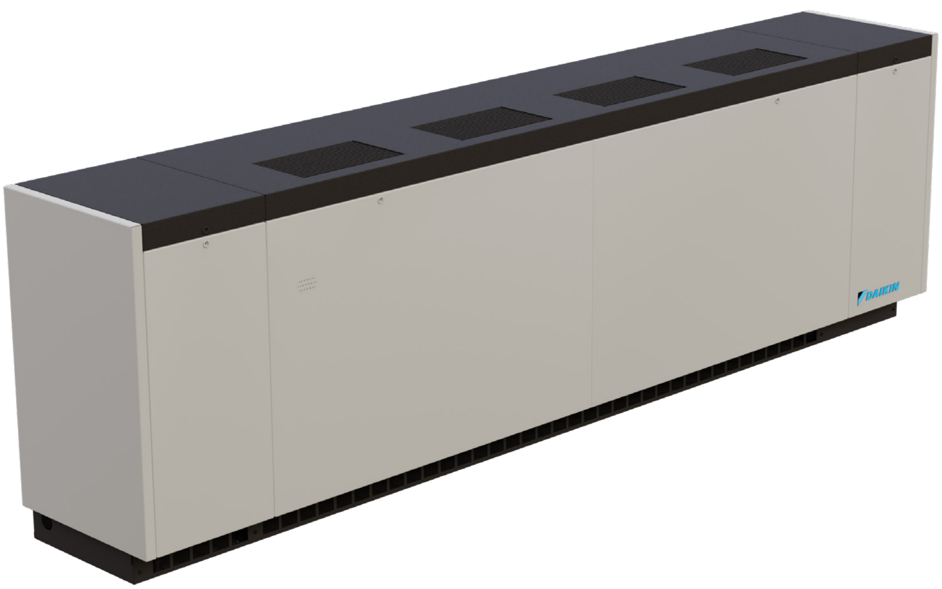
Catalog 1663

Classroom Self-Contained Unit Ventilators

Model ARQ Water Source Heat Pump – Standard Range
Model GRQ Water Source Heat Pump – Geothermal Range

Size 024 (2 Ton) to 048 (4 Ton)

MicroTech ("K" Vintage)



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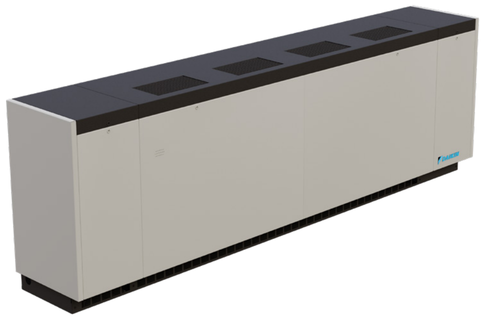
Classroom Unit Ventilators



For nearly a century schools have relied on unit ventilators to keep classrooms comfortable.

Students learn more readily in a quiet, well-ventilated environment. That is why Herman Nelson invented the unit ventilator in 1917. Daikin Applied continues to set the industry standard for performance, features and quality. Today Daikin Applied remains committed to continuing the Herman Nelson-AAF-McQuay legacy as the industry leader and meeting the changing requirements of schools with the highest quality unit ventilator products available.

We realize that keeping expenditures down is a high priority for school administrators and school boards.

Daikin Applied unit ventilators are inexpensive to install and operate, and they are designed and built to provide years of trouble-free service.

Quiet Operation

Daikin Applied unit ventilators are engineered and manufactured to deliver quiet, continuous comfort. We developed our GentleFlo air moving system to minimize operating sound levels—even as demands for more fresh air require units to operate longer and work harder.

Low Operating Costs

Daikin Applied unit ventilators minimize energy usage by utilizing a two-stage compressor and multi-speed fan to better match changing room loads. They take maximum advantage of “free” cooling opportunities to reduce operating costs. During unoccupied periods and at night, units operate sparingly to conserve energy.

Built To Last

Our proven institutional design can withstand the rigors of the classroom environment. It features an extra-sturdy chassis and double-wall damper on the inside; scuff-resistant finishes and tamper prevention features on the outside. In fact, many units installed over 30 years ago continue to provide quiet, reliable classroom comfort.

MicroTech Control For Superior Performance, Easy Integration

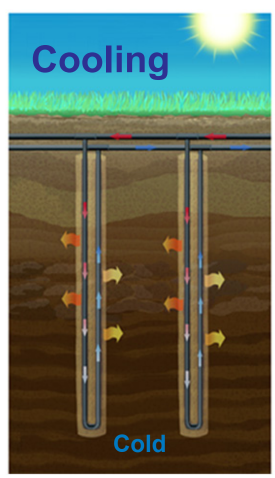
Daikin Applied unit ventilators can be equipped with MicroTech unit controllers for superior performance. Factory integrated and tested controller, sensor, actuator and unit options promote quick, reliable start-up and minimize costly field commissioning. MicroTech controls provide easy, low-cost integration into most building automation systems. Daikin Applied units with MicroTech controls have on-board BACnet® communications, with an optional LonWorks® module to communicate control and monitoring information to your BAS, without the need for costly gateways.

The Geothermal System (Model GRQ)

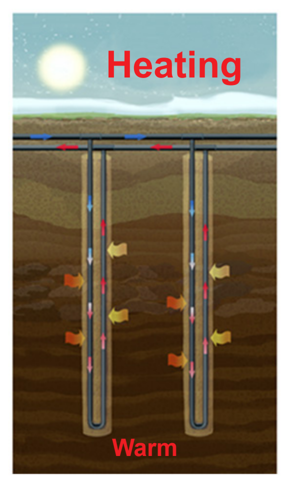
Model GRQ Ground Source heat pump utilize the natural properties of the earth to provide heating and cooling to a building. Heat addition and rejection take place below the ground, inside hundreds of feet of high density polyethylene pipe, known as a ground loop. Fluid is circulated through the ground loop and into the geothermal units. The Geothermal heat pump unit simply amplifies and directs conditioned air to the desired location.

In the **Heating Mode** the earth acts as a heat source, allowing the circulating fluid to extract natural heat from the earth and transfer it to the space where it can be used for heating.

In the **Cooling Mode**, the earth acts as a heat sink enabling the circulating fluid to transfer the excess heat, absorbed by the unit, from the building zones to the earth where it is absorbed and stored for future heating requirements.



Rejection of Heat into the Ground



Addition of Warmth from the Ground

AHRI Performance Data

Water Loop – ARQ

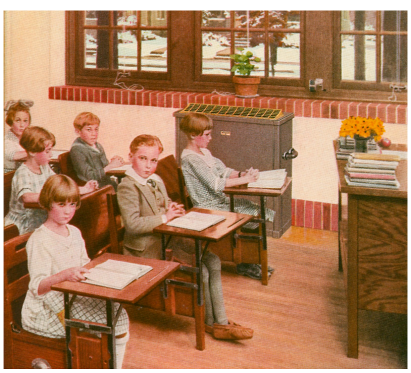
Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow	Cooling Performance		Heating Performance	
				Total Capacity	Efficiency	Total Capacity	Efficiency
			CFM	Btuh	EER	Btuh	COP
024	Full	High	1000	25400	17.4	30900	5.53
	Part	Med	750	18300	19.3	22900	5.97
	Part	Low	650	17900	19.3	22400	5.52
040	Full	High	1250	41200	15.8	47400	4.41
	Part	Med	1000	30600	17.2	35000	4.87
	Part	Low	800	28800	16.5	33000	4.21
048	Full	High	1500	46200	15.3	56100	4.34
	Part	Med	1050	31600	15.7	38600	3.98
	Part	Low	850	29100	14.5	37100	3.53

Notes: Full and part load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 86°F and high-speed fan.
Full and part load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 68°F and high-speed fan.
Fluid is fresh water.

Ground Loop – GRQ

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow	Cooling Performance		Heating Performance	
				Total Capacity	Efficiency	Total Capacity	Efficiency
			CFM	Btuh	EER	Btuh	COP
024	Full	High	1000	25700	18.2	20100	4.12
	Part	Med	750	19100	24.8	15000	4.6
	Part	Low	650	18700	25.0	14500	4.1
040	Full	High	1250	42100	17.7	31900	3.5
	Part	Med	1000	32500	23.9	23800	4.0
	Part	Low	800	30700	23.2	21700	3.3
048	Full	High	1500	47600	17.2	36400	3.5
	Part	Med	1050	34300	22.0	23800	3.1
	Part	Low	850	31800	20.5	22300	2.6

Notes: Full load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 77°F and high-speed fan.
Full load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 32°F and high-speed fan.
Part load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 68°F and medium or low-speed fan.
Part load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 41°F and medium or low-speed fan.
Fluid is 15% methanol solution.

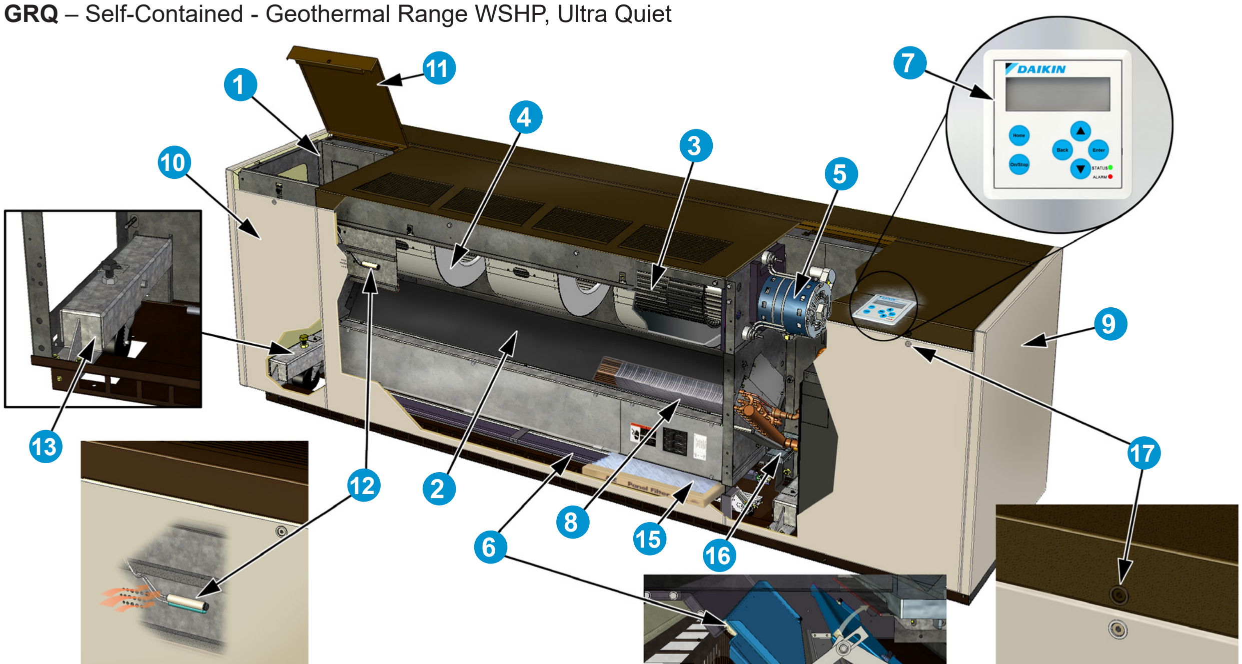


Models ARQ & GRQ Floor Unit

Models ARQ & GRQ are vertical, floor-standing units that utilize refrigerant for cooling and heating. Supplemental electric heat is available as an option. Their built-in refrigeration section eliminates the need for chillers and outdoor condensing units, making them the perfect choice for low- first cost new or retrofit construction.

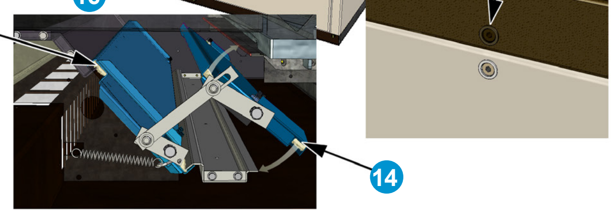
Older buildings with baseboard radiant heat or other hydronic heating systems can be easily adapted to work efficiently with these units. The major features of these models are shown below and described in more detail on the following pages.

Model ARQ – Self-Contained - Standard Range WSHP, Ultra Quiet
Model GRQ – Self-Contained - Geothermal Range WSHP, Ultra Quiet



Overall Unit Dimensions:

Size 024 – 86" × 30 × 16-5/8" or (21-7/8 with Adapter Back)
Size 040 – 98" × 30" × 16-5/8" or (21-7/8" with Adapter Back)
Size 048 – 110" × 30" × 16-5/8" or (21-7/8" with Adapter Back)



Note: *Unit size 024 shown (3-fans)*

1 Welded one-piece chassis
- offers superior strength, durability, and vibration reduction.

2 Unique draw-thru design
- provides uniform air distribution across the coil for even discharge air temperatures.

3 Quiet, aerodynamic fans
- utilize GentleFlo technology for exceptionally quiet unit operation.

4 Accessible fan section
- improves balance, alignment and simplifies maintenance.

5 Fan motor
- located out of air stream and away from heating coil reduces heat exposure to prolong life.

6 Outside air/return air dampers & linkage
- provides superior mixture of outdoor air and room air for precise temperature control.

7 MicroTech controls (optional)
- provide superior comfort control and easy integration into the building automation system of your choice.

8 Advanced heat transfer coil
- design provides extra capacity.

9 Sturdy cabinet construction
- includes hidden reinforcement, a non-glare textured surface, and a tough, scuff- and mar-resistant finish to stand up to the abuses of a classroom environment.

10 Sectionalized front access panels
- provide easy access to unit interior. Panels are easily removed by a single person. Front side panels can be removed while unit is running.

11 Two hinged top access doors
- provide easy access to the motor, electrical, and refrigeration components.

12 Sampling chamber for unit-mounted sensor
- provides accurate sensing of room temperature.

13 Optional adjustable caster
- left and right ends.

14 Insulated double-wall outdoor air damper
- seals tightly without twisting.

15 Full-length air filter
- is efficient and easy to replace. All air delivered to classroom is filtered.

16 Sloped galvanized steel drain pan

17 Tamper resistant fasteners on access panels

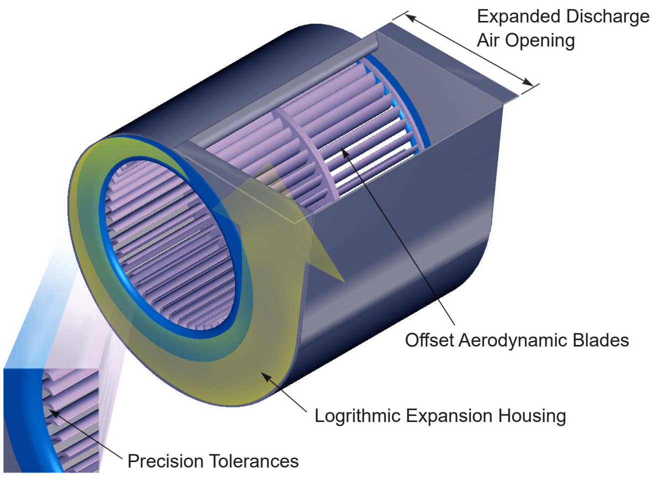
Features and Benefits

GentleFlo Delivery

Daikin Applied unit ventilators are engineered and manufactured to deliver quiet, continuous comfort. We developed our GentleFlo air moving system to minimize operating sound levels – even as demands for more fresh air require units to operate longer and work harder. GentleFlo features include:

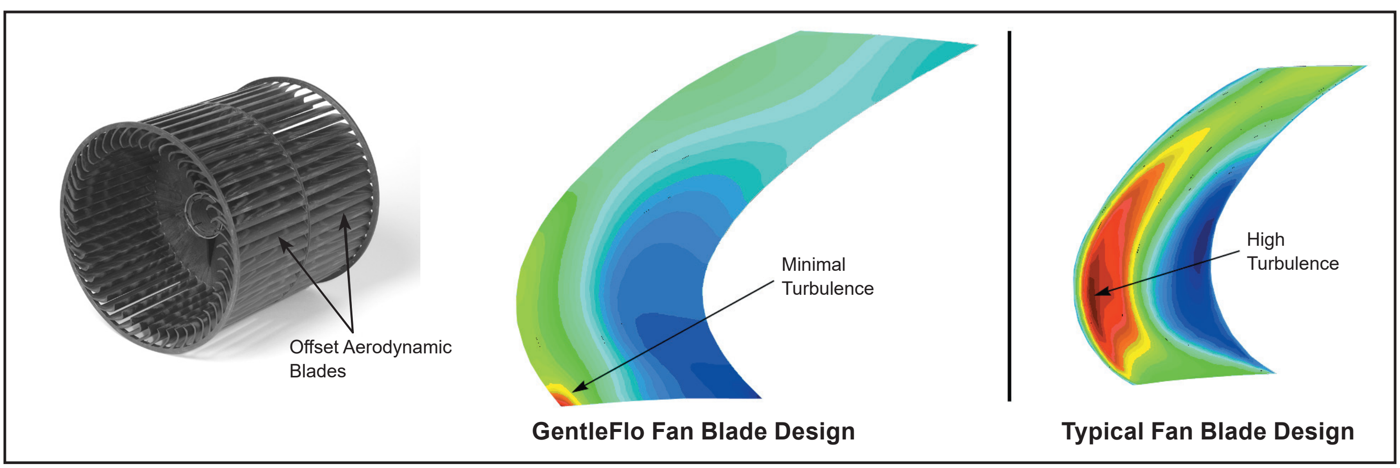
- Fan wheels are large, wide and rotate at a low speed to reduce fan sound levels. They are impact-resistant and carefully balanced to provide consistent performance.
- Offset, aerodynamic fan wheel blades move air efficiently (Figure 1).
- Precision tolerances help reduce flow and pressure turbulence, resulting in lower sound levels.

Figure 1: GentleFlo Fan Technology



- Fan housings incorporate the latest logarithmic-expansion technology for smoother, quieter air flow (Figure 2).
- A large, expanded discharge opening minimizes air resistance, further lowering sound levels.
- Fan construction contributes to equal outlet velocities and promotes quiet operation.
- Fan shafts are of ground and polished steel to minimize deflections and provide consistent, long-term operation.
- Fan assemblies are balanced before unit assembly, then tested after assembly (and rebalanced if necessary) to provide stable, quiet operation.

Figure 2: GentleFlo Reduces Turbulence



Right Amount of Fresh Air / Cooling

Daikin Applied unit ventilators deliver required amounts of fresh air to meet ventilation requirements and added cooling capacity to maintain consistent comfort for students and teachers. Our Economizer Operation, Demand Control Ventilation (DCV) and Part Load, Variable Air options allow you to match classroom comfort requirements even more closely, and reduce operating costs.

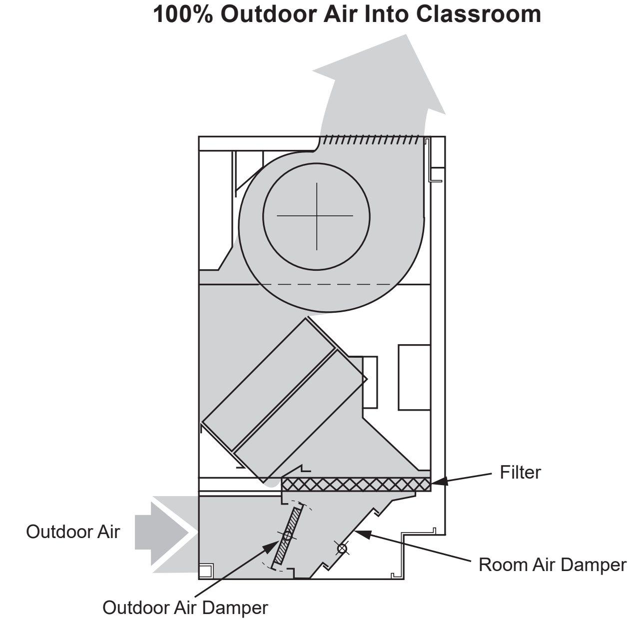
This means that you can be confident that your school is meeting ventilation standards for Indoor Air Quality and that your students are receiving adequate air to be attentive to instruction. At the same time, you are saving money in early morning hours, between classes or after hours when classrooms are heated and cooled but not always fully occupied.

Economizer Operation

It is well recognized that cooling, not heating, is the main thermal challenge in school classrooms. The typical classroom is cooled by outdoor air over half the time, even in cold climates. It is therefore essential that unit ventilators efficiently deliver outdoor air when classroom conditions call for "free" or economizer cooling.

With Daikin Applied unit ventilators, you can have outdoor air whenever it is needed. Economizer operation is facilitated by the outdoor air damper, which automatically adjusts the above-minimum outside air position to provide free cooling when the outdoor air temperature is appropriate (Figure 3). On units equipped with MicroTech controls, three levels of economizer control are available.

Figure 3: Full Economizer Mode



Part-Load Variable Air Control

Part Load Variable Air control can be used to automatically adjust the unit ventilator fan speed based upon the room load and the room temperature. This MicroTech control option provides higher latent cooling capabilities and quieter operation during non-peak load periods by basing indoor fan speed upon room load.

Lower fan speeds in conjunction with our GentleFlo fan technology contributes to a very quiet classroom environment.

Room-temperature PI control loops determine the speed of the fan, which varies according to the room load. It also provides a built-in delay to prevent overshooting for better comfort control. The outdoor air damper's minimum-air position is adjusted with the fan speed to bring in a constant amount of fresh air.

Demand Control Ventilation

Daikin Applied unit ventilators can be equipped to use input from a CO_2 controller to ventilate the space based on actual occupancy instead of a fixed design occupancy. This Demand Controlled Ventilation (DCV) system monitors the amount of CO_2 so enough fresh outdoor air is introduced to maintain good air quality. The system is designed to achieve a target ventilation rate (e.g., 15 cfm/person) based on actual occupancy.

By using DCV to monitor the actual occupancy pattern in a room, the system can allow code-specific levels of outdoor air to be delivered when needed. Unnecessary over-ventilation is avoided during periods of low or intermittent occupancy, leading to improved energy efficiencies and cost savings.

Precise Temperature and Dehumidification Control

Daikin Applied unit ventilators provide precise temperature and dehumidification control to keep students and teachers comfortable while making maximum use of "free" outdoor-air cooling to reduce operating costs. They utilize a draw-thru fan design that contributes to even heat transfer and provides uniform discharge air temperatures into the classroom. MicroTech control strategies and 2-stage compressor operation provide precise control of temperature and humidity levels under both part-load and full-load conditions.

Draw-Thru Design For Even Discharge Temperatures

The Daikin Applied draw-thru design sets our unit ventilators apart from most competitive models. With this system, fans draw air through the entire heat transfer element (Figure 4) rather than blowing it through highly concentrated areas of the coil element. The result is more uniform discharge air temperatures into the classroom and more efficient unit ventilator operation.

