Facility Energy Scoping Assessment Report
City Hall

Prepared by:

RHT Energy Solutions

June 21, 2013

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1.0 Executive Summary

RHT Energy Solutions (RHT) was contracted by the City of Ashland to perform energy audits on its municipal facilities. On February 27, 2013, Buzz Thielemann and Rick Reichert of RHT conducted an energy scoping assessment of the City Hall. The building was originally built in 1913, and has had additions and remodeling done since then. It is now 8,443 square feet in size. The combination one- and two-story building holds offices, storage rooms, a break/copier room, and a meeting room. Many of the spaces have been repurposed over the years, and many are considered inadequate for today's needs.

The City needs to make a quantum decision if the City Hall is to be retained in its current state with inadequate lighting, HVAC, and insulation, or be repurposed with extensive renovation or retrofit. Although improvements for modernization and energy efficiency would require extensive capital, there are also many low cost/no cost energy cost savings opportunities available for the City Hall.

This two-story facility has the advantage of sharing common walls on the first floor, which reduce heat loss and heat gain. Many low cost/no cost measures were identified, as well as a few suggested capital improvements. Due to the single paned windows and use of portable heaters, employee comfort is compromised. The thermostat is sometimes set to run on continuous fan, blowing cold air on the date of this audit, the offices were observed to be cold and many of the employees uncomfortable. The facility is lacking adequate insulation, which results in heat loss and employee discomfort as well. Some of the energy management practices need to be modified to improve employee comfort and for the City to realize greater energy savings.

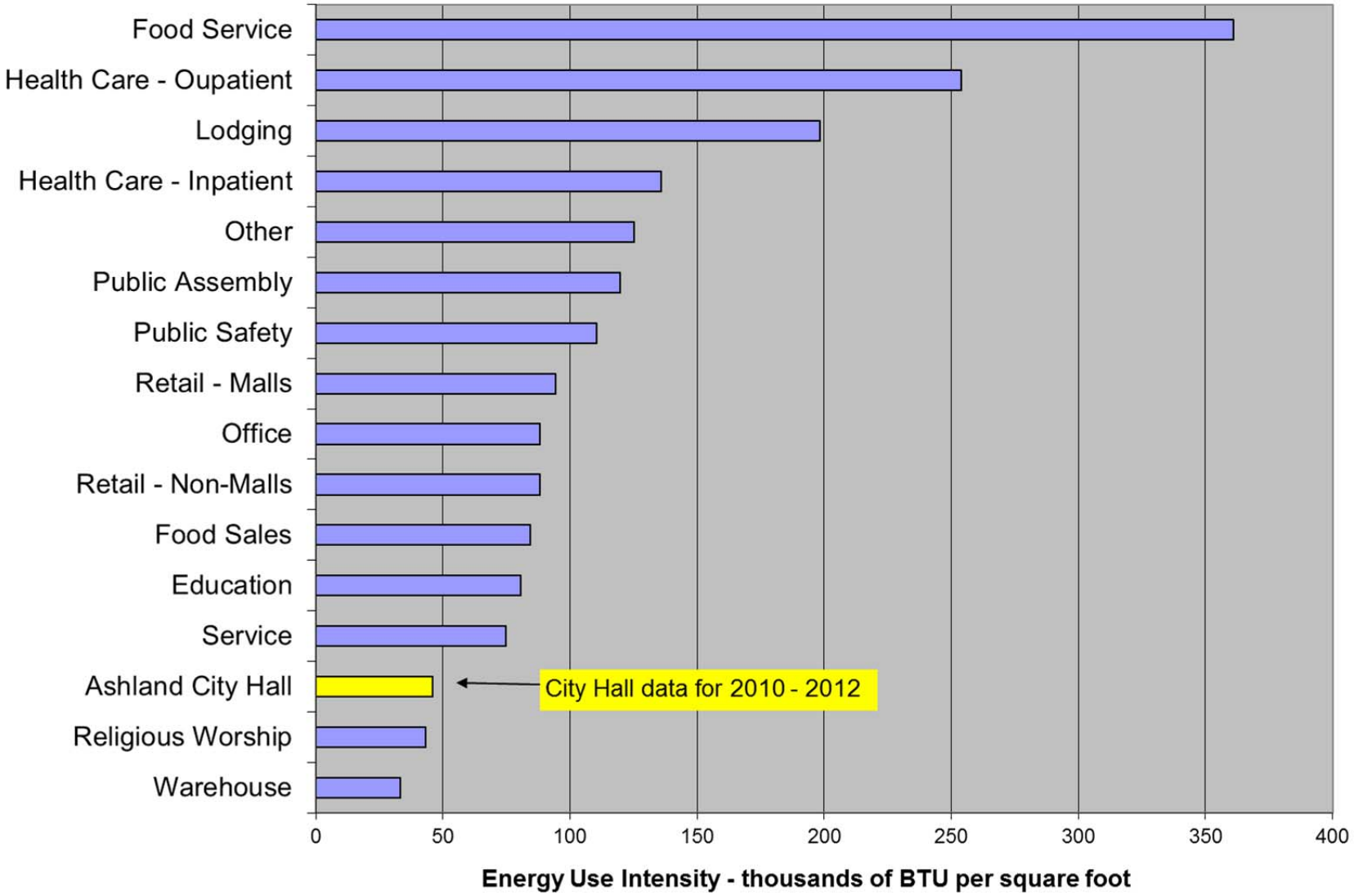
2.0 Historical energy use, occupancy, operation and occupant behavior

The City Hall's operating hours are typically 7AM to 6PM, Monday through Friday with occasional evening usage of meeting rooms. The following table summarizes the past energy data and Energy Use Index (EUI). See also the chart on the following page. EUI is a unit of measurement that describes a building's energy use relative to its size. To calculate EUI the total kWh and therm consumptions were converted to kBTU.

Meter #	Total Annual Use	Unit (kwh/therm)	Converted to kBTU	Square Feet	Average Annual EUI
14292	110,000	kWh	375,430	8,443	**44.47**

Note: The gas meter at the City Hall only serves the back-up generator, so is not included in the EUI calculation (see Appendix A for electrical energy history).

Average Energy Use Intensity, 1990 - 2003
Data Source: U.S. Department of Energy, Buildings Energy Data Book, Table 3.1.9



The City Hall has an EUI of 44.47. According to the U.S. Department of Energy, the average EUI for a building this size with a similar purpose is 54. The EUI for the City Hall falls below the median range for energy efficiency for this type of facility; i.e., it is better than the median. EUI, however, is a very general evaluation that makes no consideration for the age of the building, hours of operation, specific use, and number of shared walls and floors. For this reason, EUI may not be representative of true building efficiency. The use of heat pumps for primary heating also helps to provide a low EUI, and makes up for some of the shortcomings in the building.

2.1 Existing Equipment

Following is a table noting the existing HVAC and other hard-wired equipment at the City Hall (see Appendix F for existing equipment data sheets).

Description	Qty	Size	Make	Model	Age (years)	Serial Number	Eff	Location
Heat Pump #1	1	4.0 tons	Carrier	50TJQ004-501QE	5+	3300G20309	SEER: 10 HSPF: 7	2nd story roof
Heat Pump #2	1	4.0 tons	Carrier	50TJQ004-501QE	5+	3000G24855	"	2nd story roof
Heat Pump #3	1	1.5 tons	Payne	PH10JA018-B	new	2097E27041	SEER: 10 HSPF: 7	2nd story roof
Heat Pump #4	1	12.0 tons	Carrier	38AQS012---530---	5+	4399F58247	SEER: 10	on shed roof
HVAC Air Handler	1	1.49kW	Carrier	40RT012530	5+	D995930	n/a	Inside shed
HVAC Air Handler	3	750 Watts	Carrier	Varies	5+	Varies	n/a	Attic
Water Heater	1	19.9 gal, 4.0 kW	Rheem	81VP20S	1	RH 0910R02509	"Energy Miser"	2nd floor attic
Water Heater, instant	1	2/3 gallon, 750 Watts	In-Sinkerator	SST	2+		n/a	2nd floor break room
Window Air Conditioner	1	750 Watts	Carrier		5+			Office on 2nd floor (rarely used)

Totals:	9,216	19,668
Lighting density Watts per Sq. Ft.:	1.1	

3.0 Energy Efficiency Measures

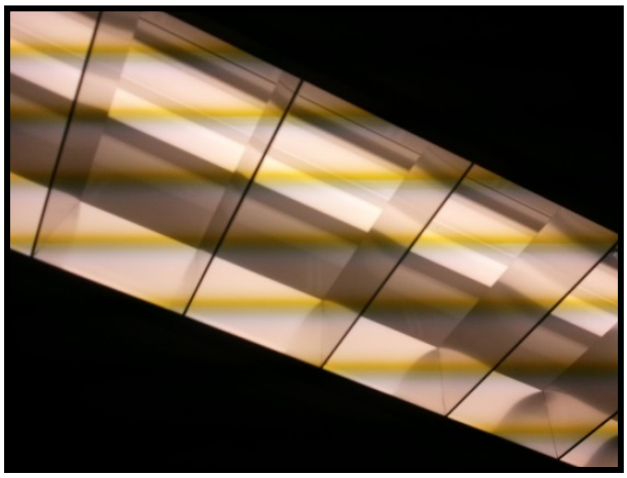
Following are the capital energy efficiency measures that were identified. Note that several low cost/no cost measures were also identified (see Section 1.4), as were two capital improvements that were deemed impractical, (see Section 1.7 and Appendix E).

#	Description	Estimated Annual Energy Savings	Unit (kWh / therms)	Estimated Annual Energy Cost Savings	Estimated Project Cost	Pre-Incentive Payback (Years)	EEM Life Expectancy (Years)
1	Lighting: Replace 38 magnetic ballasts now in use with electronic ballasts.	474	kWh	$32	$1,900	59.4 **	15
2	Lighting: De-lamp or re-fixture to achieve lighting density of approximately 0.91 Watts per square foot.	3,255	kWh	$221	$240	1.1	15
3	Install PC Power Management Software	4,281	kWh	$290	$980	3.4	15

** Note: Though the payback is long, this EEM is recommended for its non-energy benefits relative to employee comfort. Current magnetic ballasts flicker at 60 cycles per second, which can cause headaches and vision issues.

EEM 1: Lighting - Replace 38 magnetic ballasts with electronic versions

During the audit it was found that many fluorescent fixtures have been converted from T-12 to T-8, but the magnetic ballasts have been retained. This nullifies over half the energy savings. Also, magnetic ballasts flicker at 60 cycles per second which can cause headaches. Change all ballasts to electronic. On any de-lamped fixture, ensure the second ballast is electrically disconnected.



Note strobing effect of using magnetic ballast with T-8 lamps

EEM 2: Lighting - De-lamp or re-fixture to achieve lighting density of approximately 0.91 Watts per square foot.

The code in Oregon for office lighting is 0.91 Watts per square foot (per 2010 Oregon Energy Efficiency Specialty Code). Overall, the City Hall now has a lighting density of 1.1 Watts per square foot. However, in certain areas it is much higher. For example, in the front office of the City Hall there are 24 four-lamp fixtures, giving a lighting density of 1.9 Watts per square foot. This over-saturation of light is absorbed because of the dark colors that have been selected for wall paint. Thus lighting density could easily be reduced by de-lamping and utilizing lighter colors for wall paint.

Mismatch of T8 color temperature (Kelvin) in troffer

Fluorescent lamp selection note:
All fluorescent tubes should be identical for use at all City properties. Currently, it is commonplace for the same troffer fixture to contain warm white, cool white, and daylight temperature tubes. This looks unprofessional and it is not efficient. It is recommended that the City use T-8, 4100K, 800 series lamps at all locations and that the lamps are bought at one time from the same source (e.g.: GE, Sylvania, Phillips), as different manufacturers have different appearances even though the labeling is the same. Replace all lamps in a facility when 10% of the population fail. See Lighting Plug Loads in Appendix B for recommended retrofit and estimated energy savings.

EEM 3: Install PC Power Management Software to Regulate PCs and turn off monitors: Install PC power management software, which will put the computers into the lowest power demand state when idle for a specified length of time. PC power management software is centrally managed and applied to as many computers as possible in order to be cost-effective. It is beyond the scope of this report to select a PC power management software or service vendor. It is assumed that the City I.T. department will be in charge of this effort and will select the software and provide ongoing management of the chosen system. Impact on individual computer users is typically very minimal – the user simply opts-in to an email inviting participation in computer power management.

A conservative estimate of annual savings is approximately 153 kWh/yr/computer. Thus for City Hall, 28 computers x 153 kWh/yr approximately = 4,281 kWh/yr or roughly $290 per year. The cost of the PC power management software is a savings of approximately $35/computer, for a total of $980. Simple payback for this EEM is approximately 3.4 years.

To further conserve energy and reduce annual energy costs, a City-wide policy should be established to turn off all desktop computer monitors before leaving the building.

Power management software is available from several vendors. A few are listed below, in alphabetical order. There are many others to consider as well.

- IBM Endpoint Manager for Power Management http://www-03.ibm.com/software/products/us/en/ibmendpmanaforpowemana/
- Power Save Enterprise http://www.faronics.com/products/power-save/enterprise/
- PwrSmart http://www.newboundary.com
- Verdiem http://www.verdiem.com
- Verismic http://www.verismic.com

4.0 Low Cost / No Cost Recommendations

Ashland City Hall has many low cost/no cost opportunities, all of which should be explored before capital expenditures occur. Following is a table, and subsequent detail, indicating the low cost/no cost measures in the order of energy savings potential, with the measures with the greatest estimated savings potential listed first (see also Appendix D):

#	Description of Low-Cost / No Cost Recommendation	Estimated Annual Energy Savings	Unit (kWh / therms)	Estimated Annual Energy Cost Savings	Estimated Project Cost	Pre-Incentive Payback (Years)	EEM Life Expectancy (Years)
1	Establish new city portable heater policy and require removal of non-compliant units	1,451	kWh	$98	$0	0	Unlimited
2	Install lock box on 1st floor thermostat	1,162	kWh	$79	$50	1.6	15
3	Install occupancy sensors or simple mechanical timers for lighting in restrooms	200	kWh	$14	$100	7.1	10
4	Repair front main entry door seals	100	kWh	$7	$50	7.1	10
5	Standardize interior wall paint to lighter colors to improve illumination	Energy savings occurs only as a result of the de-lamping possible with lighter interior wall and ceiling paint colors.					

Low cost/no cost Recommendation 1: Establish new City portable heater policy:
A City policy on the use of portable heaters should be established immediately, and the use of all existing portable heaters should be stopped immediately pending City review. During the audit it was discovered that on February 27th, with an outdoor temperature of 47°F, the 12 ton heat pump located on the shed roof remained inoperative, partially because the first floor of the facility was being heated by portable heaters lodged under or near employees' desks, and also by other electronic equipment. Portable heaters are resistance heating devices with a C.O.P. (Coefficient of Performance) of 1.0, and they deliver 3,413 BTU per hour per kilowatt. The heat pump serving the first floor has a C.O.P. of 3.1 and delivers approximately 10,580 BTU per hour per kilowatt. Thus the heat pump is a much more efficient way to provide heat. In addition to providing inefficient heat, using portable heaters can add to the discomfort of other employees. For example, at the time of the site visit the 1st floor thermostat was set to have the air handler fan run continuously. This meant it was blowing colder air than normal because the heat pump was not coming on. When the heat pump is operating, the air being blown into the ductwork is at approximately 90° F. However, when portable heaters and other electronic equipment heat the air enough to keep the thermostat just above the set-point, the heat pump is not running but the fan is on, and the air coming out of the ducts is at approximately 70°F and is thus perceived as being "cold" compared to the usual 90°F air provided by the heat pump. This condition caused some employees receiving "cold" air to close off their HVAC duct vents, and to rely solely on their inefficient portable heaters for office heating.

Oil filled combination convection / radiation desk heater in City Hall
(Per proposed new City policy, this unit is not of the flat-panel type and should be disallowed.)

Flat-panel type heater

Portable heaters that incorporate fans operate in convection mode to heat the air, when in fact the heat is really needed by the person. Radiant flat-panel heaters operate primarily in radiation mode, providing heat directly to dense objects, including human bodies, and are thus recommended for staff use as approved by City management. Note that radiant flat-panel heaters are recommended, and not the heaters that look like traditional steam radiators (see picture above).

Because there is a wide variance in thermal comfort with all people, a wise choice would be to require the use of radiant flat-panel vanity/desk heaters with input power of 200-400 Watts each. Experience has shown that the smaller 100-watt panels do not provide adequate employee comfort and should be avoided. Even the use of a 400 Watt maximum radiant flat-panel portable heater consumes far less power than the 500-1500 Watt (adjustable) portable heaters that are now being allowed. Radiant flat-panel heaters can provide a comfortable work station for those who need extra heat without dramatically impacting thermostat functions, since they heat people rather than air.

Please note that all portable electric heaters have the same energy efficiency regardless of a manufacturer's claim, Quartz, infrared, oil are all the same efficiency.

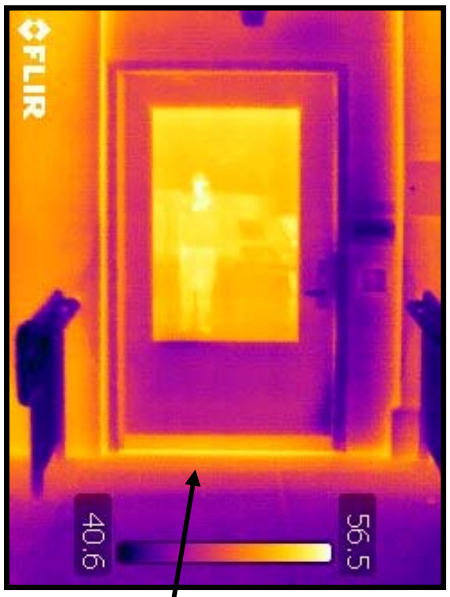
Low cost/no cost Recommendation 1 requires the creation of a new City portable heater policy, staff education and cultural changes. Care should be taken to roll out the new policy in the best way possible to maximize acceptance by City staff. A sample portable heater policy including a list of recommended portable radiant flat-panel heaters is in the summary report Appendix.

Low Cost/No Cost Recommendation 2: Install Lock Box on 1st Floor Thermostat:

As mentioned in Recommendation 1 above, the large air handler serving the first floor of the building was observed to be operating, even though the 12-ton heat pump was not running. It was discovered that the 1st floor thermostat was set to run continuously. Discussion with building staff revealed that this thermostat does get "tampered with". To resolve this problem it is recommended that an appropriate lock box be placed over the thermostat to prevent unwanted changes to the settings. It is generally recommended to have the air handler fan come on only when the heat pump is operating. Should additional ventilation be required, it is further recommended to have the system reviewed by trained HVAC professionals to determine appropriate solutions.

Low Cost/No Cost Recommendation 3: Install occupancy sensors or simple mechanical timers to restroom lighting:
This will ensure that non-priority lights do not remain on when not in use. Be sure to use program-start ballasts (not rapid-start) if occupancy sensors are used with fluorescent lamps that are subject to on-and-off short run times.

Low Cost/No Cost Recommendation 4: Repair front main entry door seals:
The seals on the main entry door facing Main Street should be replaced with tighter-fitting seals to reduce outside unconditioned air infiltration. Infrared photo shows leakage around the door.



Infrared image shows heat leakage at bottom door seal

Low Cost/No Cost Recommendation 5: Standardize interior wall and ceiling paint to lighter colors to improve illumination:
It is highly recommended that the City of Ashland select and standardize colors that give a high reflectance that can reduce lighting density, thereby improving illumination and saving energy while reducing employee eye strain. Use white ceilings, white or off-white walls, and light-to-medium colored carpets. Implementation of lighter colors will allow for de-lamping of some overhead fluorescent fixtures, thus saving some annual energy cost.

5.0 Potential Capital Improvements

Two capital improvements would save energy if implemented, but were deemed impractical due to long simple payback. See Section 1.7 below.

6.0 Non-Energy Benefits

Currently many City Hall employees are uncomfortable at their work stations. Since many magnetic ballasts are still in use in overhead fluorescent fixtures, the lighting flickers at 60 Hz and can cause headaches. In addition, the HVAC system fails to provide adequate comfort. These shortcomings accumulate to poor work production, discontent, and increased sick days. Improving the overhead lighting and providing adequate workstation HVAC comfort would translate into more productive employees with higher job satisfaction.

7.0 Measures Identified but Deemed Impractical

The following table shows those recommendations that were initially considered, but then deemed impractical due to long simple payback (see also Appendix E).

#	Description	Annual Energy Savings	Unit (kWh)	Annual Energy Cost Savings	Project Cost	Pre-Incentive Simple Payback (Years)	EEM Life (Years)
1	Add R12 insulation to exterior walls that are not adjacent to another building.	11,000	kWh	$746	$24,480	33	20
2	Replace all single-paned windows and frames with double-pane versions.	5,500	kWh	$373	$34,000	91	20

#1: Add R12 insulation to areas of the exterior walls that are inadequately insulated.

