

ASHRAE 90.1 COMPLIANT PACKAGED ROOFTOP ELECTRIC COOLING UNITS, R-410A, 14 – 20 TONS – 3 Phase, 50 Hz.

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 on all models
- All units have high and low pressure switches
- 51 mm 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
- Outdoor coils constructed of aluminum fin and aluminum tube microchannel 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
- Outdoor temperature cooling operation range 52°C to 4°C (125°F to 40°F)
- 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



14 & 15 Ton



17 & 20 Ton



UNIT PERFORMANCE DATA – Two Stage Cooling							
UNIT	Dedicated Airflow	Nominal Tons	COOLING		IPLV	Unit Dimensions H x W x L mm [inches]	Unit Weight kg. [lbs]
			Net Cap. (kW)	EER			
RAS181Z0AA0AGA	Vertical	14	47.8	10.95	12.42	1253 [49-3/8] x 2199 [86-5/8] x 3249 [127-7/8]	770 [1697]
RAS183Z0AA0AGA	Horizontal	14	47.8	10.95	12.42	1253 [49-3/8] x 2199 [86-5/8] x 3249 [127-7/8]	770 [1697]
RAS210Z0AA0AGA	Vertical	15	51.5	10.95	12.42	1253 [49-3/8] x 2199 [86-5/8] x 3249 [127-7/8]	777 [1712]
RAS213Z0AA0AGA	Horizontal	15	51.5	10.95	12.42	1253 [49-3/8] x 2199 [86-5/8] x 3249 [127-7/8]	777 [1712]
RAS240Z0AA0AGA	Vertical	17	58.8	10.73	12.11	1253 [49-3/8] x 2199 [86-5/8] x 3595 [141-1/2]	845 [1862]
RAS243Z0AA0AGA	Horizontal	17	58.8	10.73	12.11	1253 [49-3/8] x 2199 [86-5/8] x 3595 [141-1/2]	845 [1862]
RAS300Z0AA0AGA	Vertical	20	68.8	9.96	11.04	1456 [57-3/8] x 2199 [86-5/8] x 3595 [141-1/2]	903 [1991]
RAS303Z0AA0AGA	Horizontal	20	68.8	9.96	11.04	1456 [57-3/8] x 2199 [86-5/8] x 3595 [141-1/2]	903 [1991]

Z = 400-3-50

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

TABLE OF CONTENTS

	PAGE		PAGE
MODEL NUMBER NOMENCLATURE	3	COOLING TABLES	20
FACTORY OPTIONS AND/OR ACCESSORIES	4	STATIC PRESSURE ADDERS	28
ARI COOLING RATING TABLE	8	FAN PERFORMANCE	29
SOUND PERFORMANCE TABLE	8	OUTDOOR AIR INTAKE & EXHAUST PERF	38
PHYSICAL DATA	9	ELECTRICAL INFO	40
ELECTRIC DATA	12	MCA / MOCP	41
CURBS & WEIGHTS DIMENSIONS	13	TYPICAL WIRING DIAGRAMS	44
APPLICATION DATA	19	SEQUENCE OF OPERATION	46
		GUIDE SPECIFICATIONS	47

MODEL NOMENCLATURE

MODEL SERIES	R	A	S	1	8	1	Z	0	A	B	0	A	G	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														
181 = 14 Tons Dedicated Vertical SA/RA (SA = Supply Air, RA = Return Air) 183 = 14 Tons Dedicated Horizontal SA/RA 210 = 15 Tons Dedicated Vertical SA/RA 213 = 15 Tons Dedicated Horizontal SA/RA 240 = 17 Tons Dedicated Vertical SA/RA 243 = 17 Tons Dedicated Horizontal SA/RA 300 = 20 Tons Dedicated Vertical SA/RA 303 = 20 Tons Dedicated Horizontal SA/RA														
Nominal Cooling Capacity														
Z = 400-3-50														
Voltage														
0 = No Heat														
Heating Capacity														
A = Standard Motor C = Medium Static Motor B = High Static Motor														
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														
G = Alum / Alum Cond & Alum / Cu Evap K = E-Coated Alum / Alum Cond Coil, Std Alum / Cu Evap Coil														
Condenser / Evaporator Coil Configuration														
A = Sales Code														

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	
	Thru–the–base electrical connections		X
Coil Options	E–coated outdoor 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
	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	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.

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 (accessory only)

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 (accessory only)

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 (accessory only)

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

Time Guard II Control Circuit (accessory only)

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 (accessory only)

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 and Medium 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.

Thru–the–Base Connections (accessory only)

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

Electric Heaters / Single Point Kit (accessory only)

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.

ACCESSORIES – RAS181–303

FLAT ROOF CURBS		
Model Number	Description	Use With Model Size
CRRFCURB045A00	14" High Roof Curb	181/183 – 210/213
CRRFCURB047A00	14" High Roof Curb	240/243 – 300/303
CRRFCURB046A00	24" High Roof Curb	181/183 – 210/213
CRRFCURB048A00	24" High Roof Curb	240/243 – 300/303
ECONOMIZERS		
Model Number	Description	Use With Model Size
DNECOMZR052A00	Vertical & Horizontal with solid state controller (W7212)	181/183 – 210/213 – 240/243
DNECOMZR053A00	Vertical & Horizontal with solid state controller (W7212)	300/303
ECONOMIZER SENSORS		
Model Number	Description	Use With Model Size
DNTEMPSN002A00	Single (dry bulb) Control	ALL Economizers With W7212 Contoller
DNCBDIOX005A00	CO2 Sensor and aspirator box for use in return airstream.	ALL Economizers With W7212 Contoller
DNENTDIF004A00	Return Air Enthalpy Sensor	ALL Economizers With W7212 Contoller
AXB078ENT	Enthalpy Control	ALL
POWER EXHAUST*		
Model Number	Description	Use With Model Size
CRPWREXH068A00	Vertical and Horizontal, 208/230–3–60	181/183–210/213–240/243–300/303
CRPWREXH069A00	Vertical and Horizontal, 460–3–60	181/183–210/213–240/243–300/303
CRPWREXH070A00	Vertical and Horizontal, 575–3–60	181/183–210/213–240/243–300/303
MANUAL OUTDOOR AIR DAMPERS		
Model Number	Description	Use With Model Size
CRMANDPR009A00	25% Open Manual Fresh Air Damper	181/183 – 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	181/183 – 210/213 – 240/243
CRTWOPOS013A00	Motorized 2 position outdoor air damper	300/303
LOW AMBIENT CONTROLS		
Model Number	Description	Use With Model Size
CRLOWAMB027A00	Motormaster® I –20° Low Ambient Control 208/230–3–60	181/183–210/213–240/243–300/303
CRLOWAMB028A00	Motormaster® I –20° Low Ambient Control 460–3–60, 575–3–60	181/183–210/213–240/243–300/303
CRTRXKIT001A00	Motormaster® I –20° Transformer 575–3–60 ¹	181/183–210/213–240/243–300/303
CONTROL UPGRADE KITS		
Model Number	Description	Use With Model Size
DNTIMEGD001A00	Time Guard II	181 – 303
CRSDTEST001A00	Smoke detector remote Test/Reset/Alarm indicator kit	181 – 303
DNPHASE3001A02	Electronic Phase Monitor – All 208/230/460–3–60 models	181 – 303
DNPHASE3002A01	Electronic Phase Monitor – All 575–3–60 models	181 – 303
CRSTATUS005A00	Fan/filter Status Switch – Indicator light not included	181 – 303
CRSMKSEN002A00	Smoke Detector Control Module	181 – 303
CRSMKKIT002A00	Smoke Detector Control Module (Smoke Detector Sensor with sampling tube & exhaust tube)	181 – 303
DNWINSTR001A00	Winter Start Kit – Contains time delay relay for timed bypass of low pressure switch on startup	181 – 303

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

¹ Must use in conjunction with CRLOWAMB028A00 if used on 575–3–60 models.

ACCESSORIES – RAS181–303 (cont.)

4" FILTER TRACK UPGRADE KIT		
Model Number	Description	Use With Model Size
CRFLTTRK001A00	4" Field Conversion Kit	181 – 303
LOUVERED HAIL GUARDS		
Model Number	Description	Use With Model Size
CRLVHLGD017A00	Louvered Condenser Coil Hail Guard	181/183–210/213
CRLVHLGD018A00	Louvered Condenser Coil Hail Guard	240/243
CRLVHLGD019A00	Louvered Condenser Coil Hail Guard	300/303

Table 2 – AHRI COOLING RATING TABLE

UNIT RAS	NET CAPACITY		EER	IPLV	NOMINAL AIRFLOW	
	kW	Btuh			L/s	CFM
181–183	47.8	163,000	10.95	12.42	2500	5400
210–213	51.5	175,600	10.95	12.42	2900	6114
240–243	58.8	200,717	10.73	12.11	3200	6806
300–303	68.8	234,702	9.96	11.04	3800	8033

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. Tested in accordance with ARI Standard 340/360–07, as appropriate.
2. Ratings are based on:
Cooling Standard: 27°C (80°F) db, 19°C (67°F) wb indoor air temp and 35°C (95°F) db outdoor air temp.
IPLV Standard: 27°C (80°F) db, 19°C (67°F) wb indoor air temp and 27°C (80°F) db outdoor air temp.
3. All RAS units comply with ASHRAE 90.1 Energy Standard for minimum EER and IPLV requirements.



Table 3 – MINIMUM AIRFLOWS ELECTRIC HEAT

MODEL RAS	NOMINAL kW	MINIMUM AIRFLOW	
		L/s	CFM
181 – 183	17.4	2100	4500
	34.7		
	52.7		
210 – 213	17.4	2500	5200
	34.7		
	52.7		
240 – 243	17.4	2800	6000
	34.7		
	52.7		
300 – 303	17.4	3300	7000
	34.7		
	52.7		

Table 4 – SOUND PERFORMANCE TABLE

MODEL RAS	COOLING STAGES	Outdoor Sound (dB)									
		A-Wtg.	ARI 370 Rating	63	125	250	500	1000	2000	4000	8000
181 – 183	2	84.1	84	92.2	83.9	80.4	81.8	78.7	76.5	72.2	65.4
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 ARI 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 standard 270–2008.

Table 5 – PHYSICAL DATA (COOLING) RAS181–303 SI

		RAS181–183	RAS210–213	RAS240–243	RAS300–303
Refrigeration System					
	# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll
	R–410a charge A/B (kg)	4.3/5.4	4.3/5.4	5.3/4.1	5.5/5.6
	Metering device	Acutrol	Acutrol	Acutrol	Acutrol
	High–press. Trip / Reset (kPa)	4344 / 3482	4344 / 3482	4344 / 3482	4344 / 3482
	Low–press. Trip / Reset (kPa)	372 / 807	372 / 807	372 / 807	372 / 807
Evap. Coil					
	Material – Tube / Fin	Cu / Al	Cu / Al	Cu / Al	Cu / Al
	Tube Diameter	10mm	10mm	10mm	10mm
	Rows / Fins Per Meter	4 / 591	4 / 591	4 / 591	4 / 591
	Total face area (m ²)	1.8	1.8	2	2.1
	Condensate drain conn. size	19mm	19mm	19mm	19mm
Evap. fan and motor					
VERTICAL – RAS181/210/240/300					
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	2.9	3.7	6.5	6.5
	r/s range	7 – 10	8 – 10	10 – 12	11 – 13
	motor frame size	56	56	184T	184T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	381 x 381	381 x 381	381 x 381	381 x 381
Medium Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	6.5
	r/s range	10 – 12	11 – 14	12 – 15	13 – 16
	motor frame size	56	184T	184T	184T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	381 x 381	381 x 381	381 x 381	381 x 381
High Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	6.5	6.5	8.7	8.7
	r/s range	13 – 16	14 – 18	15 – 18	16 – 19
	motor frame size	184T	184T	213T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	381 x 381	381 x 381	381 x 381	381 x 381
HORIZONTAL – RAS183/213/243/303					
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	8.7
	r/s range	8 – 10	9 – 12	11 – 13	674–818
	motor frame size	56	184T	184T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279
Medium Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	8.7
	r/s range	8 – 10	9 – 12	11 – 13	16 – 19
	motor frame size	56	184T	184T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279
High Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	2 / Belt
	Max BHP	6.5	6.5	8.7	10.8
	r/s range	11 – 13	12 – 15	13 – 16	14 – 16
	motor frame size	184T	184T	213T	215T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (mm)	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279	457x381 / 381x279

Table 5 (Cont.) – PHYSICAL DATA (COOLING) RAS181–303 SI

	RAS181–183	RAS210–213	RAS240–243	RAS300–303
Cond. Coil (Circuit A)				
Coil type	Micro–channel	Micro–channel	Micro–channel	Micro–channel
Coil Length (mm)	1778	1778	2083	1905
Coil Height (mm)	1118	1118	1118	1321
Number of Passes	2	2	2	2
total face area (m ²)	2	2	2.3	2.5
Cond. Coil (Circuit B)				
Coil type	Micro–channel	Micro–channel	Micro–channel	Micro–channel
Coil Length (mm)	70	70	57	75
Coil Height (mm)	44	44	44	52
Number of Passes	2	2	2	2
total face area (m ²)	2	2	1.6	2.5
Cond. fan / motor				
Qty / Motor drive type	3 / direct	3 / direct	4 / direct	4 / direct
Motor kW / r/s	.186 / 15	.186 / 15	.186 / 15	.186 / 15
Fan diameter (mm)	559	559	559	559
Filters				
RA Filter # / size (mm)	6 / 508 x 635 x 51	6 / 508 x 635 x 51	6 / 508 x 635 x 51	9 / 406 x 635 x 51
OA inlet screen # / size (mm)	4 / 406 x 635 x 51	4 / 406 x 635 x 51	4 / 406 x 635 x 51	4 / 406 x 635 x 51

Table 6 – PHYSICAL DATA

(COOLING)

RAS181–303

English

	RAS181–183	RAS210–213	RAS240–243	RAS300–303	
Refrigeration System					
# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll	
R–410a charge A/B (lbs)	9.5/12.0	9.5/12.0	11.7/9.1	12.1/12.4	
Metering device	Acutrol	Acutrol	Acutrol	Acutrol	
High–press. Trip / Reset (psi)	630 / 505	630 / 505	630 / 505	630 / 505	
Low–press. Trip / Reset (psi)	54 / 117	54 / 117	54 / 117	54 / 117	
Evap. Coil					
Material	Cu / Al	Cu / Al	Cu / Al	Cu / Al	
Tube Diameter	3/8–in	3/8–in	3/8–in	3/8–in	
Rows / FPI	4 / 15	4 / 15	4 / 15	4 / 15	
Total face area (ft ²)	19.56	19.56	22.00	23.11	
Condensate drain conn. size	3/4–in	3/4–in	3/4–in	3/4–in	
Evap. fan and motor					
VERTICAL – RAS181/210/240/300					
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	2.9	3.7	6.5	6.5
	RPM range	440–570	485–627	603–746	638–797
	motor frame size	56	56	184T	184T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15
Medium Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	6.5
	RPM range	570–738	675–844	709–878	753–933
	motor frame size	56	184T	184T	184T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15
High Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	6.5	6.5	8.7	8.7
	RPM range	753–933	846–1061	892–1060	959–1127
	motor frame size	184T	184T	213T	213T
	Fan Qty / Type	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal	2 / Centrifugal
	Fan Diameter (in)	15 x 15	15 x 15	15 x 15	15 x 15
HORIZONTAL – RAS183/213/243/303					
Standard Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	8.7
	RPM range	485–627	542–702	638–797	674–818
	motor frame size	56	184T	184T	213T
	Fan Qty / Type	2 / Centrifugal	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	18 x 15/15 x 11
Medium Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	3.7	6.5	6.5	8.7
	RPM range	485–627	542–702	638–797	674–818
	motor frame size	56	184T	184T	213T
	Fan Qty / Type	2 / Centrifugal	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	18 x 15/15 x 11
High Static	Motor Qty / Drive type	1 / Belt	1 / Belt	1 / Belt	2 / Belt
	Max BHP	6.5	6.5	8.7	10.8
	RPM range	638–797	709–878	793–962	818–961
	motor frame size	184T	184T	213T	215T
	Fan Qty / Type	2 / Centrifugal	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	18 x 15/15 x 11

Table 6 (Cont.) – PHYSICAL DATA (COOLING) RAS181–303

English



		RAS181–183	RAS210–213	RAS240–243	RAS300–303
Cond. Coil (Circuit A)	Coil type	Micro–channel	Micro–channel	Micro–channel	Micro–channel
	Coil Length (in)	70	70	82	75
	Coil Height (in)	44	44	44	52
	Number of Passes	2	2	2	2
	total face area (ft ²)	21.4	21.4	17.4	27.1
Cond. Coil (Circuit B)	Coil type	Micro–channel	Micro–channel	Micro–channel	Micro–channel
	Coil Length (in)	70	70	57	75
	Coil Height (in)	44	44	44	52
	Number of Passes	2	2	2	2
	total face area (ft ²)	21.4	21.4	17.4	27.1
Cond. fan / motor	Qty / Motor drive type	3 / direct	3 / direct	4 / direct	4 / direct
	Motor HP / RPM	1/4 / 900	1/4 / 900	1/4 / 900	1/4 / 900
	Fan diameter (in)	22	22	22	22
Filters	RA Filter # / size (in)	6 / 20 x 25 x 2	6 / 20 x 25 x 2	6 / 20 x 25 x 2	6 / 20 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	4 / 16 x 25 x 1