Figure 4: Draw-Thru Design Provides Even Discharge Air

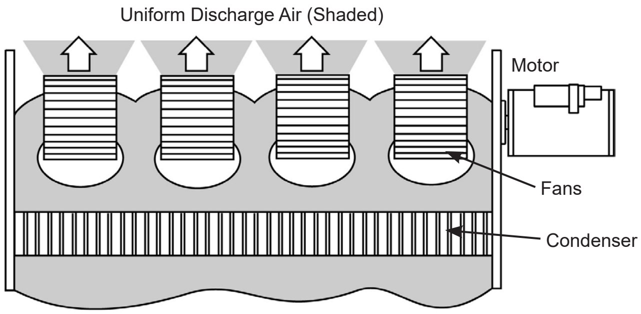
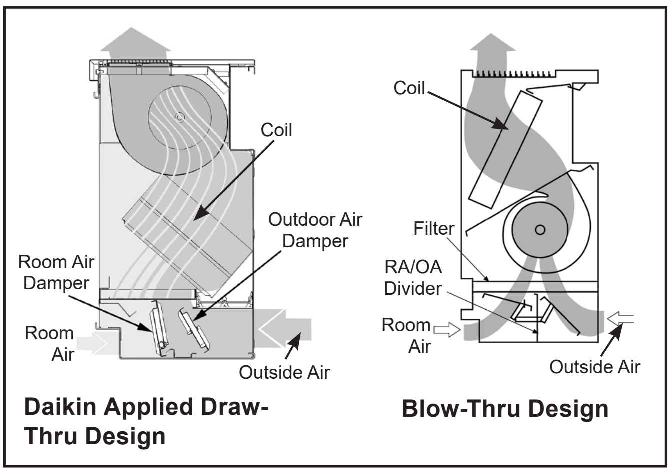


Figure 5: Draw-Thru Vs. Blow-Thru Design



Low Installation Costs

Daikin Applied unit ventilators have many features that make them economical to purchase and to install in both new construction and retrofit applications. It is this attention to detail and understanding of school applications that make them the system of choice.

Perfect For Both New & Retrofit Applications

New construction installations are easily accomplished with Daikin Applied unit ventilators because they avoid the added cost and space required for expensive ductwork. Further savings can be realized because piping installations use less space than duct systems.

This is important in existing buildings and also in new construction where floor-to-floor heights can be reduced, saving on overall building costs.

Retrofit installations are also economical because new units fit the same space occupied by existing ones. Using Daikin Applied unit ventilators, central equipment, such as chillers, can be sized smaller using building diversity. This results in a low capital-cost system.

Built In Flexibility

Daikin Applied unit ventilators include features that make them easy to set up and reconfigure as needed to meet special requirements. These features include:

- **Reversible Drain Connections:** All units come with a galvanized steel drain pan that has drain connections on either end. The drain-side connection can be selected in the field. The direction in which the drain pan slants can also be field-modified.
- **Built-In Wire Race:** A built-in metal wire race runs from one end of the unit to the other to provide extra protection for wires and protect them from unit air.

Controls Flexibility

Multiple control options offer easy, low cost integration of Daikin Applied unit ventilators into the building automation system of your choice (See "Communication Types" on page 69).

MicroTech controls come with on-board BACnet MS/TP communications, with optional LonTalk, to communicate control and monitoring information to your BAS, without the need for costly gateways.

Low Operating Costs

Schools consume more than 10% of the total energy expended in the United States for comfort heating and cooling of buildings. As energy costs increase, educators are placed in a difficult position: caught between rising costs, lower budgets and the requirements to raise educational standards.

Fortunately, the technology and the system exists for schools to take control of their energy expenditures while providing a comfortable environment for learning. And that system is the Daikin Applied unit ventilator.

Consider these realities of school environments:

- Most heating energy in schools is expended to heat unoccupied spaces. Because lights, computers and students give off considerable heat, occupied spaces require little supplemental heat.
- The removal of heat is usually required in occupied classrooms, even when outside temperatures are moderately cold (i.e., 35 to 40°F).

Then consider how Daikin Applied unit ventilators, located in each classroom, take advantage of these realities to lower operating costs:

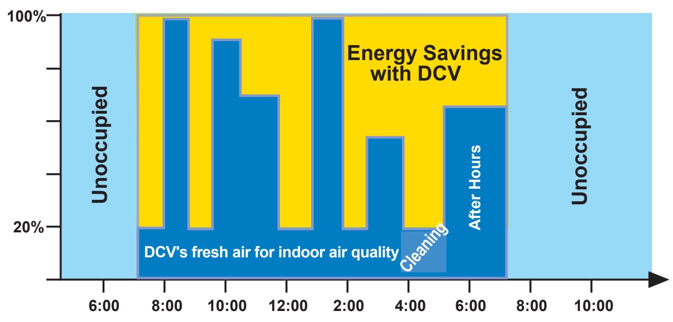
- They provide individual classroom control and comfort.
- They can be cycled on when the room is occupied and cycled off when it is not.
- They bring in fresh air from directly outside the classroom for high indoor air quality.
- During most of the school year, they use outdoor air to keep classrooms comfortable without the expense of mechanical cooling.

MicroTech Control Options Further Reduce Operating Costs

Many of the MicroTech control options available with Daikin Applied unit ventilators can further reduce operating costs. For example:

- **Economizer Operation:** Economizer operation automatically adjusts the above-minimum outside air position to provide free cooling when the outdoor air temperature is appropriate.
- **Demand Control Ventilation:** By using CO_2 levels to monitor the actual occupancy pattern in a room, the system can allow code-specific levels of outdoor air to be delivered when needed without costly over-ventilation during periods of low or intermittent occupancy (Figure 6).

Figure 6: Energy Savings with Demand Control Ventilation



- **Occupancy Mode Operation:** Units can be programmed to operate only sparingly during unoccupied periods and at night to conserve energy.

Two-Stage Compressor

Air conditioning units are usually sized for worse case conditions. During high load requirement the unit will operate in high fan speed and high compressor capacity. Most of the time there is not a full load on the compressor. Operation in lower load will be at medium or low fan speeds which will be at the lower displacement compressor stage. The two stage compressor will remain at low speed until more cooling is required. With the two-stage compressor, the unit will run on lower fan speeds most of the time improving comfort through better humidity control and quieter operation, while minimizing issues with over-sizing.

Other units utilizing single stage compressors operate at full compressor capacity all of the time regardless of fan speed.

Easy To Maintain

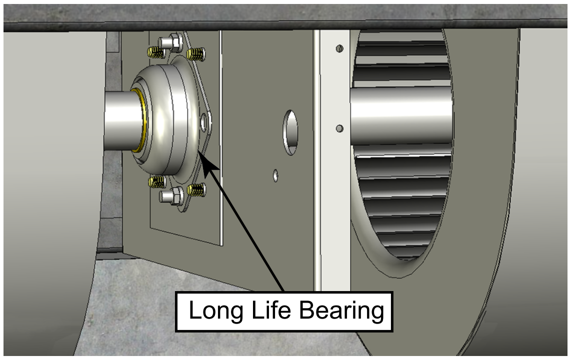
Daikin Applied unit ventilators are designed to provide easy access for maintenance and service personnel to all serviceable components. Most maintenance tasks are easily handled by a single person.

Accessible Fan Deck

The accessible fan deck provides access to fan wheels, motors, bearings, and other components for service, cleaning, or repair.

The fan deck's rotating element has one large, self-aligning end bearing and a permanently lubricated motor bearing for smooth operation. On most sizes the location of the fan shaft bearing is at the end of the shaft (out of the air stream).

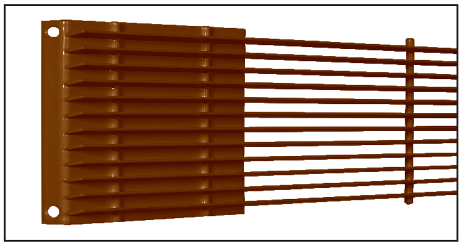
Figure 7: Long-Life Bearings



Heavy-Duty Discharge Grille

The discharge grille on the top of the unit is made from extra-strength steel bar stock, promoting long life (Figure 8). It can be removed to facilitate cleaning of fans and fan housings. A built-in 10-degree angle provides proper air throw to blanket the room for proper air circulation and comfort.

Figure 8: Heavy-Duty Steel Discharge Grille



Easy Motor Removal

Unlike with many competitive models, the motor in Daikin Applied unit ventilators is separate from the fan assembly and is located out of the airstream at the end of the fan shaft–away from the hot coil—for easier maintenance and removal. Locating the motor away from the coil (Figure 10) has the added benefit of extending motor life. Our direct-coupled motor and self-aligning motor mount facilitate motor change-out. The motor comes with a molex plug that fits all sizes and further simplifies removal.

Tamper-Resistant Fasteners

Front panels and top access doors are held in place by tamper-resistant, positive-positioning fasteners. They are quickly removed or opened with the proper tool, but deter unauthorized access to the unit's interior (Figure 10).

Sectionalized Access Panels and Doors

All units have three separate front panels and hinged top access doors, sized for convenient handling by a single person (Figure 11). The result is easy, targeted access to the component that needs servicing:

- Two end panels provide easy access to piping, temperature control components and the fan switch. Unlike units with full-length front panels, these can be removed without disturbing the normal operation of the unit.
- Hinged top access doors provide easy access into the end compartments to facilitate convenient servicing of the motor, electrical, and refrigeration components.
- Center front panel provides easy access to the filter and the fan shaft bearing on unit sizes 048.

Filter

Three filter types are offered:

- Units come standard with a single-use filter which is designed to be used once and discarded.
- Optional, permanent metal filters are available and can be removed for cleaning and reused numerous times.
- Renewable media filters, which consist of a heavy-duty, painted-metal structural frame and renewable media.

Figure 9: Easy Access to Filter

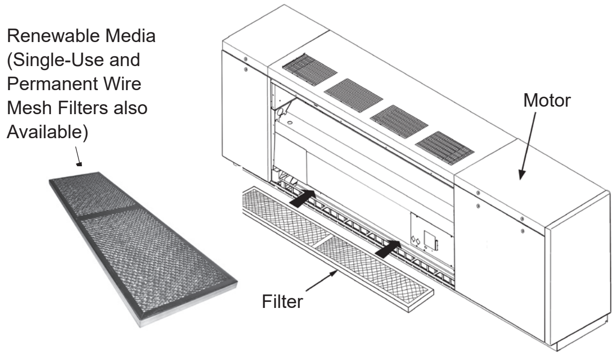


Figure 10: Accessible Design

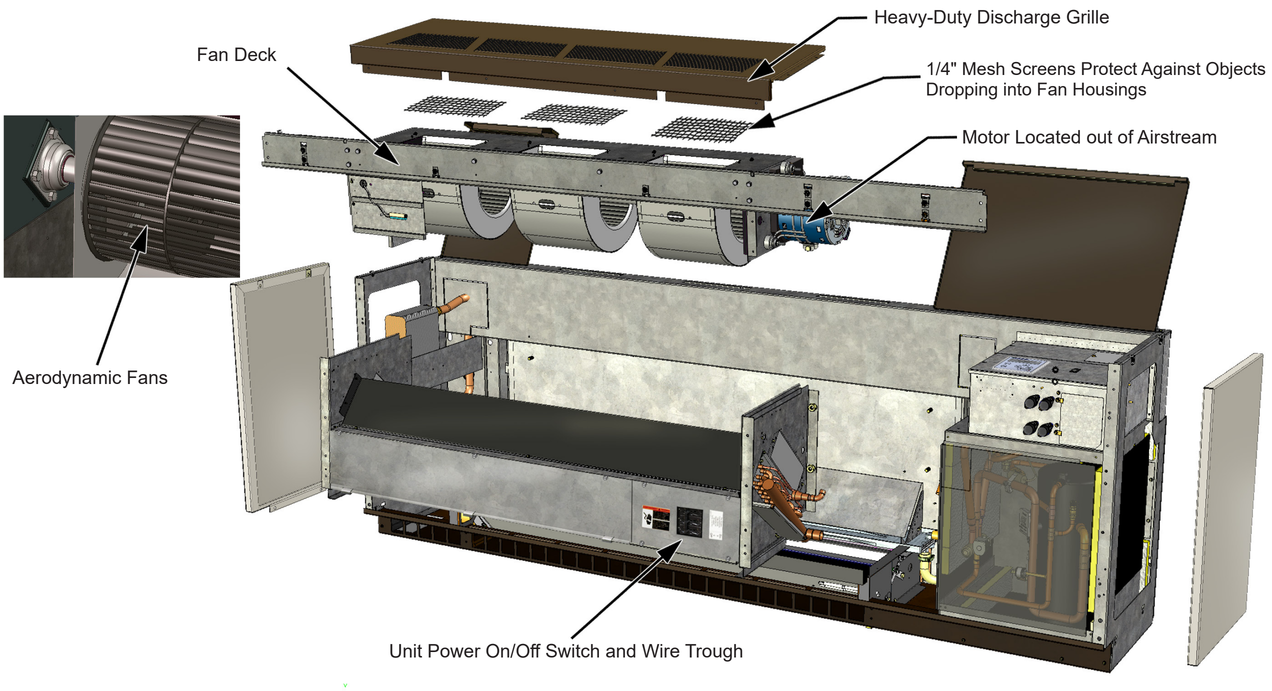
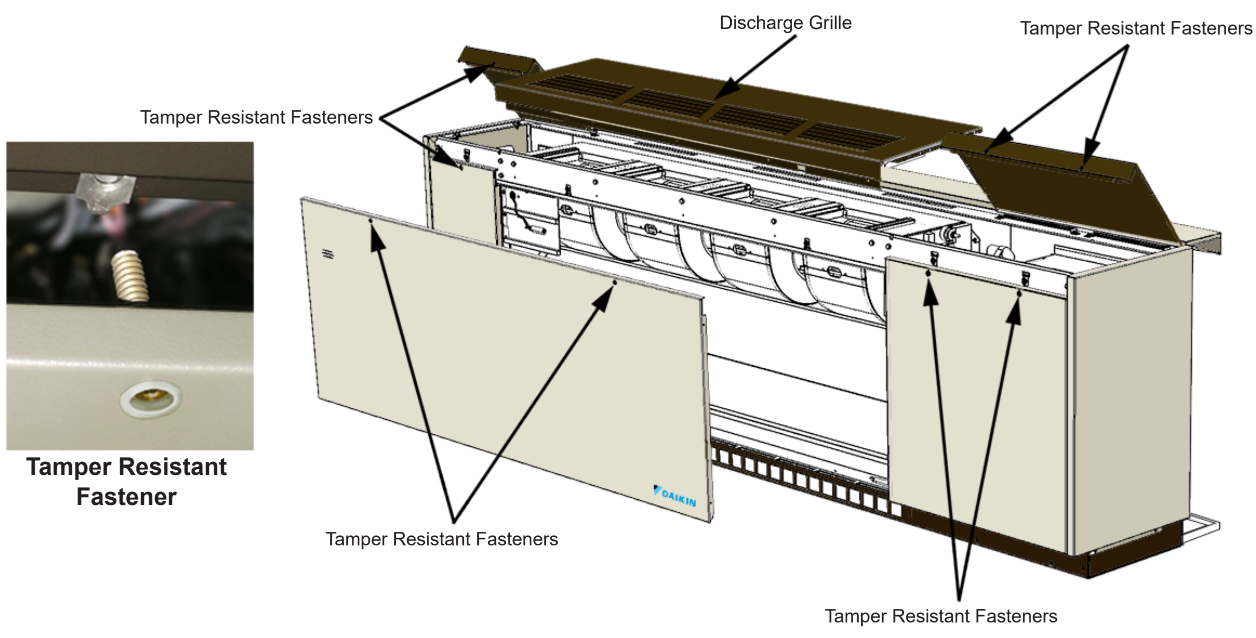


Figure 11: Easy Access with Tamper-Resistant Fasteners



Built To Last

Our industrial-strength design provides the durability to withstand the rigors of the classroom environment. Its solid construction and rugged finish promotes continued alignment, structural strength and long-lasting beauty decades after the unit is installed. In fact, many units installed over 30 years ago continue to provide quiet, reliable classroom comfort.

Heavy Duty Frame Construction

Daikin Applied's exclusive, unitized frame (Figure 12) is far superior to the fastener-type construction used by other manufacturers. Loosened fasteners can cause vibration, rattles and sagging panels. With unitized construction, there are no fasteners (screws or bolts) to come loose.

Other design features that promote trouble-free operation and long life include:

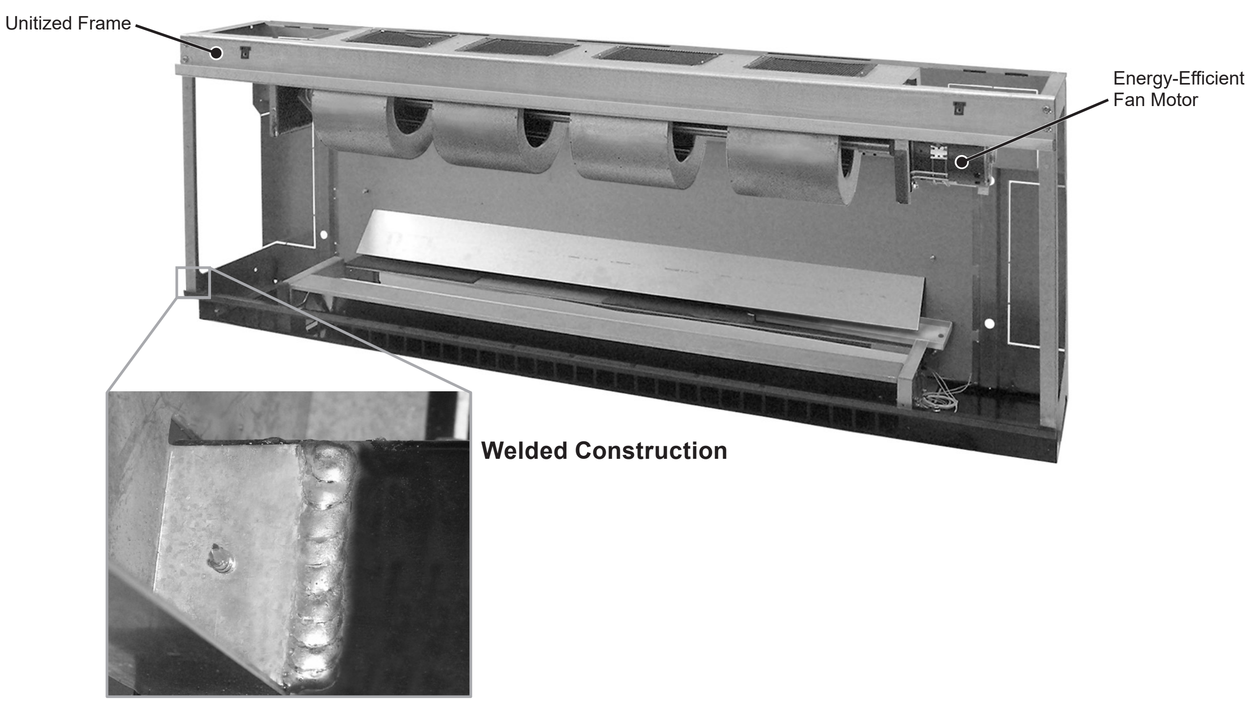
- A corrosion-resistant, galvanized-steel frame.
- Extra-strength, steel-bar discharge grille.
- Heavy-gauge-metal cabinet access panels and doors.
- An extra-strength pipe tunnel that stiffens the structure while adding aerodynamic air flow within the unit.
- Hidden reinforcement that provides additional built-in support for the top section as well as better support for the fan deck assembly.
- A rigid exterior that is strong enough to support maintenance personnel without fear of damaging the unit.

Rugged Exterior Finish

The superior finish of the unit ventilator's cabinets fosters long-lasting beauty as well as resistance to abuse and corrosion. We apply the very highest standards at every step of the finishing process to provide lasting quality:

- High-quality furniture steel is carefully inspected before painting. Scratches and marks that might show through are removed.
- After fabrication, the metal undergoes a five-stage cleaning and phosphatizing process to provide a good bonding surface and reduce the possibility of peeling or corrosion.
- A specially formulated, environmentally friendly, thermosetting urethane powder is applied electrostatically to the exterior panels. This film is oven-cured to provide correct chemical cross-linking and to obtain maximum scuff- and mar-resistance.
- The top of the unit is finished with a textured, non-glare and scuff-resistant, charcoal bronze electrostatic paint. End and front panels are available in a pleasing array of architectural colors.
- The Oxford brown steel kickplate is coated and baked with a thermosetting urethane powder paint to blend with floor moldings and provide years of trouble-free service.
- Each unit is painstakingly inspected before boxing, then encapsulated in a clear plastic bag, surrounded by an extra-heavy-duty cardboard box and secured to a skid to help provide damage-free shipment.

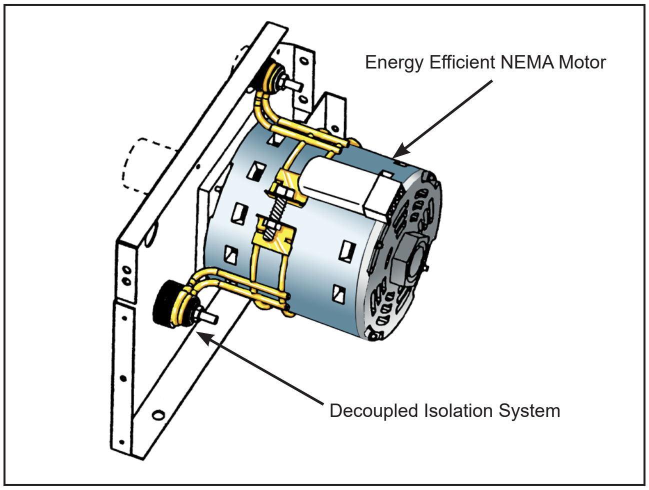
Figure 12: Heavy-Duty, Welded Chassis



Durable, Energy Efficient Fan Motors

Daikin Applied unit ventilators are equipped with 115/60/1 NEMA motors that feature low operating current and wattage (Figure 13).

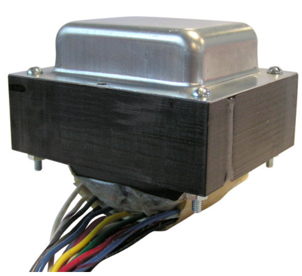
Figure 13: Energy-Efficient Fan Motor



Additional features of these motors include:

- Split-capacitor (PSC) design with automatic reset and thermal-overload protection.
- No brushes, contacts or centrifugal starting switches the most common causes of motor failure.
- A built-in, decoupled isolation system to reduce transmission of vibrations for quieter operation.
- A multi-tap, auto-transformer (Figure 14) provides multiple fan motor speed control through the speed switch. The motor is independent of supply voltage, which allows stocking of one motor (school district-wide) for various voltage applications.