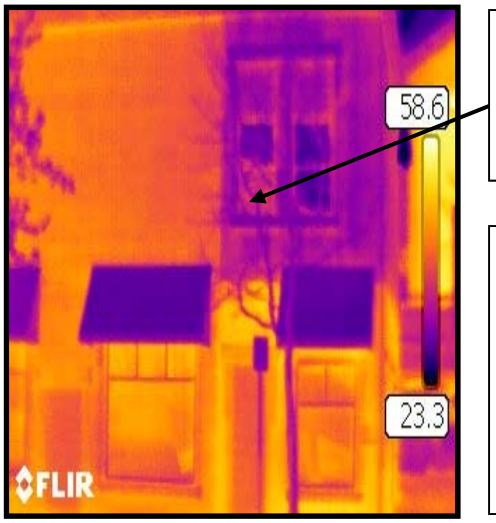
With the exception of the relatively new addition in the corner of the 2nd story, City Hall walls are inadequately insulated. This table shows the estimated insulation the City Hall currently has, and the recommended R-values:

	Estimated R-Values		
Area	Original Area As-Found	Original Area Recommended	New 2nd Floor Addition As-Found
Block / Brick	1.50	1.50	13.0
Inside Film	0.32	0.32	0.32
Outside Film	0.10	0.10	0.10
Sheet Rock	0.75	0.75	0.75
Dryvet	0.00	0.00	0.50
Recommended Additional Wall Insulation	n/a	12	n/a
Total R Value	**2.67**	**14.67**	**14.67**

Additional wall insulation should be considered for the exterior walls of this building that do not have adequate insulation, are not next to walls of an adjacent building. The lack of adequate wall insulation causes excessive heating and cooling loads in the areas

adjacent to external walls. This leads to reduced employee comfort, and a decrease in energy efficiency.

(See table above and infrared picture below.) Adding insulation to exterior walls would reduce the annual heating and cooling electricity costs for City Hall. The estimated annual energy savings is 11,000 kWh for an approximate annual energy cost savings of $746. With an estimated installed cost of $24,480, the simple payback would be 33 years. This simple payback is considered too long to be practical. However, if the building should undergo a major remodel, additional insulation should be added to the exterior walls as part of that remodel.



Note: bottom right window pane was not closed all the way. Infrared shows heat loss as a result of that.

Infrared image shows the difference between the relatively new 2nd floor addition (around the upper right window) and the older portion of the building, where more heat loss occurs through the walls and windows.

#2: Replace all single paned windows with double paned U-0.32 windows: Replacing the single paned windows with double paned windows will help keep the offices warmer during the winter and cut down on drafts and noise. During the summer, the double paned windows can cut down on heat gain, especially on the westerly facing windows and therefore help to reduce air conditioning costs. This measure was deemed impractical, however, because of the long simple payback time. Also, City Hall is a historical building, and as such, State Historical Preservation Office requirements would need to be adhered to, which adds costs to the project. The estimated annual energy savings is 5,500 kWh for an approximate annual energy cost savings of $373. With an estimated installed cost of $34,000, the simple payback would be 91 years. This simple payback is considered far too long to be practical.

8.0 Bundled Measures for Maximum Synergistic Energy Savings Impact

Consider doing wall and ceiling painting, overhead fluorescent lamp replacement, and any needed de-lamping together at a time when the City Hall is closed.

9.0 General Facility Data

Operating hours: Typically 7am to 6pm, Monday – Friday with occasional evening usage of meeting rooms.

Domestic hot water: An instant water heater was observed under the sink on the 2nd floor break room. The water heater for the restrooms is an electric unit located in the 2nd floor attic and is 20 gallons in size.

HVAC: Ducted system controlled by individual thermostats in various parts of the building.

Space Heating: Provided by four heat pumps. Three heat pumps are located on the two-story roof, while one heat pump and a large air handler are located in a shed above the one-story section of the building. Many employees utilize small forced-air electric or oil-filled radiant electric heaters to provide localized heat. These units typically have an adjustable range from about 500 to 1500 Watts, and are normally operated at about half power.

Space Cooling: Provided by four heat pumps. One office on the back side of the second floor also has a window air conditioner installed.

Overhead lighting: Provided by a mix of 2-foot and 4-foot T8 and T12 fluorescent fixtures with a mix of both magnetic and electronic ballasts. In some fixtures lamps had been removed, but the ballasts were still energized. Lamps were of various color temperatures. Spot-checks of light intensity ranged from 56 to 110 foot-candles at desktop level.

Skylights: None.

Exit signs: All are low-wattage LED units.

Windows: A combination of single-paned and double-paned, wood-framed and aluminum-framed windows are in use. Windows are not tinted, per City historical building guidelines. Most appear to be well-sealed, although one or two were not.

Exterior walls: The structure is a combination of original masonry and newer concrete block and/or frame construction. All exterior walls appear to be well-insulated on the inside of the building. While the walls have had some earthquake protection reinforcements installed, additional protection is deemed needed by City staff.

Exterior Door Seals: Two exterior doors were in good condition, while the main entry door facing Main Street requires seal repair.

Floor Insulation: None – concrete slab.

Ceiling Insulation: Assumed to be insulated but not observed.

Roofing: Membrane over 3-inch foam insulation (estimated).

Exterior Lighting: Assumed to be high-pressure sodium (HPS) on daylight sensor control.

Electric meter number: 14292

Natural Gas meter number: 123710 (serves the back-up generator)

10.0 Additional pictures

1.5 Ton Heat Pump on Roof

Two 4 Ton Heat Pumps on roof

Heat Pump #4 on shed roof
(Large air handler is inside shed)

Stationary Heat Pump
Condenser Fan

Stand-by generators

11.0 Appendix

Appendix A – Energy Data

Appendix B – Lighting and Plug Loads
(CityHall-LightingPlugLoadsEEMs-130522.xls)

Appendix C – Energy Efficiency Measures
(CityHall-LightingPlugLoadsEEMs-130522.xls)

Appendix D – Low Cost/No Cost Measures
(CityHall-LightingPlugLoadsEEMs-130522.xls)

Appendix E – Deemed Impractical Energy Efficiency Measures
(CityHall-InsulationWindows-DeemedImpractical-130521.xls)

Appendix F – Equipment Data Sheets
(Carrier-38aqs-5pd.pdf)
(Carrier-40rr,rt-1p.pdf)
(Carrier-50tjq-1pd.pdf)
(Payne-PH10JA Product Data.pdf)
(Rheem-RH_POU_SpecSheet_101-8_Rev20.pdf)

Appendix A – Energy Data

Energy Data - City Hall - Electricity Only

City Hall				Meter #:	14292 / 01 720 643		
				Months	24	Converted to kBTU	375,430
Electricity				Square Feet	8,443	Average Annual EUI	44.466

Start Date	End Date	Days in Period	kWh	$	Avg $/kWh
10/08/2012	11/07/2012	30	7,640	$ 563.43	0.0737
09/10/2012	10/08/2012	28	7,240	$ 539.84	0.0746
08/08/2012	09/10/2012	33	7,640	$ 563.43	0.0737
07/08/2012	08/08/2012	31	8,320	$ 603.53	0.0725
06/09/2012	07/08/2012	29	7,200	$ 537.48	0.0747
05/08/2012	06/09/2012	32	7,440	$ 551.64	0.0741
04/09/2012	05/08/2012	29	7,520	$ 556.35	0.0740
03/09/2012	04/09/2012	31	9,240	$ 657.78	0.0712
02/07/2012	03/09/2012	31	12,440	$ 846.49	0.0680
01/08/2012	02/07/2012	30	11,360	$ 782.80	0.0689
12/09/2011	01/08/2012	30	13,280	$ 896.02	0.0675
11/08/2011	12/09/2011	31	10,200	$ 714.39	0.0700
10/20/2011	11/08/2011	19	8,360	$ 403.93	0.0483
10/11/2011	10/20/2011	9	8,360	$ 194.21	0.0232
09/10/2011	10/11/2011	31	6,200	$ 460.15	0.0742
08/08/2011	09/10/2011	33	8,760	$ 605.33	0.0691
07/07/2011	08/08/2011	32	6,560	$ 480.57	0.0733
06/05/2011	07/07/2011	32	7,840	$ 553.16	0.0706
05/08/2011	06/05/2011	28	7,640	$ 541.81	0.0709
04/10/2011	05/08/2011	28	7,200	$ 516.86	0.0718
03/09/2011	04/10/2011	32	13,080	$ 850.32	0.0650
02/09/2011	03/09/2011	28	11,200	$ 743.70	0.0664
01/10/2011	02/09/2011	30	13,520	$ 875.27	0.0647
12/08/2010	01/10/2011	33	11,760	$ 775.46	0.0659
Total 24 months			**220,000**	**$ 14,813.95**	
Average / month			**9,167**	**$ 617.25**	
Average / year			**110,000**	**$ 7,406.98**	

Appendix B – Lighting and Plug Loads

City Hall Lighting and Plug Loads Summary, from 5/10/13 site visit

	Lighting	
	Watts	kWh / yr
1st Floor:	5,474	11,858
2nd Floor:	3,742	7,810
Total:	9,216	19,668

	Plug Loads	
	Watts	kWh / yr
1st Floor:	12,510	16,073
2nd Floor:	10,160	17,588
Total:	22,670	33,661

		Bldg Sq Ft:	**8,443**
Lighting watts/sqft:	**1.1**	**Plug Loads watts/sqft:**	**2.7**

Lighting	1st Floor Qty	2nd Floor Qty	Total Fixture Qty	Lamps per Fixture	Total Linear Fluorescent Lamp Qty	Total watts lighting	Total kWh / year
1L 4' T8 w/ Mag Ballast	6	1	7	1	7	294	611
2L 2' T8 w/ Mag Ballast	1	2	3	2	6	222	954
1L 4' T8 w/ Elec Ballast	0	34	34	1	34	1224	2,546
2L 4' T8 w/ Elec Ballast	28	7	35	2	70	2380	4,950
2L 4' T8 w/ Mag Ballast	22	0	22	2	44	1628	3,386
2L 4' T8 w/ Mag Ballast w/ only 1 lamp in use	4	0	4	2	8	144	300
3L 4' T8 w/ Mag Ballast	1	0	1	3	3	106	220
4L 4' T8 w/ Elec Ballast	8	10	18	4	72	2376	4,942
4L 4' T8 w/ Elec Ballast w/ only 2 lamps in use	0	7	7	4	28	476	990
4L 4' T8 w/ Mag Ballast	1	0	1	4	4	138	287
CFL - Recessed Ceiling CFL	11	4	15			195	405
CFL - Screw-in	1	0	1			13	7
Exit Sign	4	1	5			20	70
				Totals:	**276**	**9,216**	**19,668**

Magnetic Ballast Total:	**38**

Plug Loads	1st Floor	2nd Floor	Total	Total watts plugs	Total kWh / year
Coffee Maker	2	1	3	3,000	1,014
Computer - Desktop	17	11	28	3,920	12,231
Computer Monitor - LCD	21	18	39	3,510	9,126
Computer Printer	8	8	16	1,600	416
Copy Machine	1	1	2	1,000	260
Fan, Personal	1	1	2	100	63
Heaters, Personal	4	3	7	5,250	3,570
Laminator	1	0	1	500	65
Microwave Oven	1	1	2	2,400	312
Network Equipment	0	3	3	300	2,628
Panaboard	0	1	1	100	21
Refrigerator	1	1	2	300	874
Shredder	1	2	3	240	16
Soda Vending Machine	0	1	1	150	437
Telecom Equipment	0	3	3	300	2,628
				22,670	**33,661**

1st Floor - City Hall Lighting from 5/10/13 site visit								
1st Floor	# of Fixtures	Estimated Watts / Fixture	Total Watts	Hours / Day	Days / Week	Weeks / Year	Hours / Year	kWh / Year
1L 4' T8 w/ Mag Ballast	6	42	252	8	5	52	2,080	524
2L 2' T8 w/ Mag Ballast	1	74	74	24	7	52	8,736	646
2L 4' T8 w/ Elec Ballast	28	68	1904	8	5	52	2,080	3,960
2L 4' T8 w/ Mag Ballast	22	74	1628	8	5	52	2,080	3,386
2L 4' T8 w/ Mag Ballast w/ only 1 lamp in use	4	36	144	8	5	52	2,080	300
3L 4' T8 w/ Mag Ballast	1	106	106	8	5	52	2,080	220
4L 4' T8 w/ Elec Ballast	8	132	1056	8	5	52	2,080	2,196
4L 4' T8 w/ Mag Ballast	1	138	138	8	5	52	2,080	287
CFL - Recessed Ceiling CFL	11	13	143	8	5	52	2,080	297
CFL - Screw-in	1	13	13	2	5	52	520	7
Exit Sign	4	4	16	24	7	52	8,760	35
1st Floor Lighting Watts Total:			**5,474**					
							1st Floor Lighting kWh Total:	**11,858**

1st Floor - City Hall Plug Loads from 5/10/13 site visit								
Coffee Maker @ 33% duty cycle	2	1,000	2,000	1.3	5	52	338	676
Computer - Desktop	17	140	2,380	12	5	52	3120	7,426
Computer Monitor - LCD	21	90	1,890	10	5	52	2600	4,914
Computer Printer	8	100	800	1	5	52	260	208
Copy Machine	1	500	500	1	5	52	260	130
Fan, Personal	1	50	50	4	5	18	360	18
Heaters, Personal @ 50% max	4	750	3,000	4	5	34	680	2,040
Laminator	1	500	500	0.5	5	52	130	65
Microwave Oven	1	1,200	1,200	0.5	5	52	130	156
Refrigerator (@ 33% duty cycle)	1	150	150	8	7	52	2912	437
Shredder	1	40	40	0.25	5	52	65	3
1st Floor Plug Loads Watts Total:			**12,510**					
							1st Floor Plug Loads kWh Total:	**16,073**

Magnetic Ballast Watts:	**10**
Electronic Ballast Watts:	**4**
T8 Watts:	**32**

2nd Floor - City Hall Lighting Summary from 5/10/13 site visit								
2nd Floor	# of Fixtures	Watts / Fixture	Total Watts	Hours / Day	Days / Wk	Wks / Year	Hours / Year	kWh / Year
1L 4' T8 w/ Mag Ballast	1	42	42	8	5	52	2,080	87
2L 2' T8 w/ Mag Ballast	2	74	148	8	5	52	2,080	308
1L 4' T8 w/ Elec Ballast	34	36	1224	8	5	52	2,080	2,546
2L 4' T8 w/ Elec Ballast	7	68	476	8	5	52	2,080	990
4L 4' T8 w/ Elec Ballast	10	132	1320	8	5	52	2,080	2,746
4L 4' T8 w/ Elec Ballast w/ only 2 lamps in use	7	68	476	8	5	52	2,080	990
CFL - Recessed Ceiling CFL	4	13	52	8	5	52	2,080	108
Exit Sign	1	4	4	24	7	52	8,760	35
2nd Floor Lighting Watts Total:			**3,742**					
							2nd Floor Lighting kWh Total:	**7,810**

2nd Floor - City Hall Plug Loads Summary from 5/10/13 site visit								
Coffee Maker @ 33% duty cycle	1	1000	1000	1.3	5	52	338	338
Computer - Desktop	11	140	1540	12	5	52	3,120	4,805
Computer Monitor - LCD	18	90	1620	10	5	52	2,600	4,212
Computer Printer	8	100	800	1	5	52	260	208
Copy Machine	1	500	500	1	5	52	260	130
Fan, Personal	1	50	50	10	5	18	900	45
Heaters, Personal @ 50% max	3	750	2250	4	5	34	680	1,530
Microwave Oven	1	1200	1200	0.5	5	52	130	156
Network Equipment	3	100	300	24	7	52	8,760	2,628
Panaboard	1	100	100	2	2	52	208	21
Refrigerator @ 33% duty cycle	1	150	150	8	7	52	2,912	437
Shredder	2	100	200	0.25	5	52	65	13
Soda Vending Machine w/ Economizer @ 33% duty cycle	1	150	150	8	7	52	2,912	437
Telecom Equipment	3	100	300	24	7	52	8,760	2,628
2nd Floor Plug Loads Watts Total:			**10,160**					
							2nd Floor Plug Loads kWh Total:	**17,588**

Magnetic Ballast Watts:	**10**
Electronic Ballast Watts:	**4**
T8 Watts:	**32**

Appendix C – Energy Efficiency Measures

Ashland City Hall EEM 1:	Replace magnetic ballasts with electronic	

Electricity Rate:	$ 0.068	per kWh

Qty:	38	ballasts
Estimated energy savings:	6	Watts / ballast
Total energy savings:	228	Watts / ballast

Estimated operating hours:	2,080	hours per year
Annual energy savings:	474,240	Watt-hours per year
Annual energy savings:	**474**	kWh per year

Annual cost savings:	**$ -**	per year

Estimated new ballast cost:	$ 25	each
Estimated installation cost:	$ 25	each
Total replacement cost:	$ 50	each

Total project cost:	**$ 1,900**

Simple Payback:	**59**	years

Note: Though the simple payback on this is long, the EEM is recommended for its non-energy benefits relative to employee comfort. Current magnetic ballasts flicker at 60 cycles per second, which can cause headaches and vision issues.

Ashland City Hall EEM 2:	**De-lamp to achieve lighting density of 0.91 Watts / sq.ft.**	
Electricity Rate:	$ 0.068	per kWh
Existing lighting density:	1.1	Watts / sq.ft.
Required lighting density:	0.91	Watts / sq.ft.
Reduction required:	0.19	Watts / sq.ft.
Percent reduction needed:	17.3%	(=0.19/1.1)
Existing lighting wattage:	8,988	Watts, linear fluorescent only
Reduction needed:	1,555	Watts
Qty of existing linear fluorescents:	276	lamps
Average power per lamp:	32.6	Watts (8,988 / 276)
Qty of additional lamps to be removed:	48	(=1,555/32.6)
Average operating hours:	2,080	hours / year, linear fluorescent only
Estimated annual energy savings:	**3,255**	kWh / year
Estimated annual cost savings:	**$ 2**	per year
Estimated cost to de-lamp:	$ 5	per lamp, labor only
Estimated project cost:	**$ 240**	labor only
Simple payback:	**1.1**	years

Ashland City Hall EEM 3:	Install PC Power Management Software

Number of City Hall desktop computers:	28	
Initial implementation cost, per computer:	$ 35	
Total initial implementation cost:	**$ 980**	

Annual energy usage of City Hall computers:	12,231	kWh
Estimated percent energy savings:	35%	
Estimated annual energy savings:	**4,281**	kWh

City Hall cost per kWh:	$ 0.068	
Estimated annual cost savings:	**$ 3**	

Simple Payback:	**3.4**	Years

Note: An ongoing annual software cost of approximately 20% or $7.00 per year per computer is anticipated.

Note: This EEM should only be implemented as part of a City-Wide project to include all computers, centrally managed by the IT department.

