 Stage Cooling)

RAS240/243			AMBIENT TEMPERATURE												
			85			95			105			115			
			EAT (DB)			EAT (DB)			EAT (DB)			EAT (DB)			
			75	80	85	75	80	85	75	80	85	75	80	85	
6000 Cfm	EAT (wb)	58	THC	213.1	217.2	228.7	199.9	207.5	219.4	184.8	195.8	208.4	169.6	182.6	195.6
		SHC	194.3	217.2	228.7	188.0	207.5	219.4	179.0	195.8	208.4	169.6	182.6	195.6	
		62	THC	230.0	229.4	230.4	217.5	217.0	219.7	202.5	201.9	208.8	184.9	184.9	195.9
		SHC	170.0	199.9	225.9	164.6	194.5	219.7	158.3	187.8	208.8	150.9	178.7	195.9	
		67	THC	251.5	251.1	250.6	239.4	238.7	238.1	225.4	224.7	224.0	208.8	208.2	207.4
	SHC	137.5	168.1	198.4	132.9	163.4	193.7	127.5	158.1	188.2	121.1	151.9	181.9		
	72	THC	274.0	273.8	273.5	262.3	261.7	261.0	248.2	247.4	246.6	232.2	231.3	230.5	
	SHC	104.3	135.1	165.6	100.1	130.9	161.4	95.1	125.9	156.6	89.6	120.5	151.3		
	76	THC	–	292.9	292.2	–	280.5	279.9	–	266.3	265.6	–	250.6	249.8	
	SHC	–	108.1	138.6	–	104.1	134.9	–	99.6	130.4	–	94.6	125.5		
7000 Cfm	EAT (wb)	58	THC	220.8	229.7	241.7	208.4	219.7	232.2	194.3	208.1	221.0	180.1	194.2	207.9
		SHC	211.0	229.7	241.7	203.1	219.7	232.2	194.3	208.1	221.0	180.1	194.2	207.9	
		62	THC	237.8	237.3	241.9	225.1	224.6	232.3	209.6	210.2	221.3	191.3	196.0	208.2
		SHC	183.3	217.8	241.9	178.2	212.1	232.3	171.8	203.8	221.3	164.3	196.0	208.2	
		67	THC	260.0	259.2	258.5	247.2	246.4	245.7	232.7	231.9	231.7	215.8	215.0	214.3
	SHC	146.0	181.0	215.7	141.3	176.5	211.2	136.0	171.3	206.3	129.8	165.3	199.4		
	72	THC	283.3	282.5	281.8	270.6	269.8	268.9	255.9	255.0	254.1	240.0	238.9	238.0	
	SHC	107.9	143.2	178.1	103.6	139.0	174.1	98.6	134.2	169.5	93.2	129.0	164.4		
	76	THC	–	302.3	301.6	–	289.1	288.4	–	274.4	273.6	–	257.9	256.8	
	SHC	–	112.3	147.5	–	108.3	143.7	–	103.9	139.4	–	98.9	134.5		
8000 Cfm	EAT (wb)	58	THC	232.1	243.6	256.1	219.8	233.4	246.0	206.9	221.3	234.5	192.1	206.8	221.2
		SHC	227.5	243.6	256.1	219.8	233.4	246.0	206.9	221.3	234.5	192.1	206.8	221.2	
		62	THC	247.8	247.1	256.4	234.7	235.5	246.2	218.7	221.1	234.7	199.5	207.0	221.4
		SHC	199.5	236.7	256.4	194.3	229.1	246.2	187.8	221.1	234.7	179.9	207.0	221.4	
		67	THC	270.2	269.3	268.3	257.0	256.1	255.2	242.1	241.0	240.3	224.5	223.5	223.1
	SHC	157.6	197.1	235.6	152.7	192.6	231.0	147.3	187.2	225.3	141.0	181.0	215.6		
	72	THC	294.1	293.1	292.2	280.7	279.7	278.4	265.9	264.7	263.8	248.9	247.6	246.6	
	SHC	114.8	154.6	193.9	110.3	150.4	190.0	105.4	145.6	185.5	99.7	140.1	180.2		
	76	THC	–	313.1	312.3	–	299.3	298.2	–	283.8	282.8	–	266.7	265.4	
	SHC	–	120.2	159.6	–	116.0	155.9	–	111.4	151.5	–	106.2	146.6		
9000 Cfm	EAT (wb)	58	THC	238.5	252.5	266.0	226.8	241.6	255.6	213.1	228.2	243.0	197.5	213.0	229.2
		SHC	238.5	252.5	266.0	226.8	241.6	255.6	213.1	228.2	243.0	197.5	213.0	229.2	
		62	THC	253.0	254.1	266.3	238.6	241.6	255.7	221.0	228.4	243.3	201.1	213.2	229.4
		SHC	211.9	249.1	266.3	206.2	241.6	255.7	199.2	228.4	243.3	164.2	213.2	229.4	
		67	THC	276.9	275.8	274.8	263.0	261.8	261.0	246.5	245.2	246.6	228.2	225.9	229.6
	SHC	165.6	209.9	252.2	160.7	205.1	247.0	154.9	199.3	238.5	132.3	192.7	229.6		
	72	THC	302.2	301.0	299.7	287.9	286.6	285.4	272.3	270.9	269.6	254.3	252.9	251.6	
	SHC	118.2	162.8	206.8	113.5	158.4	202.9	108.5	153.4	198.0	102.7	147.8	165.1		
	76	THC	–	322.0	320.8	–	307.7	306.1	–	291.4	289.9	–	275.1	272.5	
	SHC	–	124.5	168.7	–	120.4	164.9	–	115.6	160.5	–	110.9	155.3		
10,000 Cfm	EAT (wb)	58	THC	245.7	259.8	273.9	233.8	248.7	263.2	219.8	235.3	250.5	203.7	219.8	236.5
		SHC	245.7	259.8	273.9	233.8	248.7	263.2	219.8	235.3	250.5	203.7	219.8	236.5	
		62	THC	256.8	260.7	274.2	242.2	249.0	263.3	224.6	235.6	250.6	205.6	220.0	236.8
		SHC	223.8	258.4	274.2	218.1	249.0	263.3	211.0	235.6	250.6	199.3	220.0	236.8	
		67	THC	280.8	279.6	266.3	266.6	265.4	265.8	249.9	248.6	251.0	231.4	229.8	237.3
	SHC	173.2	221.8	266.3	168.3	217.0	258.7	162.6	211.4	250.7	156.4	204.7	237.3		
	72	THC	306.4	305.0	274.8	292.1	290.6	289.3	276.0	274.3	273.0	257.5	256.0	254.6	
	SHC	121.2	170.1	252.2	116.6	165.9	214.8	111.5	161.0	210.0	105.7	155.4	204.5		
	76	THC	–	326.2	299.7	–	311.4	310.0	–	295.2	293.2	–	277.0	275.3	
	SHC	–	128.2	206.8	–	124.0	172.9	–	119.5	168.9	–	114.3	163.8		

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 10 – COOLING CAPACITIES 25 TONS (2 Stage Cooling)