Figure 14: Multi-Tap Auto-Transformer



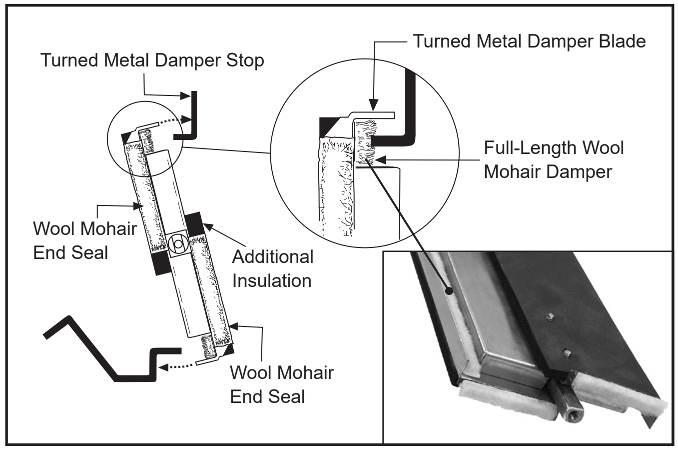
Durable Damper Design

All dampers in Daikin Applied unit ventilators use the turned-metal principle on their long closing edges (Figure 15). Positive sealing is provided by embedding the edge into wool mohair (no metal to metal contact). There are no plastic gaskets to become brittle with time, sag with heat or age, or require a difficult slot fit to seal. Nylon damper bearings foster quiet, maintenance-free operation.

Additional features include:

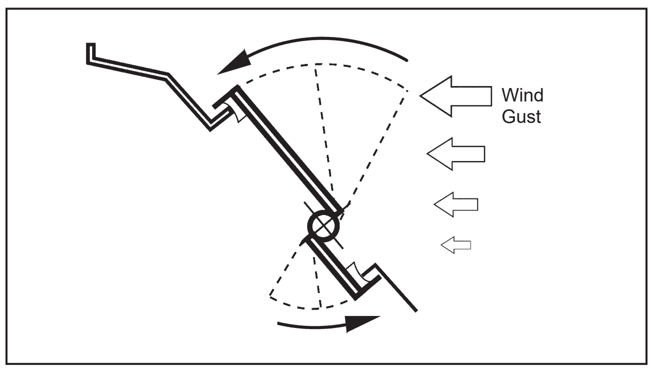
- Outdoor air dampers are made of galvanized steel to inhibit corrosion, with double-wall welded construction for rigidity and encapsulated insulation (Figure 15). Additional insulation is provided on the exterior of the outdoor air damper blade and on the outdoor air entry portion of the unit.

Figure 15: Outdoor Damper Seals Out Cold Weather



- Room air dampers are free-floating and designed to prevent intermittent gusts of cold air from blowing directly into the classroom on windy days (Figure 16). They are constructed of aluminum with built-in rigidity. The metal forming technique that is employed resists twisting and incorporates a full-length counter weight for easy rotation. The simple principle of an area exposed to a force is used to automatically close the damper, rather than open it, when gusts of cold air occur.

Figure 16: Room Air Damper Auto-Closed by Wind Gusts



General Data

Model Nomenclature

U	ARQ	K	024	H	G	12	Z	B1	AL	22	G	I	B	3
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Category	Code Item	Code Option	Code Designation & Description			
Product Category	1	1	U	Unit Ventilators		
Model Type	2	2-4	ARQ	WSHP Standard Range, Ultra Quiet	GRQ	WSHP Ground Source, Ultra Quiet
Design Series	3	5	K	Design K		
Nominal Capacity	4	6-8	024	24,000	048	48,000
			040	40,000		
Voltage	5	9	C	208/60/1	H	230/60/3
			G	230/60/1	K	460/60/3
			D	208/60/3		
Coil Options	6	10	G	Direct Expansion	9	Direct Expansion with Stainless Steel Drain Pan
Heating Options	7	11-12	12	3 Element Low Cap. Electric Heat	00	None
			13	6 Element Low Cap. Electric Heat		
Hand Orientation	8	13	Z	Not Available		
Controls	9	14-15	##	MicroTech Controls (See Control Code Table Below)		

Control Features		Feature Selections							
Open Protocol	BACnet / Stand-Alone	•		•		•	•		
	LonMark		•		•			•	•
DCV	CO_2 Sensor			•	•		•		•
Factory Installed Keypad	LUI					•	•	•	•
		Control Code							
Economizer Control	Basic	B1	B5	B9	BD	BH	BL	BP	BT
	Expanded	E1	E5	E9	ED	EH	EL	EP	ET
	Leading-Edge	L1	L5	L9	LD	LH	LL	LP	LT

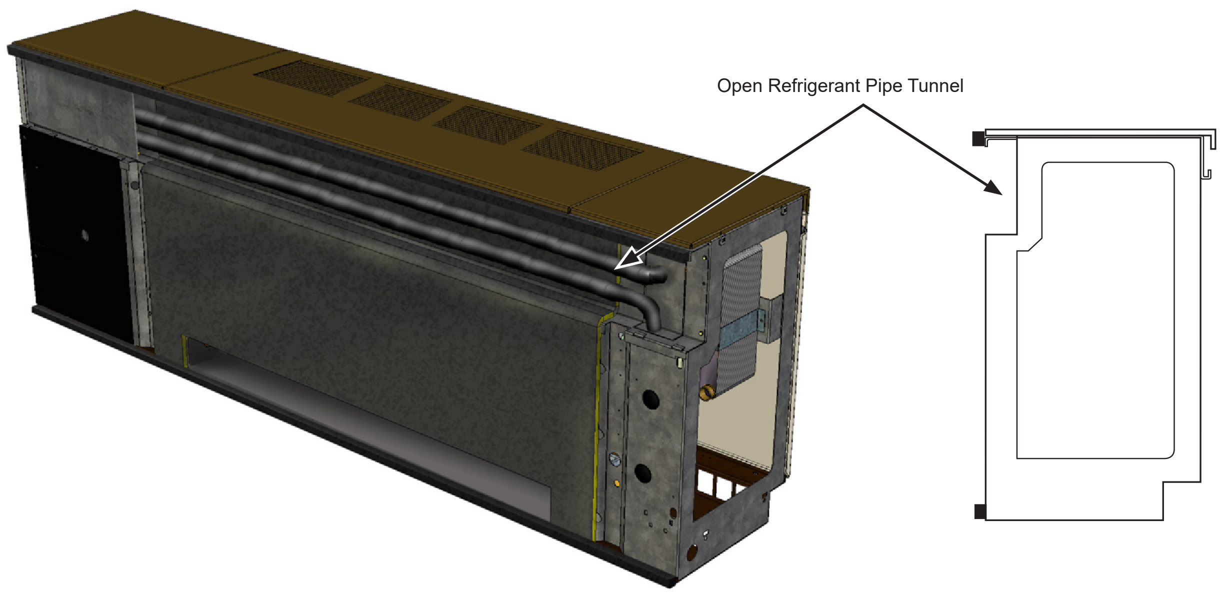
Category	Code Item	Code Option	Code Designation & Description			
Controls	9	14-15	44	Electromechanical w/2-Position OA Damper for Remote Thermostat		
Discharge	10	16-17	AL	16-5/8" Top Bar Grille	AP	21-7/8" Top Bar Grille Full Adapter Back, Cold Pipe Tunnel, Top Duct In
			AK	21-7/8" Top Bar Grille Partial Adapter Back, Open Tunnel	AM	21-7/8" Top Bar Grille 2" Step, Full Adapter Back, Closed Tunnel
			AN	21-7/8" Top Bar Grille Full Adapter Back, Closed Tunnel	AB	21-7/8" Top Bar Grille Full Adapter Back, Closed Pipe Tunnel w/ Solid Back
Return Air/ Outside Air	11	18-19	22	Return Air Bottom Front / Outdoor Air Rear	24	Recirculation Only / No OA or RA Dampers
Power Connection	12	20	G	Box with Switch		
			J	Box w/switch, w/USB		
			K	Box w/switch, w/SD		
			M	Box w/switch, w/USB, w/SD		
Color	13	21	I	Antique Ivory	G	Soft Gray
			W	Off White	C	Cupola White
			B	Putty Beige		
SKU Type	14	22	B	Standard Delivery		
Product Style	15	23	3	R-32 Refrigerant		

Unit Arrangements: 16-5/8" Deep

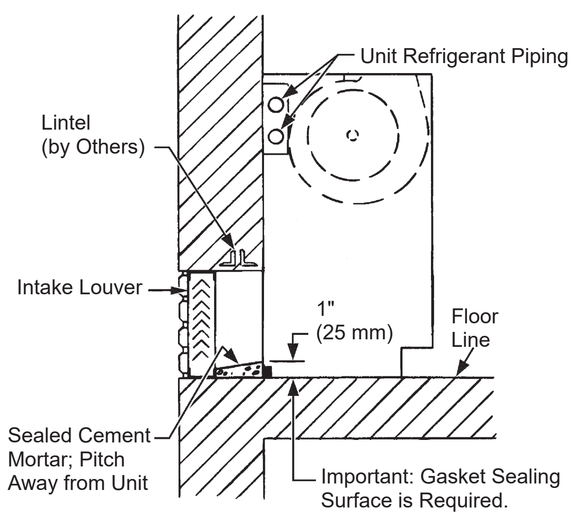
Arrangement AL – Open Refrigerant Pipe Tunnel

Arrangement AL units are 16-5/8″ deep. They are available as open refrigerant piping (Figure 17). This arrangement is most often used when there is a chased wall for water supply and return piping. Choose closed refrigerant piping arrangement when the refrigerant piping tunnel will be open to air flow along the back of the unit. See "Arrangement AL – Closed Refrigerant Pipe Tunnel Accessory" on page 23.

Figure 17: 16⅝" Arrangement AL with Open Refrigerant Piping

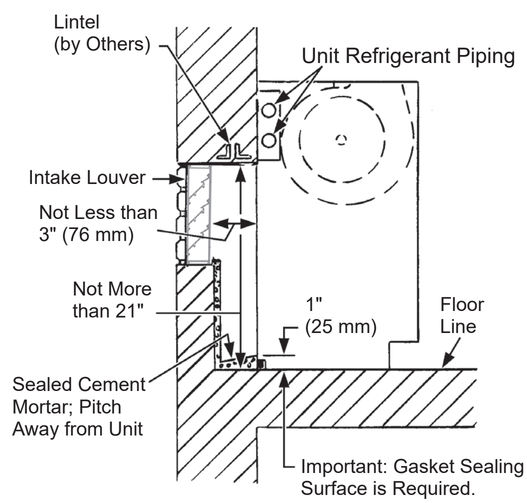


Chased Wall Unit Installation with Floor-Level Outdoor Air Intake:



Chased Wall Unit Installation with Above-Floor-Level Outdoor Air Intake:

Top of intake louver up to 21" (533 mm) above floor (with adapter back available as an accessory).

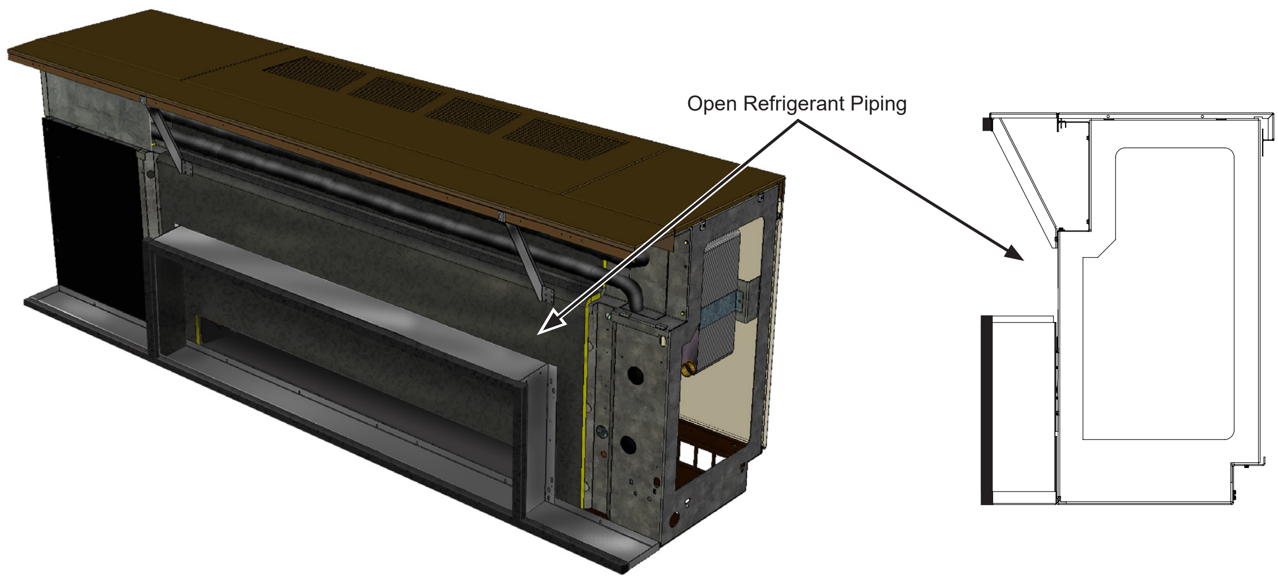


Unit Arrangements: 21-7/8" Deep

Arrangement AK

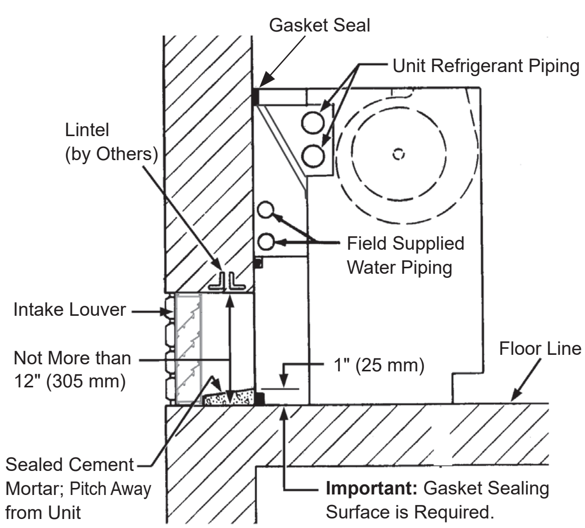
The AK arrangement has a partial adapter back with the refrigerant piping open and a rear outdoor inlet.

Figure 18: 21⅞" Arrangement AK



Installation with Floor-Level Outdoor Air Intake:

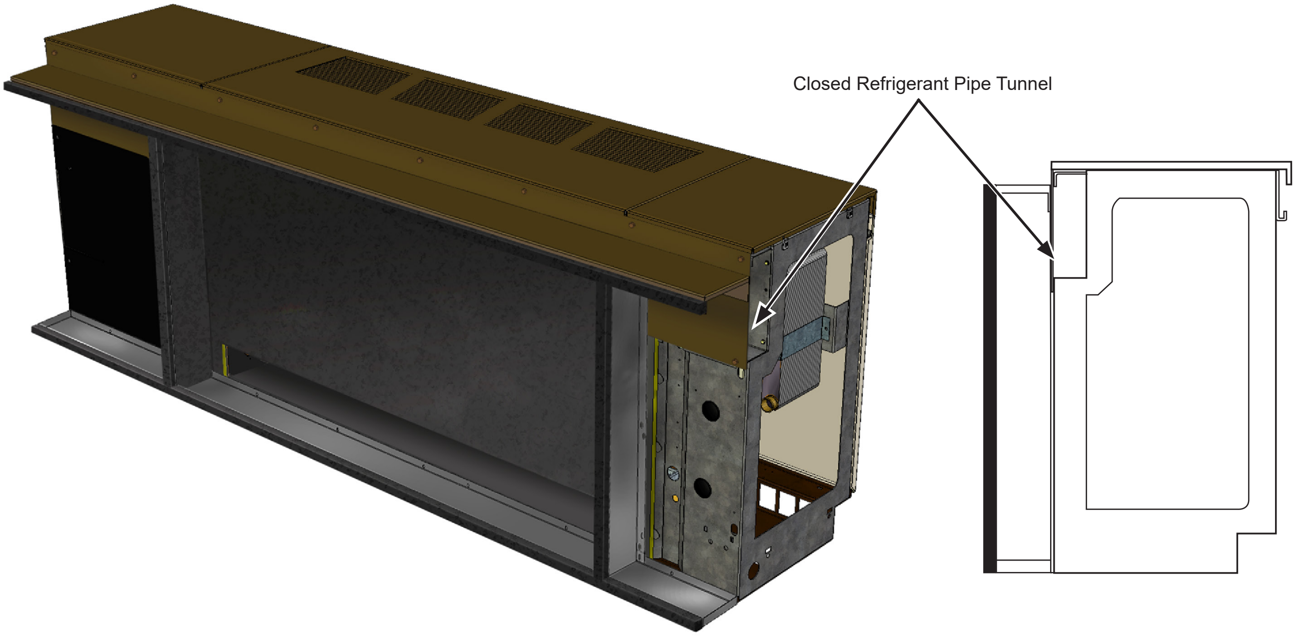
This installation provides extra space for piping. Fresh air is directlty opposite the unit outside air opening. The unit back and outdoor enclosure are insulated.



Arrangement AM

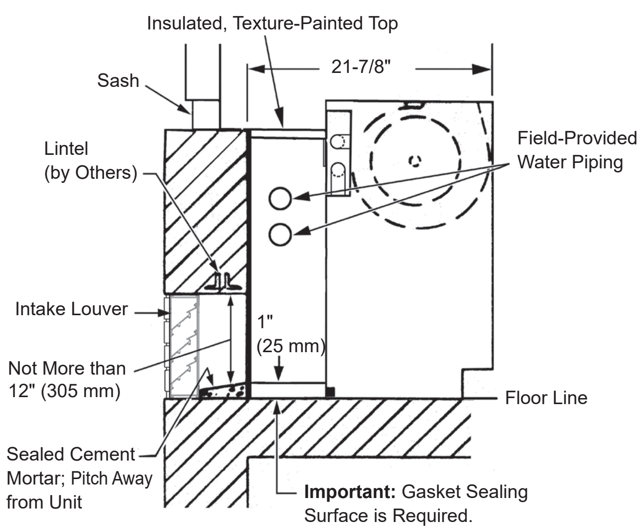
The AM arrangement has a full adapter back with the refrigerant piping closed and a 2" painted finish step down for a lower height window and sash application.

Figure 19: 21⅞" Arrangement AM



Installation with 2" Finished Stepdown Top:

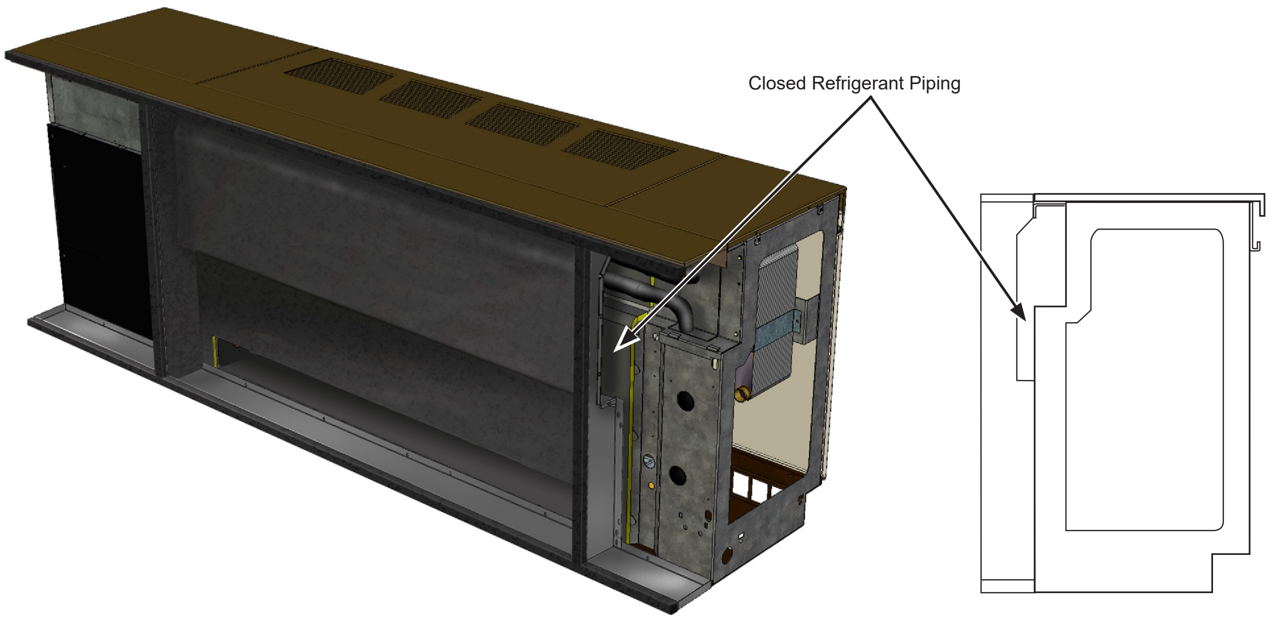
This installation allows window sills below the standard 30" unit height to project a finished image from outside. Allows fresh air to enter 27" from the floor to compensate for conditions that can arise during renovation or new construction.



Arrangement AN

The AN arrangement has a full adapter back with the refrigerant piping closed and a rear outdoor air inlet.

Figure 20: 21⅞" Arrangement AN

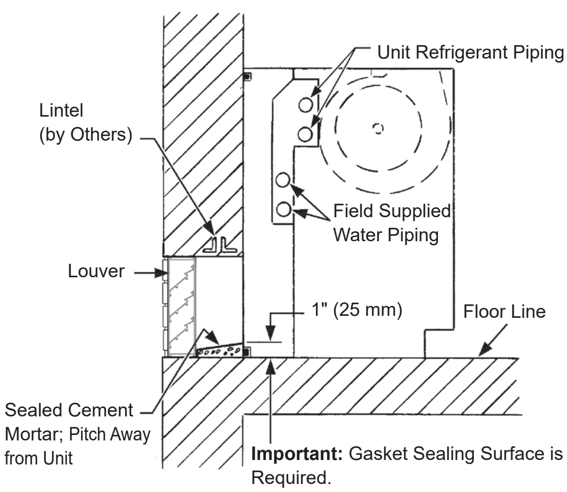


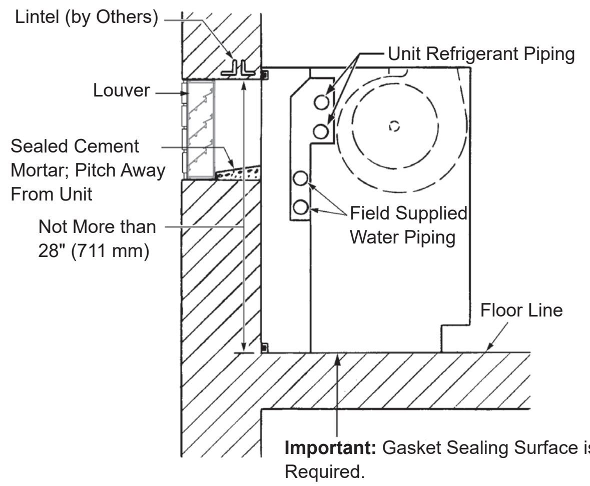
Installation with Floor-Level Outdoor Air Intake:

Fresh air is directly opposite the unit outside air opening. Piping can be run through the insulated, closed piping tunnel. Unit top, back and vertical adapter back partitions are insulated.