Appendix D – Low Cost/No Cost EEMs

Ashland City Hall Low-Cost/No-Cost Recommendation #1:	**Eliminate use of existing portable space heaters**	
Electricity Rate:	$ 0.068	per kWh
Portable heaters now in use:	7	
Estimated ypical power consumption of existing portable space heaters:	750	Watts each
Estimated annual energy consumption of existing portable space heaters:	3,570	kWh / year, total
Estimated power of replacement flat-panel radiant heaters:	300	Watts each
Estimated annual energy consumption of replacement flat-panel radiant heaters:	1,428	kWh / year, total =(300/750)*3,570
Estimated gross annual energy savings:	2,142	kWh / year (=3,570-1,428)
Estimated heat pump C.O.P.:	3.1	
Estimated annual energy consumption of heat pump needed to replace energy savings to be provided by new flat-panel radiant heaters:	691	kWh / year (=2,142/3.1)
Estimated net annual energy savings due to replacement of existing portable space heaters:	**1,451**	kWh (=3,570-1,152)
Net annual cost savings due to removal of portable space heaters:	**$ 1**	per year
Simple Payback:	**Immediate**	No direct cost to City
Total annual City Hall annual electricity usage:	110,000	kWh per year
Estimated energy reduction due to this EEM:	**1.3%**	(=1,451/110,000)

Ashland City Hall Low-Cost/No-Cost Recommendation #2:	**Install locking box on 1st floor thermostat**

1st floor air handler kW:	1.49	
1st floor air handler operating hours without lock box:	3,120	
1st floor baseline air handler annual kWh:	4,649	kWh

Estimated percent savings with lock box:	25%	
Estimated annual energy savings with lock box:	**1,162**	kWh

Electricity Rate:	$ 0.068	per kWh
Estimated annual cost savings with lock box:	**$ 1**	

Lock box cost including installation:	**$ 50**	

Simple Payback:	**0**	Years

Appendix E – Deemed Impractical Energy Efficiency Measures

Add insulation to the inside of exterior walls of City Hall

		Wall Length				
	Wall Height	**Southerly**	**Northerly**	**Westerly**	**Easterly**	**Wall SqFt**
1st floor wall square footage that is not adjacent to the building next door:	12	48	26	103	21	2,376
2nd floor wall area, not including recent addition:	12	0	30	90	90	2,520
					Total Wall AreaSqFt:	4,896

Estimated Cost / SqFt:	$5.00
Estimated Project Cost:	**$24,480**

City Hall baseline electricity usage per year:	110,000	kWh
Estimated % energy savings:	10%	
Estimated annual energy savings:	**11,000**	kWh

City Hall electricity cost / kWh:	$0.0678
Estimated annual cost savings:	$746

Simple Payback:	**33**	years

Replace single-paned windows at City Hall

Estimated Project Cost:	**$34,000**	

City Hall baseline electricity usage per year:	110,000	kWh
Estimated % energy savings:	5%	
Estimated annual energy savings:	**5,500**	kWh

City Hall electricity cost / kWh:	$0.0678
Estimated annual cost savings:	$373

Simple Payback:	**91**	years

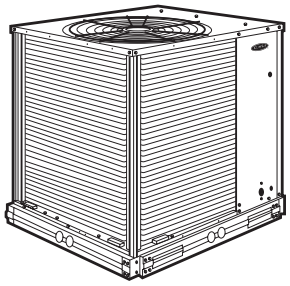
Appendix F – Existing Equipment Data Sheets

Carrier®

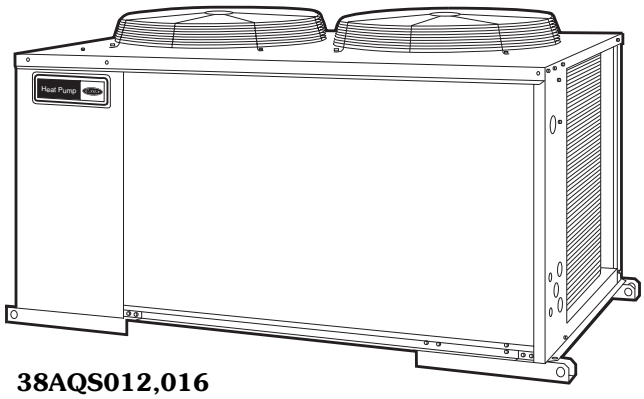
Product Data

38AQS/40RMQ Heat Pump Systems

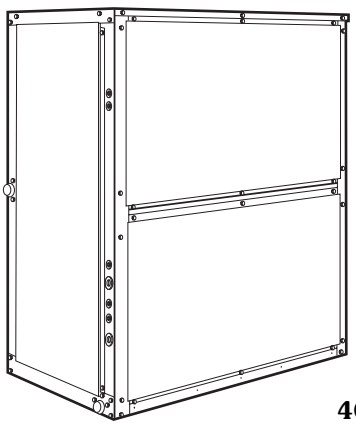
Nominal Heating: 83,000 to 275,000 Btuh
Nominal Cooling: 7 1/2 to 25 Tons



38AQS008



38AQS012,016



40RMQ

Heat Pump Systems that Save Energy and Provide Outstanding Heating and Cooling All Year

- All-season comfort in any climate
- High energy savings capability
- Suitable for new construction or replacement

Features/Benefits

System indoor and outdoor sections offer outstanding performance in either the cooling or heating mode

Heat pump system energy savings opportunity

Electrical energy consumption is always a prime concern when selecting an air-conditioning system for a commercial application. An easy, effective way to save energy is to install a heat pump. Should your building plans call for one, consider a matched Carrier 38AQS/40RMQ heat pump system. These systems not only provide highly efficient cooling, they also double as a clean, safe, efficient source of heat. In fact, they are capable of delivering approximately 3 units of heat energy for each unit of electrical power consumed.

Heat pump uniqueness

The outstanding performance of these heat pump systems is due to the heat pump's ability to absorb and transfer heat — from outdoors to indoors for heating, and from indoors to outdoors for cooling. System indoor and outdoor sections operate as evaporators or condensers, depending on whether heating or cooling is required. The heating cycle always starts with the outdoor coil absorbing heat from the

surrounding air (even outside air at extremely cold temperatures), and ends with the indoor coil releasing or rejecting heat to the air around it.

Variable refrigeration circuiting (VRC) — 38AQS units

For that extra measure of heat pump performance, variable refrigeration circuiting provides improved heat transfer. The design combines check valves and fixed-bore refrigerant metering to optimize the circuiting of the outdoor coil. This circuiting achieves the best performance possible during both the heating and cooling modes. The VRC feature provides three valuable benefits that ordinary heat pump systems cannot match:

- Improved heat transfer, resulting in a higher Coefficient of Performance (COP), especially at temperatures below 47 F.
- Improved reliability, by ensuring the proper quality of refrigerant is flowing to the compressor.
- Faster coil defrosting.

38AQS application versatility

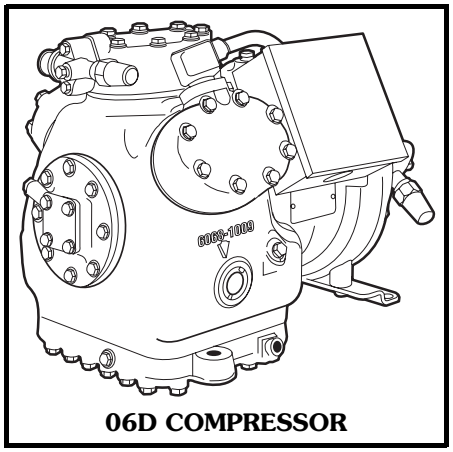
Whether for a new application or replacement, these Carrier split system heat pumps offer time-proven performance for year-round comfort in any climate.

Rugged long life compressor — 38AQS units

Model 38AQS outdoor sections are equipped with 06D semi-hermetic compressors, which are famous throughout the industry for their reliability. These compressors have vane-type oil pumps with positive oil pressure, an oil pressure regulating valve, class F stator windings, capacity reduction, oil level sight glass, and service valves. Through cylinder unloading, the 38AQS012 and 016 (one electric unloader is standard) can reduce capacity during the cooling phase to reduce energy usage and improve space temperature regulation. A Cycle-LOC™ device in the 38AQS control box holds the compressor off-line if any operational or safety device trips the compressor. The unit can be reset manually at the thermostat.

Features to consider, 38AQS008 units

Controls for performance efficiency — The 38AQS008 unit offers the building owner operating controls and components designed for performance dependability. The highly efficient semi-hermetic compressor is engineered for long life and durability. The compressor includes overload protection and compressor vibration isolation for further enhancement of quiet operation. The high-pressure switch protects the entire refrigeration system from abnormally high operating pressures. A loss-of-charge switch is also provided to protect the system against low charge conditions.



06D COMPRESSOR

The unit also includes anti-short-cycling protection which protects the compressor from the damage that can be caused by rapid compressor cycling. The 24-v control circuit transformer permits quick, easy wiring of standard and programmable 24-v thermostats.

Latest safety standards for 38AQS008 units are assured through UL (Underwriters' Laboratories) and UL, Canada approval.

The 38AQS008 utilizes a state-of-the-art defrost board with field configurable timed defrost cycles. The defrost board may be easily configured for defrost cycles of 30, 50, or 90 minutes, depending upon the application.

Features to consider, 38AQS012,016 units

A low oil pressure switch protects against loss of oil pressure. The Chronotemp™ defrost system allows defrost to occur every 60 minutes if the defrost thermostat is calling for defrosting. If the thermostat is not calling for defrosting, another 60 minutes must pass before defrosting begins.

Motor failure due to electrical overload is prevented by temperature and current sensors. Coil quality and performance are enhanced by copper tubes and aluminum fins, which provide maximum heat transfer. The coil is circuited for subcooling. A large heat transfer surface offers additional efficiency.

Heat pump performance enhanced by variable refrigeration circuiting —38AQS units

Cooling mode — During cooling, the 38AQS outdoor coil condenses the hot gas through a converging series circuit. First the check valve system feeds all the hot gas through the circuits at the bottom half of the coil. This desuperheats and partially condenses the hot gas. The hot gas is then routed through the upper half of the coil and finally through the subcooling coil. The subcooled liquid then enters the liquid line. This process also occurs during defrosting, resulting in improved, more thorough defrosting by assuring that the bottom half of the coils is hot and clear so that frost slides down and off.

Heating mode — During heating, the 38AQS outdoor coil becomes the evaporator, absorbing available heat from the outdoor air. The check valve system directs the flow of liquid refrigerant to individual parallel circuits, creating a "full face" active condition; the entire coil face is exposed to the same temperature of entering refrigerant. The result is maximum recovery of heat from outdoor air, a higher COP, and improved reliability.

Innovative Carrier 40RMQ indoor units are custom matched to 38AQS outdoor units for superior system performance

The 40RMQ Series has excellent fan performance, efficient direct-expansion (DX) coils, easy installation, and a unique combination of indoor air quality features. Its versatility and state-of-the-art features help to ensure that your heat pump system provides economical performance now and in the future.

Features/Benefits (cont)

Easy installation and service — The 40RMQ multiposition design and component layout help you to get the unit installed and running quickly. The direct-expansion (DX) coils have factory-installed thermostatic expansion valves (TXVs) with matching distributor nozzles. All 40RMQ units also include factory-installed check valves and piping for heat pump duty with matching 38AQS units.

The 40RMQ units can be converted from horizontal to vertical operation by simply repositioning the unit. Drain pan connections are duplicated on both sides of the unit. Fan motors and contactors are prewired. For easier service, the filters, motor, drive, TXVs, check valves, and coil connections are accessible by removing a single side panel.

Indoor-air quality (IAQ) features — The unique combination of IAQ features in the 40RMQ Series indoor units helps to make sure that only clean, fresh, conditioned air is delivered to the occupied space.

In the Cooling mode, direct-expansion (DX) cooling coils prevent the build-up of humidity in the room, even during part-load conditions. Unit sizes of 10 tons and above feature dual-circuit coils.

Standard 2-in. disposable filters remove dust and airborne particles from the occupied space.

Thermal insulation contains an immobilized anti-microbial agent to inhibit the growth of bacteria and fungi. The anti-microbial agent is registered with the U.S. Environmental Protection Agency (EPA).

The pitched PVC drain pan can be adjusted for a right- or left-hand connection to provide positive drainage and to prevent standing condensate.

The 40RMQ accessory economizer can provide ventilation air to improve indoor air quality. When used in conjunction with Carrier Comfort System thermostats and CO_2 sensors, the economizer admits fresh outdoor air to replace stale, recirculated indoor air.

Economy — The 40RMQ Series air handlers have low initial costs, and they continue to save money by providing reduced installation expense and energy-efficient performance.

Quick installation reduces installation costs, and TXVs, check valves, and heat pump piping are factory-installed.

High-efficiency, precision-balanced fans minimize air turbulence, surging, and unbalanced operation, cutting operating expenses.

The economizer accessory precisely controls the blend of outdoor air and room air to achieve comfort levels. When the outside air enthalpy is suitable, outside air dampers can fully open to provide "free" cooling.

Rugged dependability — 40RMQ units are made to last. The die-formed galvanized steel panels ensure structural integrity under all operating conditions. Galvanized steel fan housings are securely mounted to a die-formed galvanized steel deck. Coil housings are galvanized steel, and coils have aluminum fins mechanically bonded to copper tubes. The PVC condensate drain pans provide corrosion-free performance.

Coil flexibility — Model 40RMQ coils have galvanized steel casings; inlet and outlet connections are on the same end. The coils are designed for use with Refrigerant 22 and have $^3/_8$-in. diameter copper tubes mechanically bonded to aluminum sine-wave fins. The coils include matched, factory-installed TXVs with matching distributor nozzles. Check valves and heat pump piping are also included in all 40RMQ units.

Duplicate piping access holes on both sides of the unit eliminate drilling; condensate connections for both vertical and horizontal installations are also provided on both sides of the unit.

Table of contents

Model number nomenclature

38AQS 008 – – – 5 0 1 – –

38AQS — Split System Heat Pump

Nominal Tons
008 — 7-1/2 Tons
012 — 10 Tons
016 — 15 Tons

– – — Not Used

Outdoor Coil Protection Options
– — Aluminum (Standard)
C — Copper
V — Pre-Coated Aluminum Fins (008)
K — Pre-Coated Aluminum Fins (012,016)
***** — Post-Coated Aluminum (Contact Factory) (008 Only)
***** — Post-Coated Copper (Contact Factory) (008 Only)
E — E-Coated Al Fin/Cu Tube (012,016)
F — E-Coated Cu Fin/Cu Tube (012,016)

– – — Not Used

Packaging
0 — Base Unit
1 — Domestic

Revision Number
0 — Original

Voltage Designation
1 — 575-3-60 (Sizes 012,016 Only)
5 — 208/230-3-60
6 — 460-3-60

LEGEND
Al — Aluminum
Cu — Copper
*Size 008 only.

40RM Q 016 – – B 5 0 1 GC

40RM — Commercial Packaged Air Handler

Cooling Coil
Q — Heat Pump

Nominal Capacity — Tons
008 — 7-1/2 **024** — 20
012 — 10 **028** — 25
016 — 15

Not Used

Expansion Device
B — Thermostatic Expansion Valves

Voltage Designation
1 — 575-3-60
3 — 208/230-1-60*
5 — 208/230-3-60
6 — 460-3-60

Factory-Installed Options
GC — Unpainted, Standard Motor and Standard Drive
HC — Unpainted, Standard Motor and Medium-Static Drive
YC — Unpainted, Alternate Motor and High-Static Drive†
ED — Painted, Standard Motor and Standard Drive
FD — Painted, Standard Motor and Medium-Static Drive
WD — Painted, Alternate Motor and High-Static Drive†

Packaging
1 — Standard Domestic

Revision Number
0 — Original Model

*Size 008 only.
†For 40RMQ008 units with single-phase motors, YC and WD options denote standard motor and high-static drive.

Quality Assurance

Carrier Corporation UL REGISTERED FIRM ISO 9001 #A2325

Approvals:
ISO 9001
EN 29002
BS5750 PART 2
ANSI/ASQC Q92

c UL US

38AQS008 UNITS

Quality Assurance

Carrier Corporation UL REGISTERED FIRM ISO 9002 #A2260

Approvals:
ISO 9002
EN 29002
BS5750 PART 2
ANSI/ASQC Q92

ETL LISTED

c ETL LISTED

38AQS012,016 AND 40RMQ UNITS

ARI* capacities

OUTDOOR UNIT 38AQS	INDOOR UNIT 40RMQ	AIRFLOW (Cfm)	COOLING			HEATING				SOUND RATING (decibels)
						Hi-Temp		Low-Temp		
			Net Cap. (Btuh)	EER	IPLV	Net Cap. (Btuh)	COP	Net Cap (Btuh)	COP	
008	008	3,000	86,000	9.8	N/A	83,000	3.0	46,000	2.0	92
012	012	4,000	108,000	8.9	11.2	111,000	3.0	62,000	2.0	88
016	016	6,000	172,000	8.8	9.9	164,000	3.0	94,000	2.2	88
012,012 (Duplex)	024	8,000	216,000	8.8	10.6	222,000	2.8	124,000	1.8	—
012,016 (Duplex)	028	10,000	280,000	8.8	9.6	275,000	2.8	156,000	1.9	—

LEGEND

Bels — Sound Level (1 bel = 10 decibels)

COP — Coefficient of performance $= \frac{\text{Btuh output}}{\text{Btuh input}}$ or

$\frac{\text{Btuh output}}{\text{Unit Power Input x 3.413}}$ (Based on ARI conditions)

EER — Energy Efficiency Ratio $= \frac{\text{Btuh}}{\text{Unit Power Input}}$ (Based on ARI conditions)

IPLV — Integrated Part-Load Value

*Air Conditioning & Refrigeration Institute.

NOTES:
1. Standard ratings are net values, reflecting the effects of circulating fan heat. Supplementary electric heat is not included. Ratings are based on:

   Cooling Standard: 80 F db, 67 F wb (wet bulb) indoor entering-air temperature and 95 F db entering-air outdoor unit.

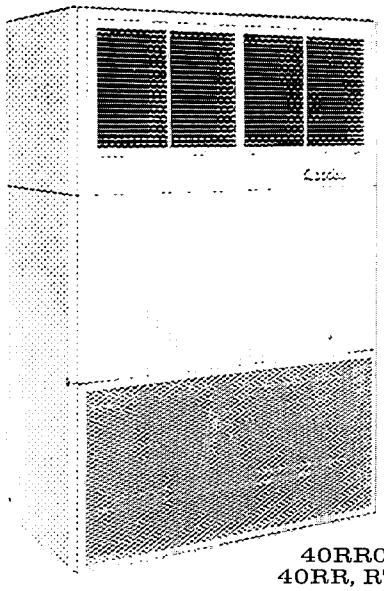
   Hi-Temp Heating Standard: 70 F db (dry bulb) indoor entering-air temperature and 47 F db/43 F wb entering-air outdoor unit.

   Lo-Temp Heating Standard: 70 F db indoor entering-air temperature and 17 F wb/15 F db entering-air outdoor unit.

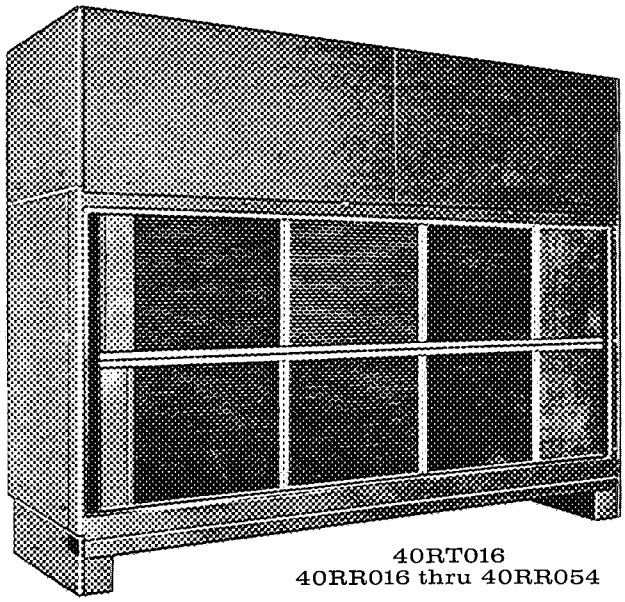
   38AQS008, 012 and 40RMQ008, 012 are rated in accordance with current ARI Standard 210/240. 38AQS016 and 40RMQ016 are rated in accordance with current ARI Standard 340/360. Unit combinations are rated in accordance with ARI standard 210/240 or 340/360 as appropriate.
2. Sound ratings are in accordance with current ARI Standard 270.
3. 38AQS012,016 are connected to 40RMQ024,028 in duplex configurations.

Carrier®

2,200 to 25,000 Cfm. **40RR, RT**



40RR008
40RR, RT012



40RT016
40RR016 thru 40RR054

Direct-Expansion Fan-Coil Units

and Indoor Heat Pump Sections

DESCRIPTION

The 40RR Weathermakers are direct-expansion fan-coil units capable of moving 2,200 to 25,000 cfm of air. They incorporate versatility and space saving advantages with an attractive appearance. When combined with appropriate condensing units, nominal cooling capacities of 61,000 to 636,000 Btuh can be obtained. By adding accessory heating coils, heating capacities of 118,000 to 1,585,000 Btuh are available.

The 40RR 016 thru 054 units can also be used for heat pump service when accessories are added. The nominal cooling range is 135,000 to 513,000 Btuh. The heating range is 110,000 to 465,000 Btuh.

The 40RT Fan-Coil series are indoor sections of a two-piece heat pump Weathermaker. When combined with their matching 38AC outdoor sections, heating capacities are 114,000 and 170,000 Btuh. Nominal cooling capacities are 123,000 and 175,000 Btuh.

These fan-coil units have great flexibility and offer many air-handling arrangements. They may be installed vertically or suspended horizontally. The 40RR008, 012, 016 and 024 are used with a plenum or ductwork. 40RR028, 034, 044 and 054 units are connected directly to duct systems. Plenums or ductwork are used with the two 40RT units.

FEATURES

- **Modular Construction** provides removable panels for interchangeable fan section positions.
- **Removable Casing Panels** provide easy access for servicing. They are made of heavy-gage Galvanneal steel, bonderized and coated with enamel.
- **Horizontal or Vertical Air Discharge.**
- **QT Fan** [SF] has compact housing, moves more air at lower speeds than conventional fans.
- **Insulated Casing** eliminates condensation and also lowers the sound level.
- **Resilient Mounting** of fan motor minimizes vibrations, means quieter operation.