RAS300/303				AMBIENT TEMPERATURE											
				85			95			105			115		
				EAT (DB)			EAT (DB)			EAT (DB)			EAT (DB)		
				75	80	85	75	80	85	75	80	85	75	80	85
7,500 Cfm	EAT (wb)	58	THC	257.3	266.5	279.6	247.5	255.4	269.0	231.5	243.3	257.2	214.3	229.2	243.7
			SHC	247.5	266.5	279.6	231.1	255.4	269.0	223.5	243.3	257.2	213.2	229.2	243.7
		62	THC	281.4	280.5	280.6	267.5	267.0	269.3	251.3	251.0	257.6	232.7	232.5	244.1
			SHC	208.2	244.0	278.0	202.3	238.4	269.3	195.8	231.5	257.6	188.1	223.4	244.1
		67	THC	307.4	306.4	305.7	293.0	292.2	291.4	276.9	276.2	275.4	259.7	259.2	258.8
	SHC		168.7	205.7	242.3	163.2	200.3	236.9	157.1	194.4	230.7	150.6	188.4	224.8	
	72	THC	333.9	333.2	332.5	320.1	319.3	318.6	304.5	303.7	302.7	287.2	285.3	284.5	
		SHC	128.1	165.4	202.3	123.1	160.6	197.8	117.6	155.1	192.5	111.5	149.0	186.6	
	76	THC	–	356.0	355.2	–	342.0	341.2	–	326.0	325.2	–	308.0	307.4	
		SHC	–	132.7	169.9	–	128.1	165.6	–	123.0	160.7	–	117.3	154.5	
8,750 Cfm	EAT (wb)	58	THC	269.8	280.2	294.4	255.3	268.9	283.2	241.1	256.1	270.7	225.5	241.3	257.3
			SHC	257.9	280.2	294.4	250.4	268.9	283.2	241.1	256.1	270.7	225.5	241.3	257.3
		62	THC	289.9	289.3	294.6	275.3	274.9	283.6	258.7	258.2	271.0	238.8	241.6	257.6
			SHC	224.2	265.0	294.6	218.6	258.6	283.6	212.0	251.7	271.0	203.9	241.6	257.6
		67	THC	316.2	315.7	314.5	301.7	300.8	299.8	285.1	284.2	283.4	266.7	266.0	265.2
	SHC		179.0	221.6	263.1	173.5	216.4	257.9	167.5	210.5	251.9	161.0	204.5	245.1	
	72	THC	343.7	342.7	341.6	315.3	327.9	327.0	313.1	311.4	310.4	294.3	293.2	292.2	
		SHC	132.4	175.4	217.7	127.6	170.7	213.3	122.0	165.3	208.3	115.6	159.2	202.5	
	76	THC	–	366.0	364.9	–	351.2	350.1	–	334.2	333.2	–	315.4	314.3	
		SHC	–	138.0	180.7	–	133.4	176.5	–	128.2	171.6	–	122.5	166.1	
10,000 Cfm	EAT (wb)	58	THC	277.1	291.8	306.8	264.9	280.2	295.3	251.2	267.0	282.3	235.1	252.2	268.1
			SHC	275.3	291.8	306.8	264.9	280.2	295.3	251.2	267.0	282.3	235.1	252.2	268.1
		62	THC	296.8	296.0	307.2	281.8	281.8	295.6	264.7	267.1	282.6	244.9	252.4	268.4
			SHC	239.8	283.9	307.2	234.0	276.8	295.6	227.5	267.1	282.6	219.4	252.4	268.4
		67	THC	323.5	322.6	321.4	308.5	307.4	306.5	291.3	290.2	289.3	272.5	271.5	270.8
	SHC		188.8	236.9	282.9	183.5	231.9	277.4	177.5	226.1	271.2	171.2	219.7	264.3	
	72	THC	351.8	350.5	349.2	336.6	335.4	334.1	319.7	318.3	317.1	300.2	298.9	297.8	
		SHC	136.6	185.1	232.8	131.6	180.4	228.6	126.0	175.1	223.7	119.7	169.1	217.9	
	76	THC	–	374.2	372.8	–	358.6	357.3	–	340.9	339.7	–	321.3	320.1	
		SHC	–	143.1	191.2	–	138.5	187.1	–	133.3	182.3	–	127.6	176.8	
11,250 Cfm	EAT (wb)	58	THC	285.8	301.5	317.0	273.8	289.0	305.1	259.8	276.1	291.7	244.0	260.9	277.4
			SHC	285.8	301.5	317.0	273.8	289.0	305.1	259.8	276.1	291.7	244.0	260.9	277.4
		62	THC	302.2	302.3	317.4	286.3	289.5	305.4	269.6	276.4	288.4	249.3	261.1	277.6
			SHC	254.3	300.2	317.4	245.8	289.5	305.4	242.1	276.4	288.4	201.5	261.1	277.6
		67	THC	328.7	327.7	326.7	313.5	312.2	311.1	296.0	294.8	294.3	277.5	275.7	277.9
	SHC		197.9	251.1	301.0	192.8	246.4	295.4	187.0	240.4	288.0	160.9	234.6	277.9	
	72	THC	357.4	355.9	354.4	341.8	340.3	339.0	324.4	322.8	321.6	304.8	303.2	302.0	
		SHC	140.2	193.9	246.7	135.2	189.4	242.8	129.7	184.3	238.2	123.5	178.4	198.1	
	76	THC	–	379.7	378.2	–	363.9	362.3	–	345.7	344.2	–	327.5	324.0	
		SHC	–	147.6	200.8	–	143.1	196.9	–	138.0	192.3	–	132.9	187.1	
12,500 Cfm	EAT (wb)	58	THC	293.7	309.8	325.6	280.3	297.3	313.5	267.0	283.5	299.8	250.8	268.3	284.8
			SHC	293.7	309.8	325.6	280.3	297.3	313.5	267.0	283.5	299.8	250.8	268.3	284.8
		62	THC	310.5	310.2	326.1	290.7	297.6	313.9	273.7	283.7	300.1	253.1	268.5	285.0
			SHC	264.9	310.1	326.1	262.1	297.6	313.9	255.7	283.7	300.1	246.9	268.5	285.0
		67	THC	333.1	331.7	330.9	317.5	316.2	315.9	299.8	298.7	300.3	280.7	279.6	285.5
	SHC		206.6	264.7	317.6	201.9	260.2	311.0	196.2	254.9	300.3	190.0	248.1	285.5	
	72	THC	362.1	360.3	358.7	346.0	344.3	343.0	328.2	326.6	325.1	308.4	306.6	305.3	
		SHC	143.6	202.4	260.2	138.7	198.1	256.5	133.2	193.2	252.1	127.1	187.5	246.5	
	76	THC	–	384.3	382.5	–	368.1	366.3	–	349.5	347.8	–	331.0	328.7	
		SHC	–	151.9	210.1	–	147.5	206.4	–	142.5	201.9	–	137.4	195.2	

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 11 – STATIC PRESSURE ADDERS (Factory Options and/or Accessories)

Economizer – Vertical and Horizontal Duct Configuration

Model Sizes 210 – 303								
CFM	4500	5000	5500	6000	6500	7000	7500	8000
Vertical & Horizontal	0.047	0.052	0.057	0.062	0.067	0.072	0.077	0.082

Model Sizes 210 – 303									
CFM	8500	9000	9500	10000	10500	11000	11500	12000	12500
Vertical & Horizontal	0.088	0.093	0.098	0.103	0.109	0.114	0.119	0.125	0.131

Electric Heaters – Vertical and Horizontal Duct Configuration

Model Sizes 210 – 303								
CFM	4500	5000	5500	6000	6500	7000	7500	8000
25 kW Heater	0.010	0.010	0.015	0.020	0.025	0.030	0.035	0.040
50 kW Heater	0.020	0.020	0.030	0.040	0.050	0.060	0.070	0.080
75 kW Heater	0.030	0.040	0.050	0.060	0.070	0.080	0.100	0.120

Model Sizes 210 – 303									
CFM	8500	9000	9500	10000	10500	11000	11500	12000	12500
25 kW Heater	0.045	0.050	0.055	0.060	0.070	0.080	0.090	0.100	0.105
50 kW Heater	0.090	0.100	0.120	0.130	0.150	0.160	0.180	0.200	0.230
75 kW Heater	0.140	0.150	0.180	0.200	0.230	0.250	0.270	0.300	0.330

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 Table 11.
4. The Fan Performance tables offer motor/drive recommendations. In cases when two motor/drive combinations would work, the lower horsepower option is recommended.
5. For information on the electrical properties of motors, please see the Electrical information section of this book.
6. For more information on the performance limits of motors, see the application data section of this book.