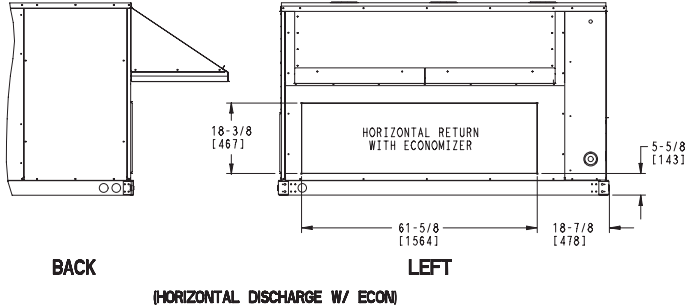
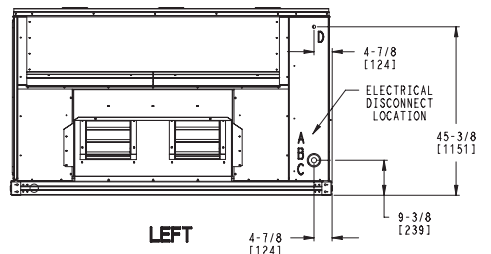
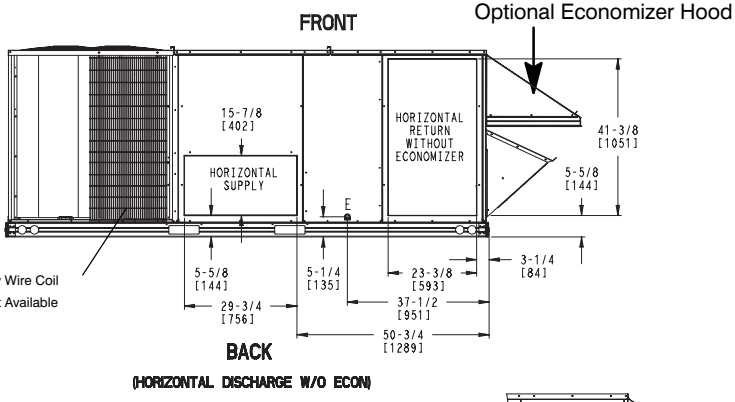
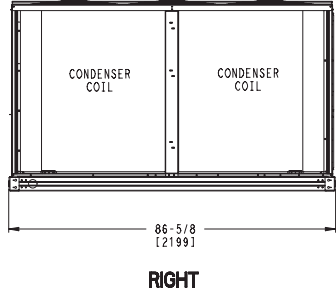
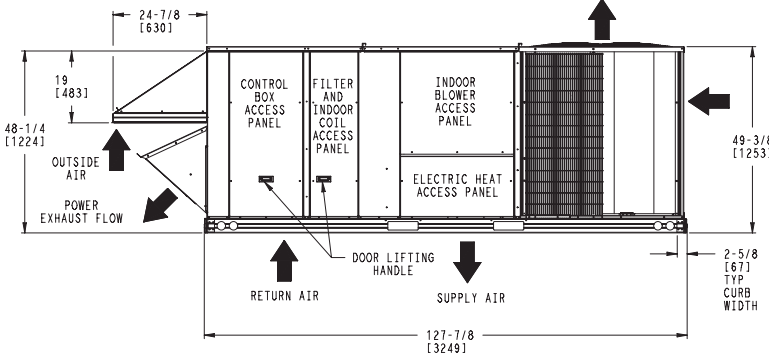
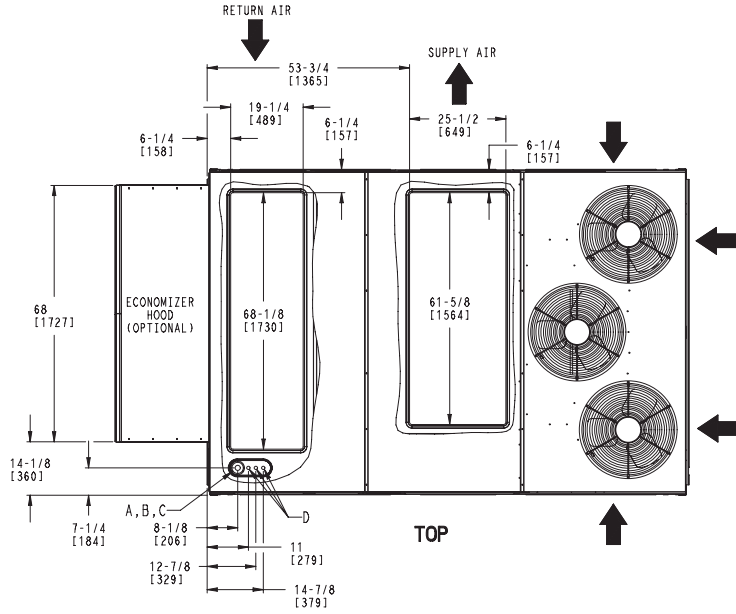
Table 7 – ELECTRIC HEAT – ELECTRICAL DATA RAS181–303

UNIT RAS	NOM. V–PH–HZ	INDOOR AIRFLOW	ELECTRIC HEATER PART NUMBER	NOMINAL (kW)	APPLICATION (kW)	APPLICATION OUTPUT	
						kW	MBH
181–183	400–3–50	VERTICAL	CRHEATER282A00	17.4	16.0	14.7	50.1
			CRHEATER283A00	34.7	31.9	29.2	99.8
			CRHEATER284A00	52.7	48.4	44.4	151.7
		HORIZONTAL	CRHEATER273A00	17.4	16.0	14.7	50.1
			CRHEATER274A00	34.7	31.9	29.2	99.8
			CRHEATER275A00	52.7	48.4	44.4	151.7
210–213	400–3–50	VERTICAL	CRHEATER282A00	17.4	16.0	14.7	50.1
			CRHEATER283A00	34.7	31.9	29.2	99.8
			CRHEATER284A00	52.7	48.4	44.4	151.7
		HORIZONTAL	CRHEATER273A00	17.4	16.0	14.7	50.1
			CRHEATER274A00	34.7	31.9	29.2	99.8
			CRHEATER275A00	52.7	48.4	44.4	151.7
240–243	400–3–50	VERTICAL	CRHEATER282A00	17.4	16.0	14.7	50.1
			CRHEATER283A00	34.7	31.9	29.2	99.8
			CRHEATER284A00	52.7	48.4	44.4	151.7
		HORIZONTAL	CRHEATER273A00	17.4	16.0	14.7	50.1
			CRHEATER274A00	34.7	31.9	29.2	99.8
			CRHEATER275A00	52.7	48.4	44.4	151.7
300–303	400–3–50	VERTICAL	CRHEATER282A00	17.4	16.0	14.7	50.1
			CRHEATER283A00	34.7	31.9	29.2	99.8
			CRHEATER284A00	52.7	48.4	44.4	151.7
		HORIZONTAL	CRHEATER273A00	17.4	16.0	14.7	50.1
			CRHEATER274A00	34.7	31.9	29.2	99.8
			CRHEATER275A00	52.7	48.4	44.4	151.7

BASE UNIT DIMENSIONS – RAS181/183, RAS210/213

NOTES:

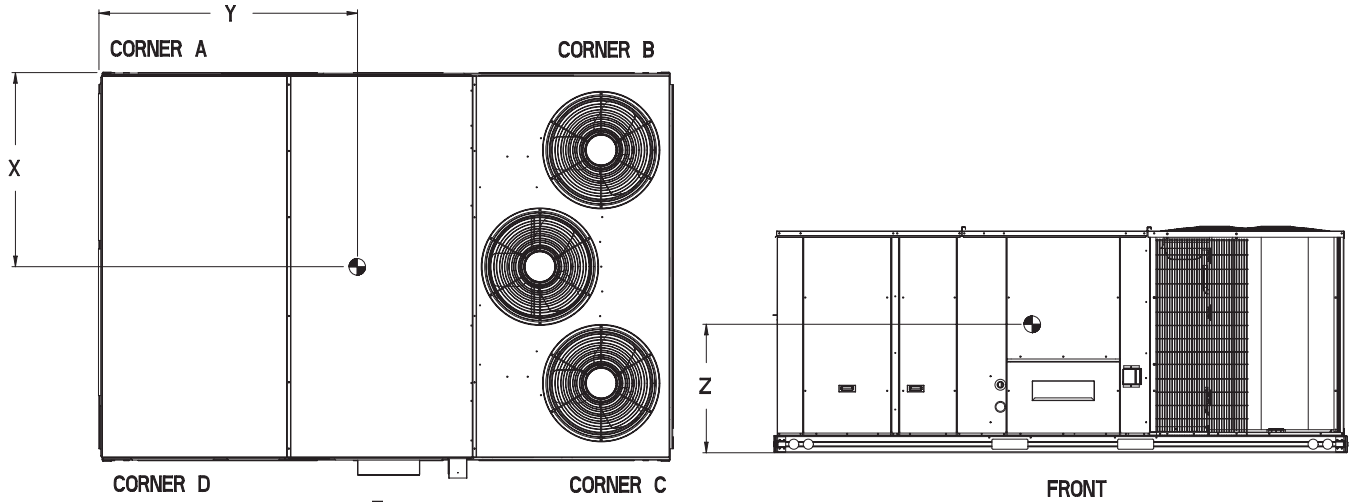
1. DIMENSIONS ARE IN INCHES. DIMENSIONS IN () ARE IN MILLIMETERS.
2.  CENTER OF GRAVITY
3.  DIRECTION OF AIR FLOW



Connection Sizes	
A	1-3/8" [35] DIA Field Power Supply Hole
B	3" [76] Field Power Supply Knockout
C	3-5/8" [92] Field Power Supply Knockout
D	7/8" [22] Field Control Wiring Hole
E	3/4" 14 NPT Condensate Drain

WEIGHT & DIMENSIONS – RAS181/183, 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
181/183	2035	923	483	219	494	224	534	242	522	237	44-3/4 [1137]	64-3/4 [1645]	16-1/2 [419]
210/213	2050	930	487	221	498	239	538	244	526	239	44-3/4 [1137]	64-3/4 [1645]	16-1/2 [419]

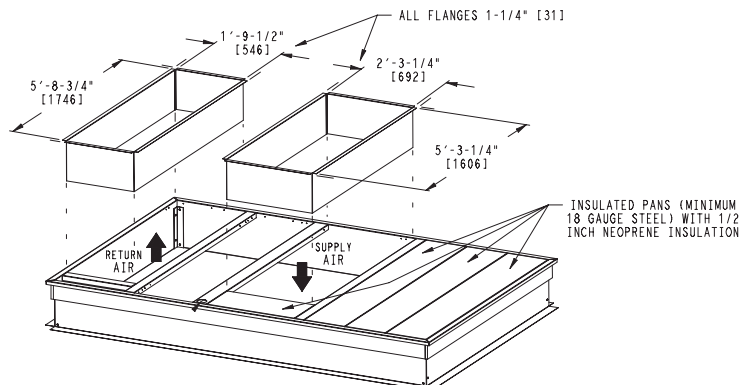
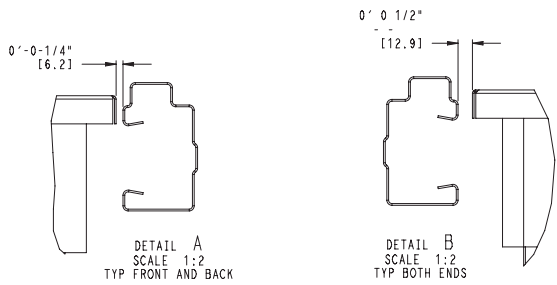
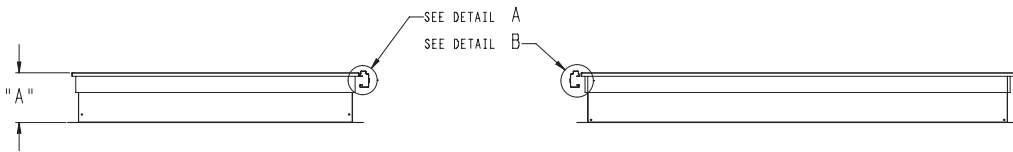
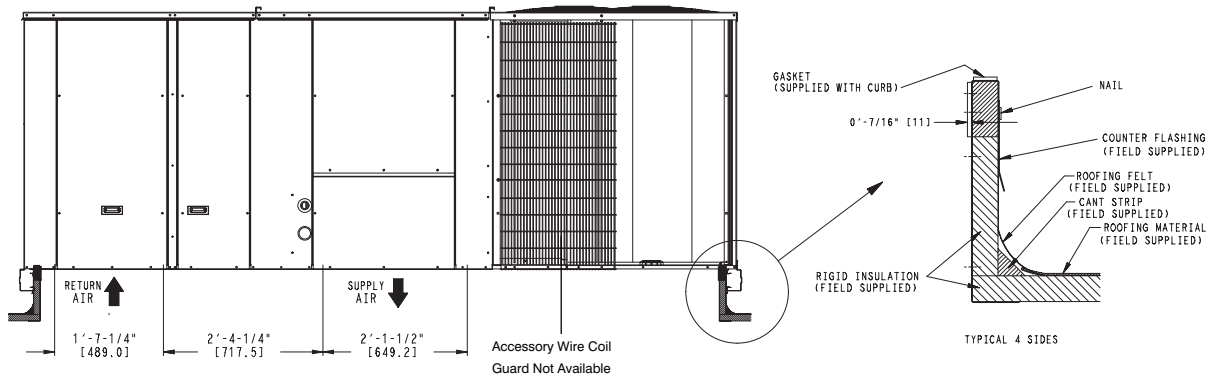
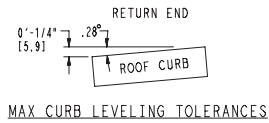
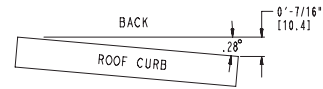
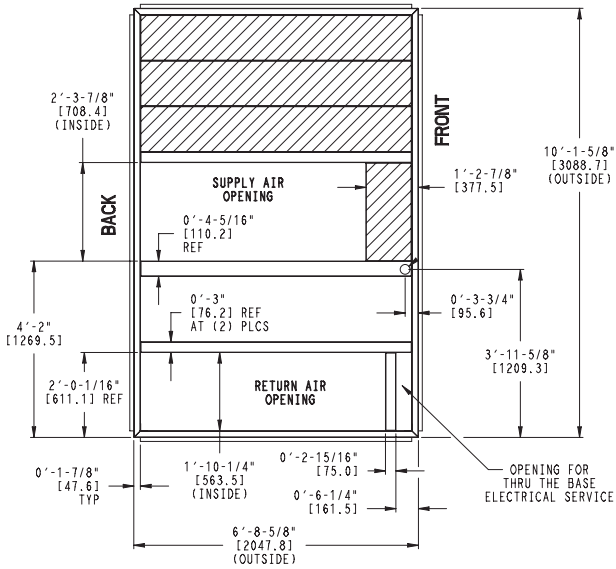


ROOF CURB DETAILS – RAS181/183, RAS210/213

RoofCurb Accessory	A	Unit Size
CRRFCURB045A01	1' 2" [356]	RAS181/183
CRRFCURB046A01	2' 0" [610]	RAS210/213



NOTES:

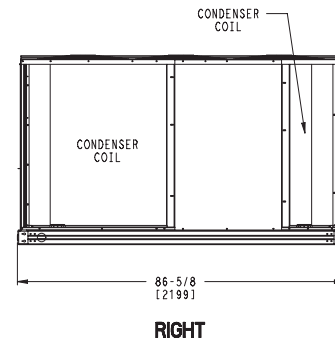
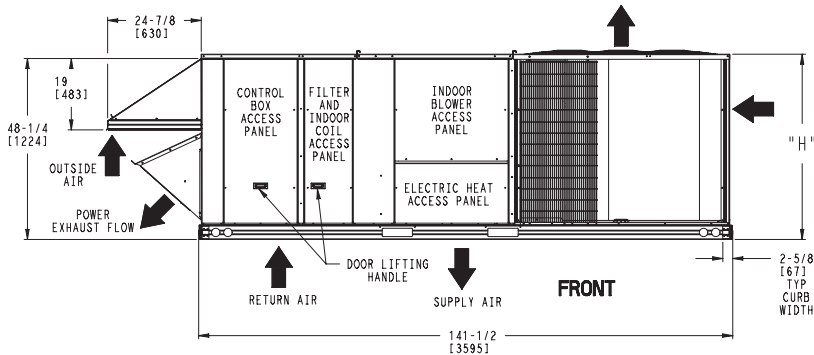
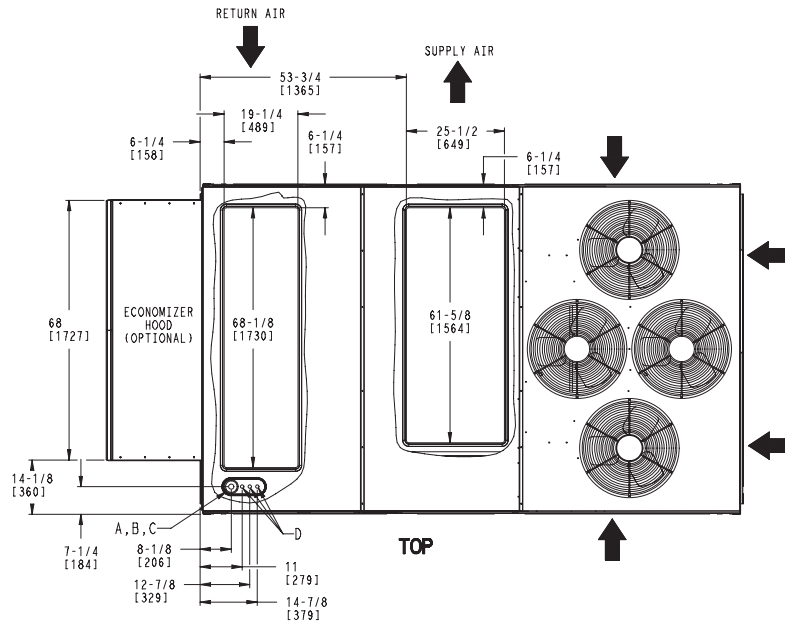
1. Roofcurb accessory is shipped disassembled.
 2. Dimensions in. [] in millimeters.
 3. Roofcurb galvanized steel.
 4. Attach ductwork to curb (Flanges of duct rest on curb)
 5. Service clearance 4' on each side.
- ➡ Direction of airflow.