ACCESSORIES

- **Suspension Package** contains hardware and springs to isolate the unit from the ceiling or wall.
- **Electric Resistance Heaters** (40RT012, 016) can be mounted to provide for heating requirements.
- **Relay Package** contains all of the components for controlling the liquid line solenoid valve or for starting the indoor fan motor.
- **Heating Coils** (40RR) are available in two types: two-row hot water or one-row nonfreeze steam coils.
- **Heat Pump Piping Package** (40RR016 thru 054) is used to pipe the indoor coil for heat pump service.
- **Subbase** is used for a floor stand or return air inlet.
- **Discharge Plenum** (40RR008 thru 024) has a grille with movable vanes for horizontal or vertical air flow.

[SF] — SINGLE FEATURE SHEET AVAILABLE

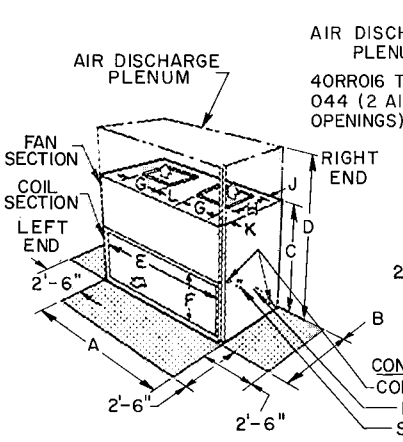
PHYSICAL DATA

UNIT 40RR		008	012	016	024	028	034	044	054
OPERATING WEIGHT (lb)									
Base Unit		340	445	620	670	1110	1150	1660	1940
Plenum		97	115	140	140	–	–	–	–
REFRIG (12, 22, 500)*									
Total Charge (lb)		3	4	5	7	9	10	14	20
COOLING COIL					Plate Type Fins				
Rows..Fins/In.		3..13	3..13	3..13	4..11	4..11	4..11	4..11	4..11
Coil Split (sq ft)	Upper	7.22	5.84	8.45	9.60	14.5	14.5	14.10	16.05
	Middle							14.10	16.05
	Lower		4.86	8.45	8.44	8.13	12.4	8.28	14.10
FAN MOTORS		Carrier Supplied				Field Supplied			
Hp		1	2	2	3	3, 5 or 7½	5 or 7½	7½ or 10	7½, 10 or 15
Speed (rpm)		3450	3450	1750	1750	1750	1750	1750	1750
FANS									
Number of Wheels		2	2	2	2	2	2	2	3
Nominal Cfm		3000	4000	6000	8000	10,000	12,000	16,000	20,000
Cfm Range		2200-3800	3000-5000	4500-7500	6000-10,000	7500-12,500	9000-15,000	12,000-20,000	15,000-25,000
HEATING COILS (access.)									
Total Face Area (sq ft)									
1-row, Nonfreeze		5.5	7.6	13.3	13.3	21.7	21.7	34 5	40.2
2-row, Hot Water		5.6	7.9	15 7	15 7	20.8	20.8	36.5	46.2
FILTERS		Carrier Supplied				Field Supplied			
Type		Low Velocity				High Velocity			
Number..Size (in.)		2..16×20×1 2..16×25×1	6..16×20×1	3 .16×25×1 3..20×25×1	3..16×25×1 3..20×25×1	6..20×25×2 2..16×20×2	6 .20×25×2 2..16×20×2	6..20×20×2 6..20×25×2	5..16×25×2 10..20×25×2
DIMENSIONS (ft-in.)	A	4-0	5- 2½	6- 8	6- 8	7- 9¾	7- 9¾	10- 6¼†	10- 6¼†
	B	2-1⅝	2- 1⅝	2- 5¼	2- 5¼	2-11¾	2-11¾	3-10¼	3-10¼
	C	4-2⅜	4- 3⅜	5- 9½†	5- 9½†	6-10⅛	6-10⅛	7- 6 †	8- 5 †
	D	6-1⅝	6- 1⅝	7-10⅛	7-10⅛	–	–	–	–
	E	3-9	4-11½	6- 3¾	6- 3¾	7- 4¼	7- 4¼	10- 0	10- 0
	F	1-7¾	1- 7¾	2-10¼	2-10¼	3- 2¼	3- 2¼	3-10	4- 9
	G‡	1-1⅛	1- 3	1- 5¼	1- 5¼	1- 8⅞	1- 8⅞	1- 8⅞	1- 8⅞‡
	H	1-1⅞	1- 4½	1- 7¼	1- 7¼	1- 8⅞	1- 8⅞	1- 8⅞	1- 8⅞
	J	0-3¼	0- 2⅜	0- ⅝	0- ⅝	0- 2⅜	0- 2⅜	0- 1¾	0- 1¾
	K	0-6	0- 9	1- 7	1- 7	1- 4	1- 4	2- 2⅝	1- 2¼
	L	0-9⅞	1- 2⅝	1- 4⅛	1- 4⅛	1- 7⅞	1- 7⅞	2- 7½	1- 5⅝
CONN., No. ..Size (in.)									
Refrigerant	– Suct	1⅛ ODM	2.. ⅞ ODM	2..1⅜ ODF	2..1⅜ ODF	2..1⅜ ODM	2..1⅜ ODM	3..1⅜ ODF	3..1⅜ ODF
	– Distr	⅝ Flare	2.. ⅞ ODM	2.. ⅞ ODM	2.. ⅞ ODM	2..1⅜ ODM	2..1⅜ ODM	1.. ⅞ ODM 2..1⅜ ODM	3..1⅜ ODM
Hot Water	– In	1¼ FPT	1..1¼ FPT	2..1½ MPT	2..1½ MPT	2..1½ MPT	2..1½ MPT	3..1½ MPT	3..1½ MPT
	– Out	1¼ FPT	1..1¼ FPT	2..1½ MPT	2..1½ MPT	2..1½ MPT	2..1½ MPT	3..1½ MPT	3..1½ MPT
Steam, 1-row	– In	1¼ FPT	1..1¼ MPT	1..1¼ MPT	2..1¼ MPT	1..1½ MPT	2..1½ MPT	2..2½ MPT	2..2½ MPT
	– Out	1¼ MPT	1..1¼ MPT	1..1¼ MPT	2..1¼ MPT	1..1¼ MPT	2..1¼ MPT	2..1½ MPT	2..1½ MPT
Condensate		¾ FPT	¾ FPT	1 FPT	1 FPT	1¼ MPT	1¼ MPT	1½ MPT	1½ MPT

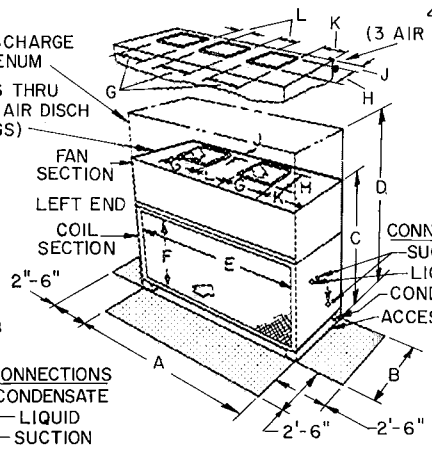
*No factory charge †Including subbase. ‡Two discharge air openings on all sizes except 40RR054 which has three

DIMENSIONS

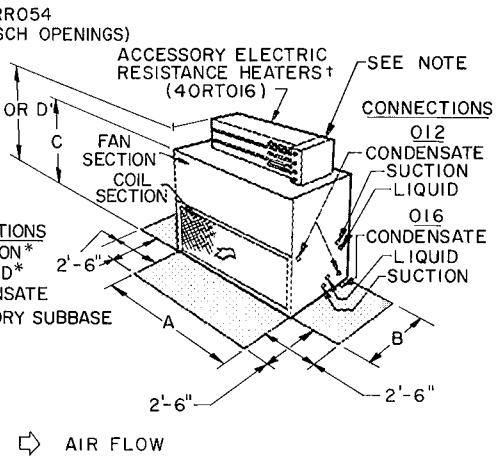
40RR008,012



40RR016 thru 054



40RT



*Located on left end on 028 thru 054 units

†40RT016 can use either electric resistance heaters or air discharge plenum but not both together On 40RT012 unit, electric resistance heaters are mounted on top of the cooling coil Therefore plenum can be used

Certified dimension drawings available on request.

NOTE:
For 40RT return and discharge air connection dimensions, refer to corresponding 40RR012 and 016 sizes

PHYSICAL DATA (Contd)

UNIT	40RT012	40RT016
OPERATING WEIGHT (lb)		
Base Unit	460	700
Plenum	115	140
REFRIGERANT*	R-500	R-22
Total Charge (lb)	–	–
COOLING	Plate Type Fins	
Number Per Unit	1	2
Rows...Fins/In.	3 (+1t)...13	3...13
Coil Split (sq ft)	10 5	8 45 8.45
FAN MOTORS		
Supplied By	Carrier	
Hp	2	2
Speed (rpm)	3450	1750
FANS		
Number of Wheels	2	2
Nominal Cfm	4000	6000
Cfm Range	3000-5000	4500-7500
RESISTANCE HEATERS (Access.)		
Kw, Each	16	20
Max Kw	48	60
FILTERS, Low Velocity		
Supplied By	Carrier	Field
Number...Size	6...16×20×1	3...16×25×1 3...20×25×1
DIMENSIONS (ft–in.)		
A	5-2½	6- 8
B	2-1⅝	2- 4⅝
C	4-1¾	5- 9½‡
D – With Plenum	6-2¾	7-10⅛
D' – With Heaters (3 max)	5-3¾	6-10½‡
CONNECTIONS (in.)		
Refrigerant – Vapor	1⅜ ODF	1⅜ ODF
Liquid	⅝ ODF	⅝ ODF
Condensate	¾ FPT	1 FPT

*No factory charge.
†One 1-Row subcooling coil, used on heating cycle only.
‡Including subbase, for top discharge Height is 6 ft 2½ in for rear discharge with subbase

NOTES TO HEATING RATINGS

1. Maximum allowable leaving air temperature is 140 F.
2. Maximum operating limits for heating coils are 200 psig and 400 F.
3. $\text{Leaving db} = \text{ent db (F)} + \frac{\text{capacity (Btuh)}}{1.08 \times \text{cfm}}$

$$\text{Gpm} = \frac{\text{capacity (Btuh)}}{500 \times \text{water temp drop (F)}}$$

4. Refer to Combination Ratings pages for heating ratings for 40RT units.

BTU CONSTANTS

HOT WATER

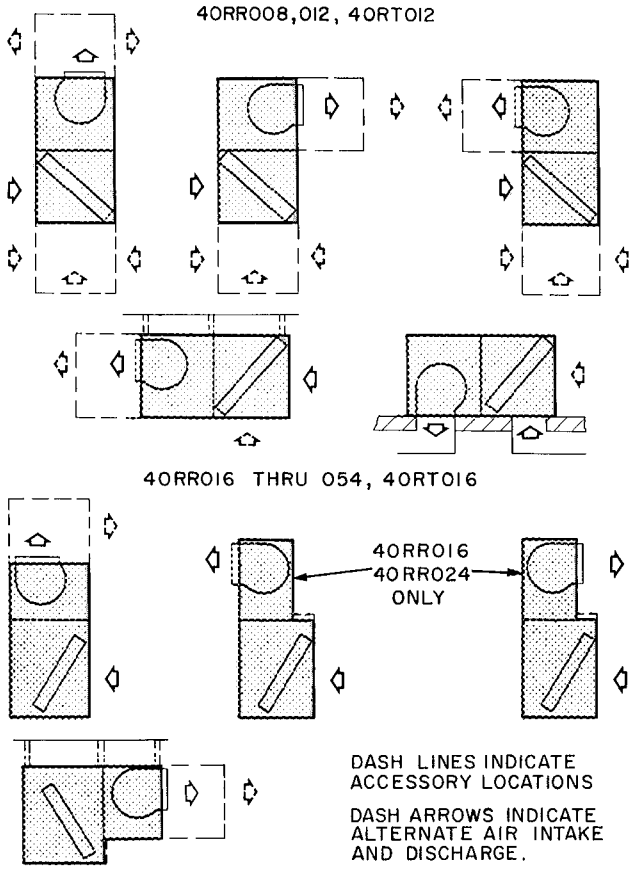
WATER TEMP DROP (F)	ENT WATER TEMP (F)	ENTERING AIR TEMP (F) 40	50	60	70	80
10	180	1.15	1.06	.96	.87	.77
	200	1.35	1.25	1.16	1.07	.97
20	180	.98	.88	.79	.70	.60
	200	1.18	1.09	1.00	.90	.81
	220	1.37	1.28	1.20	1.11	1.01
30	180	.79	.70	.61	.52	.42
	200	1.00	.91	.85	.73	.64
	220	1.22	1.12	1.03	.94	.85

STEAM

STEAM PRESSURE (psig)	ENTERING AIR TEMP (F) 40	50	60	70	80
0	1.11	1.03	.96	.89	.82
2	1.14	1.07	1.00	.93	.86
5	1.19	1.11	1.05	.98	.91

NOTE:
Multiply capacity given in Heating Ratings table by the Btu constant for conditions at which unit is actually operating. Correct leaving air temp using formulae in Note 3 above.

STANDARD DISCHARGE ARRANGEMENTS



HEATING RATINGS

UNIT 40RR	CFM	1-ROW NONFREEZE STEAM COIL* Cap.	Ldb	2-ROW HOT WATER COIL† Cap.	Ldb	Gpm	PD
008	2,200	96	101	170	132	17	3.5
	3,000	118	96	211	125	21	4.6
	3,800	133	93	240	119	24	5.5
012	3,000	126	99	222	129	22	2.5
	4,000	150	95	268	122	27	3.0
	5,000	171	92	307	117	31	3.7
016	4,500	186	98	361	134	36	1.9
	6,000	217	94	428	126	43	2.5
	7,500	248	91	490	121	49	3.4
024	6,000	209	92	410	126	41	2.4
	8,000	246	88	500	118	50	3.5
	10,000	272	85	580	114	58	3.9
028	7,500	312	99	578	131	58	3.7
	10,000	361	96	690	124	69	4.8
	12,500	406	93	786	118	79	6.2
034	9,000	344	95	645	122	65	4.4
	12,000	398	91	768	119	77	6.0
	15,000	443	87	874	114	87	7.4
044	12,000	665	111	1035	140	104	8.7
	16,000	780	105	1265	133	127	12.6
	20,000	875	100	1470	128	147	17.1
054	15,000	785	109	1300	140	130	9.7
	20,000	915	102	1585	133	159	14.1
	25,000	1030	98	1830	127	183	17.6

Cap. – Capacity (1000 Btuh)
Ldb – Leaving Air Db Temp (F)
PD – Pressure Drop (ft water)

*Based on 2 psig steam, 60 F entering air temp.
†Based on 200 F entering water, 20 F water temp drop, 60 F entering air temp.
NOTE: Max operating limits for heating coils. 200 psig and 400 F.

COOLING CAPACITIES

MODEL	EVAP AIR Cfm / Bf	Ewb	COIL REFRIGERANT TEMP (F) 30 TC	30 SHC	35 TC	35 SHC	40 TC	40 SHC	45 TC	45 SHC	50 TC	50 SHC
40RR 008	2,200 .16	72	130	59	120	55	109	51	95	46	81	41
		67	111	67	100	62	88	58	75	52	60	45
		62	93	73	82	68	69	62	56	56	41	41
	3,000 20	72	144	66	135	63	123	59	107	54	93	48
		67	126	79	114	74	101	69	86	63	69	56
		62	107	86	94	83	81	76	65	65	45	45
	3,800 .23	72	153	72	143	70	132	66	118	61	101	55
		67	135	86	124	84	111	79	95	73	74	65
		62	116	102	102	97	88	88	71	71	52	52
40RR,RT 012	3,000 16	72	173	79	157	73	142	68	122	61	97	52
		67	147	90	130	83	112	75	87	65	56	53
		62	121	99	103	90	80	79	55	55	–	–
	4,000 20	72	187	87	175	83	160	76	142	70	117	61
		67	163	102	149	96	131	88	109	79	79	66
		62	140	114	123	106	101	96	62	62	–	–
	5,000 .23	72	210	96	189	92	172	86	150	79	127	71
		67	178	117	160	110	142	103	117	94	78	78
		62	153	133	133	125	110	110	73	73	–	–
40RR,RT 016	4,500 .15	72	269	125	244	116	219	106	187	94	156	83
		67	227	139	202	128	176	118	146	105	112	90
		62	186	148	162	140	134	127	101	101	–	–
	6,000 19	72	–	–	278	132	249	122	218	108	183	97
		67	260	162	232	150	203	135	170	129	133	111
		62	217	189	188	188	158	154	121	121	84	84
	7,500 .22	72	–	–	–	–	272	174	236	159	198	145
		67	281	235	254	221	222	205	183	183	146	146
		62	237	237	207	207	174	174	134	134	–	–
40RR 024	6,000 15	72	349	157	319	146	286	135	250	123	210	109
		67	295	178	264	166	232	154	195	139	152	123
		62	242	198	212	184	181	170	139	139	–	–
	8,000 .18	72	–	–	360	168	323	157	281	143	232	130
		67	336	208	301	196	264	183	223	174	170	159
		62	278	237	243	223	207	207	161	161	–	–
	10,000 21	72	–	–	–	–	349	176	304	161	260	146
		67	–	–	326	223	286	208	242	194	194	176
		62	304	270	267	256	228	228	181	181	–	–
40RR 028	7,500 .15	72	452	222	409	195	362	176	307	154	241	128
		67	379	232	334	216	283	193	219	163	–	–
		62	311	254	262	230	200	198	–	–	–	–
	10,000 18	72	–	–	468	224	418	206	359	181	287	157
		67	438	277	390	257	333	234	263	206	–	–
		62	362	308	309	283	242	242	–	–	–	–
	12,500 21	72	–	–	–	–	456	229	394	208	320	183
		67	479	314	425	293	369	280	297	242	–	–
		62	401	354	346	330	278	278	–	–	–	–
	9,000 15	72	556	247	500	227	442	207	372	184	280	151
		67	462	277	405	254	342	229	257	194	–	–
		62	375	306	315	274	233	235	–	–	–	–
40RR 034	12,000 18	72	–	–	562	268	499	246	430	221	344	190
		67	525	332	466	308	402	280	317	247	190	190
		62	435	369	372	339	291	291	–	–	–	–
	15,000 .21	72	–	–	–	–	544	273	470	248	383	220
		67	577	366	512	348	444	323	356	290	211	211
		62	480	423	413	394	332	332	198	198	–	–
	12,000 .15	72	–	–	615	280	556	258	486	242	402	210
		67	577	357	520	332	453	303	370	270	–	–
		62	482	392	420	363	336	329	–	–	–	–
40RR 044	16,000 18	72	–	–	670	326	617	308	551	285	460	254
		67	–	–	587	391	517	364	428	328	–	–
		62	549	472	481	441	400	400	309	309	–	–
	20,000 .21	72	–	–	–	–	648	336	592	318	502	291
		67	–	–	632	435	541	407	474	381	356	338
		62	601	539	530	510	443	443	333	333	–	–
	15,000 .14	72	–	–	–	–	705	326	618	304	511	268
		67	727	450	656	417	571	382	473	343	–	–
		62	608	495	526	460	436	417	–	–	–	–
40RR 054	20,000 .18	72	–	–	–	–	781	388	697	358	583	320
		67	–	–	739	498	653	457	551	414	435	364
		62	695	595	603	556	506	506	394	394	–	–
	25,000 .20	72	–	–	–	–	–	–	743	407	634	361
		67	–	–	–	–	708	521	596	477	467	430
		62	751	686	662	638	557	557	425	425	–	–

Bf – Bypass Factor
Ewb – Entering Wet-bulb Temp (F)
TC – Total Capacity (1000 Btuh)
SHC – Sensible Heat Capacity (1000 Btuh)

NOTES:
1. Direct interpolation is permissible. Do not extrapolate.
2. Evaporator fan heat not deducted from ratings.
3. Ratings based on approximately 12 F superheat leaving coil.
4. Dashes indicate coil loading limits are exceeded.

40RR008, 012, 016 units are rated in accordance with the latest ARI Standard 210 when used in combination with components specified by the manufacturer.

The 40RT012 unit is rated in accordance with the latest ARI Standard 240 when used in combination with components specified by the manufacturer.

For combination ratings, see 38 Series Combination Rating Sheets.

40RR SELECTION PROCEDURE (With Example)

COOLING

1. Determine the cooling load and temperature and quantity of air entering the evaporator.

Given:

Grand Total Heat . . . . . 200,000 Btuh
Sensible Heat . . . . . 130,000 Btuh
Air Temp Ent Indoor Coil . . . . . 80 F db, 67 F wb
Air Qty Ent Indoor Coil . . . . . 6000 cfm
External Static Press. required . . . . . 10.6 in. wg

2. Determine unit selection and coil refrigerant temperature.

Enter Cooling Capacities table for 6000 cfm. Select a 40RR016 unit which has a total capacity of 203,000 and 170,000 Btuh at 40 and 45 F coil refrigerant temp respectively. By interpolation coil refrigerant temp of 40.5 F is needed to give a total capacity of 200,000 Btuh. Sensible capacity is 134,400 Btuh. Cooling load is satisfied.