FAN PERFORMANCE

Table 12 – RAS210, 17.5 TON VERTICAL SUPPLY / RETURN

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	473	0.83	560	1.16	637	1.51	706	1.89	770	2.30
5700	497	0.99	580	1.34	654	1.72	721	2.12	783	2.54
6100	518	1.15	598	1.53	669	1.92	735	2.34	795	2.78
6500	540	1.33	616	1.73	685	2.14	749	2.58	808	3.03
7000	567	1.59	640	2.01	707	2.45	768	2.91	826	3.38
7500	595	1.88	665	2.33	729	2.79	788	3.27	844	3.77
7900	618	2.14	685	2.60	747	3.09	805	3.59	859	4.10
8300	641	2.42	705	2.91	765	3.41	822	3.93	875	4.46
8750	666	2.77	729	3.28	787	3.80	842	4.34	893	4.90

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	829	2.72	885	3.16	938	3.61	988	4.09	1036	4.57
5700	841	2.98	895	3.43	947	3.91	997	4.40	1044	4.90
6100	852	3.23	906	3.70	957	4.19	1005	4.70	1052	5.22
6500	864	3.50	917	3.99	967	4.50	1015	5.02	1060	5.55
7000	880	3.88	931	4.38	980	4.91	1027	5.45	1072	6.01
7500	897	4.28	947	4.81	995	5.36	1041	5.92	1085	6.49
7900	911	4.63	960	5.18	1007	5.75	1052	6.32	-----	-----
8300	926	5.01	974	5.58	1020	6.16	-----	-----	-----	-----
8750	943	5.47	990	6.05	-----	-----	-----	-----	-----	-----

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

Table 13 – RAS240, 20 TON VERTICAL SUPPLY / RETURN

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	506	1.12	593	1.43	668	1.74	736	2.07	798	2.40
6500	533	1.36	616	1.70	689	2.04	754	2.39	815	2.74
7000	561	1.64	640	2.01	710	2.37	774	2.74	833	3.11
7500	588	1.96	664	2.35	732	2.74	795	3.13	852	3.53
8000	617	2.32	689	2.74	755	3.15	816	3.57	872	3.99
8500	645	2.73	715	3.17	779	3.60	837	4.04	892	4.49
9000	674	3.18	741	3.64	803	4.10	860	4.57	913	5.04
9500	703	3.67	767	4.16	827	4.65	883	5.14	935	5.64
10000	732	4.22	794	4.74	852	5.25	906	5.77	957	6.29

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	855	2.75	909	3.11	959	3.47	1008	3.85	1054	4.24
6500	871	3.11	924	3.48	974	3.87	1022	4.26	1067	4.67
7000	888	3.50	940	3.89	989	4.30	1036	4.71	1081	5.13
7500	906	3.94	957	4.35	1005	4.77	1052	5.20	1096	5.64
8000	925	4.42	975	4.85	1022	5.29	1068	5.74	1111	6.20
8500	944	4.94	993	5.40	1040	5.86	1084	6.33	1127	6.81
9000	964	5.51	1012	5.99	1058	6.48	1102	6.97	1144	7.46
9500	984	6.13	1032	6.64	1077	7.14	1120	7.65	1161	8.17
10000	1006	6.81	1052	7.33	1096	7.86	1138	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

FAN PERFORMANCE (cont.)

Table 14 – RAS300, 25 TON VERTICAL SUPPLY / RETURN

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	541	1.50	636	1.88	716	2.27	787	2.66	850	3.06
8000	563	1.76	656	2.17	735	2.58	804	3.00	867	3.42
8500	585	2.05	676	2.50	753	2.93	822	3.37	884	3.81
9000	608	2.37	697	2.85	772	3.31	840	3.77	901	4.24
9500	631	2.73	717	3.24	791	3.73	858	4.21	918	4.70
10000	654	3.12	738	3.66	811	4.18	876	4.69	936	5.20
10500	678	3.56	759	4.12	831	4.67	895	5.21	954	5.74
11000	701	4.02	781	4.62	851	5.20	914	5.76	972	6.33
11500	725	4.53	802	5.16	871	5.77	933	6.36	991	6.95
12000	748	5.09	824	5.75	892	6.38	953	7.00	1010	7.62
12500	772	5.68	846	6.38	912	7.04	973	7.69	1029	8.34

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	909	3.47	963	3.89	1014	4.32	1062	4.77	1108	5.23
8000	925	3.85	978	4.29	1029	4.74	1077	5.20	1122	5.68
8500	941	4.26	994	4.72	1044	5.19	1092	5.67	1137	6.16
9000	957	4.71	1010	5.19	1060	5.67	1107	6.17	1152	6.68
9500	974	5.19	1027	5.69	1076	6.20	1123	6.72	1167	7.24
10000	991	5.72	1043	6.24	1092	6.77	1138	7.30	-----	-----
10500	1009	6.28	1060	6.83	1109	7.37	1155	7.93	-----	-----
11000	1026	6.89	1077	7.46	1125	8.03	1171	8.60	-----	-----
11500	1044	7.54	1095	8.13	1142	8.72	-----	-----	-----	-----
12000	1062	8.23	1112	8.85	-----	-----	-----	-----	-----	-----
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

Table 15 – RAS213, 17.5 TON HORIZONTAL SUPPLY / RETURN

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	498	1.18	573	1.60	640	2.05	701	2.55	756	3.11
5700	526	1.43	599	1.89	663	2.35	721	2.86	776	3.43
6100	552	1.67	622	2.17	684	2.66	741	3.18	794	3.76
6500	579	1.95	646	2.49	706	3.00	761	3.54	813	4.12
7000	612	2.33	677	2.93	734	3.48	788	4.05	837	4.64
7500	646	2.75	708	3.42	764	4.02	815	4.62	863	5.23
7900	673	3.13	734	3.86	788	4.50	838	5.12	884	5.75
8300	700	3.53	760	4.33	812	5.01	861	5.66	906	6.32
8750	731	4.03	789	4.90	840	5.63	887	6.33	-----	-----

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	808	3.72	856	4.36	901	5.04	943	5.75	983	6.48
5700	826	4.05	874	4.71	918	5.40	960	6.13	-----	-----
6100	843	4.38	890	5.05	934	5.75	976	6.50	-----	-----
6500	861	4.75	907	5.43	951	6.14	-----	-----	-----	-----
7000	885	5.28	929	5.96	-----	-----	-----	-----	-----	-----
7500	909	5.88	-----	-----	-----	-----	-----	-----	-----	-----
7900	929	6.42	-----	-----	-----	-----	-----	-----	-----	-----
8300	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
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 16 – RAS243, 20 TON HORIZONTAL SUPPLY / RETURN

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	546	1.57	617	2.10	680	2.67	738	3.29	790	3.93
6500	579	1.90	646	2.46	707	3.07	763	3.71	814	4.39
7000	613	2.28	677	2.87	735	3.51	789	4.19	839	4.89
7500	648	2.71	708	3.34	764	4.01	816	4.72	865	5.46
8000	683	3.20	740	3.86	794	4.57	846	5.30	892	6.08
8500	718	3.76	773	4.45	825	5.18	873	5.95	919	6.75
9000	754	4.37	814	5.10	856	5.87	903	6.67	947	7.50
9500	-----	-----	840	5.82	887	6.51	933	7.45	976	8.31
10000	-----	-----	874	6.50	920	7.44	965	8.30	-----	-----