Installation with Above-Floor Outdoor Air Intake:

Allows fresh air to enter from just below the top of the unit to the bottom. Thus, architectural and snow considerations can be accommodated.

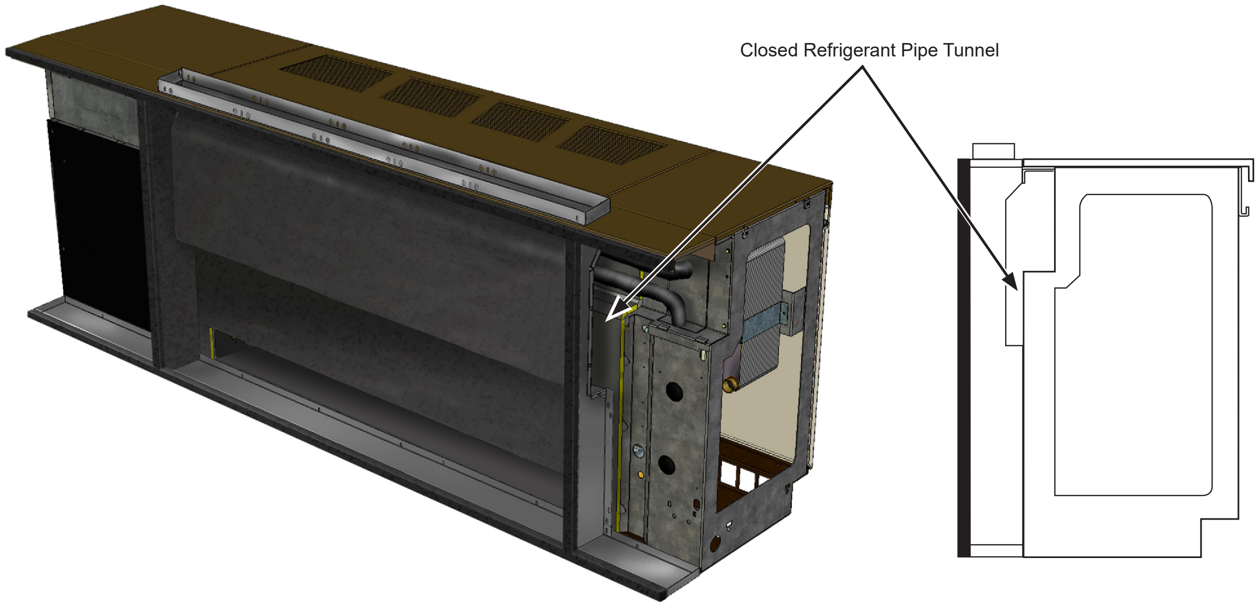




Arrangement AP

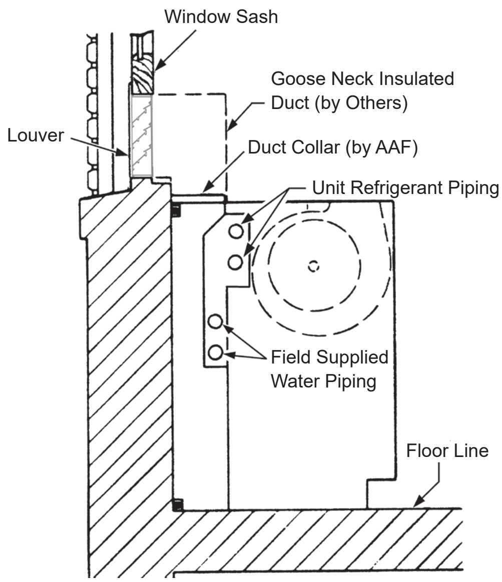
The AP arrangement has a full adapter back with the refrigerant pipe tunnel closed and an outdoor air duct collar inlet.

Figure 21: 21⅞" Arrangement AP



Installation with Floor-Level Outdoor Air Intake:

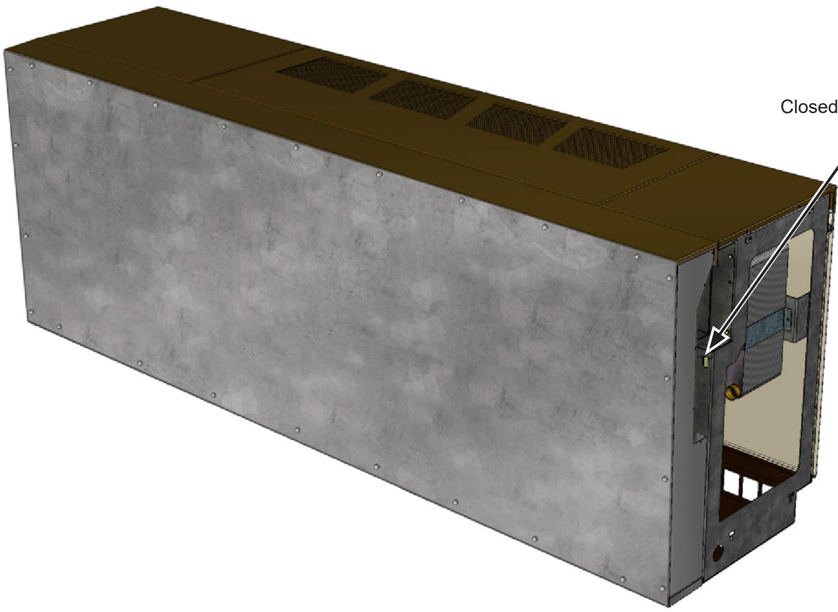
Allows fresh air to enter from the top of the unit from window intake situations that can arise during renovation or new construction.

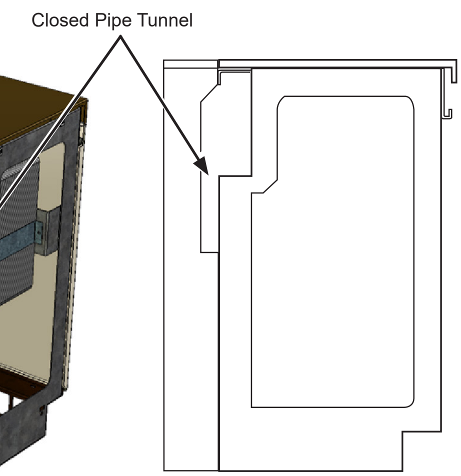


Arrangement AB

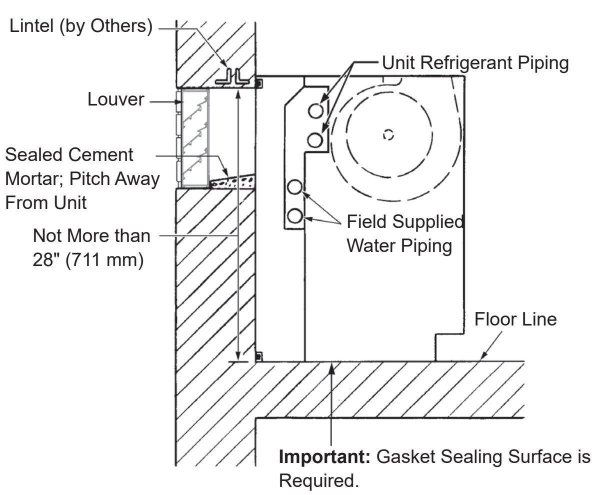
The AB arrangement has a full metal back cover that allows cutting a direct fresh air connection to the outside air opening when desired. The unit top, back vertical adapter back partitions and center inside metal back are insulated.

Figure 22: 21⅞" Arrangement AB





Installation with Floor-to-Top Outdoor Air Intake:



MicroTech Controls

Daikin Applied unit ventilators equipped with MicroTech unit controllers can provide superior performance and easy integration into your building automation system of choice. MicroTech benefits include:

- Factory integrated and tested controller, sensor, actuator and unit options promote quick, reliable start-up and minimize costly field commissioning.
- High-performance features and advanced control options can quickly pay for themselves in saved energy costs and more comfortable classrooms.
- Select from two control levels: stand-alone or network control.
- Network control applications provide easy, low-cost integration of Daikin Applied unit ventilators into most building automation systems.
- Flexible BAS network communication options guard against controls obsolescence, keeping MicroTech viable for the life of your Daikin Applied equipment.

Three Control Levels

MicroTech unit controllers provide the flexibility to operate Daikin Applied unit ventilators on any of three levels:

- As stand-alone units, with control either at the unit or from a wall sensor
- Controlled as part of a network using a centralized building automation system
- In a client-server relationship, where client units follow the server unit for some or all functions

Stand-Alone Control

When operating in stand-alone mode, the MicroTech controller performs complete room temperature and ventilation control. Units can be operated in occupied, unoccupied, stand-by, or bypass (tenant override) modes. Occupied/unoccupied changeover can be accomplished:

- Automatically by an internal Daily Schedule (two occupied times and two unoccupied times for each of the seven days, and one holiday schedule)
- Using a field-wired occupancy sensor

If a school has more than one zone, separate, internally-programmed schedules are used to regulate each zone.

Client-Server Control

Designate the server and client units and we will factory configure and install the controllers so they are set up for a local peer-to-peer network between units (leaving only the network wiring between these units to be field installed).

Client units can be field-configured to be dependent or independent as follows:

- Dependent client units follow the server unit completely. They are ideal for large spaces that have even loads across the space (such as some libraries).
- Independent client units (default) use server setpoints and client sensors. The client follows the server unit modes, such as heat or cool, but has the flexibility to provide the conditioning required for its area within the space. Independent client units perform better in spaces where loads vary from one area of the space to the other (such as stairwells or cafeterias).

Network Control

MicroTech controllers provide easy integration into your building automation system of choice. All factory-installed options are handled by the unit controller. This simplifies the transmission of monitoring and setpoint data to the building automation system.

MicroTech controls have on-board BACnet communication, with optional LonTalk, to communicate control and monitoring information to your BAS, without the need for costly gateways (see "Communication Types" on page 69).

Flexible network communication options help you avoid control obsolescence over the life of your Daikin Applied equipment.

USB Interface

An optional USB-A port can be factory-configured. This option simplifies field access to the MicroTech controller. The USB interface can be used for downloading code, changing unit configuration, accessing external memory, or a field-connection to run the service tool. Technicians will have access to read all inputs, download code, setup/download trend data, and backup, restore, or change unit configuration.

SD Card

An optional SD card can be factory configured. The SD card allows storage of data trending and configuration parameters. For further details see page 74.

Economizer Modes

Economizer operation is facilitated by the outdoor air damper, which automatically adjusts the above-minimum outside air position to provide free cooling when the outdoor air temperature is appropriate. Three levels of economizer control are available:

Basic Economizer Operation: The MicroTech controller compares the inside and outside temperatures. If the temperature comparison is satisfactory, then free- air economizer operation is used to cool the space. Reheat units also come configured with an indoor humidity sensor.

Expanded Economizer Operation: In addition to comparing inside and outside temperatures, outdoor relative humidity is measured to calculate outside air enthalpy. If the enthalpy set point is not exceeded, and the temperature comparison is satisfactory, then free economizer operation is used to cool the space. This helps to minimize the entrance of humid outside air.

Leading-Edge Economizer Operation: The MicroTech controller compares both indoor and outdoor temperatures and indoor and outdoor relative humidities. Then it calculates both inside and outside air enthalpy to determine if free economizer operation can cool the space with non-humid outside air. This is a true enthalpy economizer—a first for unit ventilators.

Demand Control Ventilation

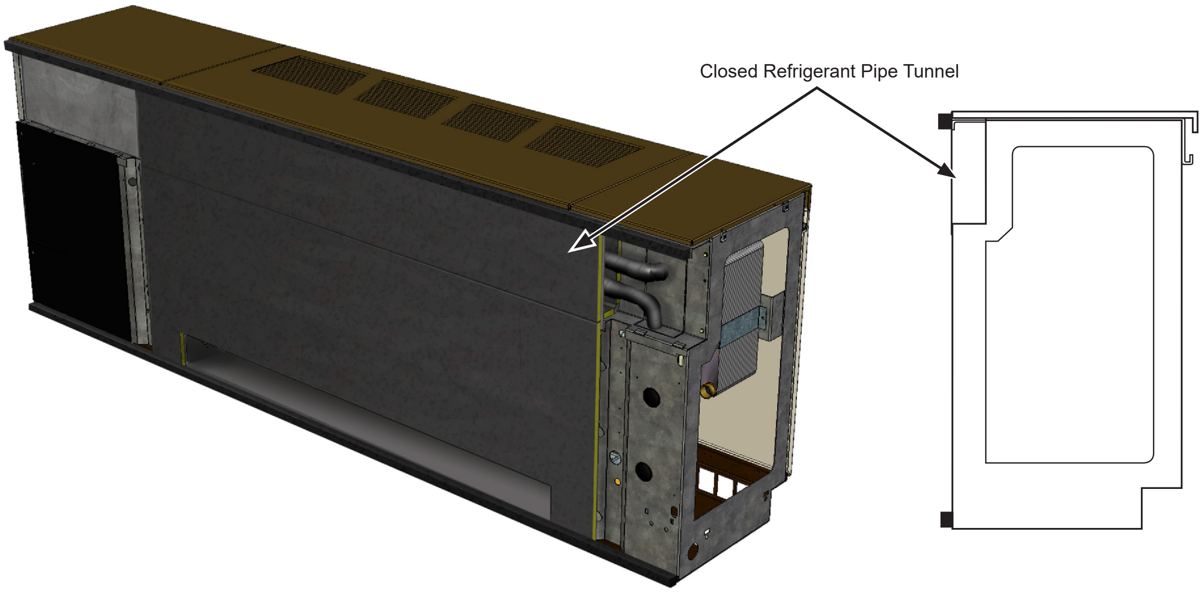
The optional unit mounted, single beam absorption infrared gas sensor has a sensing range of 0 – 2000 ppm and voltage output of 0 to 10 VDC (100 ohm output impedance). The pitot tube sensing device is located in the unit ventilator's return air stream. The optional CO_2 sensor is used with the UVC's Demand Control Ventilation feature to vary the amount of outside air based on actual room occupancy. With network applications, the unit mounted sensor can be overridden by a remote sensor through the network.

Figure 23: Optional CO_2 Sensor

Accessories

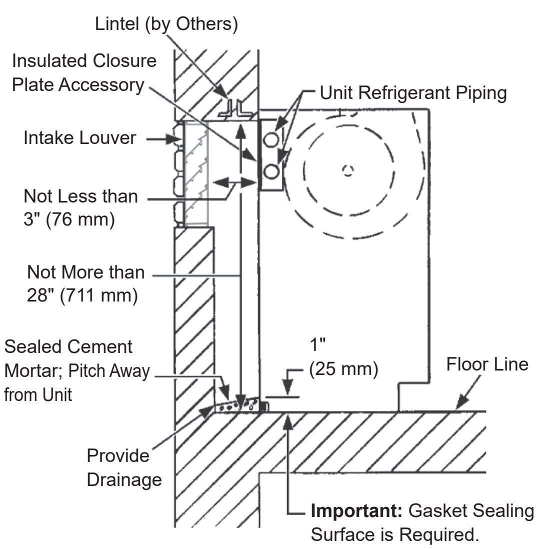
Arrangement AL – Closed Refrigerant Pipe Tunnel Accessory

Figure 24: 16⅝" Arrangement AL Closed Refrigerant Pipe Tunnel



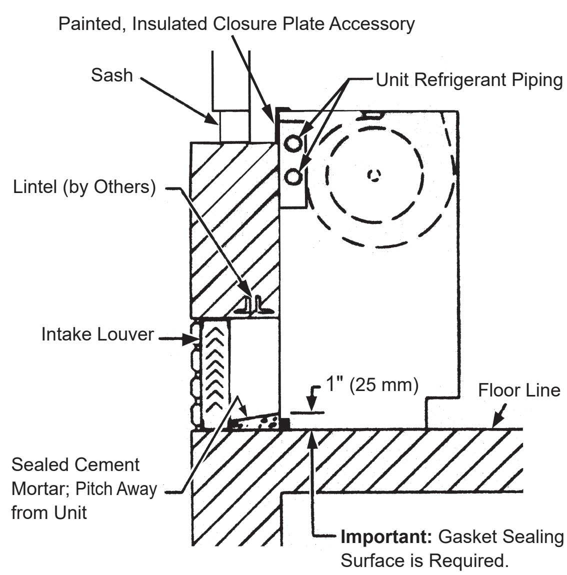
Chased Wall Unit Installation with Floor-Level Outdoor Air Intake:

Extra wall space is used to deliver fresh air to the unit outdoor opening. When a chased wall is used, pipes and fin tube radiation can be run inside the chased wall. The back of the accessory must be field-installed.



Chased Wall Unit Installation with Window Below Unit Top:

This installation allows window sills below the standard 30" unit height to project a finished image from outside. It also allows fresh air to be placed directly opposite the unit outside air opening. A 9" painted, insulated plate accessory encloses the pipe tunnel on the back of the unit.



End Panels

Daikin Applied end panels and sub-bases can be used to match up Daikin Applied unit ventilators with existing furniture or units, or with field-supplied storage, sink and bubbler cabinet offerings.

One-inch end panels are typically used to finish off stand-alone floor units (Figure 25). Six-inch end panels with kick plates can be used to provide extra space needed for piping (Figure 26). All end panels are individually wrapped in plastic and boxed to help prevent damage during construction.

Figure 25: 1" End Panel

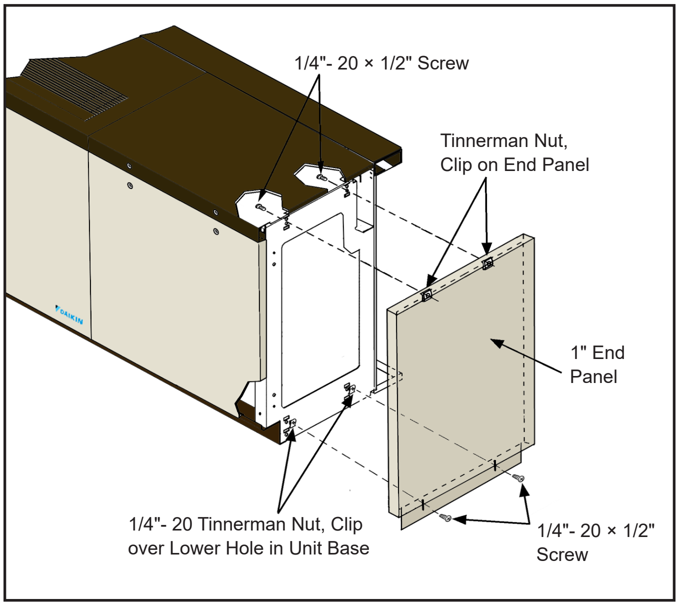
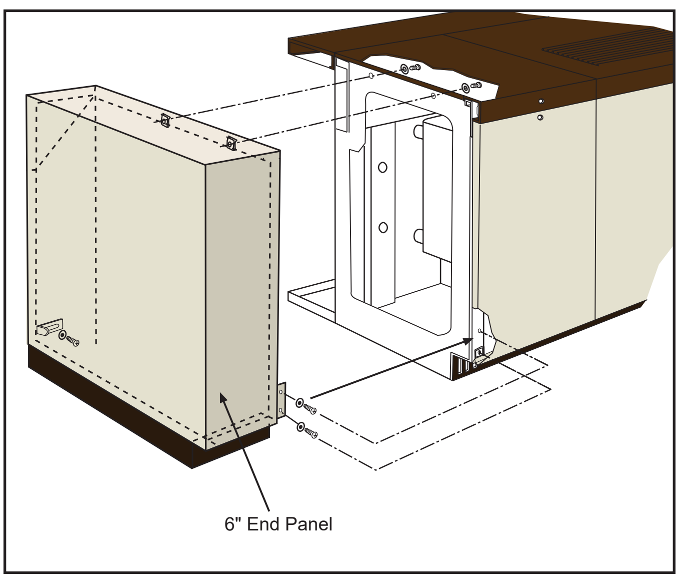


Figure 26: 6" End Panel



Wall Louvers & Grilles

Daikin Applied wall louvers allow outdoor air to be drawn in while blending with the building architecture. They are sized to match the unit outside air opening and provide maximum air intake. Heavy-gauge, all aluminum construction is standard, with a decorative grille optional.

Both louvers and grilles are available either painted or unpainted. When painted, a specially formulated, environmentally friendly thermosetting urethane powder is applied electrostatically and baked for long lasting beauty as well as resistance to corrosion. The paint is then oven cured to provide correct chemical crosslinking, which can provide years of service. The extruded 6063-T5 aluminum used for louvers and grilles is suitable for color anodizing by others.

Louver Details

Louvers are available in both horizontal and vertical blade configurations (Figure 27):

- Horizontal blade construction turns the incoming air to keep moisture from entering. Bottom weep holes drain moisture to the outside.
- Vertical-blade construction provides positive water impingement and entrapment. The bottom lip drains moisture to the outside.

Louvers can be supplied with or without flanges:

- Flanged louvers are typically used for a panel wall finish (Figure 28 on page 24).
- Unflanged louvers are typically used for recessing into a masonry wall.

Figure 27: Intake Louvers

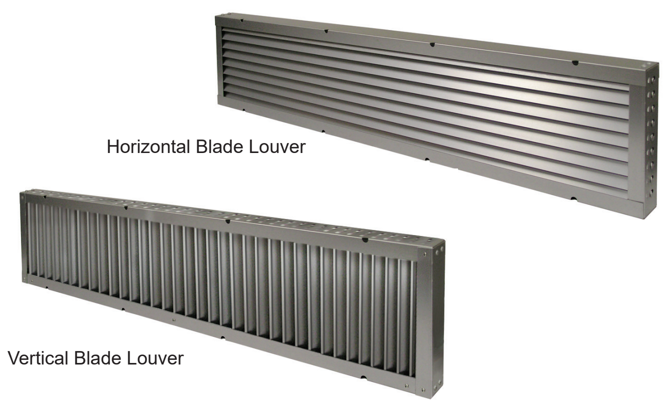
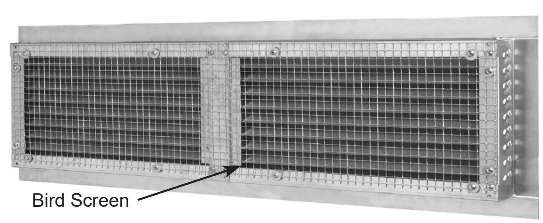


Figure 28: Flanged Louver (Indoor View)



Daikin Applied decorative intake grilles constructed of 6063-T5 extruded aluminum are available painted or unpainted with holes for mounting to building exteriors (Figure 29). Their square holes are designed to match the blades of the Daikin Applied louver, maximizing the air opening (Figure 30).