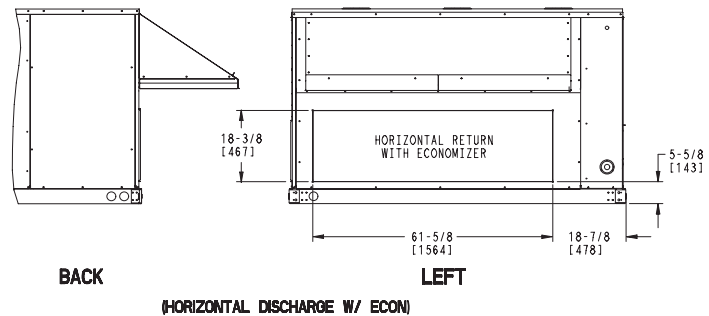
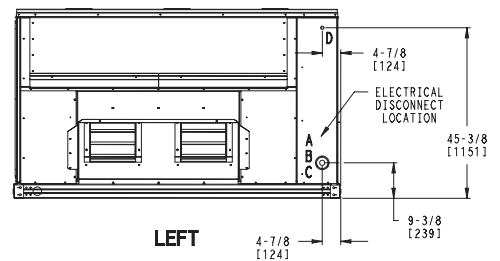
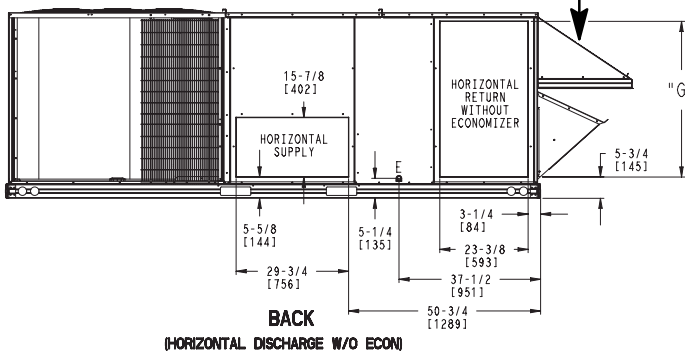
BASE UNIT DIMENSIONS – RAS240/243 – RAS300/303

NOTES:

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



Optional Economizer Hood



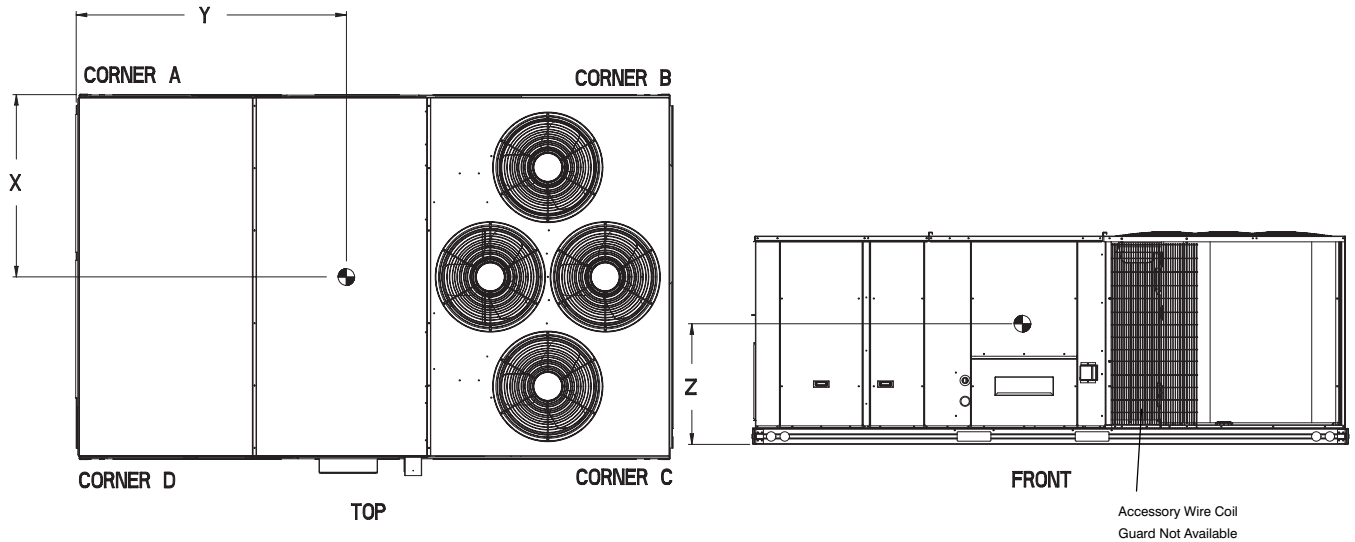
Connection Sizes

A	1-3/8" [35] DIA Field Power Supply Hole
B	3" [76] Field Power Supply Knockout
C	3-5/8" [92] Field Power Supply Knockout
D	7/8" [22] Field Control Wiring Hole
E	3/4" 14 NPT Condensate Drain

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

WEIGHT & CLEARANCE DIMENSIONS – RAS240/243, RAS300/303 (cont.)

UNIT RAS	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
210/243	1683	763	324	147	457	207	527	239	374	170	46-1/8 [1172]	82-7/8 [2105]	16-1/2 [419]
300/303	1810	821	349	158	491	223	566	257	402	182	46-1/8 [1172]	82-7/8 [2105]	19 [483]

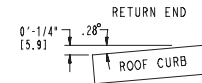
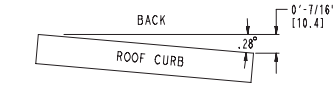
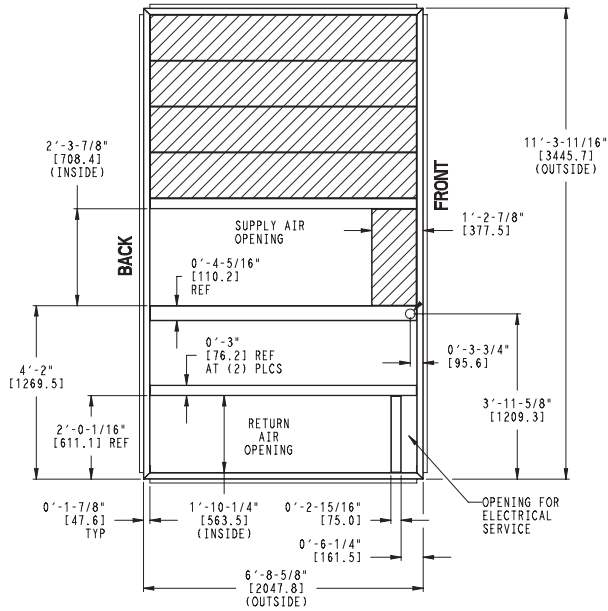


ROOF CURB DETAILS – RAS240/243, RAS300/303

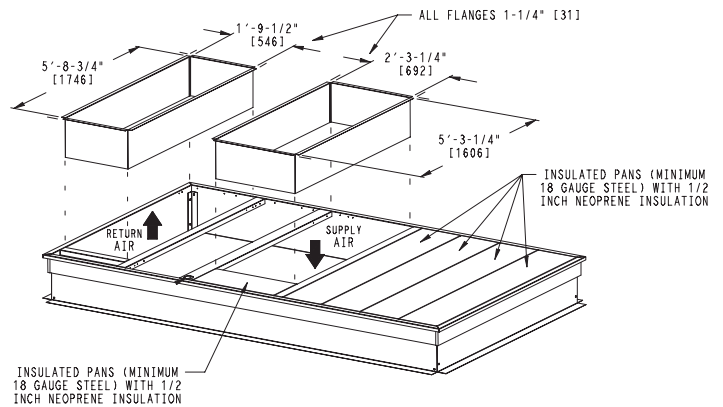
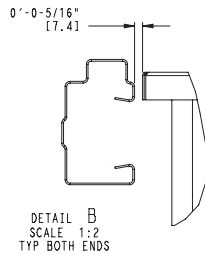
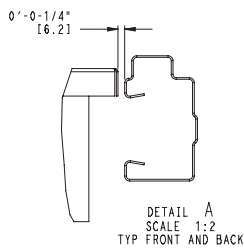
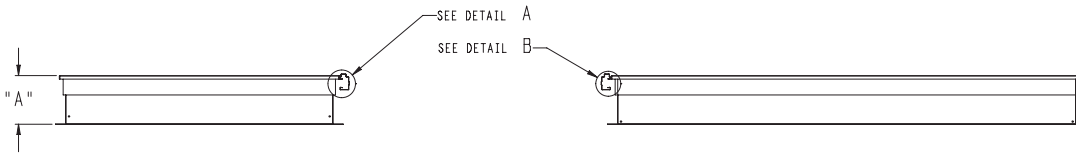
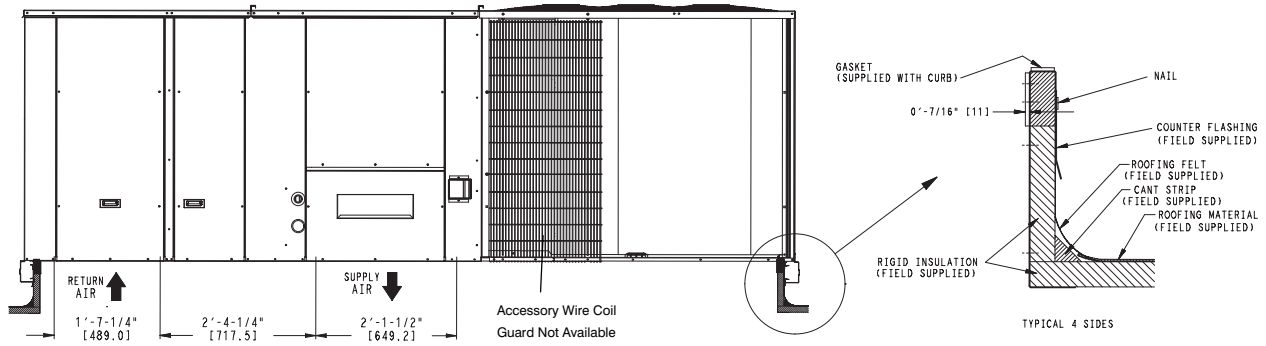
RoofCurb Accessory	A	Unit Size
CRRFCURB047A01	1' 2" [356]	RAS240/243
CRRFCURB048A01	2' 0" [610]	RAS300/303

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.



MAX CURB LEVELING TOLERANCES



APPLICATION DATA

Min operating ambient temp (cooling):

In mechanical cooling mode, your rooftop unit can safely operate down to an outdoor ambient temperature of 4°C (40°F). 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 52°C (125°F). While cooling operation above 52°C (125°F) 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.

Bigger isn't necessarily better. While an air conditioner needs to have enough capacity to meet the load, it doesn't need excess capacity. In fact, having 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 -29°C (-20°F) using the recommended accessory Motormaster low ambient controller.

Winter start

A winter start kit extends the low ambient limit of your rooftop to -4°C (25°F). 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 – GROSS COOLING CAPACITIES

14 TONS (2 Stage Cooling)

SI

RAS181/183				AMBIENT TEMPERATURE °C																	
				29			35			41			46						52		
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)						EAT (dB)		
				24	27	29	24	27	29	24	27	29	24	27	29				24	27	29
2124 L/s	EAT (wB)	14	THC	38.6	38.7	39.8	35.9	35.9	37.7	32.8	33.1	35.4	29.5	30.7	32.9	25.6	27.9	30.2			
			SHC	35.9	38.7	39.8	34.4	35.9	37.7	32.2	33.1	35.4	29.5	30.7	32.9	25.6	27.9	30.2			
		17	THC	42.1	42.1	42.2	39.4	39.4	39.4	36.2	36.3	36.3	32.8	32.8	33.0	28.0	29.2	31.6			
			SHC	31.5	37.3	41.7	30.2	36.1	39.4	28.9	34.6	36.3	27.5	32.2	33.0	24.9	29.2	31.6			
		19	THC	46.6	46.5	46.4	44.0	43.9	43.9	41.1	41.0	41.0	37.6	37.4	37.5	33.7	33.5	33.6			
			SHC	25.5	31.4	37.3	24.4	30.4	36.3	23.2	29.2	35.1	21.9	27.8	33.7	20.4	26.3	32.0			
		22	THC	51.5	51.4	51.3	49.0	48.9	48.8	45.9	45.8	45.8	42.7	42.6	42.5	38.9	38.7	38.6			
			SHC	19.3	25.3	31.2	18.4	24.4	30.4	17.3	23.3	29.3	16.1	22.2	28.2	14.8	20.8	26.8			
		24	THC	—	55.0	55.1	—	52.8	52.8	—	50.0	49.9	—	46.7	46.6	—	42.9	42.7			
			SHC	—	20.1	26.0	—	19.4	25.4	—	18.4	24.5	—	17.3	23.4	—	16.1	22.2			
2478 L/s	EAT (wB)	14	THC	40.6	40.7	42.6	37.8	38.1	40.4	34.5	35.7	38.1	30.9	32.9	35.5	27.5	30.0	32.7			
			SHC	39.4	40.7	42.6	37.2	38.1	40.4	34.5	35.7	38.1	30.9	32.9	35.5	27.5	30.0	32.7			
		17	THC	44.0	44.0	44.2	41.3	41.3	41.3	38.0	38.1	38.4	34.4	34.6	35.5	28.7	30.6	33.1			
			SHC	34.5	41.1	44.2	33.3	39.8	41.3	31.9	37.4	38.4	30.4	34.6	35.5	26.9	30.6	33.1			
		19	THC	48.9	48.8	48.8	46.0	46.0	45.9	42.9	42.8	42.9	39.3	39.2	39.3	35.5	35.2	35.7			
			SHC	27.7	34.6	41.5	26.6	33.5	40.4	25.3	32.3	39.0	23.9	30.9	37.4	22.5	29.4	35.3			
		22	THC	53.9	53.7	53.6	51.2	51.1	51.0	48.1	48.1	48.0	44.5	44.4	44.3	40.7	40.5	40.3			
			SHC	20.5	27.4	34.2	19.5	26.5	33.4	18.4	25.5	32.5	17.1	24.2	31.2	15.8	22.8	29.8			
		24	THC	—	57.0	57.4	—	55.1	55.0	—	52.1	52.0	—	48.7	48.6	—	44.4	44.2			
			SHC	—	21.3	28.1	—	20.7	27.6	—	19.7	26.7	—	18.6	25.7	—	17.2	24.3			
2832 L/s	EAT (wB)	14	THC	42.3	42.5	45.1	39.2	40.4	42.8	35.7	37.8	40.4	32.4	35.0	37.7	29.3	32.0	34.9			
			SHC	41.9	42.5	45.1	39.2	40.4	42.8	35.7	37.8	40.4	32.4	35.0	37.7	29.3	32.0	34.9			
		17	THC	45.5	45.7	45.8	42.9	43.0	43.0	39.4	39.6	40.6	35.7	35.7	37.8	29.5	31.9	34.9			
			SHC	37.4	44.3	45.8	36.3	42.3	43.0	34.8	39.6	40.6	33.2	35.7	37.8	28.6	31.9	34.9			
		19	THC	50.5	50.5	50.4	47.6	47.5	47.6	44.3	44.2	44.3	40.7	40.6	40.8	36.5	36.4	37.9			
			SHC	29.5	37.4	45.1	28.4	36.4	44.0	27.2	35.1	42.4	25.8	33.7	40.0	24.3	32.2	37.9			
		22	THC	55.5	55.6	55.4	52.8	52.7	52.6	49.7	49.6	49.4	45.9	45.7	45.6	41.9	41.6	41.5			
			SHC	21.5	29.2	36.9	20.5	28.3	36.2	19.4	27.3	35.3	18.0	26.0	34.0	16.6	24.6	32.6			
		24	THC	—	58.8	59.1	—	56.8	56.7	—	53.5	53.5	—	50.1	50.0	—	45.7	45.5			
			SHC	—	22.5	29.9	—	21.8	29.5	—	20.7	28.6	—	19.6	27.7	—	18.2	26.2			
3186 L/s	EAT (wB)	14	THC	43.5	44.7	47.4	40.5	42.3	45.0	37.2	39.8	42.4	33.9	36.8	39.7	30.7	33.8	36.7			
			SHC	43.5	44.7	47.4	40.5	42.3	45.0	37.2	39.8	42.4	33.9	36.8	39.7	30.7	33.8	36.7			
		17	THC	47.0	47.5	47.6	44.1	44.2	45.0	40.8	40.8	49.6	36.7	37.2	39.7	30.8	33.7	36.8			
			SHC	40.3	46.8	47.6	39.0	44.2	45.0	37.5	40.8	49.6	35.5	37.2	39.7	30.8	33.7	36.8			
		19	THC	52.0	51.8	51.9	49.0	48.9	49.0	45.5	45.5	45.6	41.8	41.8	41.8	37.5	37.6	40.0			
			SHC	31.4	40.1	48.5	30.3	39.2	47.4	29.0	37.9	44.9	27.6	36.5	41.8	26.1	34.8	40.0			
		22	THC	57.0	56.9	57.0	54.1	54.0	53.9	51.0	50.8	50.7	47.1	46.9	46.8	42.4	42.1	41.9			
			SHC	22.4	30.9	39.5	21.3	30.0	38.8	20.2	29.1	38.0	18.9	27.8	36.8	17.2	26.1	34.8			
		24	THC	—	60.2	60.4	—	58.1	58.1	—	54.8	54.7	—	51.2	51.1	—	47.2	46.9			
			SHC	—	23.4	31.6	—	22.8	31.3	—	21.7	30.5	—	20.6	29.6	—	19.4	28.4			
3540 L/s	EAT (wB)	14	THC	44.7	46.7	49.5	41.8	44.1	47.1	38.6	41.5	44.3	35.6	38.6	41.4	32.0	35.2	38.4			
			SHC	44.7	46.7	49.5	41.8	44.1	47.1	38.6	41.5	44.3	35.6	38.6	41.4	32.0	35.2	38.4			
		17	THC	48.3	48.6	49.5	45.2	45.3	47.1	41.8	41.9	44.3	37.8	38.6	41.4	32.1	35.1	38.3			
			SHC	43.0	48.6	49.5	41.7	45.3	47.1	40.0	41.9	44.3	37.3	38.6	41.4	32.1	35.1	38.3			
		19	THC	53.2	53.1	53.1	50.3	50.1	50.5	46.6	46.6	46.8	42.8	42.9	42.8	38.2	38.4	41.5			
			SHC	33.2	42.7	51.6	32.2	42.0	49.7	30.8	40.6	46.8	29.4	39.1	42.8	27.7	37.1	41.5			
		22	THC	58.2	58.2	58.2	55.4	55.2	55.0	52.0	51.9	51.7	48.2	48.0	47.8	43.3	43.0	42.9			
			SHC	23.2	32.5	42.0	22.2	31.8	41.4	21.1	30.9	40.6	19.7	29.6	39.5	18.0	27.8	37.5			
		24	THC	—	61.6	61.6	—	59.3	59.3	—	56.0	55.8	—	52.2	52.1	—	48.0	47.7			
			SHC	—	24.5	33.3	—	23.8	33.1	—	22.8	32.3	—	21.6	31.4	—	20.3	30.2			

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)
- L/s — Liters per second
- SHC — Sensible heat capacity — kW
- THC — Total heat capacity — kW