HEATING – 40RR

1. Determine heating load and temperature of air entering the indoor coil.

Given:

Load. . . . . .375,000 Btuh
Entering Air Temperature . . . . . 70 F
Two-row Hot Water Coils with entering water temperature of 200 F.

2. Find the heating capacity.

Enter Heating Ratings table for the 40RR016 unit at 6000 cfm. A two-row hot water coil delivers 428,000 Btuh (based on 60 F entering air temp). Since existing entering air temp is 70 F, enter the Btu Constants table for hot water coils at 200 F entering water temp and this 70 F entering air. Read a constant of .90.

428,000 × .90 = 385,200 Btuh

NOTES (Cont)

5. Formulae:

$$\text{Leaving db} = \text{entering db} - \frac{\text{sensible heat capacity (Btuh)}}{1.08 \times \text{cfm}}$$

Leaving wb = wet-bulb temp corresponding to enthalpy of air leaving coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

where h_{ewb} = enthalpy of air entering coil

6. SHC is based on 80 F db temp of air entering evap coil. Below 80 F db, subtract (corr factor × cfm) from SHC. Above 80 F db, add (corr factor × cfm) to SHC.

Bypass Factor	Entering Air Dry-Bulb Temp (F) 79	78	77	76	75	under 75
	81	82	83	84	85	over 85
	Correction Factor					
.10	.97	1.95	2.92	3.89	4.86	use formula shown below
.20	.86	1.73	2.59	3.46	4.32	
.30	.76	1.51	2.27	3.03	3.78	

Interpolation is permissible.
Correction Factor = 1.08 × (1 – BF) × (db – 80)

40RR SELECTION PROCEDURE (Cont'd)

FAN – 40RR

1. Determine fan speed and brake horsepower.

From the table titled Pressure Loss of Unit Components, read a loss of .06 in. wg for a two-row hot-water heating coil.

Total external static pressure = .60 + .06
= .66 in. wg

Enter 40RR016 Fan Performance table at 6000 cfm and .66 in. wg. Interpolate and read fan speed of 703 rpm and 1.65 bhp. This will not overload a 2-hp motor.

To select an outdoor unit for this 40RR016 indoor section, refer to the Combination Ratings sheets for Carrier condensing units.

40RT SELECTION PROCEDURE

COOLING – 40RT

1. Determine the cooling load and temperature and quantity of air entering the indoor coil.*

Given:

Grand Total Heat	160,000 Btuh
Sensible Heat	135,000 Btuh
Indoor Air Temperature	80 F db, 67 F wb
Indoor Air Quantity	6500 cfm
External Static Pressure	0.4 in. wg

2. Select a unit and determine coil refrigerant temperature.

Enter Cooling Capacities table for 67 F wb at 6500 cfm. Select a 40RT016. By interpolation a total capacity of 174,000 Btuh is available at 45 F coil refrigerant temp. Also by interpolation 160,000 Btuh can be provided by 47 F coil refrigerant temp. Corresponding sensible heat is 137,000 Btuh.

HEATING – 40RT

1. For heating capacities see the Combination Ratings sheet for the 38AC/40RT two-piece heat pump Weathermaker.

FAN – 40RT

1. Determine fan speed and brake horsepower.

Enter 40RT016 Fan Performance table at 6500 cfm and .60 in. wg. Read fan speed of 705 rpm and 1.8 bhp. This will not overload a 2-hp motor.

*Heat pumps are selected on the basis of cooling rather than heating performance.

PLENUM AIR DISTRIBUTION

FRONT OUTLET ONLY

UNIT NOM CFM	VVS	CFM	BLOW* (ft)	CEILING MIN HT (ft)
40RR008 3000	Str	3000	80	17
	22½		67	15
	45		49	14
40RR012 40RT012 4000	Str	4000	93	20
	22½		79	17
	45		58	16
40RR016 40RT016 40RR024 6000	Str	6000	113	24
	22½		96	21
	45		70	19
40RR024 8000	Str	Not recommended due to high outlet velocity and long blow*		
	22½			
	45			

VVS – Vertical Vane Setting in Degrees.

*If length of blow or outlet velocity is excessive on 016 or 024 units, two field-supplied plenum side outlet grilles may be used. Refer to 40RR,RS Application Data for details.

PRESSURE LOSS OF UNIT COMPONENTS (in. wg)

UNIT	CFM	DISCH PLENUM	INLET GRILLE	HEATING COILS 1-Row Steam	HEATING COILS 2-Row Hot Water	FILTERS*† 1-in.	FILTERS*† 2-in.
40RR 008	2,200	.17	.03	.02	.05	.05	–
	3,000	.31	.05	.04	.08	.10	–
	3,800	.49	.06	.06	.12	.18	–
40RR 40RT‡ 012	3,000	.18	.03	.03	.05	.05	–
	4,000	.32	.05	.04	.09	.09	–
	5,000	.49	.07	.06	.13	.16	–
40RR 40RT‡ 016	4,500	.18	.02	.01	.04	.05	–
	6,000	.31	.03	.02	.06	.08	–
	7,500	.48	.05	.02	.09	.14	–
40RR 024	6,000	.31	.03	.01	.05	.04	–
	8,000	.54	.06	.02	.08	.08	–
	10,000	.82	.08	.03	.11	.11	–
40RR 028	7,500	–	–	.02	.08	–	.06
	10,000	–	–	.03	.12	–	.10
	12,500	–	–	.04	.19	–	.15
40RR 034	9,000	–	–	.02	.08	–	.06
	12,000	–	–	.03	.12	–	.09
	15,000	–	–	.04	.18	–	.14
40RR 044	12,000	–	–	.04	.07	–	.07
	16,000	–	–	.07	.11	–	.11
	20,000	–	–	.10	.16	–	.16
40RR 054	15,000	–	–	.04	.07	–	.06
	20,000	–	–	.07	.11	–	.10
	25,000	–	–	.10	.15	–	.15

*For models 40RR024, 028, 034, 044, 054, filter losses are based on high velocity filters. If other filters are used, deduct these values from external system resistance and add new filter loss before selecting a fan speed 40RR008, 012, 016 filter losses are based on low-velocity filters

†Filters are supplied with 40RR008, 012, 016, 024 units For other units, procure filters locally.

‡No steam or hot water heating coils used 40RT units

NOTE:
Accessory electric resistance heater produces a negligible static pressure loss.

ELECTRIC RESISTANCE HEATER DATA

INDOOR UNIT	NUMBER OF HEATERS	HEATER SIZE (kw)	TOTAL KW	HEATER CAPACITY (1000 Btuh)	MIN AIR QTY (cfm)
40RT012	1	16	16	54.5	3000
	2	16	32	109.0	3000
	3*	16*	48*	163.5	3000
40RT016 40RR016	1	20	20	68.2	4500
	2	20	40	136.4	4500
	3*	20*	60*	204.6	4500
40RR024	1	20	20	68.2	6000
	2	20	40	136.4	6000
	3	20	60	204.6	6000
	4*	20*	80*	272.8	6000

*Maximum number, size and total kw that may be used on the unit.

NOTES:

1. 40RT016 accessory electric resistance heater may be mounted directly to the 40RR016 and 40RR024 unit discharge when applied as indoor heat pump selections
2. Ratings are based on 230- or 460-volt power. For a 10% decrease in voltage, decrease input and capacity by 19%. For a 10% increase in voltage, increase input and capacity by 21%

FAN PERFORMANCE

MODEL	CFM	EXTERNAL STATIC PRESSURE (in. wg) 0		0.1		0.2		0.3		0.4		0.5		0.6		0.7		0.8	
		Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp	Rpm	Bhp
40RR 008	2,200	–	–	–	–	714	.33	778	.44	840	.54	892	.62	953	.70	991	.80	1044	.91
	2,600	655	.35	719	.45	788	.54	852	.65	907	.73	959	.83	1009	.93	1062	1.03	–	–
	3,000	743	.59	811	.67	870	.77	927	.88	981	.97	1028	1.10	1082	1.23	–	–	–	–
	3,400	842	.83	897	.94	951	1.04	1000	1.16	*1050*	*1.27*	–	–	–	–	–	–	–	–
	3,800	938	1.15	985	1.25	*1034*	*1.35*	*1090*	*1.45*	–	–	–	–	–	–	–	–	–	–
		0		0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6	
40RR 012	3,000	520	.17	615	.40	714	.63	800	.86	882	1.10	946	1.33	1015	1.56	1078	1.80	–	–
	3,400	562	.40	658	.62	752	.84	840	1.08	917	1.33	982	1.63	1054	1.80	–	–	–	–
	3,800	614	.66	706	.87	796	1.08	880	1.32	952	1.58	1024	1.82	1082	2.07	–	–	–	–
	4,200	670	.95	756	1.14	841	1.36	922	1.62	990	1.86	1065	2.12	–	–	–	–	–	–
	4,600	728	1.25	812	1.50	889	1.69	970	1.93	1046	2.20	*1100*	*2.46*	–	–	–	–	–	–
	5,000	786	1.65	864	1.80	952	2.07	1024	2.34	*1086*	*2.56*	–	–	–	–	–	–	–	–
40RR 016	4,500	388	.13	468	.40	560	.70	615	.90	690	1.20	758	1.50	820	1.70	872	1.90	925	2.30
	5,500	440	.45	515	.75	588	1.10	664	1.30	726	1.60	790	1.80	846	2.20	900	2.40	*948*	*2.70*
	6,500	500	.93	566	1.25	645	1.50	705	1.80	*768*	*2.10*	828	*2.40*	*880*	*2.80*	*930*	*3.10*	*975*	*3.30*
	7,500	566	1.50	600	1.80	698	2.20	*762*	*2.50*	*820*	*2.90*	*872*	*3.20*	*940*	*3.50*	*970*	*3.70*	*1015*	*3.90*
40RR 024	6,000	–	–	530	1.10	610	1.40	666	1.60	742	1.80	805	2.10	860	2.40	910	2.70	955	3.00
	7,000	490	1.30	570	1.50	640	1.80	710	1.90	770	2.30	830	2.70	885	3.00	935	3.30	*985*	*3.60*
	8,000	550	1.70	620	1.90	690	2.30	750	2.70	808	3.00	868	3.30	*918*	*3.60*	*964*	*3.90*	*1015*	*4.30*
	9,000	610	2.30	680	2.70	737	3.10	795	3.40	*848*	*3.70*	*905*	*4.00*	*952*	*4.40*	*1000*	*4.90*	*1050*	*5.50*
	10,000	670	3.20	*730*	*3.50*	*782*	*3.80*	*835*	*4.20*	*890*	*4.60*	*942*	*5.10*	*990*	*5.60*	*1040*	*6.20*	*1090*	*7.00*
40RR 028	7,500	435	1.00	480	1.30	535	1.60	598	1.80	655	2.30	710	2.70	760	3.20	800	3.60	850	4.10
	8,500	475	1.50	523	1.80	580	2.10	635	2.50	689	2.80	740	3.40	785	3.80	833	4.30	880	4.80
	9,500	515	2.00	565	2.40	615	2.70	668	3.10	720	3.60	770	4.10	813	4.50	860	5.00	905	5.80
	10,500	555	2.60	600	2.90	650	3.30	703	3.80	752	4.30	798	4.80	842	5.40	888	6.00	928	6.60
	11,500	590	3.20	635	3.60	692	4.10	740	4.60	785	5.10	828	5.70	872	6.30	915	6.80	955	7.40
	12,500	630	3.90	687	4.50	732	5.00	765	5.50	818	6.00	860	6.60	905	7.30	943	7.70	1000	8.00
40RR 034	9,000	490	1.00	530	1.30	570	1.70	625	2.40	670	3.00	724	3.50	775	4.00	827	4.60	872	5.10
	11,000	560	2.10	595	2.60	640	3.30	685	3.80	730	4.40	780	4.80	830	5.40	875	6.00	914	6.60
	13,000	620	4.00	655	4.40	700	5.00	750	5.50	795	6.00	840	6.70	888	7.30	920	7.90	962	8.40
	15,000	700	6.50	715	7.00	755	7.40	830	8.10	865	8.60	900	9.10	945	9.60	–	–	–	–
40RR 044	12,000	461	2.60	505	3.00	541	3.40	597	3.80	643	4.40	691	5.00	735	5.70	775	6.30	815	7.00
	14,000	521	3.90	567	4.40	615	4.90	659	5.50	706	6.20	740	6.90	785	7.50	823	8.20	860	8.80
	16,000	581	5.30	627	6.00	675	6.90	720	7.50	755	8.20	790	9.00	830	9.50	867	10.20	905	10.80
	18,000	641	7.60	690	8.30	730	9.00	765	9.80	802	10.50	835	11.10	875	12.00	915	12.20	955	13.20
	20,000	701	10.00	750	10.80	774	11.50	805	12.20	848	12.50	885	13.30	915	14.50	950	14.80	985	15.50
40RR 054	15,000	440	2.20	480	3.00	500	4.00	618	4.90	650	5.70	692	6.50	740	7.30	771	8.10	820	9.00
	17,000	480	3.80	550	4.80	604	5.60	650	6.50	690	7.30	735	8.20	777	9.00	817	9.90	853	10.80
	19,000	540	5.60	600	6.50	644	7.50	687	8.40	730	9.30	771	10.10	812	11.00	850	12.00	882	12.80
	21,000	595	7.60	640	8.50	684	9.50	727	10.50	769	11.40	810	12.40	844	13.30	878	14.20	915	15.00
	23,000	640	9.90	681	10.90	725	11.90	766	12.90	806	13.90	840	14.90	872	15.90	933	17.00	–	–
	25,000	680	12.30	720	13.40	760	14.50	804	15.50	835	16.50	869	17.20	–	–	–	–	–	–
40RT 012	3,000	582	.18	656	.48	756	.69	839	.89	915	1.13	981	1.38	1050	1.62	–	–	–	–
	3,400	616	.50	695	.68	791	.88	869	1.09	945	1.35	1014	1.61	1076	1.85	–	–	–	–
	3,800	653	.72	735	.90	826	1.12	906	1.35	980	1.61	1050	1.86	–	–	–	–	–	–
	4,200	698	1.00	783	1.17	866	1.39	944	1.64	1016	1.90	–	–	–	–	–	–	–	–
	4,600	754	1.28	831	1.47	915	1.70	990	1.87	–	–	–	–	–	–	–	–	–	–
	5,000	813	1.70	890	1.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–
40RT 016	4,500	388	.13	468	.40	560	.70	615	.90	690	1.20	758	1.50	820	1.70	872	1.90	925	2.30
	5,500	440	.45	515	.75	588	1.10	664	1.30	726	1.60	790	1.80	846	2.20	900	2.40	948	2.70
	6,500	500	.93	566	1.25	645	1.50	705	1.80	768	2.10	828	2.40	880	2.80	930	3.10	975	3.30
	7,500	566	1.50	600	1.80	690	2.20	762	2.50	820	2.90	872	3.20	940	3.50	970	3.70	1015	3.90

Shaded areas indicate need for special drive purchased locally.

000 Italics indicate need for special motor purchased locally (applicable only to units factory furnished with motors).

NOTES:

1. Maximum allowable fan speed is 1100 rpm.
2. Fan performance is based on wet coil, clean 1-inch filters, and unit casing losses having been deducted.
3. External static pressure is to overcome resistance due to ductwork, plenum, heating coils and other accessories added to the system.
4. For heating/cooling applications, do not exceed nominal motor horsepower rating.
5. Maximum leaving air temperature is 140 F.
6. Refer to Fan Motors and Drives tables to complete the selection.

ELECTRICAL DATA (60-cycle)

UNIT	VOLTS PHASE	DSDV	VOLTAGE LIMITS*	FLA
40RR 008	208-230 1	208-230	187-253	6.3
	208-230/460 3	208-240/440-480	187-264/396-528	3.1/1.55
	575 3	550-600	495-660	1.25
40RR 012	208 3	208	187-229	6.0
	230/460 3	220-240/440-480	198-264/396-528	5.6/2.8
	575 3	550-600	495-660	2.2
40RR 016	208 3	208	187-229	6.2
	230/460 3	220-240/440-480	198-264/396-528	5.6/2.8
40RR 024	208 3	208	187-229	8.8
	230/460 3	220-240/440-480	198-264/396-528	8.6/4.3
40RT 012	208 3	208	187-229	6.0
	230/460 3	220-240/440-480	198-264/396-528	5.6/2.8
40RT 016	208 3	208	187-229	6.2
	230/460 3	220-240/440-480	198-264/396-528	5.6/2.8

DSDV – Distribution System Design Voltage
FLA – Full Load Amps

*Motors are designed for satisfactory operation at 10% above and 10% below distribution system design voltages shown. Voltage fluctuations should not exceed the allowable limits indicated.

NOTE:
Fan motors are not supplied with the 40RR028 thru 054 units.

ELECTRICAL DATA ELECTRIC RESISTANCE HEATERS

ELECTRIC HEATERS FOR	KW (each)	VOLTS PHASE	FLA
40RT012	16	208/230 3	40
		460 3	20
40RT016	20	208/230 3	50
		460 3	25

FLA – Full Load Amps

LOCATION OF HEATING COIL CONNECTIONS

COIL TYPE	ARR	40RR 008, 012	016, 024	028, 034	044, 054
		Connection Location (L or R end)*			
1 Row Steam	Horiz	L or R	L	--	L or R
	Vert		R		R
2-Row Hot Water	Horiz	L or R	L	L or R	R
	Vert	Sup. - L or R Ret. - R	R		

Sup. – Supply **Ret.** – Return **L** – Left **R** – Right

*When facing return air inlet side.

STANDARD FAN MOTORS AND DRIVES

UNIT	FAN MOTOR* Hp	NEMA Frame Size	PDR	FAN PPD	FSR†
40RR008	1	48	1.9–2.9	10.0	655–1000
40RR012	2	56	2.4–3.4	12.0	690– 980
40RR016	2	66	3.7–4.7	11.4	568– 720
40RR024	3	184	4.0–5.0	10.0	700– 875
40RR028	–	213 or 215	4.3–5.3	12.4	605– 750
40RR034	–	213 or 215	4.3–5.3	11.0	685– 845
40RR044	–	254U or 256U	5.5–6.5	15.4	615– 730‡
40RR054	–	254U or 256U	5.8–7.0	15.4	660– 795‡
40RT012	2	56	2.4–3.4	12.0	690– 980
40RT016	2	66	3.7–4.7	11.4	568– 720

PDR – Pitch Diameter Range (in.)
PPD – Pulley Pitch Diameter (in.)
FSR – Fan Speed Range (rpm)

*Motors are furnished for 40RR008, 012 and 40RT012, 016. Motors field supplied for 40RR028 and larger units. 40RR016 and 024 units available with or without motors.

†Fan speeds based on 3450 rpm motor for 40RR008, 012 and 40RT012; on 1750 rpm motor for 40RR016 and larger units.

‡When 615–730 or 660–795 rpm drive is used with 40RR054 or 044 units respectively, purchase new belt locally.

NOTE:
Drives are furnished with 40RR008, 012, 016 and 024 units. Drives are available as accessories with 40RR028, 034, 044 and 054 units. Drives for motors and speed ranges other than those shown must be purchased locally.

SPECIAL FAN MOTORS AND DRIVES

UNIT	NEMA FRAME SIZE*	CENTER LINE DISTANCE (in.) Max	Min	FAN SHAFT DIAM (in.)
40RR008	56	15.6	12.7	1
40RR012 40RT012	56	16.0	12.7	1
40RR016 40RT016	66	11.8	9.4	1
	184	11.8	9.4	
	213	11.8	8.4	
	215	11.8	8.4	
40RR024	184	11.8	9.4	1
	213	11.8	8.4	
	215	11.8	8.4	
40RR028 40RR034	213	34.4	28.8	1-3/16
	215	34.4	28.8	
	254U	33.3	29.8	
40RR044	254U	14.3	10.1	1-7/16
	256U	14.3	10.1	
40RR054	254U	33.5	29.0	1-7/16
	256U	33.5	29.0	
	284U	33.5	29.0	

*Range of motor sizes unit will accept

NOTE:
Special motors and drives must be purchased locally.

ACCESSORIES

ACCESSORY (See Notes)	40RR								40RT	
	008	012	016	024	028	034	044	054	012	016
Discharge Plenum and Grille	X	X	X	X	–	–	–	–	X	X
Return Air Grille	X	X	X	X	–	–	–	–	X	X
Base	X	X	–	–	–	–	–	–	X	–
2-Step Heat–Cool Thermostat	–	–	–	†	X	X	X	X	–	–
Heat Pump Piping Package	–	–	X	X	X	X	X	X	*	*
Overhead Suspension Package	X	X	X	X	X	X	X	X	X	X
Subbase	–	–	X	X	*	*	X	X	–	X
Panel for Horizontal Discharge	–	–	X	X	–	–	–	–	–	X
Elec Resistance Htr	–	–	X	X	–	–	–	–	X	X
Elec Resistance Htr Control	–	–	X	X	–	–	–	–	X	X
Relay Package	–	X	X	X	X	X	X	X	X	X
Fan Drive	*	*	X*	X*	X	X	X	X	*	*
Fan Motor Contactor	X	X	X	X	–	–	–	–	X	X

X – Available as accessory.