Grille Details

A diamond pattern expanded aluminum mesh bird screen (Figure 28) located on the leaving air side of the louver prevents birds and other small animals from entering. The screen's strong aluminum mesh is designed to minimize air pressure drops, unlike expanded metal mesh.

Figure 29: Horizontal Louver with Decorative Intake Grille

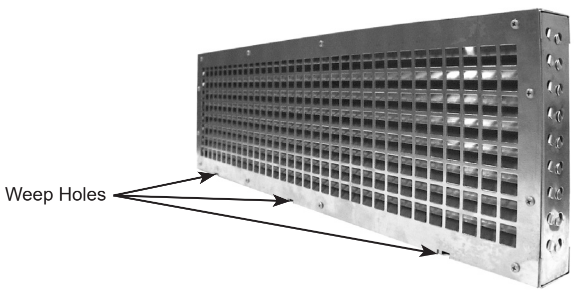
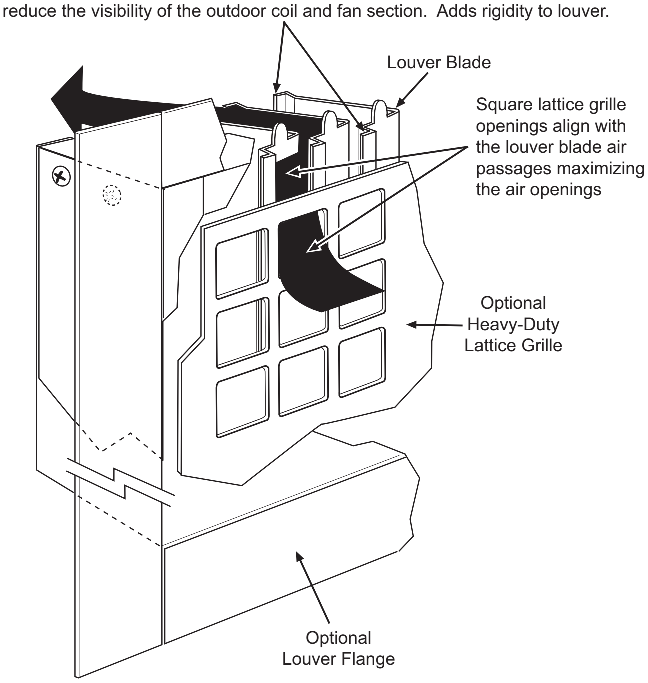


Figure 30: Vertical Louver with Decorative Intake Grille Detail

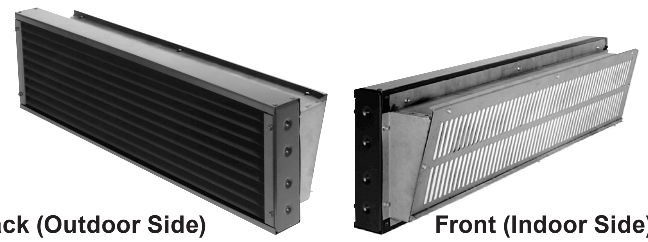


VentiMatic Shutter Room Exhaust Ventilation

Outdoor air introduced by the unit ventilator must leave the room in some way. In some states, exhaust vents are required by law or code to accomplish this. The VentiMatic Shutter is a more economical solution to the problem.

The VentiMatic shutter is a continuously variable, gravity-actuated room exhaust vent (Figure 31). It operates in direct response to positive static air pressure created when ventilation air is brought into the room by the unit ventilator. It is a "one-way" shutter that opposes any flow of air into the room.

Figure 31: VentiMatic Shutter



The VentiMatic Shutter's ability to exhaust only the amount of air required results in considerable energy savings. In the heating mode, the unit ventilator will be able to bring in only the required percent minimum outdoor air. Unlike systems that rely on powered exhaust, no energy will be wasted heating excess outdoor air. In the cooling mode, the unit ventilator will be able to bring in 100% outdoor air for full natural or free cooling when it is energy effective.

Since it is not powered, VentiMatic Shutter operation is inherently silent. Unlike other non-powered vents, it opens at an extremely low positive pressure (0.005"). Its shutter flaps are made of temperature-resistant glass fabric impregnated with silicone rubber for flexibility and long life. This fabric retains its original properties down to -50°F.

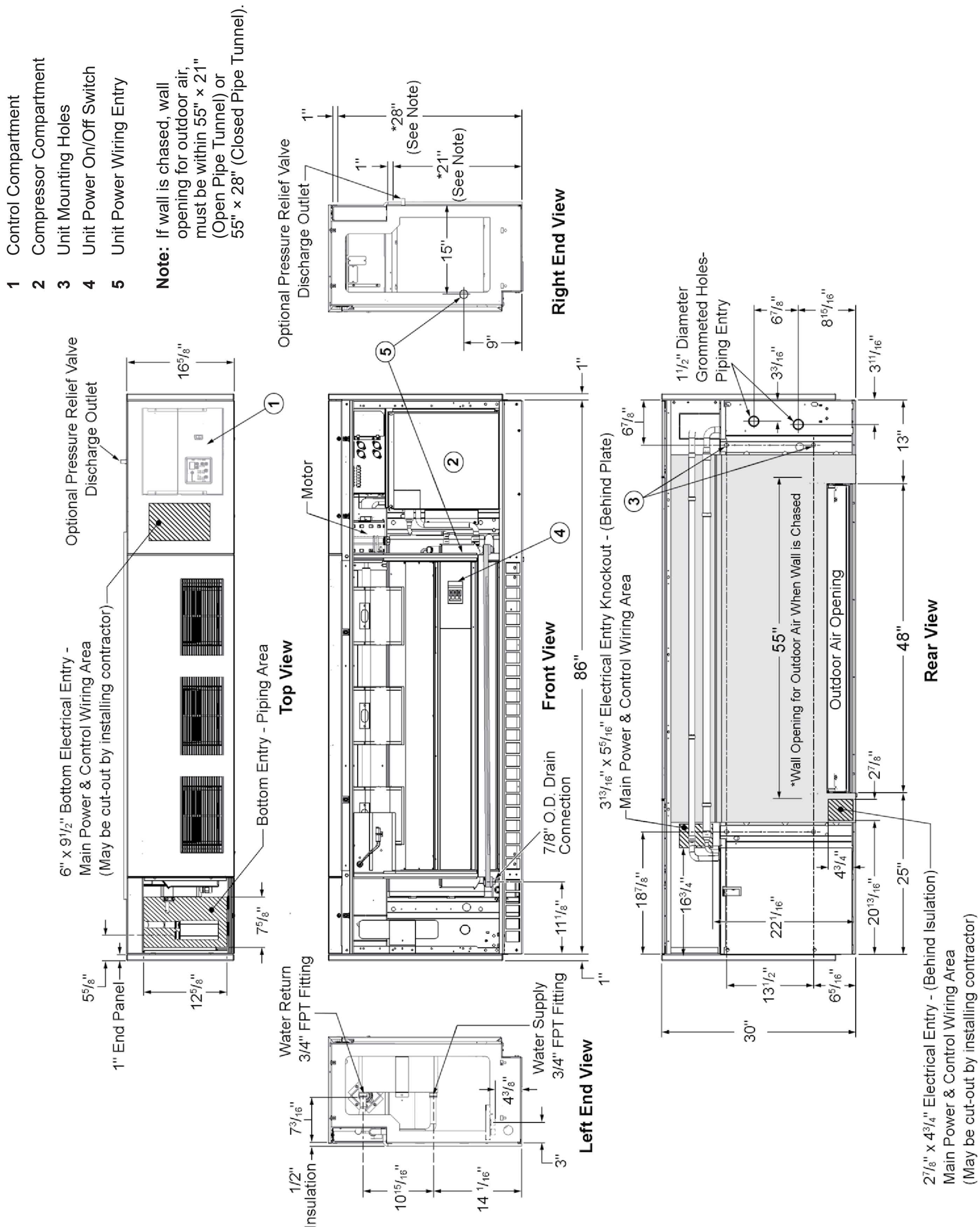
Details and Dimensions

Physical Data

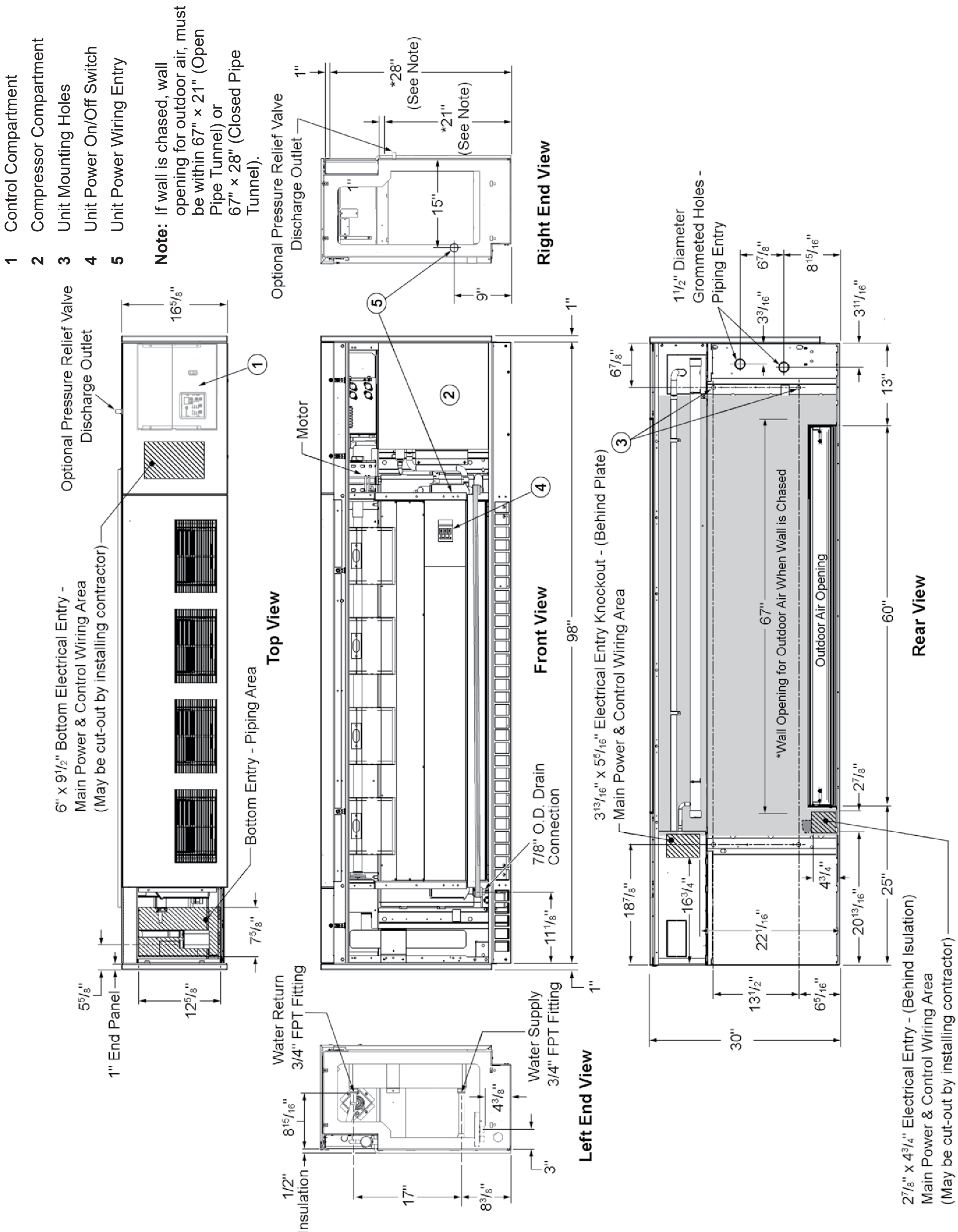
Table 1: Physical Data

			024	040	048
Overall Unit Dimensions			96″w × 38″h × 32″d or (21⅞″d w/Adapter Back)	108″w × 38″h × 32″d or (21⅞″d w/Adapter Back)	120″w × 38″h × 32″d or (21⅞″d w/Adapter Back)
Fan Data	**Nominal CFM (L/s)**	**High Speed**	1000 (472)	1100 (519)	1400 (661)
		Medium speed	750 (354)	970 (458)	940 (444)
		Low Speed	650 (307)	800 (378)	750 (354)
	Number of Fans		3	4	4
	Size	**Diameter - in (mm)**	8.12 (206)	8.12 (206)	8.12 (206)
		Width - in (mm)	8.25 (210)	8.25 (210)	8.25 (210)
Room Fan Motor Horsepower			1/4	1/4	1/4
Filter Data	**Nominal Size - in (mm)**		10 x 48½ x 1 (254 x 1232 x 25)	10 x 60½ x 1 (254 x 1537 x 25)	10 x 36½ x 1 (254 x 927 x 25)
	Area - ft^2 (m^2)		3.37 (.31)	4.2 (.39)	5.08 (.47)
	Quantity		1	1	2
Approximate Shipping Weight	**lb (kg)**		630 (286)	700 (318)	800 (363)
Refrigerant Charge (R-32)	**oz (lbs)**		72 (4.50)	74 (4.63)	100 (6.25)

Model ARQ and GRQ Self-Contained – Size 024



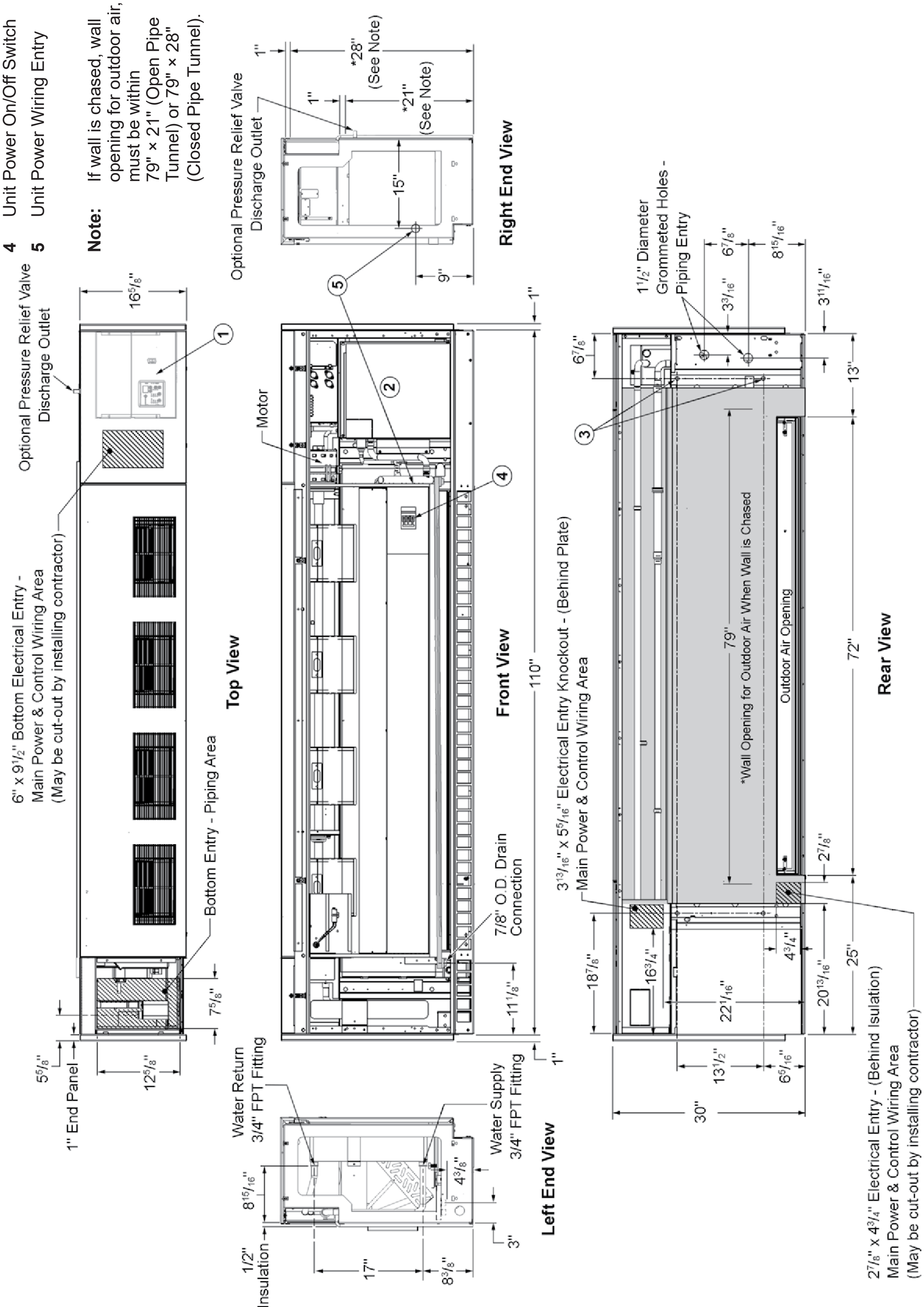
Model ARQ and GRQ Self-Contained – Size 040



Model ARQ and GRQ Self-Contained – Size 048

1 Control Compartment
2 Compressor Compartment
3 Unit Mounting Holes
4 Unit Power On/Off Switch
5 Unit Power Wiring Entry

Note: If wall is chased, wall opening for outdoor air, must be within 79" × 21" (Open Pipe Tunnel) or 79" × 28" (Closed Pipe Tunnel).



End Panels

Figure 32: 1" (25 mm) End Panel Dimensions

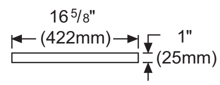
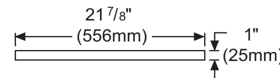
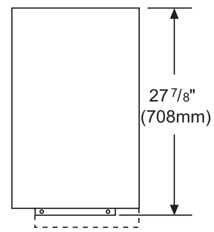
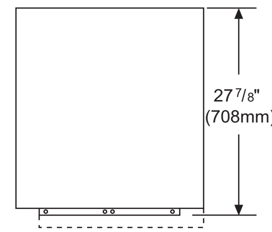
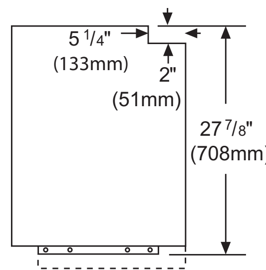
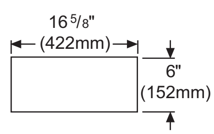
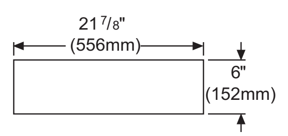
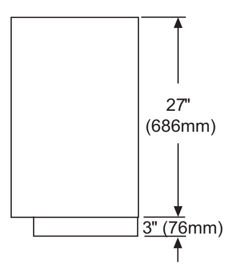
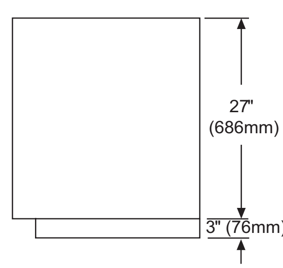
All Dim. in inches	16⅝" (422 mm) Deep End Panels	21⅞" (556 mm) Deep End Panels
Top View		
End View with No Cut-Out		
End View With 2" x 5-1/4" (51 mm x 133 mm) Step Down		

Figure 33: 6" (152 mm) End Panel Dimensions

All Dim. in inches	16⅝" (422 mm) Deep End Panels	21⅞" (556 mm) Deep End Panels
Top View		
End View with No Cut-Out		

Wall Intake Louvers & Grilles

Louvers are available in both horizontal and vertical blade configurations:

- **Horizontal blade construction** turns the incoming air to keep moisture from entering. Bottom weep holes drain moisture to the outside.
- **Vertical-blade construction** provides positive water impingement and entrapment. The bottom lip drains moisture to the outside.

Louvers can be supplied with or without flanges:

- **Flanged louvers** are typically used for a panel wall finish.
- **Unflanged louvers** are typically used for recessing into a masonry wall.

A half-inch-square mesh bird screen located on the leaving air side of the louver prevents birds and other small animals from entering. The screen's strong aluminum mesh is designed to minimize air pressure drops, unlike expanded metal mesh.