Table 9 – GROSS COOLING CAPACITIES

14 TONS (2 Stage Cooling)

ENGLISH

RAS181/183				AMBIENT TEMPERATURE °F															
				85			95			105			115			125			
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85	
4500 Cfm	EAT (wB)	58	THC	131.8	132.0	135.7	122.5	122.6	128.8	111.8	113.0	120.7	100.6	104.7	112.1	87.3	95.2	103.0	
			SHC	122.5	132.0	135.7	117.6	122.6	128.8	110.0	113.0	120.7	100.6	104.7	112.1	87.3	95.2	103.0	
		62	THC	143.6	143.7	144.1	134.3	134.4	134.5	123.5	124.0	123.9	112.0	112.0	112.8	95.5	99.6	107.7	
			SHC	107.3	127.4	142.3	103.2	123.1	134.5	98.5	118.0	123.9	93.7	110.0	112.8	84.9	99.6	107.7	
		67	THC	159.0	158.8	158.4	150.0	149.9	149.8	140.2	140.0	139.8	128.2	127.7	128.0	115.2	114.3	114.8	
			SHC	87.0	107.2	127.3	83.3	103.7	124.0	79.3	99.8	119.9	74.7	94.9	115.1	69.7	89.9	109.2	
	72	THC	175.8	175.4	175.0	167.2	166.7	166.5	156.6	156.5	156.2	145.6	145.3	145.0	132.8	132.2	131.7		
		SHC	65.8	86.3	106.4	62.7	83.3	103.7	58.9	79.5	100.0	55.0	75.6	96.2	50.4	70.9	91.4		
	76	THC	—	187.6	187.9	—	180.3	180.1	—	170.7	170.4	—	159.2	158.9	—	146.3	145.7		
		SHC	—	68.5	88.9	—	66.1	86.5	—	62.9	83.5	—	59.2	79.9	—	55.0	75.7		
	5250 Cfm	EAT (wB)	58	THC	138.6	138.7	145.3	128.9	130.2	137.9	117.8	121.7	129.9	105.4	112.3	121.1	93.8	102.3	111.6
				SHC	134.5	138.7	145.3	127.1	130.2	137.9	117.8	121.7	129.9	105.4	112.3	121.1	93.8	102.3	111.6
62			THC	150.0	150.2	150.9	140.9	141.0	141.0	129.7	129.9	130.9	117.4	117.9	121.0	97.9	104.5	112.8	
			SHC	117.7	140.4	150.9	113.8	136.0	141.0	109.0	127.7	130.9	103.9	117.9	121.0	91.8	104.5	112.8	
67			THC	166.9	166.5	166.4	157.2	156.9	156.8	146.6	146.0	146.3	134.2	133.8	134.0	121.0	120.0	121.9	
			SHC	94.5	118.0	141.6	90.6	114.4	137.8	86.4	110.1	133.2	81.6	105.4	127.6	76.8	100.3	120.4	
72		THC	183.8	183.2	182.9	174.6	174.3	173.9	164.3	164.0	163.7	151.9	151.5	151.1	139.0	138.1	137.5		
		SHC	70.0	93.3	116.6	66.6	90.4	114.1	62.9	87.0	110.9	58.5	82.6	106.6	54.0	77.9	101.8		
76		THC	—	194.5	195.9	—	188.1	187.8	—	177.8	177.5	—	166.3	165.9	—	151.6	151.0		
		SHC	—	72.8	96.1	—	70.7	94.1	—	67.3	91.1	—	63.6	87.7	—	58.8	82.9		
6000 Cfm		EAT (wB)	58	THC	144.3	145.0	153.8	133.9	137.8	145.9	122.0	129.0	137.7	110.5	119.3	128.6	100.0	109.3	119.0
				SHC	142.9	145.0	153.8	133.9	137.8	145.9	122.0	129.0	137.7	110.5	119.3	128.6	100.0	109.3	119.0
	62		THC	155.3	156.0	156.4	146.3	146.6	146.8	134.5	135.1	138.5	121.8	121.7	129.0	100.6	109.0	119.1	
			SHC	127.6	151.2	156.4	123.9	144.3	146.8	118.8	135.1	138.5	113.2	121.7	129.0	97.8	109.0	119.1	
	67		THC	172.5	172.2	172.1	162.3	162.2	162.3	151.3	151.0	151.2	139.1	138.6	139.2	124.7	124.3	129.2	
			SHC	100.9	127.6	153.9	97.1	124.2	150.2	92.8	119.9	144.6	88.1	115.2	136.5	82.9	109.8	129.2	
	72	THC	189.5	189.6	189.2	180.1	179.8	179.4	169.6	169.2	168.7	156.5	156.0	155.7	143.0	142.1	141.5		
		SHC	73.2	99.7	126.0	69.8	96.6	123.5	66.1	93.3	120.5	61.4	88.8	116.2	56.7	84.1	111.2		
	76	THC	—	200.8	201.7	—	193.7	193.4	—	182.7	182.6	—	170.9	170.6	—	155.9	155.2		
		SHC	—	76.7	102.1	—	74.4	100.6	—	70.7	97.7	—	67.0	94.4	—	62.2	89.5		
	6750 Cfm	EAT (wB)	58	THC	148.5	152.5	161.8	138.2	144.4	153.6	127.1	135.9	144.7	115.8	125.7	135.5	104.9	115.2	125.3
				SHC	148.5	152.5	161.8	138.2	144.4	153.6	127.1	135.9	144.7	115.8	125.7	135.5	104.9	115.2	125.3
62			THC	160.3	162.1	162.5	150.4	150.7	153.7	139.1	139.4	169.2	125.3	126.8	135.6	105.2	115.2	125.7	
			SHC	137.4	159.8	162.5	133.2	150.7	153.7	128.1	139.4	169.2	121.1	126.8	135.6	105.2	115.2	125.7	
67			THC	177.4	176.9	177.1	167.2	166.8	167.3	155.4	155.1	155.8	142.7	142.6	142.7	128.0	128.3	136.4	
			SHC	107.1	136.8	165.4	103.5	133.8	161.8	99.1	129.4	153.1	94.3	124.6	142.7	89.0	118.7	136.4	
72		THC	194.5	194.4	194.5	184.7	184.2	183.9	174.0	173.4	173.0	160.7	160.2	159.9	144.7	143.7	143.1		
		SHC	76.4	105.4	134.9	72.8	102.5	132.5	69.0	99.3	129.8	64.3	95.0	125.7	58.7	89.0	118.9		
76		THC	—	205.5	206.0	—	198.4	198.3	—	187.1	186.7	—	174.8	174.4	—	160.9	160.1		
		SHC	—	80.0	107.8	—	77.8	106.9	—	74.2	104.0	—	70.3	100.9	—	66.1	96.9		
7500 Cfm		EAT (wB)	58	THC	152.5	159.3	168.9	142.6	150.6	160.7	131.8	141.7	151.2	121.4	131.8	141.2	109.2	120.3	131.1
				SHC	152.5	159.3	168.9	142.6	150.6	160.7	131.8	141.7	151.2	121.4	131.8	141.2	109.2	120.3	131.1
	62		THC	164.7	166.0	168.9	154.3	154.6	160.7	142.7	143.2	151.3	129.0	131.9	141.4	109.7	119.9	130.8	
			SHC	146.8	166.0	168.9	142.2	154.6	160.7	136.4	143.2	151.3	127.2	131.9	141.4	109.7	119.9	130.8	
	67		THC	181.7	181.1	181.1	171.5	171.1	172.3	159.1	158.9	159.7	146.0	146.4	145.9	130.4	131.1	141.6	
			SHC	113.2	145.9	176.2	109.9	143.2	169.8	105.2	138.6	159.7	100.4	133.6	145.9	94.6	126.6	141.6	
	72	THC	198.6	198.6	198.7	188.9	188.5	187.9	177.6	177.2	176.6	164.4	163.8	163.3	147.9	146.9	146.3		
		SHC	79.3	110.9	143.2	75.9	108.4	141.2	71.9	105.3	138.7	67.3	101.2	134.9	61.5	95.0	127.9		
	76	THC	—	210.1	210.4	—	202.5	202.4	—	191.1	190.3	—	178.2	177.9	—	163.7	162.9		
		SHC	—	83.5	113.6	—	81.2	113.0	—	77.7	110.2	—	73.7	107.3	—	69.3	103.1		

LEGEND:

- Do not operate
Cfm — Cubic feet per minute (supply air)
EAT(db) — Entering air temperature (dry bulb)
EAT(wb) — Entering air temperature (wet bulb)
L/s — Liters per second
SHC — Sensible heat capacity — MBH
THC — Total heat capacity — MBH

Table 10 – GROSS COOLING CAPACITIES

15 TONS (2 Stage Cooling)

SI

RAS210/213				AMBIENT TEMPERATURE °C														
				29			35			41			46			52		
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)		
				24	27	29	24	27	29	24	27	29	24	27	29	24	27	29
2124 L/s	EAT (wb)	14	THC	43.6	45.1	47.8	40.5	42.6	45.4	37.2	39.9	42.8	34.2	37.0	39.8	31.0	33.8	36.6
			SHC	40.6	45.1	47.8	38.9	42.6	45.4	36.6	39.9	42.8	34.2	37.0	39.8	31.0	33.8	36.6
		17	THC	47.5	47.4	47.9	44.3	44.3	45.5	40.7	40.8	42.8	36.8	37.1	39.9	32.6	34.0	36.7
			SHC	35.5	42.0	47.4	34.1	40.5	45.5	32.5	38.8	42.8	30.8	36.5	39.9	29.0	34.0	36.7
		19	THC	52.2	52.0	51.9	49.4	49.2	49.1	46.1	45.9	45.8	42.1	41.9	41.9	37.7	37.4	37.6
			SHC	28.6	35.1	41.7	27.4	34.0	40.6	26.1	32.7	39.3	24.5	31.1	37.7	22.8	29.5	35.8
		22	THC	57.2	57.1	56.9	54.4	54.2	54.0	51.1	51.0	50.8	47.5	47.3	47.2	43.3	43.1	42.9
			SHC	21.4	28.1	34.6	20.4	27.1	33.6	19.2	25.9	32.6	17.9	24.6	31.3	16.4	23.1	29.8
		24	THC	—	61.0	61.0	—	58.3	58.2	—	55.1	55.0	—	51.4	51.3	—	47.4	47.2
			SHC	—	22.3	28.8	—	21.4	28.0	—	20.3	26.9	—	19.1	25.8	—	17.8	24.5
2478 L/s	EAT (wb)	14	THC	45.5	47.9	50.5	42.5	45.4	48.2	39.5	42.5	45.5	36.2	39.3	42.5	32.9	35.9	39.1
			SHC	44.1	47.9	50.5	41.9	45.4	48.2	39.5	42.5	45.5	36.2	39.3	42.5	32.9	35.9	39.1
		17	THC	49.0	49.0	50.6	45.9	46.0	48.3	42.2	42.7	45.6	38.1	39.5	42.5	33.9	36.2	39.0
			SHC	38.4	45.8	50.6	37.1	44.4	48.3	35.5	41.9	45.6	33.7	39.5	42.5	31.8	36.2	39.0
		19	THC	53.8	53.7	53.5	50.9	50.7	50.6	47.6	47.3	47.3	43.5	43.3	43.4	39.0	38.7	39.3
			SHC	30.5	38.0	45.5	29.4	37.0	44.5	28.1	35.7	43.1	26.5	34.1	41.3	24.8	32.3	38.8
		22	THC	58.9	58.8	58.6	56.0	55.8	55.6	52.6	52.5	52.3	48.9	48.7	48.5	44.7	44.4	44.2
			SHC	22.4	29.9	37.4	21.4	29.0	36.5	20.2	27.8	35.4	18.8	26.5	34.2	17.4	25.1	32.7
		24	THC	—	62.4	62.6	—	59.9	59.8	—	56.6	56.5	—	52.8	52.6	—	48.6	48.4
			SHC	—	23.4	30.7	—	22.5	30.0	—	21.4	29.0	—	20.2	27.8	—	18.8	26.5
2832 L/s	EAT (wb)	14	THC	47.2	50.0	52.8	44.4	47.6	50.4	41.3	44.6	47.7	38.1	41.3	44.6	34.6	37.8	41.2
			SHC	46.7	50.0	52.8	44.4	47.6	50.4	41.3	44.6	47.7	38.1	41.3	44.6	34.6	37.8	41.2
		17	THC	50.1	50.4	52.8	47.1	47.7	50.5	43.2	44.7	47.8	39.1	41.3	44.8	34.8	37.7	41.2
			SHC	41.1	48.8	52.8	39.9	47.0	50.5	38.2	44.7	47.8	36.3	41.3	44.8	33.8	37.7	41.2
		19	THC	55.1	54.9	54.8	51.9	51.8	51.8	48.6	48.3	48.5	44.5	44.3	45.0	39.7	39.6	41.2
			SHC	32.2	40.7	49.0	31.1	39.7	47.9	29.8	38.4	46.4	28.2	36.8	44.1	26.4	35.0	41.2
		22	THC	60.1	60.0	59.8	57.2	57.0	56.8	53.7	53.5	53.3	49.9	49.6	49.4	45.5	45.2	45.0
			SHC	23.2	31.5	39.8	22.2	30.6	39.1	20.9	29.5	38.1	19.6	28.2	36.8	18.1	26.8	35.4
		24	THC	—	63.5	63.6	—	61.0	60.9	—	57.6	57.5	—	53.8	53.6	—	49.5	49.2
			SHC	—	24.3	32.2	—	23.4	31.7	—	22.3	30.8	—	21.1	29.7	—	19.7	28.4
3186 L/s	EAT (wb)	14	THC	48.9	51.8	54.7	46.2	49.3	52.3	43.1	46.5	49.6	39.6	43.1	46.5	35.9	39.4	42.9
			SHC	48.9	51.8	54.7	46.2	49.3	52.3	43.1	46.5	49.6	39.6	43.1	46.5	35.9	39.4	42.9
		17	THC	51.1	52.0	54.7	48.0	49.4	52.3	44.3	46.6	49.6	40.0	43.2	46.5	36.0	39.4	43.0
			SHC	43.8	51.2	54.7	42.5	49.4	52.3	40.8	46.6	49.6	38.6	43.2	46.5	36.0	39.4	43.0
		19	THC	56.1	55.9	55.9	52.9	52.7	52.9	49.4	49.2	49.8	45.3	45.2	46.5	40.4	40.5	43.1
			SHC	33.8	43.2	52.2	32.7	42.2	51.2	31.5	41.0	48.9	29.9	39.4	46.5	28.1	37.5	43.1
		22	THC	61.1	61.0	60.8	58.1	57.9	57.7	54.6	54.4	54.1	50.6	50.4	50.1	46.2	45.9	45.7
			SHC	24.0	33.0	42.2	22.9	32.2	41.6	21.7	31.1	40.6	20.3	29.9	39.4	18.7	28.4	38.0
		24	THC	—	64.5	64.5	—	61.9	61.8	—	58.5	58.4	—	54.6	54.4	—	50.1	49.9
			SHC	—	25.1	33.7	—	24.3	33.4	—	23.2	32.5	—	22.0	31.4	—	20.6	30.2
3540 L/s	EAT (wb)	14	THC	50.4	53.4	56.4	47.8	50.9	54.0	44.6	48.0	51.2	41.1	44.7	48.0	37.0	40.8	44.5
			SHC	50.4	53.4	56.4	47.8	50.9	54.0	44.6	48.0	51.2	41.1	44.7	48.0	37.0	40.8	44.5
		17	THC	52.0	53.5	56.5	48.9	50.9	54.0	45.2	48.1	51.2	41.1	44.7	48.0	37.3	40.7	44.4
			SHC	46.3	53.5	56.5	45.0	50.9	54.0	43.2	48.1	51.2	40.5	44.7	48.0	37.3	40.7	44.4
		19	THC	57.0	56.8	57.0	53.7	53.5	54.2	50.1	50.0	51.2	46.0	46.0	48.1	41.0	41.2	44.5
			SHC	35.5	45.7	55.4	34.4	44.8	53.4	33.2	43.6	51.2	31.6	42.0	48.1	29.7	39.8	44.5
		22	THC	62.0	61.9	61.7	59.0	58.8	58.6	55.4	55.2	54.9	51.3	51.0	50.8	46.8	46.5	46.3
			SHC	24.8	34.5	44.5	23.7	33.8	44.0	22.4	32.8	43.1	21.0	31.5	42.0	19.4	30.1	40.5
		24	THC	—	65.5	65.4	—	62.8	62.7	—	59.3	59.2	—	55.3	55.1	—	50.8	50.5
			SHC	—	26.0	35.3	—	25.2	35.0	—	24.1	34.2	—	22.9	33.2	—	21.5	32.0

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)
- L/s — Liters per second
- SHC — Sensible heat capacity – kW
- THC — Total heat capacity – kW