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	839	4.60	885	5.29	928	6.01	969	6.75	1008	7.51
6500	862	5.09	907	5.82	950	6.57	990	7.34	1028	8.13
7000	886	5.63	930	6.39	972	7.17	1012	7.97	1050	8.70
7500	911	6.22	954	7.01	995	7.83	1035	8.66	-----	-----
8000	936	6.87	979	7.69	1019	8.54	-----	-----	-----	-----
8500	965	7.58	1004	8.44	-----	-----	-----	-----	-----	-----
9000	990	8.36	-----	-----	-----	-----	-----	-----	-----	-----
9500	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
10000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

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 17 – RAS303, 25 TON HORIZONTAL SUPPLY / RETURN

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	553	1.92	621	2.46	683	3.07	741	3.72	795	4.42
8000	575	2.21	639	2.77	700	3.39	756	4.07	809	4.78
8500	596	2.52	658	3.10	716	3.73	771	4.43	823	5.16
9000	616	2.86	675	3.44	732	4.10	786	4.80	836	5.55
9500	636	3.22	693	3.82	747	4.48	800	5.20	849	5.97
10000	656	3.60	710	4.21	763	4.89	813	5.62	862	6.40
10500	675	4.02	727	4.64	778	5.32	827	6.07	874	6.86
11000	694	4.46	744	5.09	793	5.79	841	6.50	887	7.34
11500	713	4.93	761	5.57	808	6.27	854	7.03	899	7.84

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	845	5.14	892	5.90	936	6.68	978	7.48	1018	8.31
8000	859	5.53	905	6.31	949	7.11	991	7.94	-----	-----
8500	872	5.93	918	6.73	961	7.56	1003	8.41	-----	-----
9000	884	6.34	930	7.16	973	8.01	-----	-----	-----	-----
9500	896	6.77	941	7.61	984	8.48	-----	-----	-----	-----
10000	908	7.22	953	8.08	-----	-----	-----	-----	-----	-----
10500	920	7.69	963	8.56	-----	-----	-----	-----	-----	-----
11000	931	8.18	-----	-----	-----	-----	-----	-----	-----	-----
11500	943	8.70	-----	-----	-----	-----	-----	-----	-----	-----

Std Static Motor and Drive – 647–791 RPM, Max BHP 4.9 Medium Static Motor and Drive – 755–923 RPM, Max BHP 6.5
 High Static Motor and Drive – 827–1010 RPM, Max BHP 8.7 ----- Outside operating range
Boldface – Field-supplied Drive

FAN PERFORMANCE (cont.)

Table 18 – PULLEY ADJUSTMENT

Unit RAS	Motor/Drive Combo	Motor Pulley turns open										
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
210 – 213	Standard Static	819	798	776	755	733	712	690	669	647	626	604
	Medium Static	958	939	920	901	882	863	843	824	805	786	767
	High Static	1134	1112	1090	1069	1047	1025	1003	981	960	938	916
240 – 243	Standard Static	819	798	776	755	733	712	690	669	647	626	604
	Medium Static	1008	989	969	950	930	911	892	872	853	833	814
	High Static	1170	1150	1129	1109	1088	1068	1047	1027	1006	986	965
300 – 303	Standard Static	819	805	790	776	762	748	733	719	705	690	676
	Medium Static	1134	1112	1090	1069	1047	1025	1003	981	960	938	916
	High Static	1293	1273	1252	1232	1211	1191	1170	1150	1129	1109	1088