Figure 34: Louver with Flange (Horizontal Blades Shown)

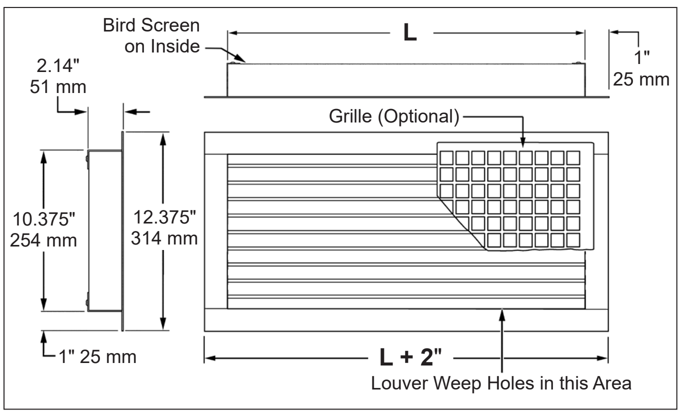


Figure 35: Louver Without Flange (Horizontal Blades Shown)

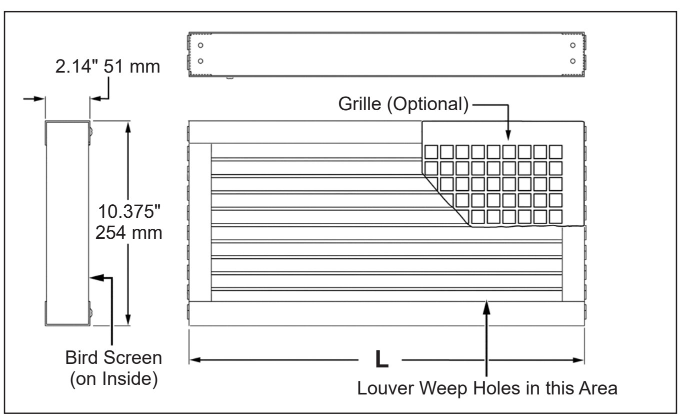


Figure 36: Louver with Flange (Vertical Blades Shown)

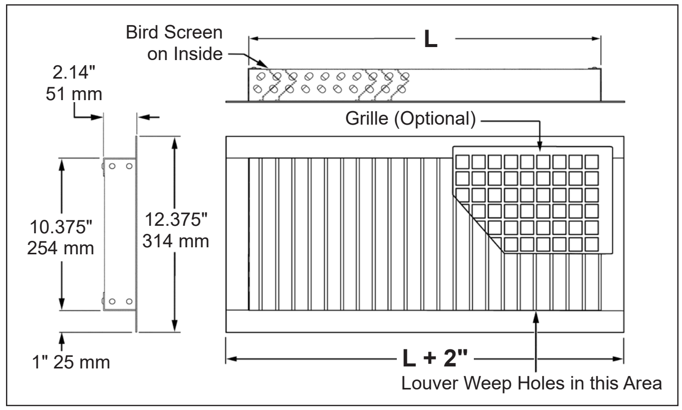


Figure 37: Louver Without Flange (Vertical Blades Shown)

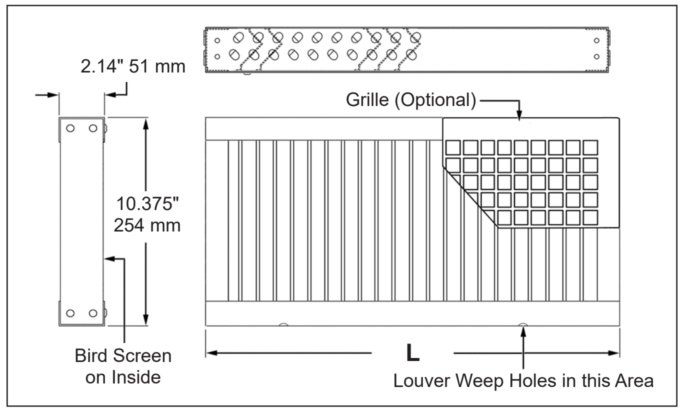


Table 2: Louver Specifications

Unit	Nominal Air Flow		Louver Dimensisons ± 1/16" (± 2 mm)		Recommended Wall Opening	
	CFM	L/s	L = Length	Height	Length	Height
024	750	472	48" (1219 mm)	10-3/8" (264 mm)	48-1/4" (1225 mm)	10-1/2" (267 mm)
040	1250	590	60" (1524 mm)		60-1/8" (1527 mm)	
048	1500	708	72" (1829 mm)		72-1/4" (1835 mm)	

VentiMatic Shutter Assembly

Notes:

1. Horizontal blade louver shown. Vertical blade louver also available with VentiMatic shutter.
2. Optional exterior grille matches unit ventilator louver in material and design. Mounted in wall louver.
3. Optional interior grille mounting hardware is not included.
4. Louver leaves seal against plate to prevent air infiltration.

Figure 38: VentiMatic Shutter Assembly with Optional Grille

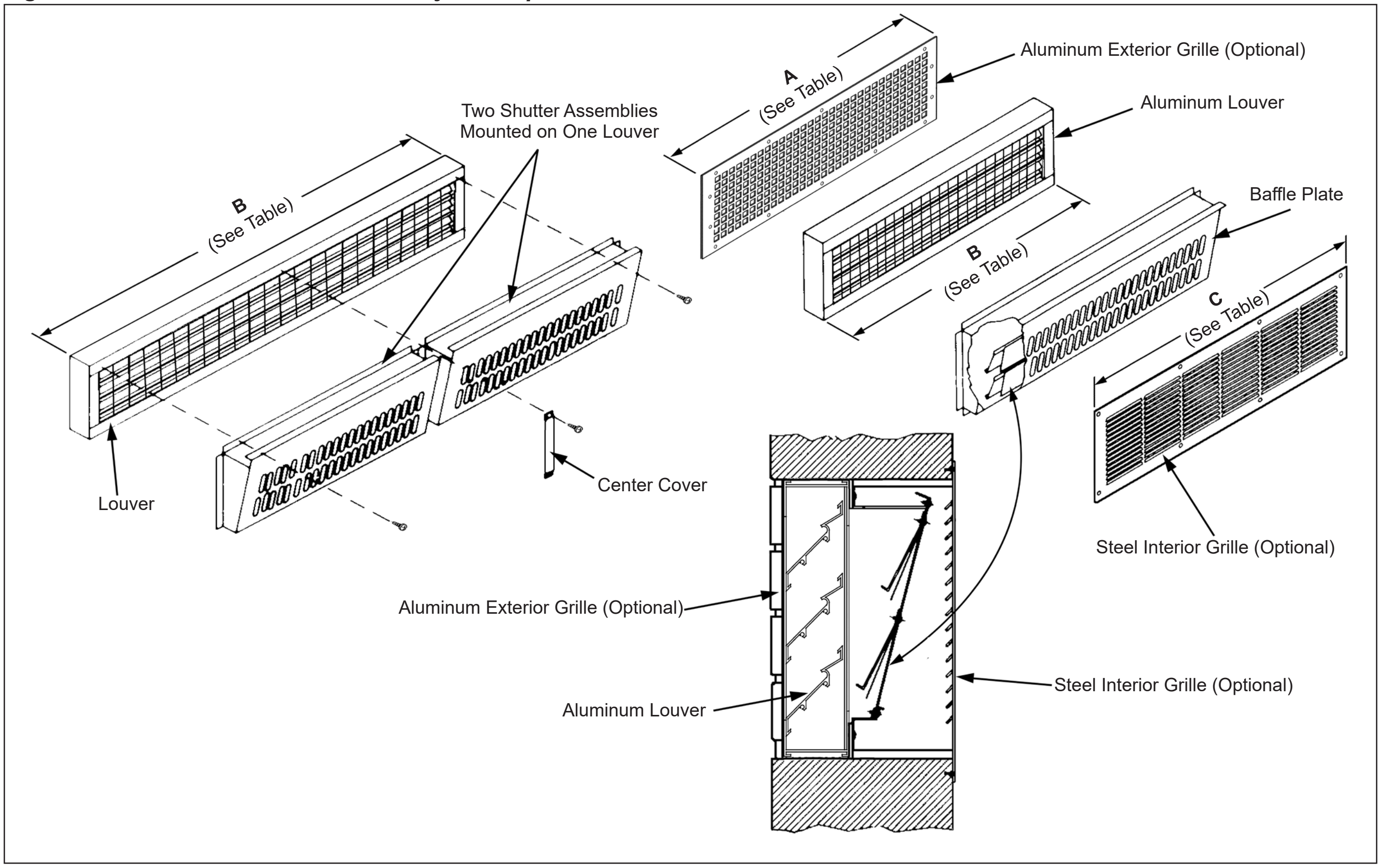


Table 3: VentiMatic Shutter Assembly Dimensions & Maximum Air Capacities

Exterior Grille A		Louver Width B		Interior Grille Width C		Recommended Wall Opening For Shutter				Max. Number of VentiMatic Shutters to Mount on Standard Louver		VentiMatic Shutter(s) Max. Air Capacity	
						Length		Width					
inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	24" (610 mm) Shutter	36" (914 mm) Shutter	CFM	L/s
23¾	603	24	610	27	686	24¼	616	10½	267	1	0	500	236
36¾	933	36	914	39	991	36¼	921			0	1	750	354
47¾	1213	48	1219	51	1295	48¼	1225			2	0	1000	472
59¾	1518	60	1524	63	1600	60¼	1530			1	1	1250	590
71¾	1822	72	1829	75	1905	72¼	1835			0	2	1500	708

Performance and Selection

Quick Selection Procedure

The following procedure will provide you with a rough determination of unit capacity for cooling and/or heating based on the number of coil rows. Use capacity tables for final selection. Consult your local Daikin Applied representative for details on the computer selection programs Daikin Applied provides for this purpose.

ARQ Cooling and Heating Capacity – Water Loop

Table 4: Standard ISO Water Loop

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow	Nominal WaterFlow	Pressure Drop		Cooling		Heating	
							Total Capacity	Efficiency	Total Capacity	Efficiency
			CFM	GPM	PSI	ft	Btuh	EER	Btuh	COP
024	Full	High	1000	6.5	0.5	1.1	25400	17.4	30900	5.53
	Part	Med	750				18300	19.3	22900	5.97
	Part	Low	650				17900	19.3	22400	5.52
040	Full	High	1250	10	3.1	7.2	41200	15.8	47400	4.41
	Part	Med	1000				30600	17.2	35000	4.87
	Part	Low	800				28800	16.5	33000	4.21
048	Full	High	1500	12	4.3	10	46200	15.3	56100	4.34
	Part	Med	1050				31600	15.7	38600	3.98
	Part	Low	850				29100	14.5	37100	3.53

Notes: Full and part load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 86°F and high-speed fan for full load.
Full and part load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 68°F and high-speed fan for full load.
Fluid is fresh water.

GRQ Cooling and Heating Capacity – Ground Loop

Table 5: Standard ISO Ground Loop

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow	Nominal WaterFlow	Pressure Drop		Cooling		Heating	
							Total Capacity	Efficiency	Total Capacity	Efficiency
			CFM	GPM	PSI	ft	Btuh	EER	Btuh	COP
024	Full	High	1000	6.5	0.5	1.1	25700	18.2	20100	4.12
	Part	Med	750				19100	24.8	15000	4.6
	Part	Low	650				18700	25.0	14500	4.1
040	Full	High	1250	10	3.2	7.5	42100	17.7	31900	3.5
	Part	Med	1000				32500	23.9	23800	4.0
	Part	Low	800				30700	23.2	21700	3.3
048	Full	High	1500	12	4.7	11	47600	17.2	36400	3.5
	Part	Med	1050				34300	22.0	23800	3.1
	Part	Low	850				31800	20.5	22300	2.6

Notes: Full load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 77°F and high-speed fan.
Full load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 32°F and high-speed fan.
Part load cooling conditions: Indoor 80.6°F db / 66.2°F wb / Entering Water Temperature 68°F and medium or low-speed fan.
Part load heating conditions: Indoor 68°F db / 59°F wb / Entering Water Temperature 41°F and medium or low-speed fan.
Fluid is 15% methanol solution.

Selection Procedure

Step 1: Determine Design Conditions

Determine design indoor and outdoor air temperatures in accordance with established engineering practices, as outlined in the ASHRAE Guide or other authoritative source. Indoor temperatures of 80°F dry bulb, 67°F wet bulb for summer and 70°F dry bulb for winter usually are acceptable for design or peak load conditions, even though the expected operating conditions of the system may be somewhat different.

Step 2: Determine Heating and Cooling Loads

Calculate design winter heating losses and summer cooling loads in accordance with the procedures outlined by the ASHRAE Guide or other authoritative source. Perhaps the greatest consideration in calculating design loads is solar heat gain. August solar heat values might be used for summer cooling loads, but should not be used for ventilation air or "natural cooling" capacity calculations; since these cooling loads reach their maximum in the spring and autumn months. The natural cooling capacity is usually calculated for 55° or 60°F outdoor air temperature.

Table 6: Outdoor Air Ventilation Sensible Cooling Capacites Based On 75°F Room Temperature

Unit Series	Nominal CFM	Outdoor Air Temperature	
		55°F	60°F
024	1000	21.7 MBH	16.3 MBH
040	1100	27.1 MBH	20.3 MBH
048	1400	32.6 MBH	24.4 MBH

Step 3: Determine Air Quantity Required

Air quantity for heating applications is determined from circulation of a definite number of room air volumes per hour. Table 7 gives the recommended number of room air changes per hour.

Table 7: Recommended Room Air Changes Per Hour

Type of Space	Recommended Number of Room Air Changes Per Hour
Classrooms, Offices	6 to 9
Laboratories, Shops	6 to 8
Cafeterias & Kitchens	4½ to 7

For rooms facing east, south or west, the higher values shown in the table should be used so adequate ventilation cooling will be available to prevent overheating during mild sunny weather. The following equation is helpful to determine the CFM air delivery for any given rate of circulation:

Equation 1: CFM for Given Rate Of Circulation

$$\frac{\text{Room Volume (cu ft)} \times \text{Room Changes per Hour}}{60} = CFM$$

In mechanical cooling applications, the total air quantity may be determined or verified by use of the sensible cooling load equation:

Equation 2: CFM Based on Sensible Cooling Load

$$CFM = \frac{Q \text{ sensible (space)}}{1.086 \times TD}$$

Q sensible is the maximum sensible room load and T.D. is the temperature difference between the room design dry bulb temperature and the final or leaving-air dry bulb temperature. For these calculations, a T.D. of 20°F is usually assumed to be desirable to avoid delivering air too cold for comfort. This figure may be varied one or two degrees for reasons of practicality.

Note: *The sensible load used in the preceding equation is the space load and excludes the ventilation load.*

Most areas have ventilation codes which govern the amount of ventilation air required for school applications. For other than school applications or areas not having codes, the ASHRAE Guide may be used for authoritative recommendations and discussion of the relation between odor control and outdoor air quantities.

The minimum outdoor air quantity recommended by ASHRAE for K-12 classrooms is 10 CFM per person plus 0.12 CFM/ft^2. Lower percent minimum outdoor air settings are more economical. In the interest of economy, it may be desirable to use lower percent minimums if there are no ventilation codes.

Step 4: Select Unit Size

The unit should be selected to meet or exceed the CFM delivery requirement previously determined. All model types are available with nominal capacities of 1000, 1100 and 1400 CFM.

Cooling Capacity

Unit cooling capacity should be selected to equal or slightly exceed the sum of computed room sensible and latent heat gains (Room Total Capacity). When operating on the mechanical cooling cycle, the control system introduces a constant amount of outdoor air for ventilation. The latent and sensible heat gain from this outdoor ventilation air must be added to the room total cooling load before choosing the proper capacity unit.

Heating Capacity

Unit heating capacity should be selected to equal or slightly exceed the computed room heat loss. For units installed for 100% recirculation, it is good practice to increase the heating capacity by 15% to aid in quick room warm-up. This allowance is unnecessary for units delivering a minimum outdoor air of 20% or more, since the outdoor air damper remains closed until the room is up to temperature. The heat normally expended in heating the minimum-percent outdoor air up to room temperature is available for quick warm-up purposes.

The heating required to warm the outdoor ventilating air up to room temperature must also be calculated. The Total Capacity should be used in sizing, piping, boilers, etc.

Cooling Selection Example

Step 1: Determine Design Conditions

Assume the following design indoor and outdoor air temperatures are given:

- Outdoor design temperature = 96°F DB / 74°F WB
- Room design temperature = 76°F DB / 65°F WB

Step 2: Determine Cooling Loads

Assume the following cooling loads are given:

- Minimum total capacity (TC) = 40.5 MBH
- Minimum sensible capacity (SC) = 23.9 MBH
- Minimum outdoor air = 20%
- Entering Fluid Temperature = 90° F
- Room volume = 9,000 cubic feet
- Desired number of air changes per hour = 8

Step 3: Determine Air Quantity Required

Equation 1 on page 34 indicates that to obtain eight room volumes per hour, a unit capable of delivering 1200 CFM standard air must be used, as follows:

$$CFM = \frac{(\text{Room Volume Ft}^3) \times (\text{Room Changes per Hour})}{80}$$

$$CFM = \frac{9000 \times 8}{60} = 1200$$

This indicates that a size 040 Unit Ventilator should be used, which delivers 1250 CFM.

Step 4: Select Unit Size

Determine the unit performance as follows:

Determine Entering Dry Bulb Temperature

The entering dry bulb (EDB) temperature is calculated using the following formula:

$$EDB = \text{Room DB} \times \frac{\%RA}{100} + \text{Outdoor DB} \times \frac{\%OA}{100}$$

$$EDB = 76(0.8) + (96)(0.2) = 80°F$$

Determine Entering Wet Bulb Temperature

The entering wet bulb (EWB) temperature is determined by calculating the Enthalpy (H) at saturation, then looking up the corresponding EWB (Table 8 on page 36). Enthalpy (H) is calculated as follows:

$$\text{Enthalpy (H)} = \text{Room Enthalpy} \times \frac{\%RA}{100} + \text{Outdoor Enthalpy} \times \frac{\%OA}{100}$$

$$\text{Enthalpy (H)} = 30.06\ (0.8) + 37.66\ (0.2) = 31.58 \text{ btu/lb}$$

Referring to Table 8 on page 36, EWB for 31.58 btu/lb = 67°F

Look Up Capacities

Look up the Total and Sensible cooling capacity for a Size 040 unit at High Fan Speed from "ARQ Size 040 (1250 SCFM) – 2nd Stage High Fan". Interpolation between the values for GPM = 6.7 and 10.0, at Entering Water Temperature = 90°F and Entering Air Temperature DB/WB = 80/67°F, will yield the following results.

- 40.5 MBH (TC)
- 25.1 MBH (SC)
- 8.2 GPM

Leaving air temperatures dry bulb °F (LDB) and wet bulb °F (LWB) may be calculated as follows:

$$LDB = EDB - \frac{SC(Btuh)}{CFM \times 1.085} = 80 - \frac{25100}{1250 \times 1.085} = 61.5°F$$

$$LWBH = EWBH - \frac{TC(Btuh)}{CFM \times 4.5} = 31.62 - \frac{40500}{1250 \times 4.5} = 24.4$$

From "Size 040 (1250 SCFM) – 2nd Stage High Fan" on page 41:

LWB at 24.4 H = 56.9°F.

Note: *Interpolation within each table and between sets of tables for each unit series is permissible.*

For conditions of performance beyond the scope of the catalog selection procedures, Daikin Applied offers computer selection programs for cooling, hot water and steam coils. Consult your local Daikin Applied representative for details.

Table 8: Enthalpy (H) at Saturation But Per Pound of Dry Air

Wet Bulb Temp. °F	Tenths of A Degree									
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	20.3	20.36	20.41	20.47	20.52	20.58	20.64	20.69	20.75	20.8
51	20.86	20.92	20.97	21.03	21.09	21.15	21.2	21.26	21.32	21.38
52	21.44	21.5	21.56	21.62	21.67	21.73	21.79	21.85	21.91	21.97
53	22.02	22.08	22.14	22.2	22.26	22.32	22.38	22.44	22.5	22.56
54	22.62	22.68	22.74	22.8	22.86	22.92	22.98	23.04	23.1	23.16
55	23.22	23.28	23.34	23.41	23.47	23.53	23.59	23.65	23.72	23.78
56	23.84	23.9	23.97	24.03	24.1	24.16	24.22	24.29	24.35	24.42
57	24.48	24.54	24.61	24.67	24.74	24.8	24.86	24.93	24.99	25.06
58	25.12	25.19	25.25	25.32	25.38	25.45	25.52	25.58	26.65	25.71
59	25.78	25.85	25.92	25.98	26.05	26.12	26.19	26.26	26.32	26.39
60	26.46	26.53	26.6	26.67	26.74	26.81	26.87	26.94	27.01	27.08
61	27.15	27.22	27.29	27.36	27.43	27.5	27.57	27.64	27.71	27.78
62	27.85	27.92	27.99	28.07	28.14	28.21	28.28	28.35	28.43	28.5
63	28.57	28.64	28.72	28.79	28.87	28.94	29.01	29.09	29.16	29.24
64	29.31	29.39	29.46	29.54	29.61	29.69	29.76	29.84	29.91	29.99
65	30.06	30.14	30.21	30.29	30.37	30.45	30.52	30.6	30.68	30.78
66	30.83	30.91	30.99	31.07	31.15	31.23	31.3	31.38	31.46	31.54
67	31.62	31.7	31.78	31.86	31.94	32.02	32.1	32.18	32.26	32.34
68	32.42	32.5	32.59	32.67	32.75	32.84	32.92	33	33.08	33.17
69	33.25	33.33	33.42	33.5	33.59	33.67	33.75	33.84	33.92	34.01
70	34.09	34.18	34.26	34.35	34.43	34.52	34.61	34.69	34.78	34.86
71	34.95	35.04	35.13	35.21	35.3	35.39	35.48	35.57	35.65	35.74
72	35.83	35.92	36.01	36.1	36.19	36.29	36.38	36.47	36.56	36.65
73	36.74	36.83	36.92	37.02	37.11	37.2	37.29	37.38	37.48	37.57
74	37.66	37.76	37.85	37.95	38.04	38.14	38.23	38.33	38.42	38.52
75	38.61	38.71	38.8	38.9	38.99	39.09	39.19	39.28	39.38	39.47
76	39.57	39.67	39.77	39.87	39.97	40.07	40.17	40.27	40.37	40.47
77	40.57	40.67	40.77	40.87	40.97	41.08	41.18	41.28	41.38	41.48
78	41.58	41.68	41.79	41.89	42	42.1	42.2	42.31	42.41	42.52
79	42.62	42.73	42.83	42.94	43.05	43.16	43.26	43.37	43.48	43.58
80	43.69	43.8	43.91	44.02	44.13	44.24	44.34	44.45	44.56	44.67
81	44.78	44.89	45	45.12	45.23	45.34	45.45	45.56	45.68	45.79
82	45.9	46.01	46.13	46.24	46.36	46.47	46.58	46.7	46.81	46.93
83	47.04	47.16	47.28	47.39	47.51	47.63	47.75	47.87	47.98	48.1
84	48.22	48.34	48.46	48.58	48.7	48.83	48.95	49.07	49.19	49.31
85	49.43	49.55	49.68	49.8	49.92	50.05	50.17	50.29	50.41	50.54

Antifreeze

In areas where minimum entering loop temperatures drop below 40°F (4°C) or where piping will be routed through areas subject to freezing, antifreeze is required.

Alcohols and glycols are commonly used as antifreeze, however, your local sales office should be consulted to determine the antifreeze best suited to your area. Freeze protection should be maintained to 15°F (9°C) below the lowest expected entering loop temperature. For example; if 30°F (-1°C) is the minimum expected entering loop temperature, the leaving loop temperature would be 22 to 25°F (-6° to -4°C) and freeze protection should be at 15°F (-10°C). Calculation is as follows: 30°F - 15°F = 15°F (-1°C - 9°C = -10°C).

Antifreeze Correction Factors

Table 9: Correction Factors for Ethylene Glycol

Ethylene Glycol% Weight	10%	20%	30%	40%	50%
Cooling Capacity	0.9950	0.9920	0.9870	0.9830	0.9790
Heating Capacity	0.9910	0.9820	0.9770	0.9690	0.9610
Pressure Drop	1.0700	1.1300	1.1800	1.2600	1.2800

Table 10: Correction Factors for Propylene Glycol

Propylene Glycol% Weight	10%	20%	30%	40%	50%
Cooling Capacity	0.9900	0.9800	0.9700	0.9600	0.9500
Heating Capacity	0.9870	0.9750	0.9620	0.9420	0.9300
Pressure Drop	1.0700	1.1500	1.2500	1.3700	1.4200

Table 11: Correction Factors for Methanol

Methanol% Weight	10%	20%	30%	40%	50%
Cooling Capacity	0.9980	0.9720	–	–	–
Heating Capacity	0.9950	0.9700	–	–	–
Pressure Drop	1.0230	1.0570	–	–	–

Table 12: Correction Factors for Ethanol

Ethanol% Weight	10%	20%	30%	40%	50%
Cooling Capacity	0.9910	0.9510	–	–	–
Heating Capacity	0.9950	0.9600	–	–	–
Pressure Drop	1.0350	1.0680	–	–	–

Table 13: Antifreeze Percentage by Volume

Type	Minimum Temperature for Low Temperature Protection			
	10°F (-12.2°C)	15°F (-9.4°C)	20°F (-6.7°C)	25°F (-3.9°C)
Methanol	25%	21%	16%	10%
Propylene Glycol[1]	38%	25%	22%	15%
Ethanol[2]	29%	25%	20%	14%

Notes: 1 100% USP Food Grade.
2 Must not be denatured with any petroleum product.