Table 11 – GROSS COOLING CAPACITIES

15 TONS (2 Stage Cooling)

ENGLISH

RAS210/213				AMBIENT TEMPERATURE °F																
				85			95			105			115			125				
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)				
				75	80	85	75	80	85	75	80	85	75	80	85	75	80	85		
4500 Cfm	EAT (wb)	58	THC	148.9	154.0	163.1	138.1	145.5	155.1	127.0	136.3	146.0	116.8	126.4	135.7	105.8	115.4	124.8		
			SHC	138.4	154.0	163.1	132.6	145.5	155.1	125.0	136.3	146.0	116.8	126.4	135.7	105.8	115.4	124.8		
		62	THC	162.0	161.8	163.6	151.3	151.1	155.3	138.9	139.3	146.2	125.6	126.8	136.0	111.2	116.0	125.4		
			SHC	121.1	143.4	161.7	116.2	138.4	155.3	110.8	132.5	146.2	105.1	124.6	136.0	98.9	116.0	125.4		
		67	THC	178.1	177.6	177.1	168.5	168.0	167.5	157.3	156.7	156.2	143.8	142.9	142.9	128.7	127.7	128.3		
			SHC	97.5	120.0	142.4	93.6	116.2	138.6	89.0	111.6	134.0	83.7	106.3	128.5	78.0	100.5	122.1		
		72	THC	195.3	194.8	194.3	185.6	184.9	184.3	174.4	174.1	173.5	162.2	161.6	161.0	147.8	147.1	146.5		
			SHC	73.1	95.9	118.1	69.6	92.4	114.8	65.6	88.5	111.1	61.2	84.1	106.8	56.1	78.9	101.7		
		76	THC	–	208.2	208.0	–	199.0	198.6	–	188.1	187.5	–	175.6	175.0	–	161.6	161.0		
			SHC	–	76.1	98.4	–	73.0	95.5	–	69.3	91.9	–	65.2	88.0	–	60.7	83.6		
		5250 Cfm	EAT (wb)	58	THC	155.1	163.4	172.4	144.9	154.8	164.7	134.7	145.1	155.4	123.7	134.1	145.1	112.3	122.5	133.5
					SHC	150.5	163.4	172.4	142.9	154.8	164.7	134.7	145.1	155.4	123.7	134.1	145.1	112.3	122.5	133.5
62	THC			167.1	167.3	172.5	156.8	157.2	164.8	144.0	145.6	155.5	130.0	134.7	144.9	115.6	123.4	133.3		
	SHC			131.1	156.3	172.5	126.6	151.6	164.8	121.1	143.1	155.5	115.0	134.7	144.9	108.4	123.4	133.3		
67	THC			183.8	183.2	182.7	173.8	173.1	172.7	162.4	161.6	161.6	148.4	147.7	148.1	133.2	132.1	134.2		
	SHC			104.1	129.8	155.4	100.2	126.2	151.7	95.8	121.8	147.2	90.3	116.4	141.0	84.5	110.4	132.5		
72	THC			201.0	200.6	200.1	191.1	190.5	189.9	179.6	179.1	178.4	166.9	166.2	165.4	152.6	151.6	150.9		
	SHC			76.5	102.2	127.6	72.9	98.8	124.6	68.8	94.9	120.9	64.3	90.6	116.7	59.2	85.5	111.7		
76	THC			–	213.1	213.6	–	204.4	204.1	–	193.2	192.7	–	180.3	179.7	–	165.8	165.1		
	SHC			–	79.8	104.7	–	76.8	102.2	–	73.1	98.9	–	68.9	95.0	–	64.3	90.6		
6000 Cfm	EAT (wb)			58	THC	161.0	170.5	180.1	151.6	162.4	172.0	141.1	152.2	162.9	130.1	140.9	152.3	118.1	129.1	140.5
					SHC	159.5	170.5	180.1	151.6	162.4	172.0	141.1	152.2	162.9	130.1	140.9	152.3	118.1	129.1	140.5
		62	THC	171.0	172.0	180.2	160.8	162.9	172.2	147.5	152.5	163.1	133.4	141.0	152.7	118.9	128.8	140.7		
			SHC	140.4	166.7	180.2	136.2	160.4	172.2	130.3	152.5	163.1	123.9	141.0	152.7	115.5	128.8	140.7		
		67	THC	188.0	187.3	187.0	177.3	176.8	176.7	165.7	165.0	165.5	152.0	151.2	153.5	135.6	135.2	140.6		
			SHC	109.9	138.8	167.3	106.0	135.4	163.5	101.7	131.0	158.3	96.3	125.7	150.5	90.2	119.4	140.6		
		72	THC	205.2	204.7	204.2	195.1	194.5	193.8	183.4	182.6	181.9	170.1	169.3	168.5	155.3	154.4	153.7		
			SHC	79.3	107.7	136.0	75.7	104.5	133.4	71.4	100.7	129.9	66.8	96.3	125.8	61.6	91.4	120.8		
		76	THC	–	216.8	217.0	–	208.3	207.9	–	196.8	196.2	–	183.6	182.9	–	168.8	168.0		
			SHC	–	82.8	109.9	–	79.9	108.2	–	76.2	105.0	–	72.0	101.3	–	67.3	96.9		
		6750 Cfm	EAT (wb)	58	THC	166.8	176.8	186.7	157.9	168.3	178.5	147.1	158.7	169.1	135.0	147.0	158.8	122.6	134.6	146.4
					SHC	166.8	176.8	186.7	157.9	168.3	178.5	147.1	158.7	169.1	135.0	147.0	158.8	122.6	134.6	146.4
62	THC			174.3	177.3	186.8	163.8	168.5	178.6	151.1	159.0	169.2	136.4	147.4	158.8	122.9	134.6	146.8		
	SHC			149.4	174.8	186.8	145.1	168.5	178.6	139.2	159.0	169.2	131.8	147.4	158.8	122.9	134.6	146.8		
67	THC			191.4	190.7	190.8	180.5	179.7	180.5	168.5	167.8	169.9	154.6	154.2	158.8	138.0	138.4	147.0		
	SHC			115.5	147.5	178.2	111.8	144.1	174.7	107.4	139.9	167.0	102.2	134.6	158.8	95.9	128.0	147.0		
72	THC			208.6	208.0	207.6	198.4	197.7	197.0	186.4	185.6	184.8	172.8	171.9	171.1	157.7	156.6	155.9		
	SHC			81.9	112.8	144.0	78.2	110.0	141.9	73.9	106.3	138.6	69.2	101.9	134.5	64.0	97.0	129.6		
76	THC			–	220.1	220.0	–	211.4	211.1	–	199.7	199.2	–	186.3	185.6	–	171.2	170.2		
	SHC			–	85.7	115.1	–	82.9	113.8	–	79.2	110.9	–	75.0	107.3	–	70.3	103.0		
7500 Cfm	EAT (wb)			58	THC	172.1	182.4	192.6	163.2	173.8	184.3	152.2	163.9	174.6	140.2	152.6	163.9	126.4	139.2	151.8
					SHC	172.1	182.4	192.6	163.2	173.8	184.3	152.2	163.9	174.6	140.2	152.6	163.9	126.4	139.2	151.8
		62	THC	177.4	182.5	192.7	166.8	173.9	184.4	154.2	164.0	174.8	140.2	152.7	164.0	127.2	139.0	151.6		
			SHC	158.1	182.4	192.7	153.7	173.9	184.4	147.4	164.0	174.8	138.3	152.7	164.0	127.2	139.0	151.6		
		67	THC	194.6	193.8	194.4	183.4	182.7	185.0	171.0	170.5	174.9	156.9	157.0	164.1	139.9	140.7	152.0		
			SHC	121.2	156.1	189.0	117.5	152.9	182.3	113.2	148.7	174.9	108.0	143.3	164.1	101.5	135.8	152.0		
		72	THC	211.7	211.1	210.7	201.4	200.7	199.9	189.1	188.3	187.4	175.3	174.2	173.4	159.7	158.6	157.9		
			SHC	84.5	117.9	151.8	80.9	115.5	150.2	76.5	111.9	147.2	71.7	107.6	143.2	66.4	102.6	138.1		
		76	THC	–	223.4	223.1	–	214.3	214.0	–	202.5	201.9	–	188.7	188.0	–	173.3	172.4		
			SHC	–	88.8	120.4	–	86.0	119.5	–	82.3	116.8	–	78.1	113.4	–	73.3	109.2		

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)
- L/s – Liters per second
- SHC – Sensible heat capacity – MBH
- THC – Total heat capacity – MBH

Table 12 – GROSS COOLING CAPACITIES

17 TONS (2 Stage Cooling)

SI

RAS240/243				AMBIENT TEMPERATURE °C															
				29			35			41			46			52			
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			
				24	27	29	24	27	29	24	27	29	24	27	29	24	27	29	
2124 L/s	EAT (wB)	14	THC	49.9	51.3	54.4	46.2	48.4	51.5	42.5	45.2	48.4	38.6	41.7	44.9	34.9	38.0	41.2	
			SHC	45.9	51.3	54.4	44.0	48.4	51.5	41.6	45.2	48.4	38.6	41.7	44.9	34.9	38.0	41.2	
		17	THC	54.4	54.3	54.9	50.6	50.5	51.6	46.4	46.4	48.4	41.8	42.2	45.0	36.8	38.1	41.2	
			SHC	40.1	47.5	54.0	38.4	45.8	51.6	36.6	43.9	48.4	34.6	41.3	45.0	32.5	38.1	41.2	
		19	THC	60.0	59.9	59.8	56.6	56.4	56.3	52.4	52.2	52.1	47.7	47.5	47.4	42.5	42.3	42.3	
			SHC	32.5	39.9	47.3	31.0	38.5	45.9	29.3	36.8	44.2	27.5	34.9	42.3	25.5	33.0	40.2	
	22	THC	65.7	65.6	65.5	62.4	62.2	62.1	58.6	58.4	58.2	54.1	53.9	53.7	48.8	48.6	48.4		
		SHC	24.4	32.0	39.4	23.2	30.7	38.2	21.8	29.3	36.8	20.1	27.7	35.1	18.3	25.8	33.3		
	24	THC	–	70.2	70.1	–	66.8	66.7	–	63.0	62.9	–	58.7	58.5	–	53.9	53.6		
		SHC	–	25.4	32.9	–	24.3	31.7	–	23.0	30.5	–	21.6	29.1	–	20.0	27.5		
	2478 L/s	EAT (wB)	14	THC	51.5	54.0	57.3	48.0	51.0	54.4	44.3	47.6	51.1	40.6	44.0	47.4	36.6	40.0	43.5
				SHC	49.6	54.0	57.3	47.1	51.0	54.4	44.3	47.6	51.1	40.6	44.0	47.4	36.6	40.0	43.5
17			THC	55.8	55.8	57.4	52.0	52.1	54.5	47.6	48.1	51.1	42.8	44.0	47.5	37.7	40.1	43.5	
			SHC	43.0	51.5	57.4	41.3	49.6	54.5	39.5	47.1	51.1	37.4	44.0	47.5	35.2	40.1	43.5	
19			THC	61.4	61.2	61.1	57.9	57.7	57.6	53.7	53.5	53.5	48.8	48.6	48.7	43.4	43.2	43.9	
			SHC	34.1	42.7	51.2	32.7	41.3	49.8	31.1	39.7	48.1	29.2	37.8	46.1	27.2	35.8	43.3	
22		THC	67.1	66.9	66.8	63.6	63.5	63.3	59.7	59.5	59.3	55.3	55.0	54.8	49.9	49.7	49.4		
		SHC	24.9	33.5	42.0	23.7	32.3	40.8	22.3	30.9	39.5	20.7	29.3	37.9	18.8	27.5	36.1		
24		THC	–	71.5	71.4	–	68.1	67.9	–	64.2	64.0	–	59.7	59.5	–	54.8	54.5		
		SHC	–	26.1	34.5	–	24.9	33.4	–	23.6	32.2	–	22.2	30.8	–	20.6	29.3		
2832 L/s		EAT (wB)	14	THC	53.3	56.5	59.7	49.8	53.3	56.8	46.2	49.8	53.5	42.4	46.0	49.7	38.2	41.8	45.5
				SHC	52.5	56.5	59.7	49.8	53.3	56.8	46.2	49.8	53.5	42.4	46.0	49.7	38.2	41.8	45.5
	17		THC	57.0	57.3	59.7	53.1	53.8	56.9	48.6	49.9	53.5	43.7	46.1	49.7	38.7	41.9	45.6	
			SHC	45.9	55.0	59.7	44.3	52.7	56.9	42.3	49.9	53.5	40.2	46.1	49.7	37.5	41.9	45.6	
	19		THC	62.5	62.4	62.3	59.0	58.8	58.7	54.8	54.6	54.7	49.7	49.5	50.3	44.2	44.0	45.6	
			SHC	35.8	45.4	54.9	34.4	44.1	53.6	32.8	42.5	51.9	30.9	40.6	49.1	28.9	38.6	45.6	
	22	THC	68.2	68.1	67.9	64.7	64.5	64.4	60.7	60.5	60.2	56.2	55.9	55.6	50.8	50.5	50.2		
		SHC	25.6	35.1	44.6	24.3	33.9	43.5	22.9	32.6	42.2	21.3	31.0	40.7	19.4	29.2	38.9		
	24	THC	–	72.6	72.5	–	69.1	69.0	–	65.1	64.9	–	60.6	60.4	–	55.5	55.3		
		SHC	–	26.9	36.2	–	25.7	35.2	–	24.4	34.0	–	23.0	32.7	–	21.4	31.2		
	3186 L/s	EAT (wB)	14	THC	54.9	58.3	61.6	51.6	55.3	58.7	47.9	51.7	55.4	43.9	47.7	51.6	39.5	43.4	47.2
				SHC	54.9	58.3	61.6	51.6	55.3	58.7	47.9	51.7	55.4	43.9	47.7	51.6	39.5	43.4	47.2
17			THC	57.8	58.6	61.7	54.0	55.4	58.8	49.4	51.7	55.5	44.6	47.7	51.6	39.7	43.4	47.3	
			SHC	48.6	57.7	61.7	47.0	55.4	58.8	45.0	51.7	55.5	42.5	47.7	51.6	39.4	43.4	47.3	
19			THC	63.4	63.2	63.2	59.7	59.5	59.7	55.5	55.3	56.0	50.4	50.2	51.7	44.7	44.7	47.3	
			SHC	37.4	48.0	58.4	36.0	46.7	57.1	34.5	45.2	54.6	32.5	43.3	51.7	30.5	41.1	47.3	
22		THC	69.1	68.9	68.7	65.5	65.3	65.1	61.4	61.1	60.9	56.8	56.5	56.2	51.5	51.1	50.9		
		SHC	26.1	36.6	47.1	24.8	35.4	46.1	23.4	34.1	44.8	21.8	32.6	43.3	20.0	30.8	41.6		
24		THC	–	73.5	73.4	–	69.8	69.7	–	65.8	65.6	–	61.2	60.9	–	56.0	55.7		
		SHC	–	27.5	37.8	–	26.4	36.9	–	25.1	35.7	–	23.7	34.4	–	22.1	32.9		
3540 L/s		EAT (wB)	14	THC	56.3	59.8	63.2	53.0	56.8	60.3	49.2	53.2	56.9	45.1	49.1	53.1	40.6	44.6	48.7
				SHC	56.3	59.8	63.2	53.0	56.8	60.3	49.2	53.2	56.9	45.1	49.1	53.1	40.6	44.6	48.7
	17		THC	58.4	59.8	63.2	54.6	56.8	60.3	50.1	53.2	56.9	45.4	49.1	53.1	40.6	44.6	48.7	
			SHC	51.1	59.8	63.2	49.5	56.8	60.3	47.4	53.2	56.9	44.4	49.1	53.1	40.6	44.6	48.7	
	19		THC	63.9	63.7	64.0	60.2	60.0	60.8	56.0	55.8	57.0	50.8	50.8	53.2	45.0	45.3	48.7	
			SHC	38.8	50.4	61.4	37.5	49.3	59.3	35.9	47.7	57.0	34.0	45.8	53.2	31.9	43.3	48.7	
	22	THC	69.6	69.5	69.3	66.0	65.8	65.5	61.8	61.6	61.3	57.1	56.8	56.5	51.8	51.4	51.2		
		SHC	26.5	37.9	49.4	25.2	36.8	48.4	23.8	35.5	47.3	22.2	34.0	45.8	20.4	32.3	44.0		
	24	THC	–	74.1	73.9	–	70.3	70.2	–	66.2	66.0	–	61.5	61.3	–	56.3	56.0		
		SHC	–	28.1	39.3	–	26.9	38.3	–	25.7	37.3	–	24.2	36.0	–	22.6	34.5		

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)
- L/s – Liters per second
- SHC – Sensible heat capacity – kW
- THC – Total heat capacity – kW