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

■ - Factory settings

DAMPER, BAROMETRIC RELIEF, AND PERFORMANCE, 17.5 TO 25 Ton

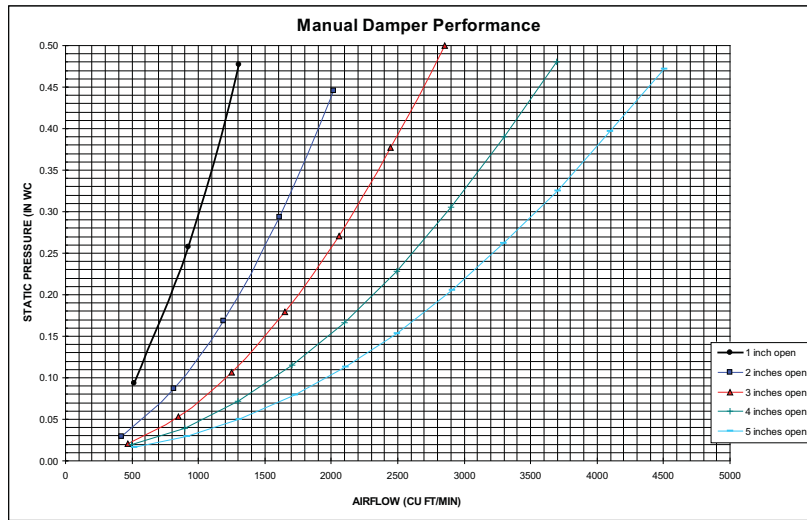


Fig 1 – Manual Damper Performance

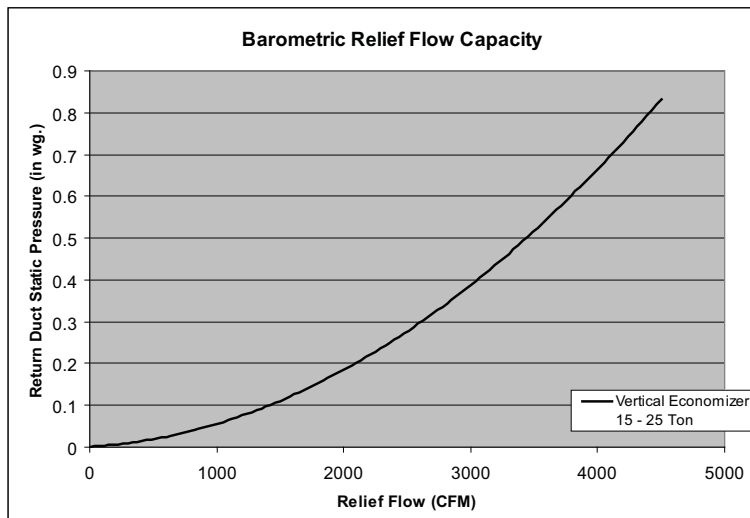


Fig 2 – Barometric Relief Flow Capacity

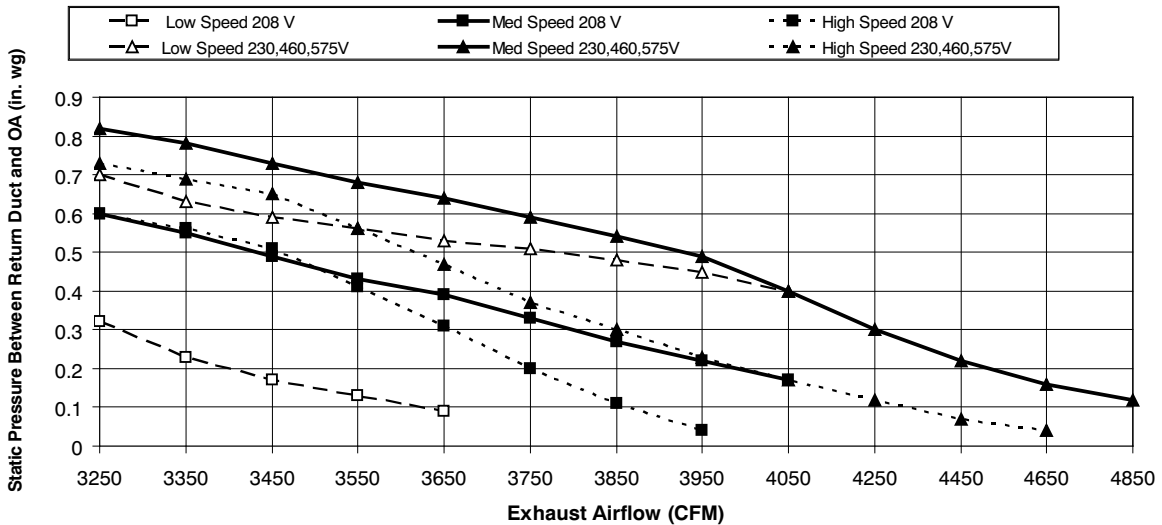


Fig 3 – Power Exhaust Fan Performance

ELECTRICAL INFORMATION

Table 19 – 2 Stage Cooling

Unit RAS	V-Ph-Hz	Voltage Range		Comp 1		Comp 2		OFM (ea)		IFM		
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Full Load Efficiency	FLA
210/213	208-3-60	187	253	29.5	195	30.1	225	350	1.5	STD	83.8%	10.2
										MED	83.6%	15.0
										HIGH-High Eff	89.5%	20.4
	230-3-60	187	253	29.5	195	30.1	225	350	1.5	STD	83.8%	10.2
										MED	83.6%	15.0
										HIGH-High Eff	89.5%	20.4
	460-3-60	414	506	14.7	95	16.7	114	277	0.9	STD	83.8%	4.8
										MED	83.6%	7.4
										HIGH-High Eff	89.5%	20.4
	575-3-60	518	633	12.2	80	12.2	80	397	0.6	STD	81.1%	2.8
										MED	83.6%	5.6
										HIGH-High Eff	89.5%	9.0
240/243	208-3-60	187	253	48.1	245	29.5	195	350	1.5	STD	83.6%	15.0
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	230-3-60	187	253	48.1	245	29.5	195	350	1.5	STD	83.6%	15.0
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	460-3-60	414	506	18.6	125	14.7	95	277	0.9	STD	83.6%	7.4
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	575-3-60	518	633	14.7	100	12.2	80	397	0.6	STD	83.6%	5.6
										MED-High Eff	89.5%	9.0
										HIGH-High Eff	91.7%	9.5
300/303	208-3-60	187	253	48.1	245	48.1	245	350	1.5	STD	83.6%	15.0
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	230-3-60	187	253	48.1	245	48.1	245	350	1.5	STD	83.6%	15.0
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	460-3-60	414	506	18.6	125	18.6	125	277	0.9	STD	83.6%	7.4
										MED-High Eff	89.5%	20.4
										HIGH-High Eff	91.7%	33.1
	575-3-60	518	633	14.7	100	14.7	100	397	0.6	STD	83.6%	5.6
										MED-High Eff	89.5%	9.0
										HIGH-High Eff	91.7%	9.5

See LEGEND on page 33.

TABLE 23 – MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O. (Cont.)

Model RAS	V-Ph-Hz	IFM TYPE	ELECTRIC HEATER		NO C.O. or UNPWR C.O.							
			Nom (kW)	FLA	NO P.E.				w/ P.E. (pwrd fr/unit)			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
240/243	208/230-3-60	STD	-	-	110.6	150.0	113	534	122.4	150.0	127	554
			18.8/25.0	52.1/60.1	110.6/110.6	150/150	113/113	534/534	122.4/122.4	150/150	127/127	554/554
			37.6/50.0	104.2/120.3	149.0/139.1	150/175	137/156	534/534	163.8/153.8	175/175	151/169	554/554
		56.3/75.0	156.4/180.4	175.2/199.2	200/225	197/225	534/534	189.9/213.9	200/250	211/238	554/554	
		MED High Eff	-	-	116.0	150.0	120.0	544.0	127.8	175.0	133.0	564.0
			18.8/25.0	52.1/60.1	116.0/116.0	150/150	120/120	544/544	127.8/127.8	175/175	133/133	564/564
			37.6/50.0	104.2/120.3	155.8/145.8	175/175	143/162	544/544	170.5/160.6	175/175	157/175	564/564
		56.3/75.0	156.4/180.4	181.9/205.9	200/250	203/231	544/544	196.7/220.7	200/250	217/244	564/564	
		HIGH High Eff	-	-	128.7	175.0	134.0	618.0	140.5	175.0	148.0	638.0
	18.8/25.0		52.1/60.1	128.7/128.7	175/175	134/134	618/618	140.5/140.5	175/175	148/148	638/638	
	37.6/50.0		104.2/120.3	171.6/161.7	175/175	158/176	618/618	186.4/176.4	200/200	171/190	638/638	
	56.3/75.0	156.4/180.4	197.8/221.8	225/250	218/246	618/618	212.5/236.5	225/250	231/259	638/638		
	460-3-60	STD	-	-	49.0	60.0	51	269	55.2	60.0	58	281
			25.0	30.1	49.0	60.0	51	269	55.2	60.0	58	281
			50.0	60.1	69.4	80.0	78	269	77.1	80.0	85	281
		75.0	90.2	99.5	110	112	269	107.2	125	119	281	
		MED High Eff	-	-	51.8	60.0	54.0	274.0	58.0	70.0	61.0	286
			25.0	30.1	51.8	60.0	54.0	274.0	58.1	70.0	61.0	286
			50.0	60.1	72.9	80.0	81.0	274.0	80.6	90.0	88.0	286
		75.0	90.2	103.0	125	115	274	110.7	125	123	286	
		HIGH High Eff	-	-	57.8	70.0	61.0	311.0	64.0	80.0	68.0	323
	25.0		30.1	57.9	70.0	61.0	311.0	65.6	80.0	68.0	323	
	50.0		60.1	80.4	90.0	88.0	311.0	88.1	100.0	95.0	323	
	75.0	90.2	110.5	125	122	311	118.2	125	129	323		
575-3-60	STD	-	-	38.6	50.0	40	224	43.4	50.0	46	232	
		24.8	23.9	38.6	50.0	40	224	43.4	50.0	46	232	
		49.6	47.7	66.6	70.0	61	224	72.6	80.0	67	232	
	74.4	71.6	78.6	90	89	224	84.6	90	94	232		
	MED High Eff	-	-	42.0	50.0	44.0	222.0	46.8	60.0	50.0	230	
		24.8	23.9	42.0	50.0	44.0	222.0	47.1	60.0	50.0	230	
		49.6	47.7	70.9	80.0	65.0	222.0	76.9	80.0	71.0	230	
	74.4	71.6	82.9	90	93	222	88.9	90	98	230		
	HIGH High Eff	-	-	42.5	50.0	45.0	249.0	47.3	60.0	50.0	257	
24.8		23.9	42.5	50.0	45.0	249.0	47.8	60.0	50.0	257		
49.6		47.7	71.5	80.0	66.0	249.0	77.5	80.0	71.0	257		
74.4	71.6	83.5	90	93	249	89.5	100	99	257			

See LEGEND on page 33.

TABLE 23 – MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O. (Cont.)