*Supplied as standard.

†Supplied with elec resistance htr control package.

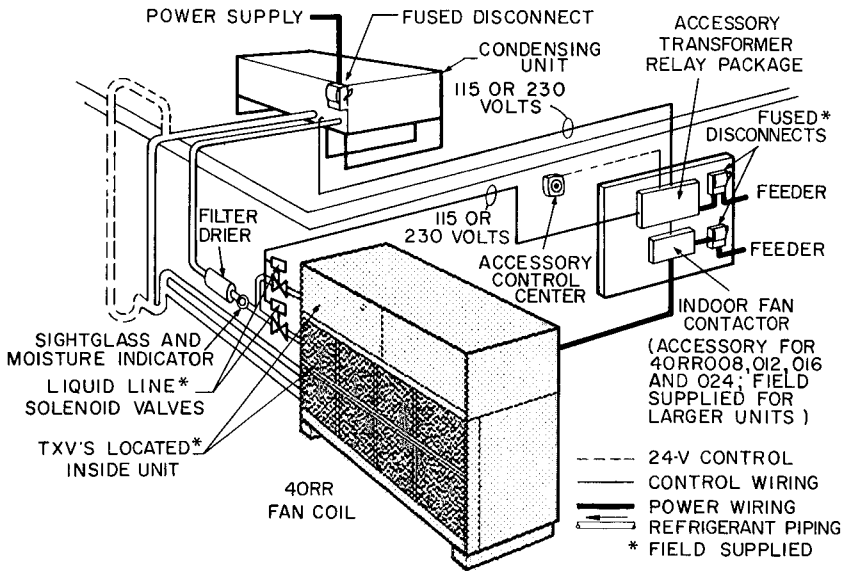
NOTES:

1 Following accessories available for all 40RR units:

2-Row Hot Water Coil
1-Row Nonfreeze Steam Coil

2 40RR016 and 024 accessory plenums cannot be used for heat pump applications when supplementary electric resistance heat is required.

TYPICAL PIPING AND WIRING CONNECTIONS



NOTES:

1. Wiring and piping shown are general points-of-connection guides only and are not intended for or to include all details for a specific installation.
2. All wiring must comply with applicable local and national codes.
3. Certain conditions of compressor unloading may require the use of a double suction riser for proper oil return. All piping must follow standard refrigerant piping techniques. Refer to Carrier System Design Manual for details.
4. One liquid line solenoid is required for capacity control on multiple-coil units. A second solenoid is required when the compression equipment requires pumpdown or single pumpout control.

GUIDE SPECIFICATIONS

Furnish and Install ____ direct expansion fan-coil unit(s) in the location(s) shown on the plans.

Total Cooling Capacity shall be _____ Btuh or more and total room sensible capacity shall be _____ Btuh or more at a coil refrigerant temperature of _____F under the following conditions:

Air entering unit _____ F db, _____ F wb
Air leaving unit _____ F db, _____ F wb

Cooling Coils shall be of nonferrous construction with mechanically bonded smooth plate fins with a total face area of not less than _____ sq ft. All tube joints shall be brazed with phoscopper or silver alloy. (When more than one coil is used, provisions should exist for increased latent heat removal at partial loads.)

Evaporator Fan Section shall have forward-curved blade, double-inlet fans mounted on a common shaft. Fans shall be statically and dynamically balanced and shall run on permanently lubricated bearings. Fans shall deliver _____ cfm with _____ in. wg external static pressure operating at _____ rpm. Fan drive shall be V-belt with a variable pitch pulley on the fan motor shaft. Fan motor shall have built-in overload protection and shall not exceed _____ hp.

Casing shall be made of Galvanneal steel, bonderized and finished with baked enamel.

Unit Construction shall be such that horizontal or vertical discharge may be achieved by relocating the L-shaped fan deck (fan section). Provisions shall exist for suspending the unit from an overhead support.

Filters shall be standard size and not less than _____ inches thick. They shall have a face area of _____ sq ft or more. High velocity permanent (low velocity throwaway) filters shall be used and shall be protected from the cooling coil condensate.

Dimensions: _____ in. width; _____ in. depth; _____ in. height.

Accessories, as indicated, shall be field installed as indicated on the plans:

Steam Heating Coil(s) shall be located as shown on the drawing(s). Supply and return connections shall be made at the same end of the coil. Entering air temperature shall be _____F with _____ cfm. Coil capacity shall be _____ Btuh with _____ psig steam. Heating coils shall be the nonfreeze type.

Hot Water Heating Coil(s) shall be located as shown on the drawing(s). Supply and return connections shall be made at the same end of the coil. Entering air temperature shall be _____ F with _____ cfm. Coil capacity shall be _____ Btuh with _____ gpm of _____F entering water.

Electric Resistance Heaters shall have a capacity of _____ Btuh, with an air quantity of _____ cfm entering at _____F db.

CARRIER AIR CONDITIONING COMPANY® • SYRACUSE, NEW YORK

Tab 9 Form 40RR-PT-1P No. Printed in U.S.A. 1-66 167 Codes B and MS (524020)

Product Data

50TJQ004-012 Single-Package Standard Efficiency Rooftop Heat Pump Units

3 to 10 Nominal Tons

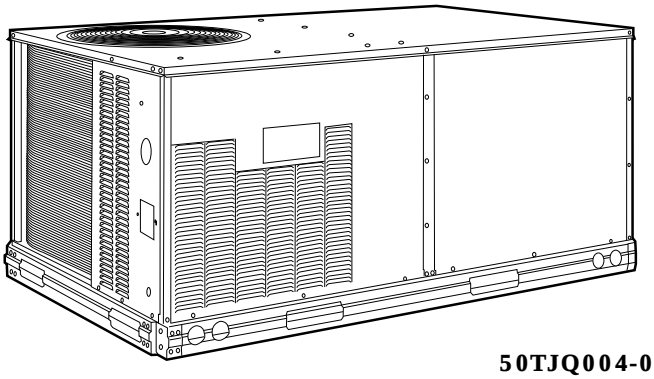
COMMERCIAL UNITARY SYSTEMS

Quality Assurance

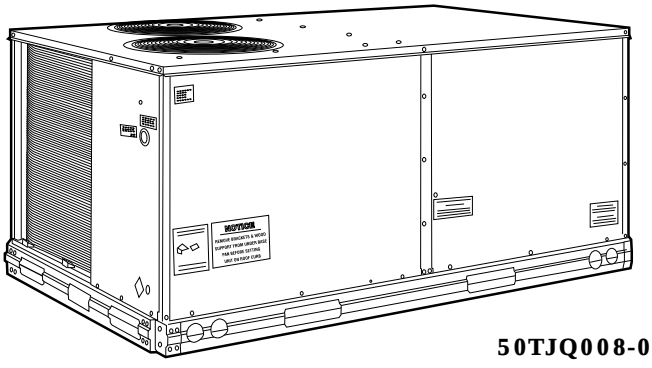
Carrier Corporation ISO 9002 #A2325

Certificate No FM 22838

Approvals:
ISO 9002
EN 29002
BS5750 PART 2
ANSI/ASQC Q92



50TJQ004-007



50TJQ008-012

Single-package standard efficiency rooftop heat pumps with:

- State-of-the-art defrost system
- Dependable 4-way valve operation
- Refrigerant filter strainer and accumulator
- Field-installed electric heaters available
- Advanced hermetic compressors mounted on vibration isolators
- Factory-installed Apollo communicating controls, non-fused disconnect switch, and convenience outlet available

Features/Benefits

The 50TJQ standard efficiency rooftop product line combines advanced technology with serviceability, performance, and flexibility.

State-of-the-art defrost system uses time and temperature to keep the outdoor coil frost-free for economical, dependable operation.

Dependable 4-way valve operation safely and efficiently accomplishes cycle reversals, defrost, and normal operation.

Refrigerant filter strainer and accumulator ensure performance dependability and circuit protection.

Field-installed electric heaters available in a wide range of capacities. Single-point wiring kit makes installation simple.

NOTE: Some electric heater applications not available for use with factory-installed disconnect switch.

Easy conversion from vertical to horizontal discharge to make retrofit and add-on jobs easier. To convert from vertical to horizontal discharge, simply interchange 2 panels. The same basic unit can be used for a variety of applications and can be quickly modified at the jobsite. All units are factory shipped in the vertical discharge configuration for fit-up to standard roof curbs. (One accessory curb fits sizes 004-007; another accessory curb fits sizes 008-012.) The contractor can order and install the roof curbs early in the construction stage, before decisions on exact size requirements have been made.

Prepainted galvanized steel cabinet with baked enamel finish is capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hour salt spray test. Paint finish is non-chalking type. All internal cabinet panels are primed, allowing the entire unit to have a longer life and a more attractive appearance.

Single continuous top panel eliminates any possibility of leaking at the seams or gaskets, which tend to deteriorate over time and shift during rigging procedures.

Heavy gage roll-formed base rails with forklift and rigging holes are integral to the unit and provide easier maneuvering and installation. Forklift slots are on 3 sides of the unit. Stretch-wrap packaging protects the unit during shipment and storage.

Exclusive tool-less removal for the filter access panel allows the replacement of filters without the need for any tools.

Two-in. return-air filters are the standard throwaway type, easily accessed and replaced through the filter access panel located directly above the air intake hood.

Thru-the-bottom electrical connection capability allows power and control wiring to be routed through the unit basepan, thereby minimizing roof penetrations.

Color-coded electrical wiring permits easy tracing and diagnostics.

Advanced hermetic compressors mounted on vibration isolators for additional sound integrity and structural support.

Enhanced copper tube, aluminum plate fin coils are thoroughly leak and pressure tested at the factory. Outdoor coils have louvered, aluminum lanced fins to provide maximum heat transfer for optimum efficiency and easy cleaning.

Acutrol™ refrigerant metering system precisely controls refrigerant flow, preventing slugging and floodback, while maintaining optimum unit performance.

Corrosion-resistant sloped condensate pan reduces possibility of biological growth and is in conformance of ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers) Standard 62 to meet many Indoor-Air Quality (IAQ) specifications. The condensate drain pan offers both bottom and end drain capability to minimize roof penetrations. The bottom drain can be used in conjunction with the thru-the-bottom connections. An external trap must be field supplied.

Commercial duty motors with permanently lubricated bearings provide additional dependability.

Standard low ambient cooling operation to 25 F; optional head pressure control kit available for outdoor ambient conditions to −20 F.

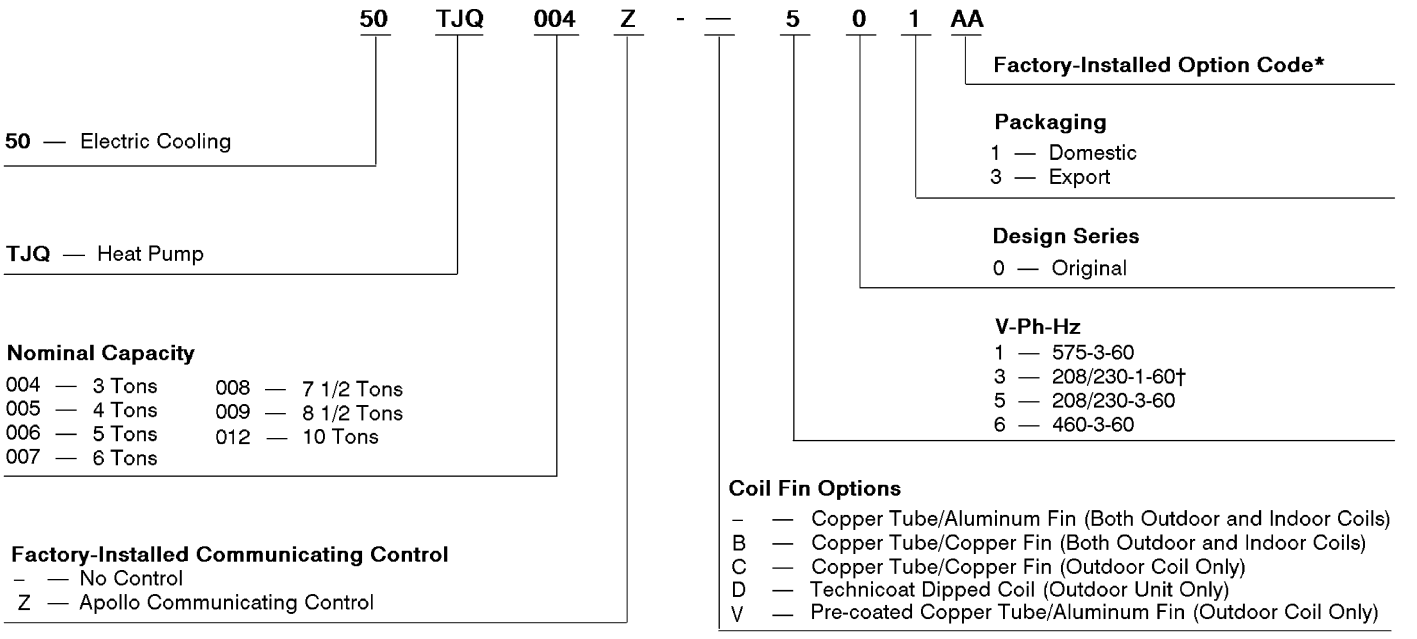
Factory run test printout included with each unit, providing certification of the unit's status at the time of manufacture. Printout includes test pressures, amperages, dates, and inspectors. Every unit is thoroughly run tested at the factory in each operating mode and evacuated prior to final charging. Every coil is then leak-tested with helium. Automated run testing allows accurate, undisputed tests and measurements which are second to none in the industry.

Ease of serviceability on all refrigerant access ports allow for quick and accurate measurements to take place. Single-side utility connections provide easy access to perform necessary service. Indoor motors are accessible through a single access door to facilitate servicing and adjustments after installation. Compressors are easily accessible for troubleshooting and system analysis.

Factory-installed Apollo communicating control (available as an option), designed exclusively by Carrier, actively monitors all modes of operation as well as indoor fan status, filter status, indoor-air quality, supply-air temperature, and outdoor-air temperature. The Apollo control board is installed in the rooftop unit control box and comes equipped with built-in diagnostic capabilities. Light-emitting diodes (LEDs) simplify troubleshooting by indicating thermostat commands for both stages of heating and cooling, indoor (evaporator) fan operation, and economizer operation. The Apollo communicating control is designed to work specifically with Carrier TEMP and VVT® thermostats.

Table of contents

Model number nomenclature



L EGEND

Al — Aluminum
Cu — Copper
FIOP — Factory-Installed Option

*Refer to 50TJQ Price Pages or contact your local Carrier representative for 50TJQ FIOP code table.
†Single phase is available on 5-ton and smaller units.

ARI* capacity ratings

UNIT 50TJQ	NOMINAL TONS	STANDARD CFM	COOLING			HEATING (High Temp)		SOUND RATING (Bels)
			Capacity (Btuh)	SEER†		Capacity (Btuh)	HSPF	
				Belt Drive	Direct Drive			
004	3	1200	35,600	10.20	10.00	34,400	6.7	8.4
005	4	1600	46,500	10.00	9.70	46,500	7.0	8.0
006	5	2000	57,000	10.00	9.90	57,000	7.5	8.2

UNIT 50TJQ	NOMINAL TONS	STANDARD CFM	COOLING		HEATING (High)		HEATING (Low)		IPLV**	SOUND RATING (Bels)
			Capacity (Btuh)	EER	Capacity (Btuh)	COP	Capacity (Btuh)	COP		
007	6	2400	70,000	9.05	72,400	3.20	42,000	2.14	—	8.2
008	7½	3200	86,000	9.00	78,000	3.00	39,000	1.80	9.3	8.6
009	8½	3600	96,000	8.90	93,000	3.10	48,000	1.90	8.9	8.6
012	10	4100	112,000	9.00	105,000	3.10	59,000	2.00	9.0	8.4

LEGEND

Bels — Sound Level (1 bel = 10 decibels)
COP — Coefficient of Performance
db — dry bulb
EER — Energy Efficiency Ratio
HSPF — Heating Seasonal Performance Factor
IPLV — Integrated Part-Load Values
SEER — Seasonal Energy Efficiency Ratio
wb — wet bulb

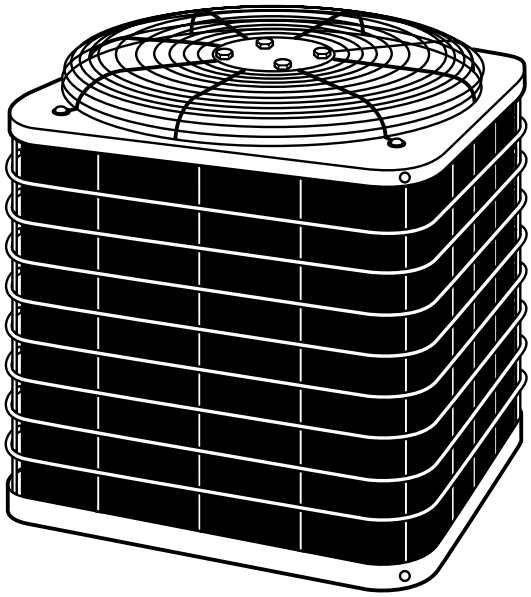
*Air Conditioning and Refrigeration Institute.
†Applies only to units with capacity of 60,000 Btuh or less.
**The IPLV only applies to 2-stage heat pump units.

NOTES:
1. Rated in accordance with ARI Standards 210/240-95 and 270-95.
2. Ratings are net values, reflecting the effects of circulating fan heat.
3. Ratings are based on:

Cooling Standard: 80 F db, 67 F wb indoor entering-air temperature and 95 F db air entering outdoor unit.
IPLV Standard: 80 F db, 67 F wb indoor entering-air temperature and 80 F db outdoor entering-air temperature.
High-Temp Heating Standard: 70 F db indoor entering-air temperature and 47 F db, 43 F wb outdoor entering-air temperature.
Low-Temp Heating Standard: 70 F db indoor entering-air temperature and 17 F db, 15 F wb outdoor entering-air temperature.

MODEL PH10
10 SEER 3 PHASE HEAT PUMP UNIT
SIZES 048, 060 — 4 AND 5 NOMINAL TONS

Product Data



FEATURES

AVAILABLE Nominal sizes are available in 048 and 060 sizes to meet the needs of light commercial applications.

EFFICIENCY: With SEER of at least 10.0 and HSPF of 7.0, these heat pump systems provide economy of operation through energy conservation. They recover heat for indoor comfort from outdoor air during the heating season and, by automatically reversing the refrigerant system, remove indoor heat and excess humidity during the cooling season.

CERTIFICATION: All models are listed with UL, (U.S. and Canada), ARI, and CEC.

ELECTRICAL Units are offered in 208–230v 3 phase in the 048 and 060 sizes.

FAN MOTOR: The totally enclosed fan motor means greater reliability under adverse weather conditions and dependable performance for many years. Permanent split capacitor type motors provide more economical operation.

CABINET: The prepainted steel cabinet is protected underneath by a galvanized coating and treated with a layer of zinc phosphate for a finish that will last for many years. All screws on cabinet exterior are coated for a long-lasting, rust-resistant, quality appearance.

UNIT DESIGN: The copper tube, enhanced sine wave, aluminum fin coil is designed for optimum heat transfer. Vertical air discharge carries sound and hot condenser air up and away from adjacent patio areas and foliage. The base pan is designed for easy removal of water, dirt, and leaves.

COMPONENTS: Includes a suction-tube accumulator that minimizes the amount of liquid refrigerant reaching the compressor; a low-pressure switch that stops the compressor if refrigerant charge is lost; and an internal compressor relief valve on all sizes.

3-PHASE (SCROLL COMPRESSOR UNITS) MONITOR BOARD Control board that monitors the electrical phase and prevents compressor operation if wired incorrectly.

DISCHARGE MUFFLER Minimizes low frequency sound and pressure pulsation generated by compressor discharge gas.