Table 14 – GROSS COOLING CAPACITIES

20 TONS (2 Stage Cooling)

SI

RAS300–303				AMBIENT TEMPERATURE °C														
				29			35			41			46			52		
				EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)			EAT (dB)		
				24	27	29	24	27	29	24	27	29	24	27	29	24	27	29
2124 L/s	EAT (wB)	14	THC	58.7	59.7	62.9	54.8	56.7	60.1	50.4	53.2	56.8	45.9	49.4	53.0	41.6	45.4	48.9
			SHC	52.7	59.7	62.9	50.8	56.7	60.1	48.6	53.2	56.8	45.9	49.4	53.0	41.6	45.4	48.9
		17	THC	63.2	63.1	63.4	59.6	59.5	60.1	55.2	55.2	56.9	50.2	50.3	53.1	44.7	45.4	49.0
			SHC	45.3	54.1	62.2	43.8	52.5	60.1	41.9	50.6	56.9	39.8	48.3	53.1	37.6	45.4	49.0
		19	THC	69.0	68.9	68.8	65.5	65.4	65.3	61.6	61.4	61.3	56.8	56.6	56.5	51.1	51.0	50.9
			SHC	35.7	44.4	53.1	34.4	43.2	51.9	32.9	41.7	50.4	31.1	39.9	48.6	29.0	37.8	46.5
		22	THC	75.1	75.0	74.9	71.6	71.4	71.3	67.6	67.4	67.3	63.1	62.9	62.7	58.0	57.8	57.5
			SHC	25.7	34.7	43.3	24.6	33.5	42.2	23.2	32.1	40.9	21.8	30.6	39.5	20.1	29.0	37.8
2478 L/s	EAT (wB)	14	THC	60.9	63.1	66.4	57.1	60.2	63.6	52.8	56.7	60.3	48.7	52.6	56.5	44.4	48.2	52.2
			SHC	57.5	63.1	66.4	55.6	60.2	63.6	52.8	56.7	60.3	48.7	52.6	56.5	44.4	48.2	52.2
		17	THC	65.2	65.2	66.5	61.5	61.6	63.6	57.2	57.4	60.4	51.9	52.7	56.6	46.1	48.3	52.2
			SHC	49.1	59.0	66.5	47.6	57.5	63.6	45.8	55.5	60.4	43.6	52.7	56.6	41.3	48.3	52.2
		19	THC	71.1	71.0	70.9	67.5	67.3	67.2	63.4	63.2	63.1	58.6	58.4	58.4	52.8	52.5	52.9
			SHC	38.1	48.1	58.0	36.8	46.9	56.9	35.3	45.4	55.4	33.5	43.7	53.6	31.4	41.6	51.2
		22	THC	77.3	77.2	77.1	73.6	73.5	73.3	69.5	69.3	69.1	64.8	64.6	64.4	59.5	59.2	59.0
			SHC	27.0	37.0	46.9	25.8	35.8	45.8	24.4	34.5	44.6	22.8	33.0	43.1	21.1	31.3	41.5
2832 L/s	EAT (wB)	14	THC	62.8	66.0	69.4	59.4	63.0	66.5	55.5	59.5	63.2	51.2	55.4	59.3	46.6	50.7	54.9
			SHC	61.7	66.0	69.4	59.4	63.0	66.5	55.5	59.5	63.2	51.2	55.4	59.3	46.6	50.7	54.9
		17	THC	66.8	67.0	69.5	63.1	63.5	66.6	58.6	59.6	63.2	53.3	55.4	59.4	47.4	50.7	54.9
			SHC	52.7	63.6	69.5	51.3	62.0	66.6	49.5	59.6	63.2	47.3	55.4	59.4	44.7	50.7	54.9
		19	THC	72.9	72.7	72.6	69.1	68.9	68.9	64.8	64.6	64.7	59.9	59.7	60.0	54.1	53.9	55.0
			SHC	40.5	51.6	62.7	39.2	50.4	61.6	37.6	49.0	60.1	35.9	47.3	58.1	33.8	45.2	55.0
		22	THC	79.1	79.0	78.8	75.3	75.1	75.0	71.0	70.8	70.6	66.1	65.9	65.7	60.7	60.4	60.2
			SHC	28.3	39.3	50.3	27.0	38.1	49.3	25.5	36.8	48.1	23.9	35.3	46.7	22.1	33.6	45.0
3186 L/s	EAT (wB)	14	THC	64.8	68.4	72.0	61.7	65.4	69.1	57.9	61.9	65.6	53.4	57.7	61.6	48.5	52.9	57.1
			SHC	64.8	68.4	72.0	61.7	65.4	69.1	57.9	61.9	65.6	53.4	57.7	61.6	48.5	52.9	57.1
		17	THC	68.2	68.7	72.1	64.3	65.4	69.1	59.9	61.9	65.6	54.6	57.7	61.7	48.6	52.9	57.2
			SHC	56.2	67.7	72.1	54.8	65.4	69.1	53.0	61.9	65.6	50.7	57.7	61.7	47.8	52.9	57.2
		19	THC	74.4	74.2	74.2	70.4	70.2	70.4	66.0	65.8	66.2	61.0	60.8	61.7	55.1	55.0	57.2
			SHC	42.8	55.0	67.1	41.4	53.9	65.9	39.9	52.5	64.3	38.1	50.8	61.7	36.0	48.6	57.2
		22	THC	80.7	80.5	80.4	76.7	76.5	76.4	72.2	72.0	71.8	67.3	67.0	66.8	61.7	61.4	61.1
			SHC	29.5	41.6	53.6	28.1	40.4	52.6	26.6	39.0	51.5	24.9	37.5	50.1	23.1	35.8	48.5
3540 L/s	EAT (wB)	14	THC	66.8	70.5	74.3	63.6	67.4	71.2	59.8	63.8	67.6	55.2	59.6	63.5	50.1	54.7	58.9
			SHC	66.8	70.5	74.3	63.6	67.4	71.2	59.8	63.8	67.6	55.2	59.6	63.5	50.1	54.7	58.9
		17	THC	69.3	70.6	74.3	65.4	67.4	71.2	61.0	63.8	67.6	55.8	59.6	63.6	50.1	54.7	59.0
			SHC	59.5	70.6	74.3	58.1	67.4	71.2	56.3	63.8	67.6	53.8	59.6	63.6	50.1	54.7	59.0
		19	THC	75.5	75.3	75.5	71.5	71.3	71.7	66.9	66.7	67.7	61.8	61.7	63.6	55.8	55.9	59.0
			SHC	44.9	58.3	71.1	43.5	57.2	69.8	42.0	55.8	67.7	40.3	54.1	63.6	38.1	51.8	59.0
		22	THC	82.0	81.8	81.6	77.9	77.7	77.5	73.3	73.0	72.8	68.1	67.9	67.6	62.4	62.1	61.9
			SHC	30.6	43.6	56.7	29.1	42.4	55.8	27.5	41.1	54.7	25.8	39.6	53.4	23.9	37.8	51.7
	24	THC	–	87.0	86.8	–	82.8	82.6	–	78.1	77.9	–	72.9	72.7	–	–	66.9	
		SHC	–	32.3	45.1	–	31.0	44.0	–	29.5	42.8	–	27.9	41.5	–	–	40.0	

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)
- L/s – Liters per second
- SHC – Sensible heat capacity – kW
- THC – Total heat capacity – kW

Table 16 – STATIC PRESSURE ADDERS (Factory Options and/or Accessories)

Economizer – Vertical and Horizontal Duct Configuration, SI

RAS181 – 303, SI								
L/s	2124	2360	2596	2832	3067	3303	3539	3775
Pa	12	13	14	15	17	18	19	20

RAS181 – 303, SI									
L/s	4011	4247	4483	4719	4955	5191	5427	5663	5899
Pa	22	23	24	26	27	28	30	31	33

Electric Heaters – Vertical and Horizontal Duct Configuration, SI

RAS181 – 303, SI								
L/s	2124	2360	2596	2832	3067	3303	3539	3775
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

RAS181 – 303, SI									
L/s	4011	4247	4483	4719	4955	5191	5427	5663	5899
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

Economizer – Vertical and Horizontal Duct Configuration, English

RAS181 – 303, English								
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

RAS181 – 303, English									
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, English

RAS181 – 303, English								
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

RAS181 – 303, English									
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 the above tables.
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 17 – RAS181, 14 TON VERTICAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
1911	–	–	513	0.79	598	1.15	673	1.55	741	1.98
2072	–	–	526	0.88	608	1.25	681	1.66	748	2.10
2230	447	0.64	539	0.98	619	1.36	690	1.78	756	2.23
2388	464	0.73	552	1.09	630	1.48	700	1.91	765	2.38
2549	481	0.84	567	1.21	642	1.62	711	2.06	774	2.54
2709	499	0.95	581	1.34	655	1.76	722	2.22	784	2.71
2867	517	1.08	596	1.48	668	1.92	734	2.38	794	2.88
3025	535	1.22	612	1.63	682	2.08	746	2.56	805	3.08
3186	553	1.37	628	1.80	696	2.26	758	2.76	817	3.29

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
1911	803	2.44	862	2.94	917	3.46	969	4.01	1018	4.59
2072	810	2.58	867	3.08	922	3.61	973	4.17	1023	4.76
2230	817	2.72	874	3.23	927	3.77	979	4.34	–	–
2388	825	2.87	881	3.40	934	3.95	984	4.52	–	–
2549	833	3.04	888	3.58	941	4.14	990	4.72	–	–
2709	842	3.22	896	3.77	948	4.34	997	4.85	–	–
2867	851	3.41	905	3.97	956	4.55	–	–	–	–
3025	861	3.62	914	4.19	964	4.78	–	–	–	–
3186	872	3.84	924	4.42	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 18 – RAS183, 14 TON HORIZONTAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
1911	–	–	524	1.19	592	1.67	652	2.94	705	2.74
2072	–	–	544	1.35	610	1.85	669	3.20	722	2.96
2230	487	1.02	563	1.51	628	2.04	686	3.49	738	3.20
2388	509	1.18	584	1.70	647	2.25	704	3.81	756	3.46
2549	533	1.37	605	1.91	667	2.49	723	4.16	773	3.74
2709	557	1.57	626	2.14	687	2.74	742	4.53	792	4.05
2867	580	1.79	648	2.39	707	3.02	761	4.93	810	4.37
3025	605	2.03	670	2.66	728	3.32	780	5.37	829	4.72
3186	629	2.31	693	2.96	749	3.64	801	5.84	848	5.09

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
1911	755	3.33	800	3.94	843	4.58	–	–	–	–
2072	771	3.57	816	4.20	858	4.87	–	–	–	–
2230	787	3.83	831	4.48	–	–	–	–	–	–
2388	803	4.11	847	4.78	–	–	–	–	–	–
2549	820	4.41	864	5.11	–	–	–	–	–	–
2709	838	4.74	–	–	–	–	–	–	–	–
2867	–	–	–	–	–	–	–	–	–	–
3025	–	–	–	–	–	–	–	–	–	–
3186	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 19 – RAS210, 15 TON VERTICAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2124	–	–	530	0.91	611	1.29	684	1.70	751	2.14
2301	–	–	545	1.03	624	1.41	695	1.84	760	2.30
2478	–	–	560	1.15	637	1.56	706	1.99	770	2.46
2655	493	0.91	576	1.29	651	1.71	718	2.16	781	2.65
2832	513	1.05	593	1.45	665	1.88	731	2.35	792	2.84
3009	533	1.20	610	1.62	680	2.06	744	2.55	804	3.06
3186	553	1.37	628	1.80	696	2.26	758	2.76	817	3.29
3363	574	1.55	646	2.00	712	2.48	773	2.99	830	3.53
3540	595	1.75	665	2.22	729	2.72	788	3.25	844	3.80

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2124	812	2.62	869	3.13	924	3.66	975	4.23	–	–
2301	820	2.79	877	3.30	930	3.85	981	4.42	–	–
2478	829	2.97	885	3.50	938	4.05	988	4.63	–	–
2655	839	3.16	894	3.70	946	4.27	995	4.85	–	–
2832	849	3.37	903	3.92	954	4.50	–	–	–	–
3009	860	3.60	913	4.16	963	4.76	–	–	–	–
3186	872	3.84	924	4.42	973	4.85	–	–	–	–
3363	884	4.10	935	4.69	–	–	–	–	–	–
3540	897	4.38	947	4.84	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 20 – RAS213, 15 TON HORIZONTAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2124	–	–	550	1.40	616	1.91	674	2.46	727	3.04
2301	–	–	572	1.60	637	2.13	694	2.71	746	3.32
2478	–	–	595	1.82	658	2.38	714	2.98	765	3.62
2655	549	1.50	619	2.06	680	2.66	735	3.28	785	3.94
2832	575	1.74	643	2.33	703	2.96	757	3.61	806	4.30
3009	602	2.01	668	2.63	726	3.28	778	3.97	827	4.68
3186	629	2.31	693	2.96	749	3.64	801	4.36	–	–
3363	657	2.63	718	3.32	773	4.03	824	4.78	–	–
3540	685	3.00	744	3.71	798	4.46	847	4.85	–	–

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2124	776	3.65	821	4.29	863	4.96	–	–	–	–
2301	794	3.95	839	4.62	–	–	–	–	–	–
2478	813	4.28	857	4.96	–	–	–	–	–	–
2655	832	4.63	–	–	–	–	–	–	–	–
2832	852	5.01	–	–	–	–	–	–	–	–
3009	–	–	–	–	–	–	–	–	–	–
3186	–	–	–	–	–	–	–	–	–	–
3363	–	–	–	–	–	–	–	–	–	–
3540	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 21 – RAS240, 17 TON VERTICAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2407	–	–	–	–	633	1.32	704	1.67	768	2.04
2608	–	–	–	–	649	1.50	719	1.86	782	2.24
2808	–	–	–	–	666	1.69	734	2.07	796	2.47
3009	–	–	610	1.53	683	1.91	750	2.30	811	2.72
3209	–	–	630	1.75	701	2.14	766	2.56	826	2.99
3410	–	–	651	1.99	720	2.40	783	2.84	842	3.29
3610	–	–	672	2.26	739	2.69	801	3.14	858	3.61
3811	621	2.11	693	2.55	759	3.00	819	3.47	875	3.96
0	–	–	–	–	–	–	–	–	–	–

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2407	828	2.43	883	2.84	935	3.27	985	3.72	1032	4.19
2608	840	2.65	895	3.07	946	3.52	995	3.98	1042	4.46
2808	853	2.89	907	3.33	958	3.78	1006	4.26	1052	4.75
3009	867	3.15	920	3.60	970	4.07	1018	4.56	1064	5.07
3209	881	3.44	934	3.91	983	4.39	1030	4.89	–	–
3410	896	3.75	948	4.23	997	4.73	1043	5.25	–	–
3610	912	4.09	962	4.59	1010	5.10	1056	5.63	–	–
3811	928	4.46	977	4.97	1025	5.50	–	–	–	–
0	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 22 – RAS243, 17 TON HORIZONTAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2407	–	–	–	–	650	2.20	706	2.76	758	3.36
2608	–	–	–	–	674	2.49	730	3.08	780	3.70
2808	–	–	640	2.21	700	2.81	754	3.43	803	4.09
3009	–	–	668	2.54	726	3.17	778	3.82	827	4.50
3209	–	–	696	2.90	752	3.56	804	4.25	851	4.96
3410	664	2.64	725	3.30	780	4.00	830	4.72	876	5.46
3610	696	3.05	754	3.75	807	4.47	856	5.23	901	6.00
3811	728	3.50	784	4.24	836	5.00	883	5.78	927	6.49

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2407	805	3.98	849	4.63	891	5.31	931	6.01	–	–
2608	827	4.36	870	5.03	912	5.73	951	6.46	–	–
2808	849	4.77	892	5.47	933	6.20	–	–	–	–
3009	872	5.21	914	5.95	954	6.49	–	–	–	–
3209	895	5.70	937	6.46	–	–	–	–	–	–
3410	919	6.23	–	–	–	–	–	–	–	–
3610	944	6.49	–	–	–	–	–	–	–	–
3811	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 23 – RAS300, 20 TON VERTICAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2832	–	–	–	–	664	1.56	737	1.97	803	2.40
3068	–	–	–	–	681	1.77	753	2.19	818	2.65
3304	–	–	–	–	698	2.00	770	2.45	834	2.92
3540	–	–	636	1.80	716	2.25	787	2.72	850	3.21
3776	–	–	656	2.05	735	2.53	804	3.02	867	3.54
4012	–	–	676	2.33	753	2.83	822	3.35	884	3.89
4248	–	–	697	2.64	772	3.17	840	3.71	901	4.27
4484	–	–	717	2.97	791	3.53	858	4.10	918	4.68
4719	654	2.76	738	3.34	811	3.93	876	4.52	936	5.13

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2832	863	2.86	918	3.34	970	3.84	1019	4.36	1066	4.91
3068	878	3.12	933	3.62	984	4.13	1033	4.67	1079	5.23
3304	893	3.41	948	3.92	999	4.46	1047	5.01	1093	5.58
3540	909	3.72	963	4.26	1014	4.81	1062	5.38	1108	5.97
3776	925	4.07	978	4.62	1029	5.19	1077	5.78	1122	6.38
4012	941	4.44	994	5.01	1044	5.60	1092	6.20	–	–
4248	957	4.84	1010	5.43	1060	6.04	1107	6.66	–	–
4484	974	5.28	1027	5.89	1076	6.52	1123	7.16	–	–
4719	991	5.74	1043	6.38	1092	7.02	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 24 – RAS303, 20 TON HORIZONTAL SUPPLY / RETURN – SI

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	50		100		150		200		250	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2832	–	–	601	2.43	657	3.04	709	3.69	757	4.36
3068	–	–	632	2.88	686	3.53	736	4.21	782	4.91
3304	607	2.73	664	3.38	716	4.07	764	4.79	809	5.53
3540	642	3.26	697	3.95	746	4.68	793	5.43	836	6.21
3776	678	3.85	730	4.59	777	5.36	822	6.15	864	6.96
4012	713	4.52	763	5.30	809	6.11	852	6.94	893	7.79
4248	749	5.27	797	6.09	841	6.94	883	7.81	–	–
4484	786	6.10	831	6.96	874	7.85	–	–	–	–
4719	822	7.02	866	7.92	–	–	–	–	–	–

L/s	AVAILABLE EXTERNAL STATIC PRESSURE (PA)									
	300		350		400		450		500	
	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2832	801	5.06	843	5.78	883	6.54	921	7.31	–	–
3068	826	5.65	866	6.40	905	7.19	943	8.00	–	–
3304	851	6.30	891	7.09	929	7.91	–	–	–	–
3540	877	7.01	916	7.84	–	–	–	–	–	–
3776	904	7.80	–	–	–	–	–	–	–	–
4012	–	–	–	–	–	–	–	–	–	–
4248	–	–	–	–	–	–	–	–	–	–
4484	–	–	–	–	–	–	–	–	–	–
4719	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 25 – RAS181, 14 TON VERTICAL SUPPLY / RETURN – ENGLISH

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
4050	–	–	513	1.06	598	1.54	673	2.07	741	2.65
4390	–	–	526	1.18	608	1.68	681	2.22	748	2.82
4725	447	0.86	539	1.31	619	1.83	690	2.39	756	3.00
5060	464	0.98	552	1.46	630	1.99	700	2.57	765	3.19
5400	481	1.12	567	1.62	642	2.17	711	2.76	774	3.40
5740	499	1.28	581	1.79	655	2.36	722	2.97	784	3.63
6075	517	1.45	596	1.98	668	2.57	734	3.20	794	3.87
6410	535	1.63	612	2.19	682	2.79	746	3.44	805	4.13
6750	553	1.83	628	2.41	696	3.04	758	3.70	817	4.41

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
4050	803	3.27	862	3.94	917	4.64	969	5.38	1018	6.15
4390	810	3.45	867	4.13	922	4.84	973	5.60	1023	6.38
4725	817	3.65	874	4.33	927	5.06	979	5.82	–	–
5060	825	3.85	881	4.55	934	5.29	984	6.07	–	–
5400	833	4.08	888	4.79	941	5.55	990	6.33	–	–
5740	842	4.32	896	5.05	948	5.82	997	6.50	–	–
6075	851	4.58	905	5.32	956	6.10	–	–	–	–
6410	861	4.85	914	5.61	964	6.41	–	–	–	–
6750	872	5.15	924	5.93	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 26 – RAS183, 14 TON HORIZONTAL SUPPLY / RETURN – ENGLISH

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
4050	–	–	524	1.60	592	2.24	652	2.94	705	3.68
4390	–	–	544	1.80	610	2.48	669	3.20	722	3.97
4725	487	1.37	563	2.03	628	2.74	686	3.49	738	4.29
5060	509	1.59	584	2.28	647	3.02	704	3.81	756	4.64
5400	533	1.83	605	2.56	667	3.34	723	4.16	773	5.02
5740	557	2.11	626	2.87	687	3.68	742	4.53	792	5.43
6075	580	2.40	648	3.20	707	4.05	761	4.93	810	5.86
6410	605	2.73	670	3.57	728	4.45	780	5.37	829	6.32
6750	629	3.09	693	3.97	749	4.88	801	5.84	848	6.83

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
4050	755	4.46	800	5.28	843	6.15	–	–	–	–
4390	771	4.79	816	5.64	858	6.53	–	–	–	–
4725	787	5.13	831	6.01	–	–	–	–	–	–
5060	803	5.51	847	6.42	–	–	–	–	–	–
5400	820	5.92	864	6.85	–	–	–	–	–	–
5740	838	6.35	–	–	–	–	–	–	–	–
6075	–	–	–	–	–	–	–	–	–	–
6410	–	–	–	–	–	–	–	–	–	–
6750	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 27 – RAS210, 15 TON VERTICAL SUPPLY / RETURN – ENGLISH