Model RAS	V-Ph-Hz	IFM TYPE	ELECTRIC HEATER		NO C.O. or UNPWR C.O.							
			Nom (kW)	FLA	NO P.E.		w/ P.E. (pwrd fr/unit)					
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
300/303	208/230-3-60	STD	-	-	129.2	175.0	135	584	141.0	175.0	148	604
			18.8/25.0	52.1/60.1	129.2/129.2	175/175	135/135	584/584	141.0/141.0	175/175	148/148	604/604
			37.6/50.0	104.2/120.3	149.0/139.1	175/175	137/156	584/584	163.8/153.8	175/175	151/169	604/604
		56.3/75.0	156.4/180.4	175.2/199.2	200/225	197/225	584/584	189.9/213.9	200/250	211/238	604/604	
		MED High Eff	-	-	134.6	175.0	141.0	594.0	146.4	175.0	155.0	614
			18.8/25.0	52.1/60.1	134.6/134.6	175/175	141/141	594/594	146.4/146.4	175/175	155/155	614/614
			37.6/50.0	104.2/120.3	155.8/145.8	175/175	143/162	594/594	170.5/160.6	175/175	157/175	614/614
		56.3/75.0	156.4/180.4	181.9/205.9	200/250	203/231	594/594	196.7/220.7	200/250	217/244	614/614	
		HIGH High Eff	-	-	147.3	175.0	156.0	668.0	159.1	200.0	169.0	688
			18.8/25.0	52.1/60.1	147.3/147.3	175/175	156/156	668/668	159.1/159.1	200/200	169/169	688/688
			37.6/50.0	104.2/120.3	171.6/161.7	175/175	158/176	668/668	186.4/176.4	200/200	171/190	688/688
		56.3/75.0	156.4/180.4	197.8/221.8	225/250	218/246	668/668	212.5/236.5	225/250	231/259	688/688	
	460-3-60	STD	-	-	52.9	60.0	55	299	59.1	70.0	63	311
			25.0	30.1	52.9	60.0	55	299	59.1	70.0	63	311
			50.0	60.1	69.4	80.0	78	299	77.1	80.0	85	311
		75.0	90.2	99.5	110	112	299	107.2	125	119	311	
		MED High Eff	-	-	55.7	70.0	59.0	304.0	61.9	80.0	66.0	316
			25.0	30.1	55.7	70.0	59.0	304.0	61.9	80.0	66.0	316
			50.0	60.1	72.9	80.0	81.0	304.0	80.6	90.0	88.0	316
		75.0	90.2	103.0	125	115	304	110.7	125	123	316	
		HIGH High Eff	-	-	61.7	80.0	66.0	341.0	67.9	80.0	73.0	353
			25.0	30.1	61.7	80.0	66.0	341.0	67.9	80.0	73.0	353
			50.0	60.1	80.4	90.0	88.0	341.0	88.1	100.0	95.0	353
		75.0	90.2	110.5	125	122	341	118.2	125	129	353	
575-3-60	STD	-	-	41.1	50.0	43	244	45.9	60.0	49	252	
		24.8	23.9	41.1	50.0	43	244	45.9	60.0	49	252	
		49.6	47.7	66.6	70.0	61	244	72.6	80.0	67	252	
	74.4	71.6	78.6	90	89	244	84.6	90	94	252		
	MED High Eff	-	-	44.5	50.0	47.0	242.0	49.3	60.0	52.0	250	
		24.8	23.9	44.5	50.0	47.0	242.0	49.3	60.0	52.0	250	
		49.6	47.7	70.9	80.0	65.0	242.0	76.9	80.0	71.0	250	
	74.4	71.6	82.9	90	93	242	88.9	90	98	250		
	HIGH High Eff	-	-	45.0	50.0	47.0	269.0	49.8	60.0	53.0	277	
		24.8	23.9	45.0	50.0	47.0	269.0	49.8	60.0	53.0	277	
		49.6	47.7	71.5	80.0	66.0	269.0	77.5	80.0	71.0	277	
	74.4	71.6	83.5	90	93	269	89.5	100	99	277		

LEGEND:

- C.O. - Convenient outlet
- DISC - Disconnect
- FLA - Full load amps
- IFM - Indoor fan motor
- LRA - Locked rotor amps
- MCA - Minimum circuit amps
- MOCP - Maximum over current protection
- P.E. - Power exhaust
- UNPWRD CO - Unpowered convenient outlet



Example: Supply voltage is 230-3-60



- AB = 224 v
- BC = 231 v
- AC = 226 v

$$\text{Average Voltage} = \frac{(224 + 231 + 226)}{3} = \frac{681}{3} = 227$$

Determine maximum deviation from average voltage.

- (AB) 227 - 224 = 3 v
- (BC) 231 - 227 = 4 v
- (AC) 227 - 226 = 1 v

Maximum deviation is 4 v.

Determine percent of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{4}{227} = 1.76\%$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.

IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

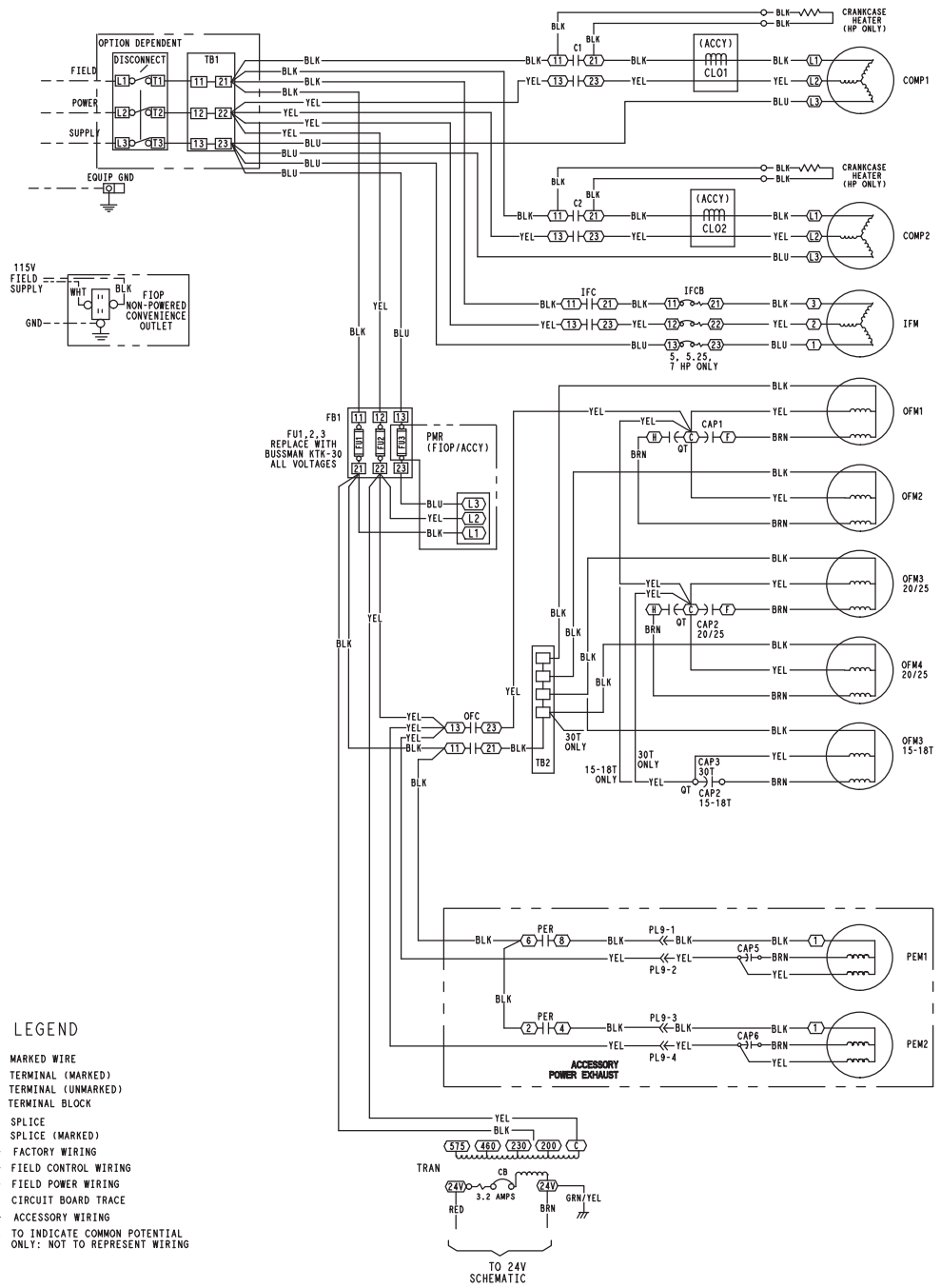
NOTES:

1. In compliance with NEC requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker. Canadian units may be fuse or circuit breaker.