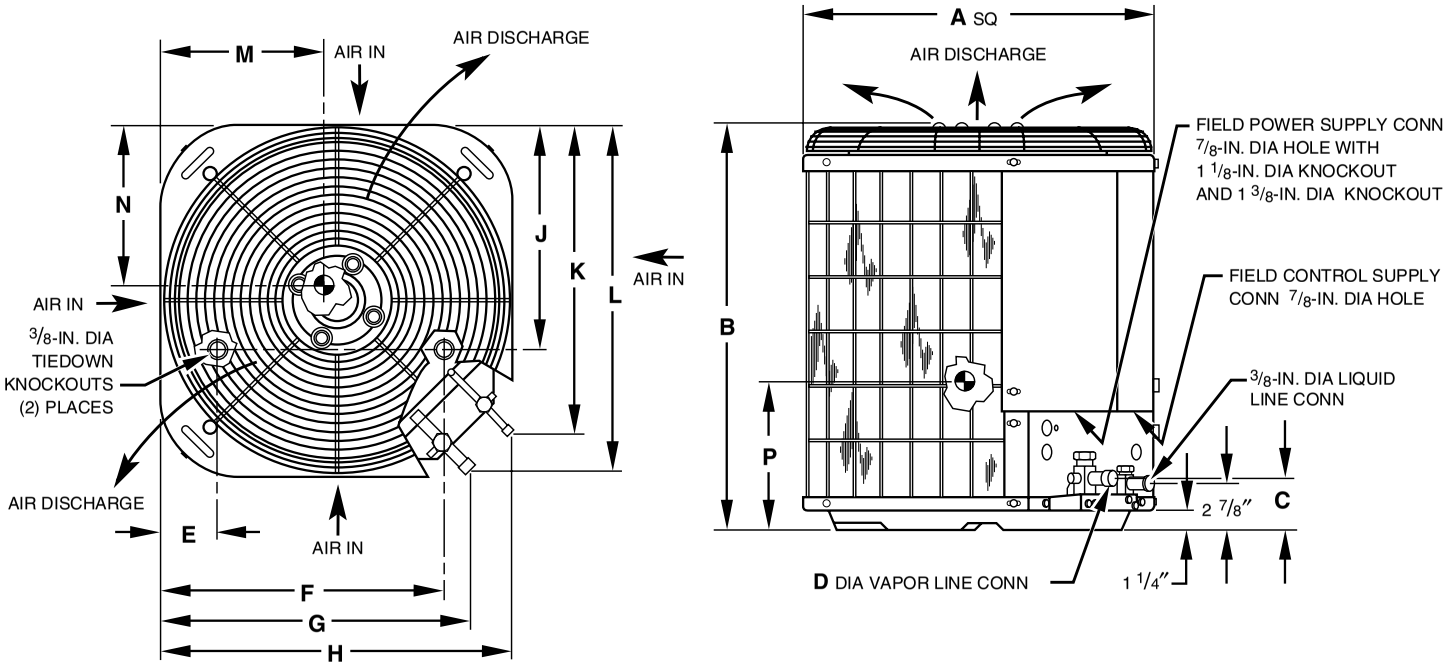
DEFROST CONTROL BOARD: Incorporates a defrost relay, defrost timer and low-voltage terminations. The defrost control is a time/temperature initiation/termination control which includes 3 field-selectable time periods of 30, 60, and 90 minutes. The control includes built-in 5-minute compressor delay.

COMPRESSOR: Designed specifically for heat pump duty, with energy efficiency during heating and cooling operation. Each compressor is hermetically sealed against contamination to assure long life and dependable performance and externally mounted on rubber isolators for quiet operation. Continuous compressor operation is approved down to –30°F (–34°C) in the heating mode and down to 55°F (12.8°C) in the cooling mode. For improved serviceability, all models are equipped with a compressor terminal plug.

SERVICE VALVES: Both service valves are brass, front seating type with sweat connections. Valves are externally located so refrigerant tube connections can be made quickly and easily. Each valve has a service port for ease of checking operating refrigerant pressures.

SERVICEABILTY: One panel provides access to electrical controls. Removal of top gives access to fan motor, compressor, and condenser coil.

LIMITED WARRANTY: Standard 1-year limited warranty on all parts and 5-year limited warranty on compressor parts.



NOTES:

1. Allow 30 in. clearance to service side of unit, 48 in. above unit, 6 in. on one side, 12 in. on remaining side, and 24 in. between units for proper airflow.
2. Minimum outdoor operating ambient in cooling mode is 55°F, max. 125°F.
3. Maximum outdoor operating ambient in heating mode is 66°F.
4. Series designation is the 14th position of the unit model number.
5. Center of gravity ◔.

A97071

DIMENSIONS (IN.)

UNIT SIZE	SERIES	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Min Mounting PAD Dim (in.)
048	A	30	39-15/16	3-1/4	7/8	6-1/2	23-1/2	27-/12	29-1/8	20	26-3/8	29-9/16	15	15-3/4	15-1/2	30 x 30
060	A	30	39-15/16	3-1/4	7/8	6-1/2	23-1/2	27-1/4	29-1/8	20	26-3/8	29-9/16	13-3/4	15-5/8	15	30 x 30

SPECIFICATIONS

UNIT SIZE-SERIES	048-A	060-A
Operating Weight (Lb)	221	238
Shipping Weight (Lb)	242	260
ELECTRICAL		
Unit Volts—Phase—Hertz	208-230—3—60	208-230—3—60
Operating Voltage Range	187—253	187—253
Unit Ampacity for Wire Sizing (MCA)	17.5	27.3
Min Wire Size 60°C Copper (AWG)*	14	10
Min Wire Size 75°C Copper (AWG)*	14	10
Max Wire Length 60°C Copper (Ft)†	51	82
Max Wire Length 75°C Copper (Ft)†	48	78
Max Branch Circuit Fuse Size (Amps)	25	35
Compressor Rated Load Amps	12.9	20.7
Compressor Locked Rotor Amps	91.0	137.0
Fan Motor Full Load Amps	1.4	1.4
COMPRESSOR AND REFRIGERANT		
Compressor Type	Scroll	
Refrigerant Type	R-22	
Refrigerant Charge (Lb)	9.38	10.50
OUTDOOR COIL & FAN		
Coil Face Area (Sq Ft)	22.40	
Coil Fins per In.—Rows—Circuits	20—1—4	25—1—5
Fan Motor HP	1/4	1/4
Fan Motor RPM	1100	1100
Rated Airflow (CFM)	3300	3300
OPTIONAL EQUIPMENT		
Time-Delay Relay	KAATD0101TDR	
Outdoor Thermostat	KHAOT0301FST	
Secondary Outdoor Thermostat	KHAOT0201SEC	
Cycle Protector	KSACY0101AAA	
Compressor Crankcase Heater	Standard	Standard
Compressor Start Assist—Capacitor/Relay	N/A	N/A
Compressor Start Thermistor—PTC	N/A	N/A
Compressor Sound Hood	KSASH2101COP	
TXV Kits (Hard Shutoff)	KSATX0701HSO	KSATX1001HSO
High-Pressure Switch	KHAHI0101HPS	
Low-Ambient Pressure Switch	KSALA0201R22	
MotorMaster® Control	KSALA0401AAA	
Ball Bearing Fan Motor	HC40GE232	
Filter Drier (RCD)	P504-8163S	
Evaporator Freeze Thermostat‡‡	KAAFT0101AAA	
Isolation Relay‡‡	KHAIR0101AAA	
Liquid-Line Solenoid Valve	KHALS0401LLS	
Thermostat, Auto Changeover, Non-Programmable, °F/°C, 1-Stage Heat, 1-Stage Cool	TSTATPPBHP01-A	
Thermostat, Auto Changeover, 7-Day Programmable, °F/°C, 1-Stage Heat, 1-Stage Cool	TSTATPPPHP01-A	
Outdoor Air Temperature Sensor (For Programmable Thermostat)	TSTATXXSEN01-B	
Backplate for Non-Programmable Thermostat	TSTATXXBBP01	
Backplate for Programmable Thermostat	TSTATXXPBP01	
Thermostat Conversion Kit (4 to 5 Wire) — 10 pack	TSTATXXCNV10	

* The ampacity of non-metallic (NM) sheathed cable shall be that of 60°C (140˚F) conductors per NEC 1999, Article 336-26. If wire used is other than specified in chart, refer to applicable tables available in 1999 NEC. Copper wire must be used from disconnect to unit.
† Length shown is as measured 1 way along the wire path between the unit and the service panel for a voltage drop not to exceed 2%.
‡ Units may use fuses or circuit breakers (U.S. only).
‡‡ Consult low-ambient control Installation Instructions for application.
N/A—Not Applicable

REFRIGERANT METERING DEVICE AND LINE SET DATA

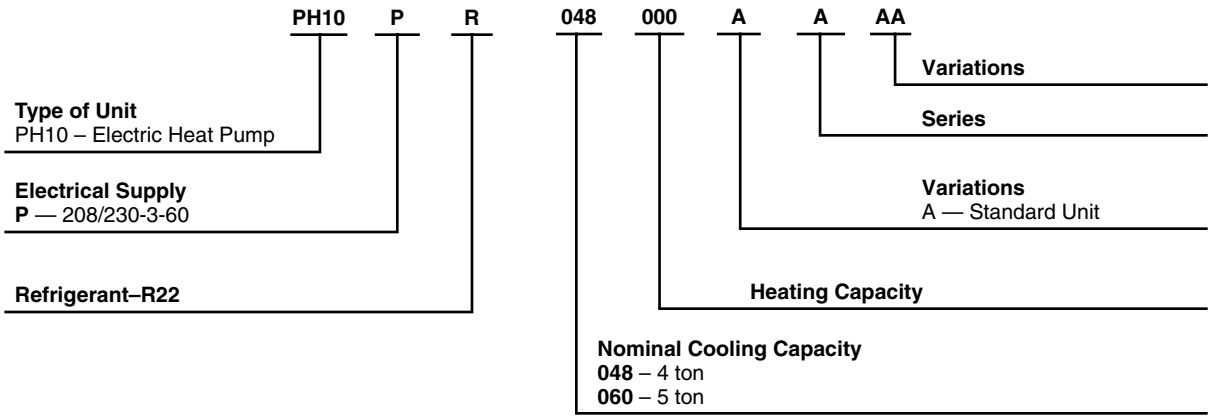
UNIT SIZE-SERIES	048-A	060-A
METERING DEVICE		
Outdoor Piston Size	70	86
Indoor Piston Size*	76	96
Required Subcooling (°F)†	15	10
REFRIGERANT LINE CONNECTION DIAMETERS (IN. ID)		
Liquid Line	3/8	
Vapor Line	7/8	7/8
REFRIGERANT LINE DIAMETERS (IN. OD)		
Liquid Line (All Applications Maximum Diameter)	3/8	
Vapor Line (0–80 Ft Line Lengths)	7/8	1-1/8
Vapor Line (Long-Line Applications Maximum Diameter)	1-1/8	1-1/8

* Piston listed is for any approved coil combination.
† Charging subcooling for indoor TXV-type expansion device.

SOUND RATING (dBA)

UNIT SIZE–SERIES	SOUND RATING
048-A	80
060-A	80

MODEL NUMBER NOMENCLATURE



OPTIONAL EQUIPMENT USAGE GUIDELINE

ACCESSORY	REQUIRED FOR LOW-AMBIENT APPLICATIONS (Below 55°F)	REQUIRED FOR LONG-LINE APPLICATIONS* (Over 80 Ft)
Crankcase Heater	Yes	Yes
Evaporator Freeze Thermostat	Yes	No
Accumulator	No	No
MotorMaster® Control or Low-Ambient Pressure Switch	Yes	No
Wind Baffle	See Low-Ambient Instructions	No
Support Feet	Recommended	No
Liquid-Line Solenoid Valve or Hard Shutoff TXV	No	See Long-Line Application Guideline
Ball Bearing Fan Motor	Yes‡	No

* For tubing line sets between 80 and 200 ft (250 ft total equivalent length), refer to the Residential Split-System Long-Line Application Guideline.
‡ Required for low-ambient controller (full modulation feature) and MotorMaster® Control only.

OPTIONAL EQUIPMENT DESCRIPTION AND USAGE (Listed Alphabetically)

1. **Ball Bearing Fan Motor**
   A fan motor with ball bearings which permits speed reduction while maintaining bearing lubrication.

SUGGESTED USE: Required on all units where Low-Ambient Controller (full modulation feature) or MotorMaster® Control has been added.

2. **Compressor Crankcase Heater**
   An electric resistance heater which mounts to the base of the compressor to keep the lubricant warm during off cycles. Improves compressor lubrication on restart and minimizes chance of refrigerant slugging. May or may not include a thermostat control.

SUGGESTED USE: When interconnecting tube length exceeds 80 ft.
When unit will be operated below 55°F (12.8°C) outdoor air temperature. (Use with low-ambient controller.)
All commercial installations.

3. **Compressor Sound Hood**
   Wraparound sound attenuation cover for the compressor. Reduces unit sound level by about 2 dBA.

SUGGESTED USE: Unit installed closer than 15 ft to quiet areas—bedrooms, etc.
Unit installed between 2 houses less than 10 ft apart.

4. **Cycle Protector**
   Solid-state timing device which prevents compressor rapid recycling. Control provides an approximate 5-minute delay after power to the compressor has been interrupted for any reason, including normal room thermostat cycling.

SUGGESTED USE: Installations in areas where power interruptions are frequent.
Where user is likely to play with room thermostat.
All commercial installations.
Installations where interconnecting tube length exceeds 80 ft.
High-rise applications.

5. **Evaporator Freeze Thermostat**
   An SPST temperature actuated switch which stops unit operation when evaporator reaches freeze-up conditions.

SUGGESTED USE: All units where Low-Ambient Controller has been added.

6. **Filter Drier—Bi-Flow**
   A device for removing contaminants from refrigerant circulating in a heat pump system: 2-direction flow.

SUGGESTED USE: All field-connected split-system heat pumps.

7. **High-Pressure Switch**
   Auto reset SPST switch activated by refrigerant pressure on high side of refrigerant circuit. Cycles compressor off if refrigerant pressure rises to about 426 ± 7 psig and resets at 320 ± 20 psig. Provides protection against compressor damage due to loss of outdoor airflow. To prevent rapid compressor recycling, Cycle Protector can be used with this switch.

SUGGESTED USE: Installations exposed to very “dirty” outdoor air.
Installations where condenser inlet air temperature exceeds 125°F (51.7°C).

8. **Isolation Relay**
   An SPDT relay which switches the Low-Ambient Controller out of the outdoor fan motor circuit when the heat pump switches to heating mode.

SUGGESTED USE: All heat pumps where Low-Ambient Controller has been added.

9. **Liquid-Line Solenoid Valve**
   An electrically operated shutoff valve to be installed at the outdoor or indoor unit (depending on tubing configuration) which stops and starts refrigerant liquid flow in response to compressor operation. Maintains a column of refrigerant liquid ready for action at next compressor operation cycle.

SUGGESTED USE: For improved system performance in heat pumps for certain combinations of indoor and outdoor units. Refer to ARI Unitary Directory.
In certain long-line applications. Refer to the Residential Split System Long-Line Application Guideline.

10. **Low-Ambient Pressure Switch**
    A long life pressure switch which is mounted to outdoor unit service valve. It is designed to cycle the outdoor fan motor in order to maintain head pressure within normal operating limits (approximately 100 psig to 225 psig). The control will maintain working head pressure at low-ambient temperatures down to 0°F (–17.8°C) when properly installed.

SUGGESTED USE: Cooling operation at outdoor temperatures below 55°F (12.8°C).

11. **MotorMaster® Control**
    A fan speed control device activated by a temperature sensor. Designed to control condenser fan motor speed in response to the saturated, condensing temperature during operation in cooling mode only. For outdoor temperatures down to –20°F, it maintains condensing temperature at 100°F ± 10°F.

SUGGESTED USE: Cooling operation at outdoor temperatures below 55°F (12.8°C).
All commercial installations.

12. **Outdoor Air Temperature Sensor**
    A device that allows the temperature at a remote location (outdoors) to be displayed at the thermostat.

SUGGESTED USE: All Payne programmable thermostats.

13. **Outdoor Thermostat**
    An SPDT temperature-actuated switch which turns on supplemental electric heaters when outdoor air temperature drops below set point.

SUGGESTED USE: Heat pump installations with multiple-stage supplemental heaters.

14. **Secondary Outdoor Thermostat**
    An SPDT temperature actuated switch which turns on third-stage of supplemental electric heaters when outdoor air temperature drops below the second-stage set point.

SUGGESTED USE: Heat pump installations where 3-stage operation of supplemental heaters is desired.

15. **Thermostatic Expansion Valve (TXV)—Bi-Flow**
    A modulating flow control valve which meters refrigerant liquid flow rate into the evaporator in response to the superheat of the refrigerant gas leaving the evaporator. Kit includes valve, adapter tubes, and external equalizer tube.

SUGGESTED USE: For improved system performance in cooling mode for certain combinations of indoor and outdoor units. Refer to ARI Unitary Directory.

16. **Time-Delay Relay**
    An SPST delay relay which briefly continues operation of the indoor blower motor to provide additional cooling after the compressor cycles off.

SUGGESTED USE: For improved efficiency ratings for certain combinations of indoor and outdoor units. Refer to ARI Unitary Directory.

COMBINATION RATINGS

UNIT SIZE-SERIES	INDOOR UNIT	ARI STANDARD RATINGS**										
		Cooling						Heating				
			SEER					High-Temp		Low-Temp		
		TC	Factory-Supplied Enhance-ment	Standard Rating	Accessory TXV	Payne Gas Furnace or Accessory TDR†	EER	TC	COP	TC	COP	HSPF
048-A	*PF1MNB048	45,500	TDR	10.00	—	—	9.15	47,000	3.20	30,200	2.34	7.20
	CAR**4817A**	45,000	TXV	—	—	10.00	9.20	46,500	3.28	28,600	2.44	7.20
	CAR**4821A**	45,000	TXV	—	—	10.00	9.20	46,500	3.28	29,000	2.44	7.20
	CAR**4824A**	45,000	TXV	—	—	10.00	9.20	46,500	3.28	29,000	2.44	7.20
	CAR**6021A**	47,000	TXV	—	—	10.20	9.50	45,500	3.30	29,000	2.46	7.20
	CAR**6024A**	47,000	TXV	—	—	10.20	9.40	45,500	3.30	29,000	2.46	7.20
	CC5A/CD5AA060	45,000	NONE	—	10.00	10.00	9.25	46,500	3.06	29,800	2.30	7.20
	CC5A/CD5AC048	43,500	NONE	—	10.00	10.00	9.15	46,000	2.94	29,400	2.26	7.00
	CC5A/CD5AW048	45,000	NONE	—	10.00	10.00	9.15	46,500	3.12	29,800	2.32	7.20
	CC5A/CD5AW060	46,000	NONE	—	10.00	10.00	9.40	47,000	3.22	29,800	2.36	7.20
	CD5AA048	45,000	NONE	—	10.00	10.00	9.20	46,500	3.12	29,800	2.32	7.20
	CE3AA048	45,000	NONE	—	10.00	10.00	9.35	47,000	3.12	29,600	2.34	7.20
	CE3AA060	46,000	NONE	—	10.00	10.00	9.45	47,000	3.18	29,800	2.38	7.50
	CF5AA048	44,500	NONE	—	10.00	10.00	9.30	46,500	2.94	29,000	2.28	7.20
	CK3BA048	45,000	NONE	—	10.00	10.00	9.25	46,500	3.16	29,800	2.36	7.20
	CK3BA060	45,000	NONE	—	10.00	10.00	9.40	46,500	3.30	30,000	2.40	7.20
	CK5A/CK5BA048	45,000	NONE	—	10.00	10.00	9.25	46,500	3.16	29,800	2.36	7.20
	CK5A/CK5BA060	45,000	NONE	—	10.00	10.00	9.40	46,500	3.30	30,000	2.40	7.20
	CK5A/CK5BT048	45,000	NONE	—	10.00	10.00	9.25	46,500	3.16	29,800	2.36	7.20
	CK5A/CK5BT060	45,000	NONE	—	10.00	10.00	9.40	46,500	3.30	30,000	2.40	7.20
	CK5A/CK5BW048	45,000	NONE	—	10.00	10.00	9.25	46,500	3.16	29,800	2.36	7.20
	CK5A/CK5BX060	46,000	NONE	—	10.00	10.00	9.50	47,000	3.28	30,000	2.42	7.20
	CNRV*4821A**	45,000	TXV	—	—	10.00	9.20	46,500	3.28	29,000	2.44	7.20
	CNRV*4824A**	45,000	TXV	—	—	10.00	9.20	46,500	3.28	29,000	2.44	7.20
	CNRV*6024A**	47,000	TXV	—	—	10.20	9.50	45,500	3.28	29,000	2.46	7.20
	CNRH*4821A**	46,000	TXV	—	—	10.00	9.40	46,500	3.28	29,000	2.44	7.20
	CNRH*6024A**	47,000	TXV	—	—	10.20	9.50	45,500	3.28	29,000	2.46	7.20
	CNRF*4818A**	45,000	TXV	—	—	10.00	9.20	46,000	3.18	28,600	2.40	7.20
	CSRH*4812A**	46,000	TXV	—	—	10.00	9.20	46,500	3.32	29,000	2.46	7.20
	CSRH*6012A**	47,000	TXV	—	—	10.20	9.50	45,500	3.36	29,000	2.48	7.20
	PF1MNB060	46,500	TDR	10.00	—	—	9.20	47,000	3.22	30,400	2.36	7.50
	PF1MNB070	47,000	TDR	10.00	—	—	9.45	42,500	3.30	30,400	2.42	7.50
	PF1MNC048	46,000	TDR&TXV	10.00	—	—	9.30	47,000	3.30	29,400	2.44	7.20
	PF1MNC060	47,000	TDR&TXV	10.00	—	—	9.40	46,000	3.32	29,400	2.44	7.20
060-A	*PF1MNB060	56,000	TDR	10.10	—	—	9.00	58,000	3.16	38,500	2.38	7.50
	CAR**6021A**	55,000	TXV	—	—	10.20	9.40	56,000	3.20	38,500	2.48	7.20
	CAR**6024A**	56,000	TXV	—	—	10.50	9.40	55,000	3.18	39,000	2.48	7.20
	CC5A/CD5AA060	53,500	NONE	—	10.20	10.20	9.15	56,000	2.94	37,200	2.30	7.00
	CC5A/CD5AW060	55,500	NONE	—	10.50	10.50	9.30	56,500	3.14	37,600	2.40	7.50
	CE3AA060	56,000	NONE	—	10.20	10.20	9.35	56,500	3.16	37,600	2.40	7.50
	CK3BA060	53,500	NONE	—	10.20	10.20	9.30	56,000	3.06	37,200	2.36	7.00
	CK5A/CK5BA060	53,500	NONE	—	10.20	10.20	9.30	56,000	3.06	37,200	2.36	7.00
	CK5A/CK5BT060	53,500	NONE	—	10.20	10.20	9.30	56,000	3.06	37,200	2.36	7.00
	CK5A/CK5BX060	55,500	NONE	—	10.50	10.50	9.40	56,500	3.20	37,800	2.42	7.50
	CNRV*6024A**	56,000	TXV	—	—	10.50	9.40	56,000	3.26	39,000	2.48	7.20
	CNRH*6024A**	56,000	TXV	—	—	10.50	9.40	56,000	3.26	39,000	2.48	7.20
	CSRH*6012A**	56,000	TXV	—	—	10.50	9.50	56,000	3.30	39,000	2.50	7.20
	PF1MNB070	56,500	TDR	10.50	—	—	9.00	57,000	3.32	38,000	2.46	7.50
	PF1MNC060	57,000	TDR&TXV	10.50	—	—	9.50	56,500	3.22	39,000	2.46	7.50

* Outdoor section/indoor section combination tested in accordance with DOE test procedures for heat pumps. Ratings for other combinations are determined under DOE computer simulation procedures.