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	–	–	530	1.22	611	1.72	684	2.28	751	2.87
4875	–	–	545	1.38	624	1.90	695	2.47	760	3.08
5250	–	–	560	1.55	637	2.09	706	2.67	770	3.30
5625	493	1.22	576	1.73	651	2.29	718	2.90	781	3.55
6000	513	1.41	593	1.94	665	2.52	731	3.15	792	3.81
6375	533	1.61	610	2.17	680	2.77	744	3.41	804	4.10
6750	553	1.83	628	2.41	696	3.04	758	3.70	817	4.41
7125	574	2.08	646	2.68	712	3.33	773	4.02	830	4.74
7500	595	2.35	665	2.97	729	3.64	788	4.35	844	5.10

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	812	3.51	869	4.19	924	4.91	975	5.67	–	–
4875	820	3.74	877	4.43	930	5.16	981	5.93	–	–
5250	829	3.98	885	4.69	938	5.43	988	6.22	–	–
5625	839	4.24	894	4.96	946	5.73	995	6.50	–	–
6000	849	4.52	903	5.26	954	6.04	–	–	–	–
6375	860	4.82	913	5.58	963	6.38	–	–	–	–
6750	872	5.15	924	5.93	973	6.50	–	–	–	–
7125	884	5.50	935	6.30	–	–	–	–	–	–
7500	897	5.88	947	6.49	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 28 – RAS213, 15 TON HORIZONTAL SUPPLY / RETURN – ENGLISH

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	–	–	550	1.88	616	2.56	674	3.30	727	4.08
4875	–	–	572	2.14	637	2.86	694	3.63	746	4.45
5250	–	–	595	2.43	658	3.19	714	4.00	765	4.85
5625	549	2.01	619	2.76	680	3.56	735	4.40	785	5.28
6000	575	2.33	643	3.13	703	3.96	757	4.84	806	5.76
6375	602	2.69	668	3.53	726	4.40	778	5.32	827	6.27
6750	629	3.09	693	3.97	749	4.88	801	5.84	–	–
7125	657	3.53	718	4.45	773	5.41	824	6.40	–	–
7500	685	4.02	744	4.98	798	5.98	847	6.50	–	–

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4500	776	4.90	821	5.76	863	6.65	–	–	–	–
4875	794	5.30	839	6.19	–	–	–	–	–	–
5250	813	5.73	857	6.65	–	–	–	–	–	–
5625	832	6.20	–	–	–	–	–	–	–	–
6000	852	6.71	–	–	–	–	–	–	–	–
6375	–	–	–	–	–	–	–	–	–	–
6750	–	–	–	–	–	–	–	–	–	–
7125	–	–	–	–	–	–	–	–	–	–
7500	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 29 – RAS240, 17 TON VERTICAL SUPPLY / RETURN – ENGLISH

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
5100	459	0.94	553	1.34	633	1.77	704	2.24	768	2.73
5525	481	1.12	571	1.55	649	2.00	719	2.49	782	3.01
5950	504	1.33	590	1.79	666	2.27	734	2.77	796	3.31
6375	526	1.57	610	2.05	683	2.56	750	3.09	811	3.64
6800	550	1.84	630	2.34	701	2.87	766	3.43	826	4.01
7225	573	2.13	651	2.67	720	3.22	783	3.80	842	4.41
7650	597	2.46	672	3.03	739	3.61	801	4.21	858	4.84
8075	621	2.83	693	3.42	759	4.03	819	4.66	875	5.31

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
5100	828	3.26	883	3.81	935	4.39	985	4.99	1032	5.62
5525	840	3.55	895	4.12	946	4.71	995	5.33	1042	5.98
5950	853	3.87	907	4.46	958	5.07	1006	5.71	1052	6.37
6375	867	4.23	920	4.83	970	5.46	1018	6.12	1064	6.79
6800	881	4.61	934	5.24	983	5.89	1030	6.56	–	–
7225	896	5.03	948	5.68	997	6.35	1043	7.04	–	–
7650	912	5.48	962	6.15	1010	6.84	1056	7.55	–	–
8075	928	5.98	977	6.67	1025	7.38	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 30 – RAS243, 17 TON HORIZONTAL SUPPLY / RETURN – ENGLISH

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
5100	–	–	–	–	650	2.94	706	3.70	758	4.50
5525	–	–	613	2.58	674	3.33	730	4.13	780	4.97
5950	–	–	640	2.97	700	3.77	754	4.60	803	5.48
6375	602	2.60	668	3.40	726	4.25	778	5.12	827	6.04
6800	633	3.04	696	3.89	752	4.78	804	5.70	851	6.65
7225	664	3.54	725	4.43	780	5.36	830	6.32	876	7.32
7650	696	4.09	754	5.03	807	6.00	856	7.01	901	8.05
8075	728	4.70	784	5.68	836	6.70	883	7.75	927	8.70

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
5100	805	5.34	849	6.21	891	7.12	931	8.06	–	–
5525	827	5.84	870	6.75	912	7.69	951	8.67	–	–
5950	849	6.39	892	7.33	933	8.31	–	–	–	–
6375	872	6.99	914	7.97	954	8.70	–	–	–	–
6800	895	7.64	937	8.66	–	–	–	–	–	–
7225	919	8.35	–	–	–	–	–	–	–	–
7650	944	8.70	–	–	–	–	–	–	–	–
8075	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 31 – RAS300, 20 TON VERTICAL SUPPLY / RETURN – ENGLISH

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	–	–	–	–	664	2.09	737	2.64	803	3.22
6500	–	–	–	–	681	2.37	753	2.94	818	3.55
7000	–	–	617	2.10	698	2.68	770	3.28	834	3.91
7500	–	–	636	2.41	716	3.02	787	3.65	850	4.31
8000	–	–	656	2.75	735	3.39	804	4.05	867	4.74
8500	585	2.46	676	3.12	753	3.80	822	4.50	884	5.21
9000	608	2.83	697	3.54	772	4.25	840	4.98	901	5.73
9500	631	3.24	717	3.99	791	4.74	858	5.50	918	6.28
10000	654	3.70	738	4.48	811	5.27	876	6.06	936	6.87

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	863	3.83	918	4.48	970	5.15	1019	5.85	1066	6.58
6500	878	4.19	933	4.85	984	5.54	1033	6.27	1079	7.01
7000	893	4.57	948	5.26	999	5.98	1047	6.72	1093	7.49
7500	909	4.99	963	5.71	1014	6.45	1062	7.21	1108	8.00
8000	925	5.46	978	6.19	1029	6.96	1077	7.74	1122	8.55
8500	941	5.96	994	6.72	1044	7.51	1092	8.32	–	–
9000	957	6.49	1010	7.29	1060	8.10	1107	8.94	–	–
9500	974	7.08	1027	7.90	1076	8.74	1123	9.60	–	–
10000	991	7.70	1043	8.55	1092	9.42	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

Table 32 – RAS303, 20 TON HORIZONTAL SUPPLY / RETURN – ENGLISH

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	–	–	601	3.26	657	4.08	709	4.94	757	5.84
6500	–	–	632	3.86	686	4.73	736	5.64	782	6.59
7000	607	3.66	664	4.54	716	5.46	764	6.42	809	7.41
7500	642	4.37	697	5.30	746	6.27	793	7.28	836	8.33
8000	678	5.17	730	6.16	777	7.18	822	8.24	864	9.34
8500	713	6.07	763	7.11	809	8.19	852	9.30	893	10.44
9000	749	7.07	797	8.17	841	9.30	883	10.47	–	–
9500	786	8.18	831	9.34	874	10.52	–	–	–	–
10000	822	9.41	866	10.62	–	–	–	–	–	–

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	801	6.78	843	7.76	883	8.76	921	9.81	–	–
6500	826	7.57	866	8.59	905	9.64	943	10.72	–	–
7000	851	8.44	891	9.51	929	10.60	–	–	–	–
7500	877	9.41	916	10.52	–	–	–	–	–	–
8000	904	10.46	–	–	–	–	–	–	–	–
8500	–	–	–	–	–	–	–	–	–	–
9000	–	–	–	–	–	–	–	–	–	–
9500	–	–	–	–	–	–	–	–	–	–
10000	–	–	–	–	–	–	–	–	–	–

- = Standard Drive
- = Medium Drive
- = High
- = Not Applicable

FAN PERFORMANCE (cont.)

Table 33 – PULLEY ADJUSTMENT – VERTICAL

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
181 – 183	Standard Static	570	557	544	531	518	505	492	479	466	453	440
	Medium Static	738	721	704	688	671	654	637	620	604	587	570
	High Static	933	915	897	879	861	843	825	807	789	771	753
210 – 213	Standard Static	627	613	599	584	570	556	542	528	513	499	485
	Medium Static	844	827	810	793	776	760	743	726	709	692	675
	High Static	1022	1004	986	968	950	933	915	897	879	861	843
240 – 243	Standard Static	746	732	717	703	689	675	660	646	632	617	603
	Medium Static	878	861	844	827	810	794	777	760	743	726	709
	High Static	1060	1043	1026	1010	993	976	959	942	926	909	892
300 – 303	Standard Static	797	781	765	749	733	718	702	686	670	654	638
	Medium Static	933	915	897	879	861	843	825	807	789	771	753
	High Static	1127	1110	1093	1077	1060	1043	1026	1009	993	976	959

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

■ – Factory settings

Table 34 – PULLEY ADJUSTMENT – HORIZONTAL

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
181 – 183	Std – Med Static	627	613	599	584	570	556	542	528	513	499	485
	High Static	797	781	765	749	733	718	702	686	670	654	638
210 – 213	Std – Med Static	702	686	670	654	638	622	606	590	574	558	542
	High Static	878	861	844	827	810	794	777	760	743	726	709
240 – 243	Std – Med Static	797	781	765	749	733	718	702	686	670	654	638
	High Static	962	945	928	911	894	878	861	844	827	810	793
300 – 303	Std – Med Static	818	804	789	775	760	746	732	717	703	688	674
	High Static	961	947	932	918	904	890	875	861	847	832	818

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

■ – Factory settings

DAMPER, BAROMETRIC RELIEF, AND PERFORMANCE, 14 to 20 Ton

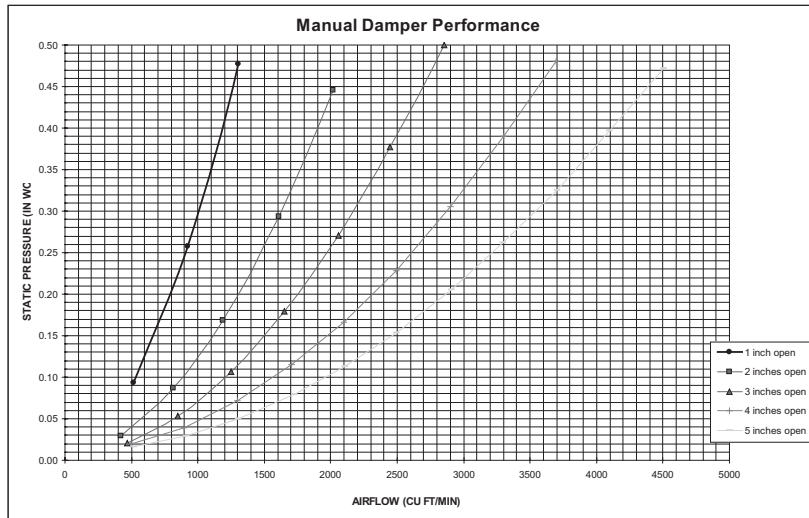


Fig 1 – Manual Damper Performance

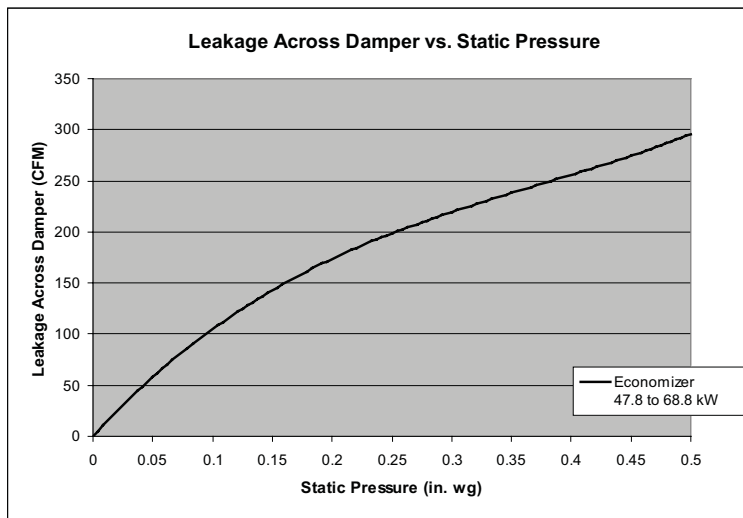


Fig 2 – Power Exhaust Fan Performance

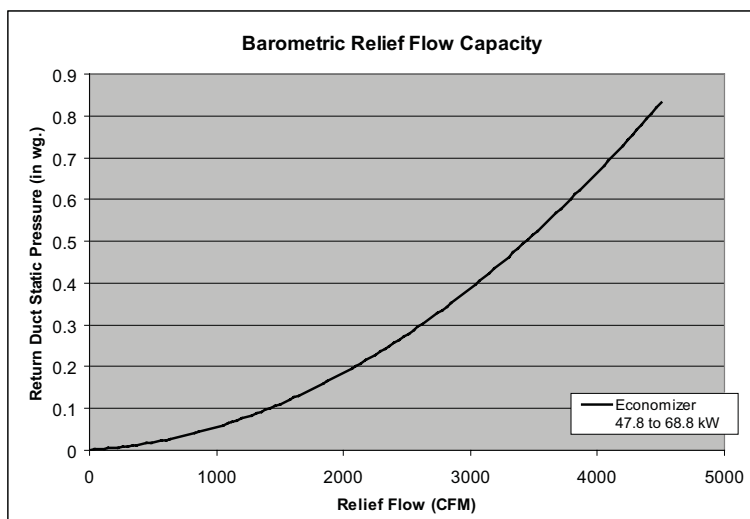


Fig 3 – Barometric Relief Flow Capacity

DAMPER, BAROMETRIC RELIEF, AND PERFORMANCE (CONT.), 14 to 20 Ton

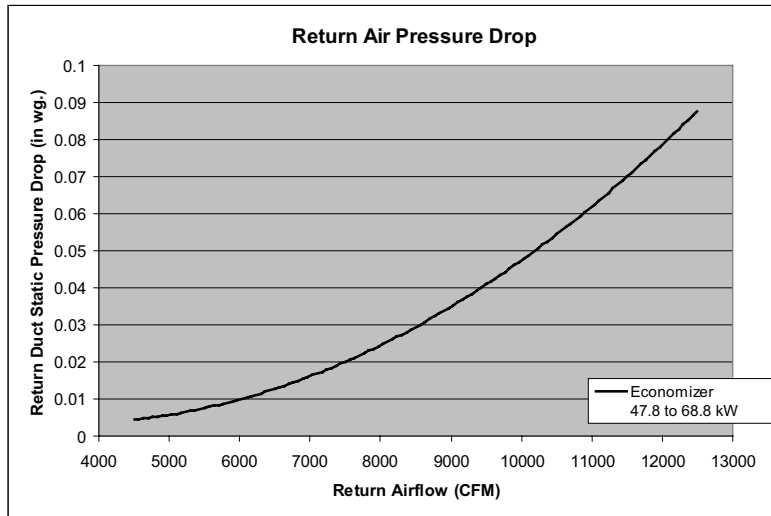


Fig 4 – Return Air Pressure Drop

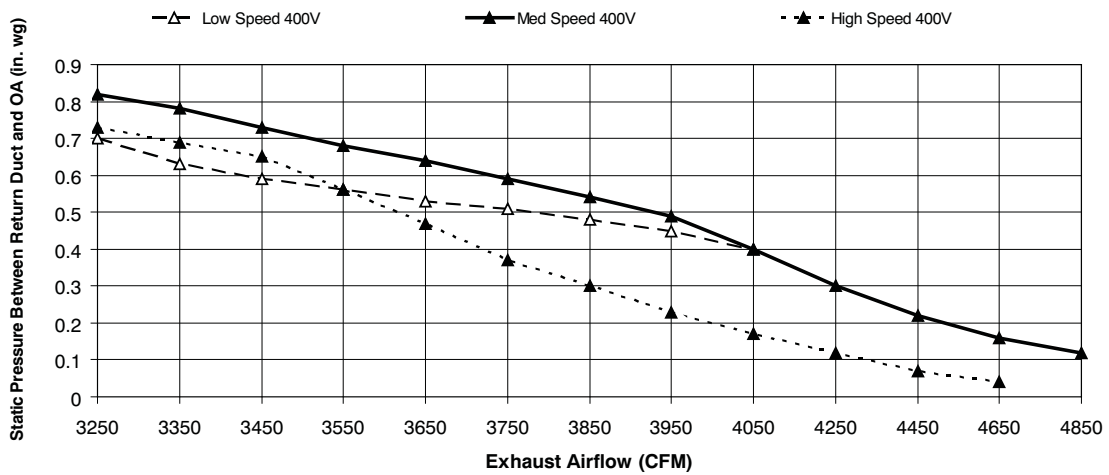


Fig 5 – Power Exhaust Fan Performance

ELECTRICAL INFORMATION

Table 35 – 2 Stage Cooling – Vertical

Unit RAS	V-Ph-Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (EA)		IFM (VERTICAL)			
				RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	FLA
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA				
181	400-3-50	360	440	14.7	95	16.7	111.0	347	0.8	STD	2278	3.57	3.4
										MED	2694	4.62	4.4
										HIGH	6275	7.98	7.6
210	400-3-50	360	440	14.7	95	16.7	111.0	347	0.8	STD	2694	4.62	4.4
										MED	6275	7.98	7.6
										HIGH	6275	7.98	7.6
240	400-3-50	360	440	18.6	118.0	14.7	95	347	0.8	STD	6275	7.98	7.6
										MED	6275	7.98	7.6
										HIGH	8134	11.97	11.4
300	400-3-50	360	440	18.6	118.0	18.6	118.0	347	0.8	STD	6275	7.98	7.6
										MED	6275	7.98	7.6
										HIGH	8134	11.97	11.4