2. Unbalanced 3-Phase Supply Voltage

Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance.

$$\% \text{ Voltage Imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$



- LEGEND**
- (Y) MARKED WIRE
 - (I) TERMINAL (MARKED)
 - (O) TERMINAL (UNMARKED)
 - (X) TERMINAL BLOCK
 - SPLICE
 - SPLICE (MARKED)
 - FACTORY WIRING
 - FIELD CONTROL WIRING
 - FIELD POWER WIRING
 - - - CIRCUIT BOARD TRACE
 - - - ACCESSORY WIRING
 - TO INDICATE COMMON POTENTIAL ONLY: NOT TO REPRESENT WIRING

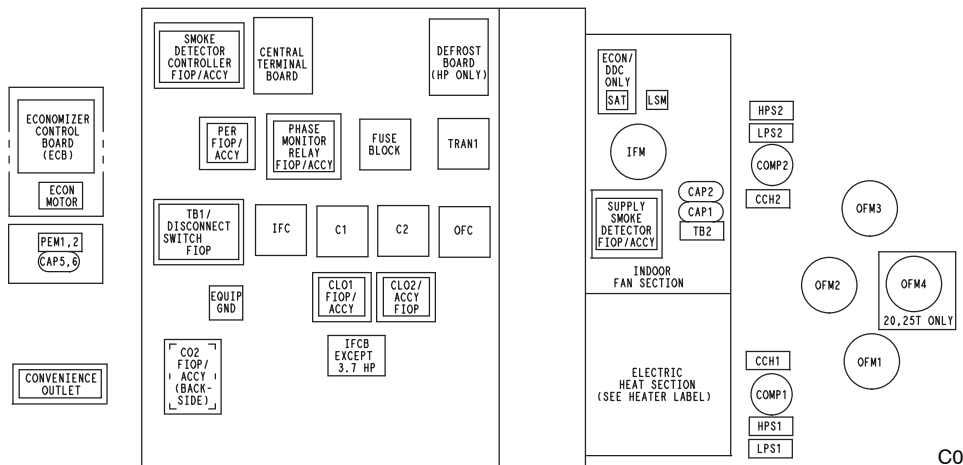
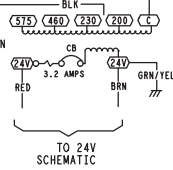
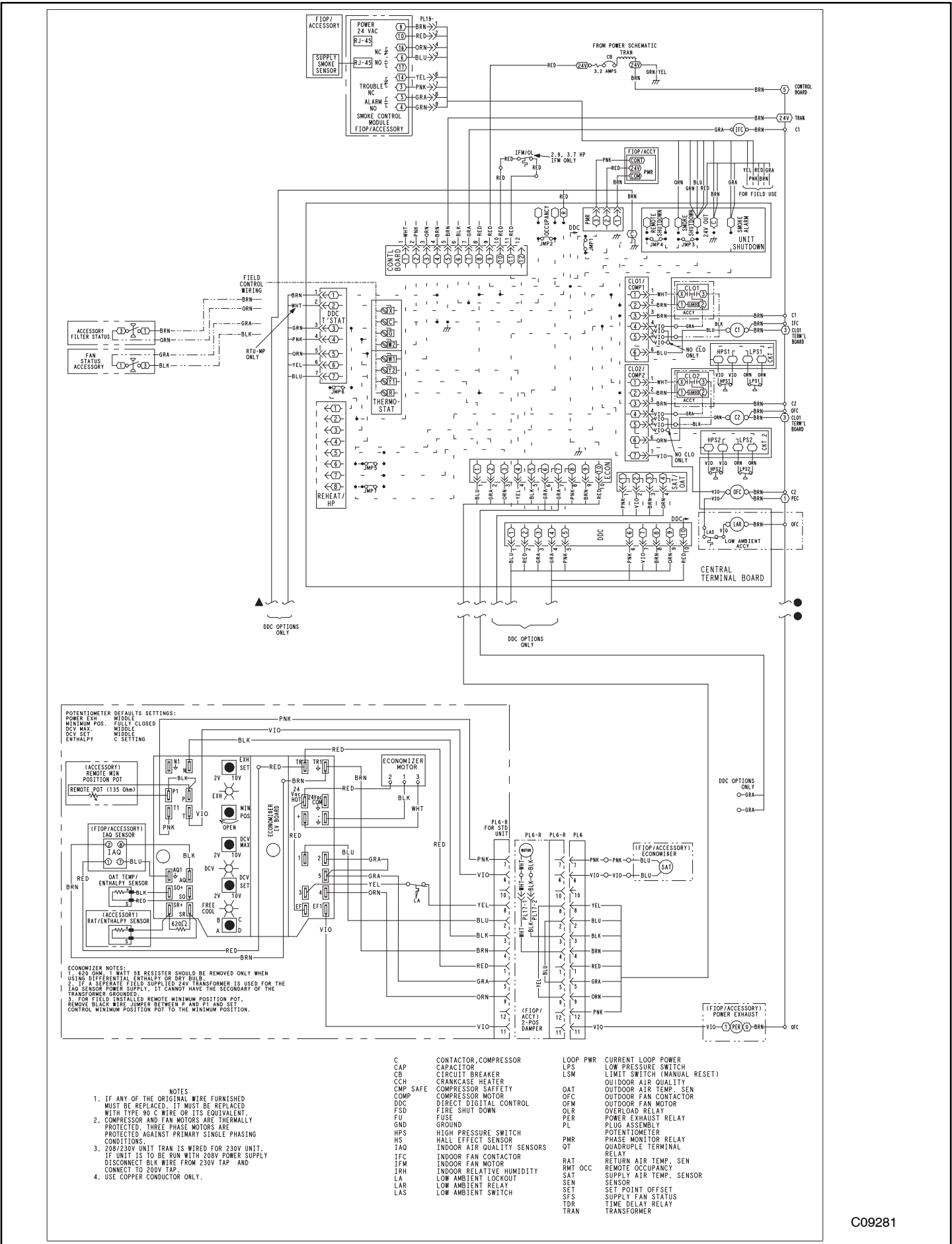


Fig. 4 Typical Power Diagram (2 Stage Cooling)



C09281

Fig. 5 Typical Control Diagram (2 Stage Cooling)

SEQUENCE OF OPERATION

General

The sequence below describes the sequence of operation for an electro-mechanical unit with and without a factory installed "economizer". For information regarding a direct digital controller, see the start-up, operations, and troubleshooting manual for the applicable controller.

Units with no Economizer

Cooling —

When the field supplied commercial grade thermostat calls for cooling, terminals G and Y1 are energized. As a result, the indoor-fan contactor (IFC) and the compressor contactor (C1) are energized, causing the indoor-fan motor (IFM), compressor #1, and outdoor fan to start. If the unit has 2 stages of cooling, the thermostat will additionally energize Y2. The Y2 signal will energize compressor contactor #2 (C2), causing compressor #2 to start. Regardless of the number of stages, the outdoor-fan motor runs continuously while unit is cooling.

Heating —

NOTE: This unit is sold as cooling only. If electric heaters are required, use only factory-approved electric heaters. They will operate as described below.

Units have 2 stages of electric heat. When the thermostat calls for heating, power is applied to the W1 terminal at the unit. The unit control will energize the indoor fan contactor and the first stage of electric heat. On units with two-stage heating, when additional heating is required, the second stage of electric heat (if equipped) will be energized when power is applied at the W2 terminal on the unit.

Units with an Economizer

Cooling —

When free cooling is not available, the compressors will be controlled by the zone thermostat. When free cooling is available, the outdoor-air damper is modulated by the Economizer control to provide a 50°F (10°C) to 55°F (13°C) mixed-air temperature into the zone. As the mixed air temperature fluctuates above 55°F (13°C) or below 50°F (10°C) dampers will be modulated (open or close) to bring the mixed-air temperature back within control. If mechanical cooling is utilized with free cooling, the outdoor-air damper will maintain its current position at the time the compressor is started. If the increase in cooling capacity causes the mixed-air temperature to drop below 45°F (7°C), then the outdoor-air damper position will be decreased to the minimum position. If the mixed-air temperature continues to fall, the outdoor-air damper will close. Control returns to normal once the mixed-air temperature rises above 48°F (9°C). The power exhaust fans will be energized and de-energized, if installed, as the outdoor-air damper opens and closes.