† In most cases, only 1 method should be used to achieve TDR function. Using more than 1 method in a system may cause degradation in performance. Use either the accessory Time-Delay Relay KAATD0101TDR or a furnace equipped with TDR. All Payne furnaces are equipped with TDR.

‡ Requires hard shutoff TXV; based on computer simulation.

** Ratings are net values reflecting the effects of circulating fan heat. Supplemental electric heat is not included.
Ratings are based on:
Cooling Standard: 80°F (27°C) db, 67°F (19°C) wb indoor entering air temperature and 95°F (35°C) db air entering outdoor unit.
High-Temperature Heating Standard: 70°F (21°C) db indoor entering air temperature and 47°C (8°C) db 43°F (6°C) wb air entering outdoor unit.
Low-Temperature Heating Standard: 70°F (21°C) db indoor entering air temperature and 17°F (–9°C) db, 15°F (–10°C) wb air entering outdoor unit.

COP — Coefficient of Performance
EER — Energy Efficiency Ratio
HSPF — Heating Seasonal Performance Factor
SEER — Seasonal Energy Efficiency Ratio
TC — Total Capacity (Btuh)
TDR — Time-Delay Relay
TXV — Thermostatic Expansion Valve

DETAILED COOLING CAPACITIES*

EVAP AIR		CONDENSER ENTERING AIR TEMPERATURES °F											
		85			95			105			115		
CFM	EWB	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**
PH10PR048-A Outdoor Section With PF1MNB048 Indoor Section													
1500	72	51.2	26.1	4.53	48.8	25.3	4.96	46.4	24.4	5.44	43.7	23.5	5.95
	67	46.9	33.8	4.44	44.7	32.9	4.87	42.4	32.0	5.33	40.0	31.0	5.84
	63††	43.7	32.8	4.38	41.6	31.9	4.80	39.4	30.9	5.26	37.0	29.9	5.75
	62	43.2	41.0	4.37	41.2	40.0	4.79	39.2	38.8	5.25	37.1	37.1	5.76
	57	42.5	42.5	4.35	40.8	40.8	4.78	39.0	39.0	5.25	37.1	37.1	5.76
1600	72	51.5	26.7	4.58	49.1	25.9	5.01	46.6	25.0	5.49	43.9	24.1	6.00
	67	47.3	34.8	4.49	45.0	33.9	4.92	42.6	33.0	5.39	40.2	32.0	5.89
	63††	44.0	33.7	4.42	41.8	32.8	4.85	39.6	31.8	5.31	37.2	30.8	5.80
	62	43.6	42.3	4.42	41.6	41.1	4.84	39.6	39.6	5.31	37.7	37.7	5.82
	57	43.2	43.2	4.41	41.5	41.5	4.84	39.6	39.6	5.31	37.7	37.7	5.82
1700	72	51.8	27.3	4.63	49.4	26.4	5.06	46.8	25.5	5.54	44.1	24.6	6.05
	67	47.6	35.8	4.54	45.3	34.9	4.97	42.9	34.0	5.44	40.4	33.0	5.94
	63††	44.2	34.6	4.47	42.1	33.7	4.90	39.8	32.8	5.36	37.4	31.7	5.85
	62	44.0	43.4	4.47	42.1	42.0	4.90	40.2	40.2	5.37	38.2	38.2	5.88
	57	43.8	43.8	4.46	42.0	42.0	4.90	40.2	40.2	5.37	38.2	38.2	5.88

Multipliers for Determining the Performance With Other Indoor Sections

Indoor Section	Size	Cooling Capacity	Cooling Power	Indoor Section	Size	Cooling Capacity	Cooling Power
CAR**	4817A**	0.98	0.94	CK5A/CK5BT	048	0.99	0.98
	4821A**	0.98	0.95		060	1.01	0.99
	4824A**	0.98	0.96	CK5A/CK5BW	048	0.99	0.98
	6021A**	1.00	0.96	CK5A/CK5BX	060	1.03	1.00
	6024A**	1.00	0.96	CNRV*	4821A**	0.98	0.95
CC5A/CD5AA	060	0.99	0.99		4824A**	0.98	0.95
CC5A/CD5AC	048	0.97	0.98		6024A**	1.00	0.96
CC5A/CD5AW	048	0.98	0.98	CNRH*	4821A**	0.98	0.95
CD5AA	048	0.98	0.98		6024A**	1.00	0.96
CE3AA	048	0.99	0.98	CNRF*	4818A**	0.98	0.96
	060	1.02	0.98	CSRH*	4812A**	0.98	0.95
CF5AA	048	1.00	0.98		6012A**	1.00	0.95
CK3BA	048	0.99	0.98	PF1MNB	048	1.00	1.00
	060	1.03	1.00		060	1.02	1.02
CK5A/CK5BA	048	0.99	0.98		070	1.06	1.02
	060	1.01	0.99	PF1MNC	048	0.98	0.96
	—	—	—		060	1.00	0.97

See notes on page 8.

DETAILED COOLING CAPACITIES* Continued

EVAP AIR		CONDENSER ENTERING AIR TEMPERATURES °F											
		85			95			105			115		
CFM	EWB	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**	Capacity MBtuh† Total	Capacity MBtuh† Sens‡	Total Sys kW**
PH10PR060-A Outdoor Section With PF1MNB060 Indoor Section													
1900	72	64.2	32.6	5.73	61.2	31.5	6.25	58.0	30.4	6.83	54.7	29.3	7.46
	67	58.6	42.4	5.61	55.8	41.2	6.13	52.8	40.1	6.69	49.7	38.9	7.31
	63††	54.4	41.0	5.53	51.8	39.9	6.04	49.0	38.7	6.60	46.0	37.4	7.19
	62	53.7	51.5	5.51	51.3	50.2	6.03	48.7	48.6	6.59	46.3	46.3	7.20
	57	53.0	53.0	5.50	50.9	50.9	6.02	48.7	48.7	6.59	46.3	46.3	7.20
2000	72	64.5	33.2	5.79	61.4	32.1	6.32	58.1	31.0	6.89	54.9	29.8	7.52
	67	58.9	43.4	5.67	56.0	42.2	6.19	53.0	41.0	6.76	49.9	39.9	7.37
	63††	54.7	42.0	5.59	52.0	40.8	6.10	49.1	39.6	6.66	46.2	38.3	7.26
	62	54.2	52.8	5.58	51.6	51.3	6.09	49.2	49.2	6.66	46.8	46.8	7.27
	57	53.7	53.7	5.57	51.5	51.5	6.09	49.2	49.2	6.66	46.8	46.8	7.28
2100	72	64.8	33.7	5.85	61.6	32.6	6.38	58.4	31.5	6.95	55.0	30.4	7.58
	67	59.1	44.4	5.73	56.1	43.2	6.25	53.1	42.0	6.82	50.0	40.8	7.43
	63††	55.0	42.9	5.64	52.1	41.7	6.16	49.4	40.5	6.72	46.3	39.2	7.32
	62	54.6	53.9	5.64	52.2	52.1	6.16	49.8	49.8	6.73	47.3	47.3	7.35
	57	54.3	54.3	5.63	52.1	52.1	6.16	49.7	49.7	6.73	47.3	47.3	7.35

Multipliers for Determining the Performance With Other Indoor Sections

Indoor Section	Size	Cooling Capacity	Cooling Power	Indoor Section	Size	Cooling Capacity	Cooling Power
CAR**	6021A**	1.00	0.94	CK5A/CK5BX	060	1.01	0.96
	6024A**	1.00	0.94	CNRV*	6024A**	1.00	0.95
CC5A/CD5AA	060	0.96	0.96	CNRH*	6024A**	1.00	0.95
CC5A/CD5AW	060	0.99	0.97	CSRH*	6012A**	1.00	0.94
CE3AA	060	1.01	0.97	PF1MNB	060	1.00	1.00
CK3BA	060	1.01	0.96		070	1.03	0.99
CK5A/CK5BA	060	0.97	0.95	PF1MNC	060	1.00	0.97
CK5A/CK5BT	060	0.97	0.95		—	—	—

NOTE: When the required data fall between the published data, interpolation may be performed. Extrapolation is not an acceptable practice.

*Detailed cooling capacities are based on indoor and outdoor unit at the same elevation and connected by 25 ft (4.59m) of tubing. If other than 25 ft (4.59m) of tubing is used and/or indoor unit is located above outdoor unit, a slight variation in capacity may occur.

† Total and sensible capacities are net capacities. Blower motor heat has been subtracted.

‡ Sensible capacities shown are based on 80°F (27°C) entering air at the indoor coil. For sensible capacities at other than 80°F (27°C), deduct 835 Btuh (245 kW) per 1000 CFM (480 L/S) of indoor coil air for each degree below 80°F (27°C), or add 835 Btuh (245 kW) per 1000 CFM (480 L/S) of indoor coil air per degree above 80°F (27°C).

** System kW is total of indoor and outdoor unit kilowatts.

††At TVA rating indoor condition (75°F edb/63°F ewb). All other indoor air temperatures are at 80°F edb.

HEAT PUMP HEATING PERFORMANCE

INDOOR AIR		OUTDOOR COIL ENTERING AIR TEMPERATURES °F																								
		–3			7			17			27			37			47			57			67			
		Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr
EDB	CFM	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡
PH10PR048-A Outdoor Section With PF1MNB048 Indoor Section																										
65	1500	26.4	24.2	3.76	30.0	27.5	3.79	33.5	30.6	3.80	37.2	33.0	3.83	40.9	37.2	3.87	45.2	45.2	3.96	50.4	50.4	4.12	53.2	53.2	4.17
	1600	26.5	24.4	3.79	30.1	27.7	3.81	33.7	30.7	3.82	37.4	33.2	3.84	41.1	37.4	3.87	45.5	45.5	3.95	50.6	50.6	4.10	52.8	52.8	4.11
	1700	26.7	24.6	3.82	30.3	27.9	3.83	33.9	30.9	3.84	37.6	33.4	3.85	41.3	37.6	3.88	45.7	45.7	3.96	50.8	50.8	4.09	53.2	53.2	4.11
70	1500	26.0	23.9	3.90	29.6	27.2	3.94	33.2	30.3	3.96	36.8	32.7	3.99	40.5	36.8	4.04	44.7	44.7	4.13	49.9	49.9	4.29	53.6	53.6	4.41
	1600	26.2	24.1	3.93	29.8	27.4	3.96	33.4	30.5	3.98	37.0	32.9	4.00	40.7	37.0	4.04	45.0	45.0	4.12	50.2	50.2	4.29	53.6	53.6	4.36
	1700	26.4	24.3	3.96	30.0	27.6	3.98	33.6	30.6	4.00	37.2	33.1	4.01	40.9	37.2	4.04	45.2	45.2	4.12	50.4	50.4	4.28	53.5	53.5	4.33
75	1500	25.5	23.4	4.03	29.3	26.9	4.09	32.9	30.0	4.13	36.5	32.4	4.17	40.1	36.5	4.21	44.2	44.2	4.30	49.3	49.3	4.47	53.6	53.6	4.64
	1600	25.7	23.6	4.06	29.5	27.1	4.12	33.1	30.2	4.14	36.7	32.6	4.17	40.3	36.7	4.21	44.5	44.5	4.29	49.6	49.6	4.46	53.7	53.7	4.60
	1700	25.9	23.8	4.09	29.7	27.3	4.14	33.3	30.3	4.16	36.9	32.7	4.18	40.5	36.8	4.22	44.7	44.7	4.29	49.8	49.8	4.45	53.4	53.4	4.54

Multipliers for Determining the Performance With Other Indoor Sections

Indoor Section	Size	Heating		Indoor Section	Size	Heating	
		Capacity	Power			Capacity	Power
CAR**	4817A**	0.96	0.93	CK5A/CK5BT	048	0.99	1.00
	4821A**	0.96	0.93		060	1.00	1.01
	4824A**	0.96	0.94	CK5A/CK5BW	048	0.99	1.00
	6021A**	0.79	0.88	CK5A/CK5BX	060	0.98	0.96
	6024A**	0.79	0.88	CNRV*	4821A**	0.96	0.93
CC5A/CD5AA	060	0.99	1.03		4824A**	0.96	0.93
CC5A/CD5AC	048	0.96	1.03		6024A**	0.88	0.92
CC5A/CD5AW	048	0.99	1.02	CNRH*	4821A**	0.96	0.93
CD5AA	048	0.99	1.02		6024A**	0.88	0.92
CE3AA	048	0.99	1.01	CNRF*	4818A**	0.96	0.96
	060	0.97	0.96	CSRH*	4812A**	0.96	0.93
CF5AA	048	0.95	1.00		6012A**	0.85	0.89
CK3BA	048	0.99	1.00	PF1MNB	048	1.00	1.00
	060	0.98	0.96		060	0.97	0.97
CK5A/CK5BA	048	0.99	1.00		070	0.90	0.92
	060	1.00	1.01	PF1MNC	048	0.94	0.94
	—	—	—		060	0.82	0.90

See notes on page 10.

HEAT PUMP HEATING PERFORMANCE Continued

INDOOR AIR		OUTDOOR COIL ENTERING AIR TEMPERATURES °F																								
		–3			7			17			27			37			47			57			67			
		Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr	Capacity MBtuh†		Total Pwr
EDB	CFM	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡	Total	Int	kW‡
PH10PR060-A Outdoor Section With PF1MNB060 Indoor Section																										
65	1900	28.0	25.8	4.36	32.8	30.2	4.51	38.2	34.8	4.67	44.0	39.1	4.86	50.9	46.3	5.12	59.4	59.4	5.50	69.7	69.7	6.06	79.0	79.0	6.35
	2000	28.2	25.9	4.40	33.0	30.4	4.54	38.4	35.0	4.70	44.3	39.3	4.89	51.2	46.6	5.14	59.7	59.7	5.52	70.0	70.0	6.08	78.8	78.8	6.51
	2100	28.4	26.1	4.44	33.2	30.5	4.58	38.6	35.2	4.73	44.5	39.5	4.92	51.4	46.8	5.17	59.9	59.9	5.54	70.3	70.3	6.11	78.5	78.5	6.47
70	1900	27.7	25.5	4.51	32.5	29.8	4.68	37.8	34.4	4.86	43.6	38.7	5.06	50.3	45.8	5.32	58.7	58.7	5.70	68.8	68.8	6.27	78.7	78.7	6.87
	2000	27.9	25.6	4.55	32.7	30.0	4.71	38.0	34.6	4.88	43.8	38.9	5.08	50.6	46.0	5.34	59.0	59.0	5.72	69.0	69.0	6.28	78.9	78.9	6.85
	2100	28.1	25.8	4.59	32.9	30.2	4.75	38.2	34.8	4.91	44.0	39.1	5.11	50.8	46.2	5.36	59.3	59.3	5.74	69.4	69.4	6.31	78.8	78.8	6.82
75	1900	27.3	25.1	4.66	32.1	29.5	4.85	37.4	34.1	5.05	43.1	38.3	5.26	49.7	45.3	5.53	58.0	58.0	5.92	68.0	68.0	6.49	78.2	78.2	7.16
	2000	27.5	25.3	4.70	32.3	29.7	4.89	37.6	34.3	5.07	43.3	38.5	5.28	50.0	45.5	5.55	58.3	58.3	5.94	68.3	68.3	6.50	78.4	78.4	7.16
	2100	27.7	25.5	4.74	32.5	29.9	4.92	37.8	34.5	5.10	43.6	38.7	5.31	50.2	45.7	5.57	58.5	58.5	5.95	68.6	68.6	6.52	78.8	78.8	7.19

Multipliers for Determining the Performance With Other Indoor Sections

Indoor Section	Size	Heating		Indoor Section	Size	Heating	
		Capacity	Power			Capacity	Power
Indoor Section	Size	Heating		Indoor Section	Size	Heating	
		Capacity	Power			Capacity	Power
CAR**	6021A**	0.97	0.94	CK5A/CK5BX	060	0.98	0.97
	6024A**	0.96	0.93	CNRV*	6024A**	0.98	0.95
CC5A/CD5AA	060	0.97	1.03	CNRH*	6024A**	0.98	0.95
CC5A/CD5AW	060	0.98	1.00	CSRH*	6012A**	0.98	0.93
CE3AA	060	0.98	0.98	PF1MNB	060	1.00	1.00
CK3BA	060	0.98	0.97		070	1.00	0.96
CK5A/CK5BA	060	0.97	1.00	PF1MNC	060	0.97	0.95
CK5A/CK5BT	060	0.97	1.00		—	—	—

NOTE: When the required data fall between the published data, interpolation may be performed. Extrapolation is not an acceptable practice.

† The Btuh heating capacity values shown are net integrated values from which the defrost effect has been subtracted. The Btuh heating from supplement heaters should be added to those values to obtain total system capacity.

‡ The kW values include the compressor, outdoor fan motor, and indoor blower motor. The kW from supplement heaters should be added to these values to obtain total system kilowatts.

EDB—Entering Dry Bulb

SYSTEM DESIGN

1. Intended for outdoor installation with free air inlet and outlet. Outdoor fan external static pressure available is less than 0.01-in. wc.
2. Minimum outdoor operating air temperature for cooling mode without low-ambient operation accessory is 55°F (12.8°C).
3. Maximum outdoor operating air temperature for cooling mode is 115°F (46.1°C).
4. Minimum outdoor operating air temperature for heating mode is –30°F (–34.4°C).
5. Maximum outdoor operating air temperature for heating mode is 66°F (18.9°C).
6. For reliable operation, unit should be level in all horizontal planes.
7. Maximum elevation of indoor coil above or below base of outdoor unit is: indoor coil above = 60 ft, indoor coil below = 200 ft. (See items 8 and 9 following.)
8. For interconnecting refrigerant tube lengths greater than 80 ft or 20 ft vertical differential (250 ft total equivalent length), consult the Residential Split-System Long-Line Application Guideline available from equipment distributor.
9. IF ANY refrigerant tubing is buried, provide a minimum 6-in. vertical rise to the valve connections at the unit. Refrigerant tubing lengths up to 36 in. may be buried without further consideration.
10. Use only copper wire for electric connection at unit. Aluminum and clad aluminum are not acceptable for the type of connector provided.

 Printed in U.S.A. edition date: 3/06 Catalog No. SS-PH10-09

 Replaces: SS-PH10-08