Table 36 – 2 Stage Cooling – Horizontal

Unit RAS	V-Ph-Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (EA)		IFM (HORIZONTAL)			
				RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	FLA
		MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA				
183	400-3-50	360	440	14.7	95	16.7	111.0	347	0.8	STD	2694	4.62	4.4
										STD	2694	4.62	4.4
										HIGH	6275	7.98	7.6
213	400-3-50	360	440	14.7	95	16.7	111.0	347	0.8	STD	6275	7.98	7.6
										STD	6275	7.98	7.6
										HIGH	6275	7.98	7.6
243	400-3-50	360	440	18.6	118.0	14.7	95	347	0.8	STD	6275	7.98	7.6
										STD	6275	7.98	7.6
										HIGH	8134	11.97	11.4
303	400-3-50	360	440	18.6	118.0	18.6	118.0	347	0.8	STD	8134	11.97	11.4
										STD	8134	11.97	11.4
										HIGH	10042	16.9	16.1

Table 37 – MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RAS	NOM. V-PH-HZ	IFM TYPE	IFM FLA	ELECTRIC HEATER		PWR EXH	PWR EXH FLA (EA)	POWER SUPPLY		DISCONNECT SIZE	
				Nom. kW	FLA			MCA	MOCP	FLA	LRA
181-183	400-3-50	STD	3.4	-	-	NONE	-	41.4	50	43	240
				17.4	25.1			41.4	50	43	240
				34.7	50.1			66.9	70	62	240
				52.1	75.2			79.5	90	90	240
		MED	4.4	-	-	NONE	-	42.4	50	44	249
				17.4	25.1			42.4	50	44	249
				34.7	50.1			68.1	70	63	249
				52.1	75.2			80.7	90	92	249
		HIGH	7.6	-	-	NONE	-	45.6	60	48	253
				17.4	25.1			45.6	60	48	253
				34.7	50.1			72.1	80	66	253
				52.1	75.2			84.7	100	95	253
STD	3.4	-	-	YES	3.1	47.6	60	50	252		
		17.4	25.1			47.6	60	50	252		
		34.7	50.1			74.6	80	69	252		
		52.1	75.2			87.2	90	98	252		
MED	4.4	-	-	YES	3.1	48.6	60	51	261		
		17.4	25.1			48.6	60	51	261		
		34.7	50.1			75.9	80	70	261		
		52.1	75.2			88.5	100	99	261		
HIGH	7.6	-	-	YES	3.1	51.8	60	55	265		
		17.4	25.1			51.8	60	55	265		
		34.7	50.1			79.9	80	73	265		
		52.1	75.2			92.5	100	102	265		
210-213	400-3-50	STD	4.4	-	-	NONE	-	42.4	50	44	249
				17.4	25.1			42.4	50	44	249
				34.7	50.1			68.1	70	63	249
				52.1	75.2			80.7	90	92	249
		MED	7.6	-	-	NONE	-	45.6	60	48	253
				17.4	25.1			45.6	60	48	253
				34.7	50.1			72.1	80	66	253
				52.1	75.2			84.7	100	95	253
		HIGH	7.6	-	-	NONE	-	45.6	60	48	253
				17.4	25.1			45.6	60	48	253
				34.7	50.1			72.1	80	66	253
				52.1	75.2			84.7	100	95	253
STD	4.4	-	-	YES	3.1	48.6	60	51	261		
		17.4	25.1			48.6	60	51	261		
		34.7	50.1			75.9	80	70	261		
		52.1	75.2			88.5	100	99	261		
MED	7.6	-	-	YES	3.1	51.8	60	55	265		
		17.4	25.1			51.8	60	55	265		
		34.7	50.1			79.9	80	73	265		
		52.1	75.2			92.5	100	102	265		
HIGH	7.6	-	-	YES	3.1	51.8	60	55	265		
		17.4	25.1			51.8	60	55	265		
		34.7	50.1			79.9	80	73	265		
		52.1	75.2			92.5	100	102	265		

TABLE 37 (Cont.) – MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O. (Cont.)

UNIT RAS	NOM. V-PH-HZ	IFM TYPE	IFM FLA	ELECTRIC HEATER		PWR EXH	PWR EXH FLA (EA)	POWER SUPPLY		DISCONNECT SIZE	
				Nom. kW	FLA			MCA	MOCP	FLA	LRA
240–243	400–3–50	STD	7.6	–	–	NONE	–	48.8	60	51	262
				17.4	25.1			48.8	60	51	262
				34.7	50.1			72.1	80	66	262
				52.1	75.2			84.7	100	95	262
		MED	7.6	–	–	NONE	–	48.8	60	51	262
				17.4	25.1			48.8	60	51	262
				34.7	50.1			72.1	80	66	262
		HIGH	11.4	–	–	NONE	–	52.6	60	55	281
				17.4	25.1			52.6	60	55	281
				34.7	50.1			76.9	80	71	281
		STD	7.6	–	–	YES	3.1	55	60	58	274
				17.4	25.1			55.0	60	58	274
34.7	50.1			79.9	80			73	274		
52.1	75.2			92.5	100			102	274		
MED	7.6	–	–	YES	3.1	55	60	58	274		
		17.4	25.1			55.0	60	58	274		
		34.7	50.1			79.9	80	73	274		
HIGH	11.4	–	–	YES	3.1	58.8	70	62	293		
		17.4	25.1			58.8	70	62	293		
		34.7	50.1			84.6	90	78	293		
300–303	400–3–50	STD	7.6	–	–	NONE	–	52.7	60	55	285
				17.4	25.1			52.7	60	55	285
				34.7	50.1			72.1	80	66	285
				52.1	75.2			84.7	100	95	285
		MED	7.6	–	–	NONE	–	52.7	60	55	285
				17.4	25.1			52.7	60	55	285
				34.7	50.1			72.1	80	66	285
		HIGH	11.4	–	–	NONE	–	56.5	70	60	304
				17.4	25.1			56.5	70	60	304
				34.7	50.1			76.9	80	71	304
		STD	7.6	–	–	YES	3.1	58.9	70	62	297
				17.4	25.1			58.9	70	62	297
34.7	50.1			79.9	80			73	297		
52.1	75.2			92.5	100			102	297		
MED	7.6	–	–	YES	3.1	58.9	70	62	297		
		17.4	25.1			58.9	70	62	297		
		34.7	50.1			79.9	80	73	297		
HIGH	11.4	–	–	YES	3.1	62.7	80	67	316		
		17.4	25.1			62.7	80	67	316		
		34.7	50.1			84.6	90	78	316		
				52.1	75.2			97.2	100	107	316

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



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.

1. 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.

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

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) $227 - 224 = 3 \text{ v}$

(BC) $231 - 227 = 4 \text{ v}$

(AC) $227 - 226 = 1 \text{ v}$

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.

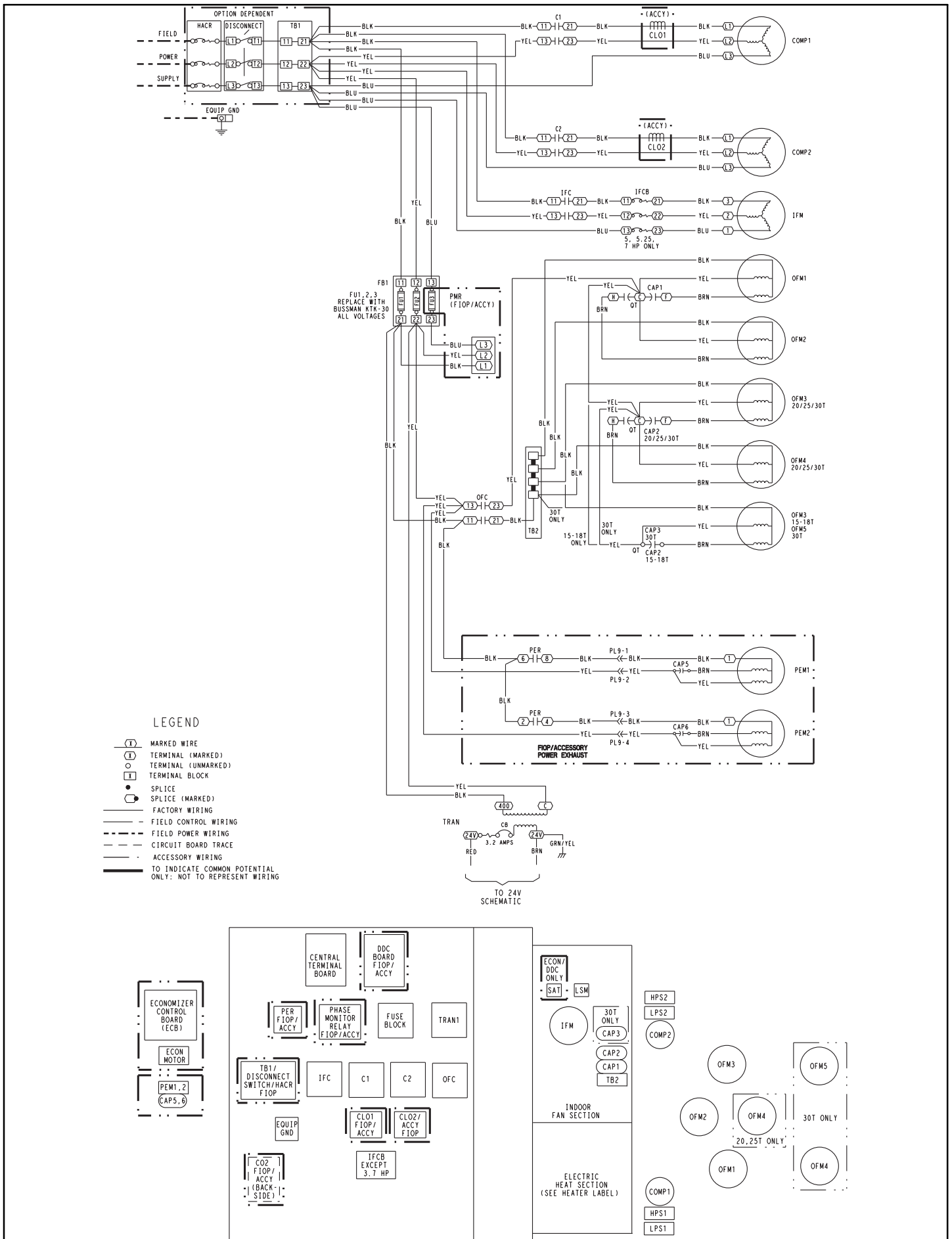


Fig. 4 Typical Power Diagram (2 Stage Cooling)

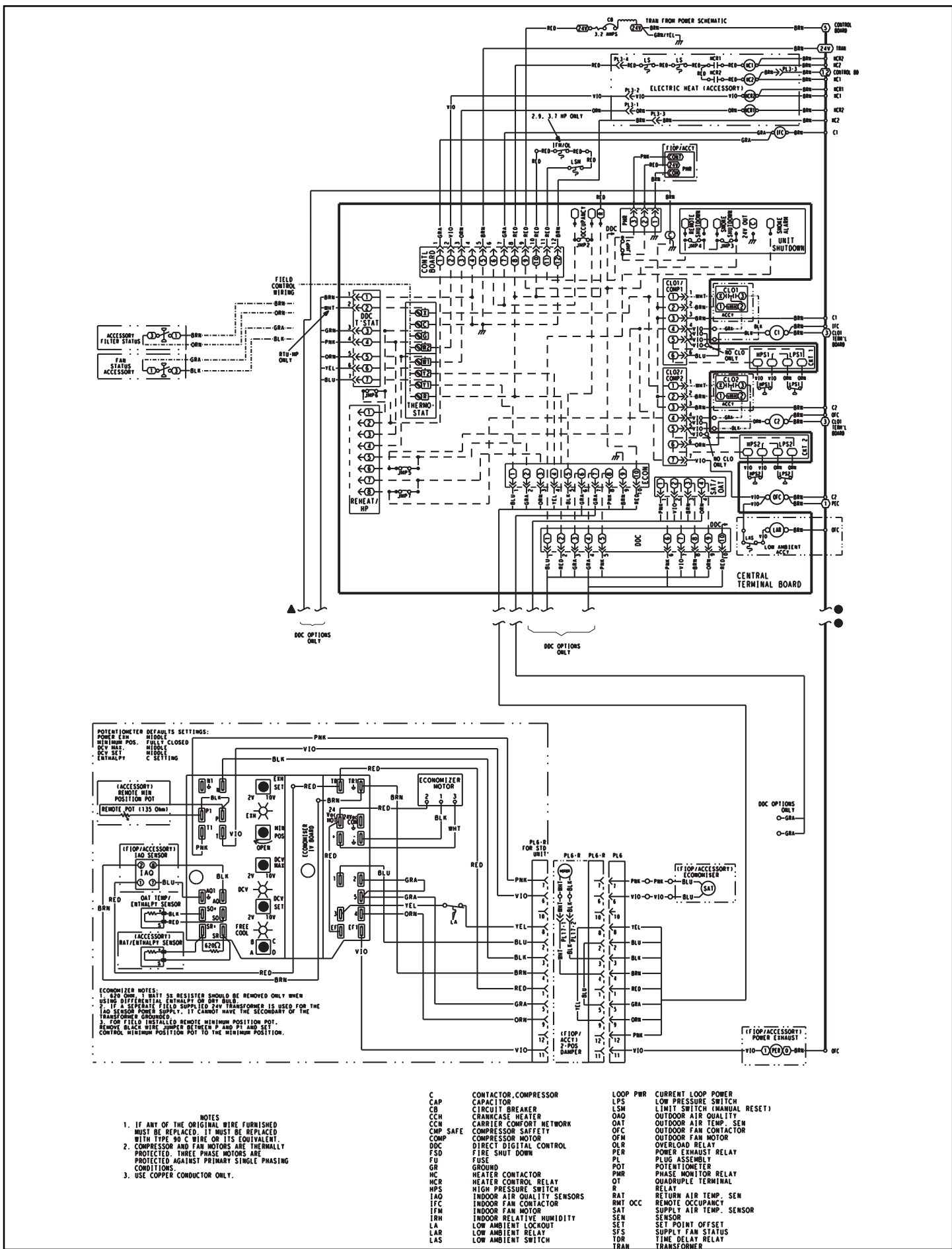


Fig. 5 Typical Control Diagram (2 Stage Cooling)

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 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 either 1 or 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 EconoMi\$er IV control to provide a 10°C (50°F) to 13°C (55°F) mixed-air temperature into the zone. As the mixed air temperature fluctuates above 13°C (55°F) or below 10°C (50°F) 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 9°C (45°F), 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 9°C (48°F). 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 10°C (50°F) to 13°C (55°F). 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 – RAS181 – 303

Note about this specification:

COOLING ONLY / ELECTRIC HEAT PACKAGED ROOFTOP

HVAC Guide Specifications

Size Range:14 to 20 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 13mm (1/2-in.) thick, minimum .7 kg (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, DDC control options, 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.
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 compressors 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, throwaway 51mm (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 panel.
4. 4-in filter capabilities shall be capable with pre engineered and approved Carrier filter track field installed accessory. This kit requires field furnished filters.

23 81 19 Self-Contained Air Conditioners

23 81 19.13 Medium-Capacity Self-Contained Air Conditioners (RAS181-303)

23 81 19.13.A. General

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

23 81 19.13.B. Quality Assurance

1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
2. Unit shall be rated in accordance with AHRI Standard 340/360.
3. Unit shall be designed to conform to ASHRAE 15.
4. 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.
5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
6. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
7. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
8. Unit shall be designed in accordance with ISO 9001:2000, and shall be manufactured in a facility registered by ISO 9001:2000.
9. Roof curb shall be designed to conform to NRCA Standards.
10. 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.
11. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.

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.D. Project Conditions

1. As specified in the contract.

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 52°C (125°F) 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 from 4°C (40°F) , ambient outdoor temperatures. Accessory kits are necessary if mechanically cooling at ambient temperatures below 4°C (40°F).
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 kits 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) 0.076mm/0.003 inches minimum, gloss (per ASTM D523, 16°C/60°F): 60, Hardness: H-2H Pencil hardness.
3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 13mm (1/2-in.) thick, .45 kg (1-lb) density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.
4. Base of unit shall have a minimum of four locations for factory thru-the-base electrical connections. 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 19mm (3/4-in.) -14 NPT drain connection at the end 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 interlocking 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 filters 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. permanently attached, and recessed into the panel.
- e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
- f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

23 81 19.13.I. N/A

23 81 19.13.J. Coils

1. Standard Coils:

- a. Standard evaporator 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. Standard condenser coils shall have all aluminum Micro-channel Heat Exchanger Technology design consisting of aluminum multi port flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.
 - d. 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 Copper-fin evaporator 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.
 3. 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.

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.
 - c. Service gauge connections on suction and discharge lines.
 - d. Pressure gauge access through a specially designed screen on the side of the unit.
2. Compressors
 - a. Unit shall use one fully hermetic, scroll compressor for each independent refrigeration circuit.
 - b. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
 - c. Compressors shall be internally protected from high discharge temperature conditions.
 - d. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
 - e. Compressor shall be factory mounted on rubber grommets.
 - f. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
 - g. 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 51mm (2-in.) thick fiberglass filters.
4. Filters shall be standard, commercially available sizes.
5. Only one size filter per unit is allowed.
6. 102mm (4-in.) filter capability is possible with a field installed pre engineered slide out filter track accessory. 102mm (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 lubricate fittings at are accessible 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 1in 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 4 to 38°C (40 to 100°F). 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 2°C (35°F) and close closes at 10°C (50°F).
- 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.
 - b. Shall consist of solid–state control and condenser–coil temperature sensor to maintain condensing temperature between 32°C (90°F) and 43°C (110°F) at outdoor ambient temperatures down to –29°C (–20°F).
- 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. Thru–the–Base Connectors:
 - a. Kits shall provide connectors to permit electrical connections to be brought to the unit through the unit basepan.
 - b. Minimum of four connection locations per unit.
- 8. Fan/Filter Status Switch:
 - a. Switch shall provide status of indoor evaporator fan (ON/OFF) or filter (CLEAN/DIRTY).
 - b. Status shall be displayed either over communication bus (when used with direct digital controls) or with an indicator light at the thermostat.
- 9. Centrifugal 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.
- 10. Roof Curbs (Vertical):
 - a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
 - b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
 - c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
- 11. High–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.
- 12. Thru–the–Bottom Utility Connectors:
 - a. Kit shall provide connectors to permit gas and electrical connections to be brought to the unit through the basepan.
- 13. 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.
- 14. 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.
- 15. 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, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.
- 16. Smoke detectors:
 - 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.
- 17. 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 -4°C (25°F).
 - c. Shall not be required to operate on an economizer when below an outdoor ambient of 4°C (40°F).
- 18. 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.
- 19. Electric Heat:
 - a. Heating Section
 - (1.) Heater element open coil resistance wire, nickel-chrome alloy, 7.4mm (0.29-in.) 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.