Operating Limits

Table 14: Air Limits in °F (°C)

Air Limits	Standard Range Units		Extended Range (Geothermal) Units	
	Cooling (DB/WB)	Heating	Cooling (DB/WB)	Heating
Minimum Ambient Air[1]	50°F (10°C)	50°F (10°C)	40°F (4°C)	40°F (4°C)
Common Design Ambient Air	80°F (27°C)	70°F (21°C)	80°F (27°C)	70°F (21°C)
Maximum Ambient Air[2]	100°F/77°F (38°C/25°C)	85°F (29°C)	100°F/77°F (38°C/25°C)	85°F (29°C)
Minimum Entering Air[1]	50°F (10°C)	50°F (10°C)	50°F (10°C)	40°F (4°C)
Common Design Entering Air	80°F/67°F (27°C/19°C)	70°F (21°C)	80°F/67°F (27°C/19°C)	70°F (21°C)
Maximum Entering Air[2]	100°F/83°F (38°C/28°C)	80°F (27°C)	100°F/83°F (38°C/28°C)	80°F (27°C)

[1] Maximum and minimum values may not be combined. If one value is at maximum or minimum, the other conditions may not exceed the normal condition for standard units. Extended range units may combine any two maximum conditions, but not more than two, with all other conditions being normal conditions.

[2] This is not for continuous operation. It is assumed that such a start-up is for the purpose of bringing the building space up to occupancy temperature.

Table 15: Fluid Limits

Fluid Limits	Standard Range Units		Extended Range (Geothermal) Units	
	Cooling	Heating	Cooling	Heating
Minimum Entering Fluid	55°F (13°C)	55°F (13°C)	30°F (-1°C)	20°F (-7°C)
Common Design Entering Fluid	85 (29°C)	70°F (21°C)	77°F (25°C)	40°F (4°C)
Maximum Entering Fluid	110°F (43°C)	90°F (32°C)	110°F (43°C)	90°F (32°C)
Minimum GPM/Ton	2.0			
Nominal GPM/Ton	3.0			
Maximum GPM/Ton	4.0			

Capacity Data

ARQ – Size 024

Table 16: ARQ Size 024 (1000 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	0.2	0.4	26900	19300	1.247	31200	21.6	27400	1.594	22000	5.0
	6.0	0.4	1.0	27000	19400	1.189	31100	22.7	28000	1.609	22500	5.1
	8.0	0.7	1.7	27100	19500	1.131	31000	24.0	28600	1.625	23100	5.2
70	4.0	0.2	0.4	26300	19000	1.383	31000	19.0	29500	1.638	23900	5.3
	6.0	0.4	0.9	26400	19100	1.325	30900	19.9	30100	1.654	24500	5.3
	8.0	0.7	1.6	26500	19200	1.267	30800	20.9	30700	1.670	25000	5.4
80	4.0	0.2	0.4	25700	18900	1.533	30900	16.8	31200	1.676	25500	5.5
	6.0	0.4	0.9	25800	19000	1.475	30800	17.5	31800	1.691	26000	5.5
	8.0	0.7	1.6	25900	19100	1.417	30700	18.3	32400	1.707	26600	5.6
90	4.0	0.2	0.4	25100	18900	1.708	30900	14.7	32400	1.703	26600	5.6
	6.0	0.4	0.9	25300	19000	1.65	30900	15.3	33000	1.719	27100	5.6
	8.0	0.7	1.6	25400	19100	1.592	30800	16.0	33600	1.735	27700	5.7
100	4.0	0.2	0.4	24200	18600	1.930	30800	12.5	Operation Not Recommended			
	6.0	0.4	0.9	24300	18700	1.872	30700	13.0				
	8.0	0.7	1.5	24500	18800	1.814	30700	13.5				
110	4.0	0.2	0.4	22200	17500	2.229	29800	10.0				
	6.0	0.4	0.9	22300	17600	2.171	29700	10.3				
	8.0	0.7	1.5	22400	17700	2.113	29600	10.6				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 17: ARQ Size 024 (750 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	0.2	0.4	19800	14000	0.737	22300	26.9	19500	1.080	15800	5.3
	6.0	0.4	1.0	20000	14100	0.679	22300	29.5	20100	1.096	16400	5.4
	8.0	0.7	1.7	20100	14200	0.621	22200	32.4	20700	1.111	16900	5.5
70	4.0	0.2	0.4	19200	13700	0.873	22200	22.0	21600	1.125	17800	5.6
	6.0	0.4	0.9	19300	13800	0.815	22100	23.7	22200	1.141	18300	5.7
	8.0	0.7	1.6	19400	13900	0.757	22000	25.6	22800	1.156	18900	5.8
80	4.0	0.2	0.4	18600	13600	1.023	22100	18.2	23300	1.162	19300	5.9
	6.0	0.4	0.9	18800	13700	0.965	22100	19.5	23900	1.178	19900	5.9
	8.0	0.7	1.6	18900	13800	0.907	22000	20.8	24500	1.194	20400	6.0
90	4.0	0.2	0.4	18100	13600	1.198	22200	15.1	24500	1.190	20400	6.0
	6.0	0.4	0.9	18200	13700	1.140	22100	16.0	25100	1.206	21000	6.1
	8.0	0.7	1.6	18300	13800	1.082	22000	16.9	25600	1.221	21400	6.1
100	4.0	0.2	0.4	17200	13300	1.420	22000	12.1	Operation Not Recommended			
	6.0	0.4	0.9	17300	13400	1.362	22000	12.7				
	8.0	0.7	1.5	17400	13600	1.304	21900	13.3				
110	4.0	0.2	0.4	15100	12300	1.719	21000	8.8				
	6.0	0.4	0.9	15200	12400	1.661	20900	9.1				
	8.0	0.7	1.5	15400	12500	1.604	20900	9.6				

Table 18: ARQ Size 024 (650 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	0.2	0.4	19400	13700	0.716	21800	27.1	19000	1.145	15100	4.9
	6.0	0.4	1.0	19500	13800	0.659	21700	29.6	19600	1.160	15600	5.0
	8.0	0.7	1.7	19600	13900	0.601	21700	32.6	20200	1.176	16200	5.0
70	4.0	0.2	0.4	18800	13400	0.852	21700	22.1	21100	1.189	17000	5.2
	6.0	0.4	0.9	18900	13500	0.794	21600	23.8	21700	1.205	17600	5.3
	8.0	0.7	1.6	19000	13600	0.736	21500	25.8	22300	1.221	18100	5.4
80	4.0	0.2	0.4	18200	13300	1.002	21600	18.2	22800	1.227	18600	5.4
	6.0	0.4	0.9	18300	13400	0.944	21500	19.4	23400	1.243	19200	5.5
	8.0	0.7	1.6	18400	13500	0.886	21400	20.8	24000	1.258	19700	5.6
90	4.0	0.2	0.4	17600	13300	1.178	21600	14.9	23900	1.254	19600	5.6
	6.0	0.4	0.9	17800	13400	1.120	21600	15.9	24500	1.270	20200	5.7
	8.0	0.7	1.6	17900	13500	1.062	21500	16.9	25100	1.286	20700	5.7
100	4.0	0.2	0.4	16700	13000	1.399	21500	11.9	Operation Not Recommended			
	6.0	0.4	0.9	16900	13100	1.342	21500	12.6				
	8.0	0.7	1.5	17000	13200	1.284	21400	13.2				
110	4.0	0.2	0.4	14700	11900	1.699	20500	8.7				
	6.0	0.4	0.9	14800	12000	1.641	20400	9.0				
	8.0	0.7	1.5	14900	12100	1.583	20300	9.4				

LEGEND					
Btu/h	British Termal Units per Hour	EWT	Entering Water Temperature	THA	Total Heat of Absorption
COP	Coefficient of Performance	ft of W.C.	Feet of Water Column	THR	Total Heat of Rejection
EAT	Entering Air Temperature	kW	Kilowatts	WPD	Waterside Pressure Drop
EER	Energy Efficiency Ratio	PSI	Pounds per square Inch		

ARQ – Size 040

Table 19: ARQ Size 040 (1250 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.5	3.4	44600	28200	2.085	51700	21.4	43600	3.090	33000	4.1
	6.0	3.2	7.3	44800	28500	2.013	51700	22.3	44400	3.128	33700	4.2
	8.0	5.5	12.6	45000	28800	1.941	51600	23.2	45100	3.166	34300	4.2
70	4.0	1.4	3.3	43300	27600	2.297	51100	18.9	47100	3.211	36100	4.3
	6.0	3.1	7.1	43400	27900	2.225	51000	19.5	47800	3.249	36700	4.3
	8.0	5.3	12.3	43600	28300	2.153	51000	20.3	48600	3.288	37400	4.3
80	4.0	1.4	3.2	42200	27200	2.525	50800	16.7	49500	3.315	38200	4.4
	6.0	3.0	7.0	42300	27600	2.453	50700	17.2	50300	3.353	38800	4.4
	8.0	5.2	12.1	42500	27900	2.381	50600	17.9	51000	3.391	39400	4.4
90	4.0	1.4	3.2	41200	26900	2.790	50700	14.8	50500	3.397	38900	4.4
	6.0	3.0	6.9	41400	27200	2.718	50700	15.2	51200	3.436	39500	4.4
	8.0	5.2	11.9	41500	27500	2.646	50500	15.7	52000	3.474	40100	4.4
100	4.0	1.4	3.2	39600	25900	3.131	50300	12.6	Operation Not Recommended			
	6.0	2.9	6.8	39800	26200	3.059	50200	13.0				
	8.0	5.1	11.8	40000	26500	2.987	50200	13.4				
110	4.0	1.3	3.1	36100	23400	3.599	48400	10.0				
	6.0	2.9	6.7	36300	23700	3.527	48300	10.3				
	8.0	5.0	11.6	36400	24100	3.455	48200	10.5				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 20: ARQ Size 040 (1000 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.5	3.4	34000	20900	1.265	38300	26.9	31300	2.047	24300	4.5
	6.0	3.2	7.3	34200	21200	1.193	38300	28.7	32000	2.085	24900	4.5
	8.0	5.5	12.6	34400	21500	1.121	38200	30.7	32700	2.123	25400	4.5
70	4.0	1.4	3.3	32600	20300	1.476	37600	22.1	34800	2.168	27400	4.7
	6.0	3.1	7.1	32800	20700	1.405	37600	23.4	35500	2.206	28000	4.7
	8.0	5.3	12.3	33000	21000	1.333	37600	24.8	36200	2.244	28500	4.7
80	4.0	1.4	3.2	31600	20000	1.704	37400	18.5	37200	2.271	29400	4.8
	6.0	3.0	7.0	31700	20300	1.633	37300	19.4	37900	2.310	30000	4.8
	8.0	5.2	12.1	31900	20600	1.561	37200	20.4	38600	2.348	30600	4.8
90	4.0	1.4	3.2	30600	19600	1.970	37300	15.5	38200	2.354	30200	4.8
	6.0	3.0	6.9	30800	19900	1.898	37300	16.2	38900	2.392	30700	4.8
	8.0	5.2	11.9	30900	20200	1.826	37100	16.9	39600	2.431	31300	4.8
100	4.0	1.4	3.1	29000	18600	2.311	36900	12.6	Operation Not Recommended			
	6.0	2.9	6.8	29200	19000	2.239	36800	13.0				
	8.0	5.1	11.7	29400	19300	2.167	36800	13.6				
110	4.0	1.3	3.1	25500	16200	2.779	35000	9.2				
	6.0	2.9	6.7	25700	16500	2.707	34900	9.5				
	8.0	5.0	11.6	25800	16800	2.635	34800	9.8				

Table 21: ARQ Size 040 (800 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.5	3.4	32200	19800	1.232	36400	26.1	29300	2.234	21700	3.8
	6.0	3.2	7.3	32400	20100	1.160	36400	27.9	30000	2.272	22200	3.9
	8.0	5.5	12.6	32600	20400	1.088	36300	30.0	30700	2.310	22800	3.9
70	4.0	1.4	3.3	30900	19200	1.443	35800	21.4	32700	2.355	24700	4.1
	6.0	3.1	7.1	31000	19500	1.371	35700	22.6	33500	2.393	25300	4.1
	8.0	5.3	12.3	31200	19900	1.300	35600	24.0	34200	2.432	25900	4.1
80	4.0	1.4	3.2	29800	18800	1.671	35500	17.8	35200	2.459	26800	4.2
	6.0	3.0	7.0	29900	19200	1.599	35400	18.7	35900	2.497	27400	4.2
	8.0	5.2	12.1	30100	19500	1.528	35300	19.7	36600	2.535	27900	4.2
90	4.0	1.4	3.2	28800	18500	1.937	35400	14.9	36100	2.541	27400	4.2
	6.0	3.0	6.9	29000	18800	1.865	35400	15.5	36900	2.580	28100	4.2
	8.0	5.2	11.9	29200	19100	1.793	35300	16.3	37600	2.618	28700	4.2
100	4.0	1.4	3.1	27200	17500	2.278	35000	11.9	Operation Not Recommended			
	6.0	2.9	6.8	27400	17800	2.206	34900	12.4				
	8.0	5.1	11.7	27600	18200	2.134	34900	12.9				
110	4.0	1.3	3.1	23700	15000	2.746	33100	8.6				
	6.0	2.9	6.7	23900	15400	2.674	33000	8.9				
	8.0	5.0	11.6	24000	15700	2.602	32900	9.2				

LEGEND					
Btu/h	British Termal Units per Hour	EWT	Entering Water Temperature	THA	Total Heat of Absorption
COP	Coefficient of Performance	ft of W.C.	Feet of Water Column	THR	Total Heat of Rejection
EAT	Entering Air Temperature	kW	Kilowatts	WPD	Waterside Pressure Drop
EER	Energy Efficiency Ratio	PSI	Pounds per square Inch		

ARQ – Size 048

Table 22: ARQ Size 048 (1500 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.9	4.3	50600	32000	2.504	59200	20.2	50500	3.667	38000	4.0
	6.0	4.4	10.2	50800	32100	2.420	59100	21.0	51700	3.719	39000	4.1
	8.0	8.1	18.7	51000	32200	2.336	59000	21.8	52800	3.771	39900	4.1
70	4.0	1.8	4.2	49100	31300	2.701	58300	18.2	55800	3.879	42600	4.2
	6.0	4.3	10.0	49300	31400	2.617	58200	18.8	56900	3.931	43500	4.2
	8.0	7.9	18.3	49500	31500	2.532	58100	19.5	58000	3.983	44400	4.3
80	4.0	1.8	4.2	47600	30500	2.939	57600	16.2	60400	4.078	46500	4.3
	6.0	4.2	9.8	47800	30600	2.855	57600	16.7	61500	4.129	47400	4.4
	8.0	7.8	17.9	48000	30700	2.771	57500	17.3	62600	4.181	48300	4.4
90	4.0	1.8	4.1	46100	29600	3.236	57200	14.2	64100	4.248	49600	4.4
	6.0	4.2	9.6	46300	29700	3.152	57100	14.7	65200	4.300	50500	4.4
	8.0	7.6	17.7	46500	29800	3.068	57000	15.2	66300	4.352	51400	4.5
100	4.0	1.7	4.0	44500	28700	3.605	56800	12.3	Operation Not Recommended			
	6.0	4.1	9.5	44700	28800	3.521	56700	12.7				
	8.0	7.5	17.4	44900	28900	3.437	56600	13.1				
110	4.0	1.7	4.0	42500	27800	4.061	56400	10.5				
	6.0	4.1	9.4	42700	27900	3.977	56300	10.7				
	8.0	7.5	17.2	42900	28000	3.893	56200	11.0				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 23: ARQ Size 048 (1050 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.9	4.3	36000	21400	1.495	41100	24.1	33100	2.715	23800	3.6
	6.0	4.4	10.2	36200	21500	1.411	41000	25.7	34200	2.767	24800	3.6
	8.0	8.1	18.7	36400	21500	1.327	40900	27.4	35400	2.819	25800	3.7
70	4.0	1.8	4.2	34500	20700	1.692	40300	20.4	38300	2.927	28300	3.8
	6.0	4.3	10.0	34700	20800	1.608	40200	21.6	39500	2.979	29300	3.9
	8.0	7.9	18.3	34900	20900	1.524	40100	22.9	40600	3.031	30200	3.9
80	4.0	1.8	4.2	33000	19900	1.931	39600	17.1	42900	3.125	32200	4.0
	6.0	4.2	9.8	33200	20000	1.847	39500	18.0	44100	3.177	33200	4.1
	8.0	7.8	18.0	33400	20100	1.763	39400	19.0	45200	3.229	34200	4.1
90	4.0	1.8	4.1	31500	19000	2.227	39100	14.1	46600	3.296	35300	4.1
	6.0	4.2	9.6	31600	19100	2.143	38900	14.7	47700	3.348	36300	4.2
	8.0	7.6	17.7	31800	19200	2.059	38800	15.4	48900	3.400	37300	4.2
100	4.0	1.7	4.0	29800	18100	2.596	38700	11.5	Operation Not Recommended			
	6.0	4.1	9.5	30000	18200	2.512	38600	11.9				
	8.0	7.5	17.4	30200	18300	2.428	38500	12.4				
110	4.0	1.7	4.0	27900	17200	3.053	38300	9.1				
	6.0	4.1	9.4	28100	17300	2.969	38200	9.5				
	8.0	7.5	17.2	28200	17400	2.885	38100	9.8				

Table 24: ARQ Size 048 (850 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
60	4.0	1.9	4.3	33500	19500	1.484	38600	22.6	31500	2.958	21400	3.1
	6.0	4.4	10.2	33700	19600	1.400	38500	24.1	32700	3.010	22400	3.2
	8.0	8.1	18.7	33900	19700	1.315	38400	25.8	33800	3.062	23300	3.2
70	4.0	1.8	4.2	32000	18800	1.680	37700	19.0	36800	3.170	26000	3.4
	6.0	4.3	10.0	32200	18900	1.596	37700	20.2	37900	3.222	26900	3.4
	8.0	7.9	18.3	32400	19000	1.512	37600	21.4	39000	3.274	27800	3.5
80	4.0	1.8	4.2	30500	18000	1.919	37100	15.9	41400	3.368	29900	3.6
	6.0	4.2	9.8	30700	18100	1.835	37000	16.7	42500	3.420	30800	3.6
	8.0	7.8	18.0	30900	18200	1.751	36900	17.6	43600	3.472	31700	3.7
90	4.0	1.8	4.1	29000	17200	2.215	36600	13.1	45100	3.539	33000	3.7
	6.0	4.2	9.6	29200	17200	2.131	36500	13.7	46200	3.591	33900	3.8
	8.0	7.6	17.7	29400	17300	2.047	36400	14.4	47300	3.643	34900	3.8
100	4.0	1.7	4.0	27400	16300	2.584	36200	10.6	Operation Not Recommended			
	6.0	4.1	9.5	27500	16300	2.500	36000	11.0				
	8.0	7.5	17.4	27700	16400	2.416	36000	11.5				
110	4.0	1.7	4.0	25400	15400	3.041	35800	8.4				
	6.0	4.1	9.4	25600	15400	2.957	35700	8.7				
	8.0	7.5	17.2	25800	15500	2.873	35600	9.0				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