If field-installed accessory CO₂ sensors are connected to the economizer control, a demand controlled ventilation strategy will begin to operate. As the CO₂ level in the zone increases above the CO₂ setpoint, the minimum position of the damper will be increased proportionally. As the CO₂ level decreases because of the increase in fresh air, the outdoor-air damper will be proportionally closed. For economizer operation, there must be a thermostat call for the fan (G). If the unit is occupied and the fan is on, the damper will operate at minimum position. Otherwise, the damper will be closed.

When the economizer control is in the occupied mode and a call for cooling exists (Y1 on the thermostat), the control will first check for indoor fan operation. If the fan is not on, then cooling will not be activated. If the fan is on, then the control will open the economizer damper to the minimum position.

On the initial power to the economizer control, it will take the damper up to 2 1/2 minutes before it begins to position itself. After the initial power-up, further changes in damper position can take up to 30 seconds to initiate. Damper movement from full closed to full open (or vice versa) will take between 1 1/2 and 2 1/2 minutes. If free cooling can be used as determined from the appropriate changeover command (switch, dry bulb, enthalpy curve, differential dry bulb, or differential enthalpy), then the control will modulate the dampers open to maintain the mixed-air temperature setpoint at 50°F (10°C) to 55°F (13°C). If there is a further demand for cooling (cooling second stage – Y2 is energized), then the control will bring on compressor stage 1 to maintain the mixed-air temperature setpoint. The economizer damper will be open at maximum position. economizer operation is limited to a single compressor.

Heating —

The sequence of operation for the heating is the same as a unit with no economizer. The only difference is how the economizer acts. The economizer will stay at the Economizer Minimum Position while the evaporator fan is operating. The outdoor-air damper is closed when the indoor fan is not operating.

Refer to Service and Maintenance Manual for further details.

GUIDE SPECIFICATIONS – RAS210 – 303

Note about this specification:

COOLING ONLY / ELECTRIC HEAT PACKAGED ROOFTOP

HVAC Guide Specifications

Size Range: 17.5 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. Electric 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 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, economizer, thermostat, and low and high pressure switches.
4. 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.

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 filter capabilities shall be capable with pre-engineered and approved 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 (RAS210-303)

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 electric heat accessories 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, R-410A 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 in accordance with ISO 9001:2000, and shall be manufactured in a facility registered by ISO 9001:2000.
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 115°F (46°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 30°F (-1°C), ambient outdoor temperatures. Accessory winter start kit is necessary if mechanically cooling at ambient temperatures below 30°F (-1°C).
3. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
4. Unit shall be factory configured and ordered for vertical supply & return configurations.
5. Unit shall be factory furnished for either vertical or horizontal configuration without the use of special conversion kits. No field conversion is possible.
6. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

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 electrical connections standard. 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 -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. 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.
9. 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 panels shall engage into heat resistant, molded composite collars.
 - f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

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. Fixed orifice metering system shall prevent mal-distribution of two-phase refrigerant by including multiple fixed orifice devices in each refrigeration circuit. Each orifice is to be optimized to the coil circuit it serves.
 - 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 and microchannel condenser coils.
 - 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-ampereage 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 filter capability is possible with a field installed pre engineered slide out filter track accessory. 4-in 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. Integrated Economizers:
 - a. Integrated, gear-driven parallel modulating blade design type capable of simultaneous economizer and compressor operation.
 - b. Independent modules for vertical or horizontal return configurations shall be available. Vertical and horizontal return modules shall be available as a factory installed option.
 - c. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
 - d. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
 - e. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 - f. Shall be equipped with low-leakage dampers, not to exceed 2% leakage at 1 in. wg pressure differential.
 - g. Shall be capable of introducing up to 100% outdoor air.
 - h. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air.
 - i. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
 - j. Dry bulb outdoor-air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F / 4 to 38°C. Additional sensor options shall be available as accessories.
 - k. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
 - l. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy. A remote potentiometer may be used to override the damper setpoint.
 - m. Dampers shall be completely closed when the unit is in the unoccupied mode.

- n. Economizer controller shall accept a 2–10Vdc CO₂ sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor–air damper to provide ventilation based on the sensor input.
 - o. Compressor lockout sensor shall open at 35°F (2°C) and close closes at 50°F (10°C).
 - p. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
 - q. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.
2. Two–Position Motorized Damper
 - a. Damper shall be a Two–Position Damper. Damper travel shall be from the full closed position to the field adjustable %–open setpoint.
 - b. Damper shall include adjustable damper travel from 25% to 100% (full open).
 - c. Damper shall include single or dual blade, gear driven dampers and actuator motor.
 - d. Actuator shall be direct coupled to damper gear. No linkage arms or control rods shall be acceptable.
 - e. Damper will admit up to 100% outdoor air for applicable rooftop units.
 - f. Damper shall close upon indoor (evaporator) fan shutoff and/or loss of power.
 - g. The damper actuator shall plug into the rooftop unit’s wiring harness plug. No hard wiring shall be required.
 - h. Outside air hood shall include aluminum water entrainment filter.
 3. Manual damper
 - a. Manual damper package shall consist of damper, air inlet screen, and rain hood which can be preset to admit up to 25% outdoor air for year round ventilation.
 4. Head Pressure Control Package
 - a. Controller shall control coil head pressure by condenser–fan speed modulation or condenser–fan cycling and wind baffles (field supplied).
 - 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. Condenser Coil Hail Guard Assembly
 - a. Shall protect against damage from hail.
 - b. Shall be louvered style design.
 6. 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.
 7. Convenience Outlet:
 - e. 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.
 - (6.) Outlet shall include a field–installed “Wet in Use” cover.
 8. Centrifugal Propeller Power Exhaust:
 - a. Power exhaust shall be used in conjunction with an integrated economizer.
 - b. Independent modules for vertical or horizontal return configurations shall be available.
 - c. Horizontal power exhaust is shall be mounted in return ductwork.
 - d. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0–100% adjustable setpoint on the economizer control.
 9. 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.
 10. High–Static Indoor Fan Motor(s) and Drive(s):
 - a. High–static motor(s) and drive(s) shall be factory–installed to provide additional performance range.
 11. Outdoor Air Enthalpy Sensor:

- a. The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.
12. Return Air Enthalpy Sensor:
 - a. The return air enthalpy sensor shall be used in conjunction with an outdoor air enthalpy sensor to provide differential enthalpy control.
 13. Indoor Air Quality (CO₂) Sensor:
 - a. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
 - b. The IAQ sensor shall be available in duct mount. The setpoint shall have adjustment capability.
 14. Smoke detectors (Supply):
 - 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
 15. 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).
 16. 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.
 17. Electric Heat:
 - a. Heating Section
 - (1.) Heater element open coil resistance wire, nickel-chrome alloy, 0.29 inches inside diameter, strung through ceramic insulators mounted on metal frame. Coil ends are staked and welded to terminal screw slots.
 - (2.) Heater assemblies are provided with integral fusing for protection of internal heater circuits not exceeding 48 amps each. Auto reset thermo limit controls, magnetic heater contactors (24 v coil) and terminal block all mounted in electric heater control box (minimum 18 ga galvanized steel) attached to end of heater assembly.
 18. Barometric Hood (Horizontal Economizer Applications)
 - a. Shall be required when a horizontal economizer and barometric relief are required. Barometric relief damper must be installed in the return air (horizontal) duct work. This hood provides weather protection.