GRQ – Size 024

Table 25: GRQ Size 024 (1000 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	0.2	0.5	Operation Not Recommended					17000	1.414	12200	3.5
	6.0	0.5	1.1						17600	1.429	12700	3.6
	8.0	0.8	1.8						18200	1.445	13300	3.7
30	4.0	0.2	0.5	24200	17200	0.964	27500	25.1	18700	1.439	13800	3.8
	6.0	0.4	1.0	24300	17300	0.906	27400	26.8	19300	1.455	14300	3.9
	8.0	0.8	1.8	24500	17400	0.848	27400	28.9	19900	1.470	14900	4.0
40	4.0	0.2	0.5	26700	19000	1.024	30200	26.1	22000	1.491	16900	4.3
	6.0	0.4	1.0	26900	19100	0.966	30200	27.9	22600	1.507	17500	4.4
	8.0	0.8	1.7	27000	19200	0.908	30100	29.7	23200	1.523	18000	4.5
50	4.0	0.2	0.5	27300	19400	1.124	31100	24.3	24900	1.544	19600	4.7
	6.0	0.4	1.0	27400	19600	1.066	31000	25.7	25500	1.559	20200	4.8
	8.0	0.7	1.7	27500	19700	1.008	30900	27.3	26100	1.575	20700	4.9
60	4.0	0.2	0.4	26900	19300	1.247	31200	21.6	27400	1.594	22000	5.0
	6.0	0.4	1.0	27000	19400	1.189	31100	22.7	28000	1.609	22500	5.1
	8.0	0.7	1.7	27100	19500	1.131	31000	24.0	28600	1.625	23100	5.2
70	4.0	0.2	0.4	26300	19000	1.383	31000	19.0	29500	1.638	23900	5.3
	6.0	0.4	0.9	26400	19100	1.325	30900	19.9	30100	1.654	24500	5.3
	8.0	0.7	1.6	26500	19200	1.267	30800	20.9	30700	1.670	25000	5.4
80	4.0	0.2	0.4	25700	18900	1.533	30900	16.8	31200	1.676	25500	5.5
	6.0	0.4	0.9	25800	19000	1.475	30800	17.5	31800	1.691	26000	5.5
	8.0	0.7	1.6	25900	19100	1.417	30700	18.3	32400	1.707	26600	5.6
90	4.0	0.2	0.4	25100	18900	1.708	30900	14.7	32400	1.703	26600	5.6
	6.0	0.4	0.9	25300	19000	1.650	30900	15.3	33000	1.719	27100	5.6
	8.0	0.7	1.6	25400	19100	1.592	30800	16.0	33600	1.735	27700	5.7
100	4.0	0.2	0.4	24200	18600	1.930	30800	12.5	Operation Not Recommended			
	6.0	0.4	0.9	24300	18700	1.872	30700	13.0				
	8.0	0.7	1.5	24500	18800	1.814	30700	13.5				
110	4.0	0.2	0.4	22200	17500	2.229	29800	10.0				
	6.0	0.4	0.9	22300	17600	2.171	29700	10.3				
	8.0	0.7	1.5	22400	17700	2.113	29600	10.6				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 26: GRQ Size 024 (750 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	0.2	0.5	Operation Not Recommended					9100	0.900	6000	3.0
	6.0	0.5	1.1						9700	0.916	6600	3.1
	8.0	0.8	1.8						10300	0.932	7100	3.2
30	4.0	0.2	0.5	17200	11900	0.454	18800	37.9	10800	0.926	7600	3.4
	6.0	0.4	1.0	17300	12000	0.396	18700	43.7	11400	0.941	8200	3.5
	8.0	0.8	1.8	17400	12100	0.338	18600	51.5	12000	0.957	8700	3.7
40	4.0	0.2	0.5	19700	13700	0.514	21500	38.3	14100	0.978	10800	4.2
	6.0	0.4	1.0	19800	13900	0.456	21400	43.4	14600	0.994	11200	4.3
	8.0	0.8	1.7	19900	14000	0.398	21300	50.0	15200	1.009	11800	4.4
50	4.0	0.2	0.5	20200	14200	0.614	22300	32.9	17000	1.030	13500	4.8
	6.0	0.4	1.0	20300	14300	0.556	22200	36.5	17600	1.046	14000	4.9
	8.0	0.7	1.7	20500	14400	0.498	22200	41.1	18200	1.062	14600	5.0
60	4.0	0.2	0.4	19800	14000	0.737	22300	26.9	19500	1.080	15800	5.3
	6.0	0.4	1.0	20000	14100	0.679	22300	29.5	20100	1.096	16400	5.4
	8.0	0.7	1.7	20100	14200	0.621	22200	32.4	20700	1.111	16900	5.5
70	4.0	0.2	0.4	19200	13700	0.873	22200	22.0	21600	1.125	17800	5.6
	6.0	0.4	0.9	19300	13800	0.815	22100	23.7	22200	1.141	18300	5.7
	8.0	0.7	1.6	19400	13900	0.757	22000	25.6	22800	1.156	18900	5.8
80	4.0	0.2	0.4	18600	13600	1.023	22100	18.2	23300	1.162	19300	5.9
	6.0	0.4	0.9	18800	13700	0.965	22100	19.5	23900	1.178	19900	5.9
	8.0	0.7	1.6	18900	13800	0.907	22000	20.8	24500	1.194	20400	6.0
90	4.0	0.2	0.4	18100	13600	1.198	22200	15.1	24500	1.190	20400	6.0
	6.0	0.4	0.9	18200	13700	1.140	22100	16.0	25100	1.206	21000	6.1
	8.0	0.7	1.6	18300	13800	1.082	22000	16.9	25600	1.221	21400	6.1
100	4.0	0.2	0.4	17200	13300	1.420	22000	12.1	Operation Not Recommended			
	6.0	0.4	0.9	17300	13400	1.362	22000	12.7				
	8.0	0.7	1.5	17400	13600	1.304	21900	13.3				
110	4.0	0.2	0.4	15100	12300	1.719	21000	8.8				
	6.0	0.4	0.9	15200	12400	1.661	20900	9.1				
	8.0	0.7	1.5	15400	12500	1.604	20900	9.6				

LEGEND					
Btu/h	British Termal Units per Hour	EWT	Entering Water Temperature	THA	Total Heat of Absorption
COP	Coefficient of Performance	ft of W.C.	Feet of Water Column	THR	Total Heat of Rejection
EAT	Entering Air Temperature	kW	Kilowatts	WPD	Waterside Pressure Drop
EER	Energy Efficiency Ratio	PSI	Pounds per square Inch		

Table 27: GRQ Size 024 (650 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	0.2	0.5	Operation Not Recommended					8600	0.965	5300	2.6
	6.0	0.5	1.1						9200	0.980	5900	2.8
	8.0	0.8	1.8						9800	0.996	6400	2.9
30	4.0	0.2	0.5	16700	11600	0.433	18200	38.5	10900	1.006	7500	3.2
	6.0	0.4	1.0	16800	11700	0.376	18100	44.7	11500	1.022	8000	3.3
	8.0	0.8	1.8	17000	11800	0.318	18100	53.5	13500	1.042	9900	3.8
40	4.0	0.2	0.5	19200	13400	0.493	20900	38.9	14100	1.058	10500	3.9
	6.0	0.4	1.0	19400	13500	0.435	20900	44.6	14700	1.074	11000	4.0
	8.0	0.8	1.7	19500	13600	0.377	20800	51.7	16500	1.095	12800	4.4
50	4.0	0.2	0.5	19800	13800	0.594	21800	33.3	17000	1.110	13200	4.5
	6.0	0.4	1.0	19900	13900	0.536	21700	37.1	17600	1.126	13800	4.6
	8.0	0.7	1.7	20000	14000	0.478	21600	41.8	19000	1.145	15100	4.9
60	4.0	0.2	0.4	19400	13700	0.716	21800	27.1	19600	1.160	15600	5.0
	6.0	0.4	1.0	19500	13800	0.659	21700	29.6	20200	1.176	16200	5.0
	8.0	0.7	1.7	19600	13900	0.601	21700	32.6	21100	1.189	17000	5.2
70	4.0	0.2	0.4	18800	13400	0.852	21700	22.1	21700	1.205	17600	5.3
	6.0	0.4	0.9	18900	13500	0.794	21600	23.8	22300	1.221	18100	5.4
	8.0	0.7	1.6	19000	13600	0.736	21500	25.8	22800	1.227	18600	5.4
80	4.0	0.2	0.4	18200	13300	1.002	21600	18.2	23400	1.243	19200	5.5
	6.0	0.4	0.9	18300	13400	0.944	21500	19.4	24000	1.258	19700	5.6
	8.0	0.7	1.6	18400	13500	0.886	21400	20.8	23900	1.254	19600	5.6
90	4.0	0.2	0.4	17600	13300	1.178	21600	14.9	24500	1.270	20200	5.7
	6.0	0.4	0.9	17800	13400	1.120	21600	15.9	25100	1.286	20700	5.7
	8.0	0.7	1.6	17900	13500	1.062	21500	16.9	10900	1.006	7500	3.2
100	4.0	0.2	0.4	16700	13000	1.399	21500	11.9	Operation Not Recommended			
	6.0	0.4	0.9	16900	13100	1.342	21500	12.6				
	8.0	0.7	1.5	17000	13200	1.284	21400	13.2				
110	4.0	0.2	0.4	14700	11900	1.699	20500	8.7				
	6.0	0.4	0.9	14800	12000	1.641	20400	9.0				
	8.0	0.7	1.5	14900	12100	1.583	20300	9.4				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

GRQ – Size 040

Table 28: GRQ Size 040 (1250 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	1.6	3.7	Operation Not Recommended					27700	2.568	18900	3.2
	6.0	3.5	8.0						28500	2.607	19600	3.2
	8.0	6.0	13.9						29200	2.645	20200	3.2
30	4.0	1.6	3.7	43200	27400	1.573	48600	27.5	30000	2.649	21000	3.3
	6.0	3.4	7.9	43300	27800	1.501	48400	28.8	30800	2.687	21600	3.4
	8.0	5.9	13.7	43500	28100	1.429	48400	30.4	31500	2.726	22200	3.4
40	4.0	1.5	3.6	45900	28800	1.705	51700	26.9	34800	2.806	25200	3.6
	6.0	3.3	7.7	46100	29100	1.633	51700	28.2	35500	2.844	25800	3.7
	8.0	5.7	13.3	46200	29400	1.561	51500	29.6	36200	2.883	26400	3.7
50	4.0	1.5	3.5	45800	28700	1.884	52200	24.3	39400	2.954	29300	3.9
	6.0	3.2	7.5	46000	29100	1.812	52200	25.4	40100	2.992	29900	3.9
	8.0	5.6	12.9	46200	29400	1.740	52100	26.5	40900	3.030	30600	4.0
60	4.0	1.5	3.4	44600	28200	2.085	51700	21.4	43600	3.090	33000	4.1
	6.0	3.2	7.3	44800	28500	2.013	51700	22.3	44400	3.128	33700	4.2
	8.0	5.5	12.6	45000	28800	1.941	51600	23.2	45100	3.166	34300	4.2
70	4.0	1.4	3.3	43300	27600	2.297	51100	18.9	47100	3.211	36100	4.3
	6.0	3.1	7.1	43400	27900	2.225	51000	19.5	47800	3.249	36700	4.3
	8.0	5.3	12.3	43600	28300	2.153	51000	20.3	48600	3.288	37400	4.3
80	4.0	1.4	3.2	42200	27200	2.525	50800	16.7	49500	3.315	38200	4.4
	6.0	3.0	7.0	42300	27600	2.453	50700	17.2	50300	3.353	38800	4.4
	8.0	5.2	12.1	42500	27900	2.381	50600	17.9	51000	3.391	39400	4.4
90	4.0	1.4	3.2	41200	26900	2.790	50700	14.8	50500	3.397	38900	4.4
	6.0	3.0	6.9	41400	27200	2.718	50700	15.2	51200	3.436	39500	4.4
	8.0	5.2	11.9	41500	27500	2.646	50500	15.7	52000	3.474	40100	4.4
100	4.0	1.4	3.2	39600	25900	3.131	50300	12.6	Operation Not Recommended			
	6.0	2.9	6.8	39800	26200	3.059	50200	13.0				
	8.0	5.1	11.8	40000	26500	2.987	50200	13.4				
110	4.0	1.3	3.1	36100	23400	3.599	48400	10.0				
	6.0	2.9	6.7	36300	23700	3.527	48300	10.3				
	8.0	5.0	11.6	36400	24100	3.455	48200	10.5				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 29: GRQ Size 040 (1000 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	1.6	3.7	Operation Not Recommended					15400	1.525	10200	3.0
	6.0	3.5	8.0						16100	1.563	10800	3.0
	8.0	6.0	13.9						16900	1.602	11400	3.1
30	4.0	1.6	3.7	32500	20200	0.753	35100	43.2	17700	1.606	12200	3.2
	6.0	3.4	7.9	32700	20500	0.681	35000	48.0	18400	1.644	12800	3.3
	8.0	5.9	13.7	32900	20800	0.609	35000	54.0	19100	1.682	13400	3.3
40	4.0	1.5	3.6	35300	21500	0.885	38300	39.9	22400	1.763	16400	3.7
	6.0	3.3	7.7	35400	21900	0.813	38200	43.5	23100	1.801	16900	3.8
	8.0	5.7	13.3	35600	22200	0.741	38100	48.0	23900	1.839	17600	3.8
50	4.0	1.5	3.5	35200	21500	1.064	38800	33.1	27100	1.910	20600	4.2
	6.0	3.2	7.5	35400	21800	0.992	38800	35.7	27800	1.949	21100	4.2
	8.0	5.6	12.9	35600	22100	0.920	38700	38.7	28500	1.987	21700	4.2
60	4.0	1.5	3.4	34000	20900	1.265	38300	26.9	31300	2.047	24300	4.5
	6.0	3.2	7.3	34200	21200	1.193	38300	28.7	32000	2.085	24900	4.5
	8.0	5.5	12.6	34400	21500	1.121	38200	30.7	32700	2.123	25400	4.5
70	4.0	1.4	3.3	32600	20300	1.476	37600	22.1	34800	2.168	27400	4.7
	6.0	3.1	7.1	32800	20700	1.405	37600	23.4	35500	2.206	28000	4.7
	8.0	5.3	12.3	33000	21000	1.333	37600	24.8	36200	2.244	28500	4.7
80	4.0	1.4	3.2	31600	20000	1.704	37400	18.5	37200	2.271	29400	4.8
	6.0	3.0	7.0	31700	20300	1.633	37300	19.4	37900	2.310	30000	4.8
	8.0	5.2	12.1	31900	20600	1.561	37200	20.4	38600	2.348	30600	4.8
90	4.0	1.4	3.2	30600	19600	1.970	37300	15.5	38200	2.354	30200	4.8
	6.0	3.0	6.9	30800	19900	1.898	37300	16.2	38900	2.392	30700	4.8
	8.0	5.2	11.9	30900	20200	1.826	37100	16.9	39600	2.431	31300	4.8
100	4.0	1.4	3.2	29000	18600	2.311	36900	12.6	Operation Not Recommended			
	6.0	2.9	6.8	29200	19000	2.239	36800	13.0				
	8.0	5.1	11.8	29400	19300	2.167	36800	13.6				
110	4.0	1.3	3.1	25500	16200	2.779	35000	9.2				
	6.0	2.9	6.7	25700	16500	2.707	34900	9.5				
	8.0	5.0	11.6	25800	16800	2.635	34800	9.8				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 30: GRQ Size 040 (800 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	1.6	3.7	Operation Not Recommended					13400	1.712	7600	2.3
	6.0	3.5	8.0						14100	1.751	8100	2.4
	8.0	6.0	13.9						14800	1.789	8700	2.4
30	4.0	1.6	3.7	30800	19000	0.720	33300	42.8	15700	1.793	9600	2.6
	6.0	3.4	7.9	30900	19400	0.648	33100	47.7	16400	1.831	10100	2.6
	8.0	5.9	13.7	31100	19700	0.576	33100	54.0	17100	1.870	10700	2.7
40	4.0	1.5	3.6	33500	20400	0.852	36400	39.3	20400	1.950	13700	3.1
	6.0	3.3	7.7	33700	20700	0.780	36400	43.2	21100	1.988	14300	3.1
	8.0	5.7	13.3	33800	21100	0.708	36200	47.7	21800	2.027	14900	3.2
50	4.0	1.5	3.5	33400	20300	1.031	36900	32.4	25000	2.098	17800	3.5
	6.0	3.2	7.5	33600	20700	0.959	36900	35.0	25800	2.136	18500	3.5
	8.0	5.6	12.9	33800	21000	0.887	36800	38.1	26500	2.174	19100	3.6
60	4.0	1.5	3.4	32200	19800	1.232	36400	26.1	29300	2.234	21700	3.8
	6.0	3.2	7.3	32400	20100	1.160	36400	27.9	30000	2.272	22200	3.9
	8.0	5.5	12.6	32600	20400	1.088	36300	30.0	30700	2.310	22800	3.9
70	4.0	1.4	3.3	30900	19200	1.443	35800	21.4	32700	2.355	24700	4.1
	6.0	3.1	7.1	31000	19500	1.371	35700	22.6	33500	2.393	25300	4.1
	8.0	5.3	12.3	31200	19900	1.300	35600	24.0	34200	2.432	25900	4.1
80	4.0	1.4	3.2	29800	18800	1.671	35500	17.8	35200	2.459	26800	4.2
	6.0	3.0	7.0	29900	19200	1.599	35400	18.7	35900	2.497	27400	4.2
	8.0	5.2	12.1	30100	19500	1.528	35300	19.7	36600	2.535	27900	4.2
90	4.0	1.4	3.2	28800	18500	1.937	35400	14.9	36100	2.541	27400	4.2
	6.0	3.0	6.9	29000	18800	1.865	35400	15.5	36900	2.580	28100	4.2
	8.0	5.2	11.9	29200	19100	1.793	35300	16.3	37600	2.618	28700	4.2
100	4.0	1.4	3.2	27200	17500	2.278	35000	11.9	Operation Not Recommended			
	6.0	2.9	6.8	27400	17800	2.206	34900	12.4				
	8.0	5.1	11.8	27600	18200	2.134	34900	12.9				
110	4.0	1.3	3.1	23700	15000	2.746	33100	8.6				
	6.0	2.9	6.7	23900	15400	2.674	33000	8.9				
	8.0	5.0	11.6	24000	15700	2.602	32900	9.2				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

GRQ – Size 048

Table 31: GRQ Size 048 (1500 SCFM) – 2nd Stage High Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	2.1	4.8	Operation Not Recommended					31600	3.013	21300	3.1
	6.0	4.9	11.2						32700	3.065	22200	3.1
	8.0	8.9	20.6						33800	3.117	23200	3.2
30	4.0	2.0	4.7	53500	33000	2.019	60400	26.5	34000	3.084	23500	3.2
	6.0	4.8	11.0	53700	33000	1.935	60300	27.8	35200	3.136	24500	3.3
	8.0	8.8	20.3	53900	33100	1.851	60200	29.1	36300	3.188	25400	3.3
40	4.0	2.0	4.5	53100	32900	2.178	60500	24.4	39400	3.256	28300	3.5
	6.0	4.6	10.7	53300	32900	2.094	60500	25.4	40500	3.308	29200	3.6
	8.0	8.5	19.7	53500	33000	2.010	60400	26.6	41600	3.360	30100	3.6
50	4.0	1.9	4.4	52000	32500	2.335	60000	22.3	45000	3.455	33200	3.8
	6.0	4.5	10.4	52200	32600	2.251	59900	23.2	46100	3.507	34100	3.9
	8.0	8.3	19.1	52400	32700	2.167	59800	24.2	47200	3.559	35000	3.9
60	4.0	1.9	4.3	50600	32000	2.504	59200	20.2	50500	3.667	38000	4.0
	6.0	4.4	10.2	50800	32100	2.420	59100	21.0	51700	3.719	39000	4.1
	8.0	8.1	18.7	51000	32200	2.336	59000	21.8	52800	3.771	39900	4.1
70	4.0	1.8	4.2	49100	31300	2.701	58300	18.2	55800	3.879	42600	4.2
	6.0	4.3	10.0	49300	31400	2.617	58200	18.8	56900	3.931	43500	4.2
	8.0	7.9	18.3	49500	31500	2.532	58100	19.5	58000	3.983	44400	4.3
80	4.0	1.8	4.2	47600	30500	2.939	57600	16.2	60400	4.078	46500	4.3
	6.0	4.2	9.8	47800	30600	2.855	57600	16.7	61500	4.129	47400	4.4
	8.0	7.8	17.9	48000	30700	2.771	57500	17.3	62600	4.181	48300	4.4
90	4.0	1.8	4.1	46100	29600	3.236	57200	14.2	64100	4.248	49600	4.4
	6.0	4.2	9.6	46300	29700	3.152	57100	14.7	65200	4.300	50500	4.4
	8.0	7.6	17.7	46500	29800	3.068	57000	15.2	66300	4.352	51400	4.5
100	4.0	1.7	4.0	44500	28700	3.605	56800	12.3	Operation Not Recommended			
	6.0	4.1	9.5	44700	28800	3.521	56700	12.7				
	8.0	7.5	17.4	44900	28900	3.437	56600	13.1				
110	4.0	1.7	4.0	42500	27800	4.061	56400	10.5				
	6.0	4.1	9.4	42700	27900	3.977	56300	10.7				
	8.0	7.5	17.2	42900	28000	3.893	56200	11.0				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 32: GRQ Size 048 (1050 SCFM) – 1st Stage Medium Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	2.1	4.8	Operation Not Recommended					14100	2.061	7100	2.0
	6.0	4.9	11.2						15200	2.112	8000	2.1
	8.0	8.9	20.6						16400	2.164	9000	2.2
30	4.0	2.0	4.7	38900	22300	1.010	42400	38.5	16600	2.132	9300	2.3
	6.0	4.8	11.0	39100	22400	0.926	42300	42.2	17700	2.184	10200	2.4
	8.0	8.8	20.3	39300	22500	0.842	42200	46.7	18800	2.236	11200	2.5
40	4.0	2.0	4.5	38500	22200	1.170	42500	32.9	21900	2.304	14000	2.8
	6.0	4.6	10.7	38600	22300	1.086	42300	35.6	23100	2.356	15100	2.9
	8.0	8.5	19.7	38800	22400	1.002	42200	38.7	24200	2.408	16000	2.9
50	4.0	1.9	4.4	37400	21900	1.326	41900	28.2	27500	2.503	19000	3.2
	6.0	4.5	10.4	37600	22000	1.242	41800	30.3	28700	2.555	20000	3.3
	8.0	8.3	19.1	37800	22100	1.158	41800	32.6	29800	2.607	20900	3.4
60	4.0	1.9	4.3	36000	21400	1.495	41100	24.1	33100	2.715	23800	3.6
	6.0	4.4	10.2	36200	21500	1.411	41000	25.7	34200	2.767	24800	3.6
	8.0	8.1	18.7	36400	21500	1.327	40900	27.4	35400	2.819	25800	3.7
70	4.0	1.8	4.2	34500	20700	1.692	40300	20.4	38300	2.927	28300	3.8
	6.0	4.3	10.0	34700	20800	1.608	40200	21.6	39500	2.979	29300	3.9
	8.0	7.9	18.3	34900	20900	1.524	40100	22.9	40600	3.031	30200	3.9
80	4.0	1.8	4.2	33000	19900	1.931	39600	17.1	42900	3.125	32200	4.0
	6.0	4.2	9.8	33200	20000	1.847	39500	18.0	44100	3.177	33200	4.1
	8.0	7.8	17.9	33400	20100	1.763	39400	19.0	45200	3.229	34200	4.1
90	4.0	1.8	4.1	31500	19000	2.227	39100	14.1	46600	3.296	35300	4.1
	6.0	4.2	9.6	31600	19100	2.143	38900	14.7	47700	3.348	36300	4.2
	8.0	7.6	17.7	31800	19200	2.059	38800	15.4	48900	3.400	37300	4.2
100	4.0	1.7	4.0	29800	18100	2.596	38700	11.5	Operation Not Recommended			
	6.0	4.1	9.5	30000	18200	2.512	38600	11.9				
	8.0	7.5	17.4	30200	18300	2.428	38500	12.4				
110	4.0	1.7	4.0	27900	17200	3.053	38300	9.1				
	6.0	4.1	9.4	28100	17300	2.969	38200	9.5				
	8.0	7.5	17.2	28200	17400	2.885	38100	9.8				

LEGEND					
Btu/h	British Termal Units per Hour	**EWT**	Entering Water Temperature	**THA**	Total Heat of Absorption
COP	Coefficient of Performance	**ft of W.C.**	Feet of Water Column	**THR**	Total Heat of Rejection
EAT	Entering Air Temperature	**kW**	Kilowatts	**WPD**	Waterside Pressure Drop
EER	Energy Efficiency Ratio	**PSI**	Pounds per square Inch		

Table 33: GRQ Size 048 (850 SCFM) – 1st Stage Low Fan

EWT (°F)	GPM	WPD		Cooling - EAT 80/67° F					Heating - EAT 70° F			
		PSI	ft of W.C.	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	THR (Btu/h)	EER	Total (Btu/h)	Power Input (kW)	THA (Btu/h)	COP
25	4.0	2.1	4.8	Operation Not Recommended					12500	2.304	4600	1.6
	6.0	4.9	11.2						13700	2.356	5700	1.7
	8.0	8.9	20.6						14800	2.407	6600	1.8
30	4.0	2.0	4.7	36400	20500	0.999	39800	36.5	15000	2.375	6900	1.9
	6.0	4.8	11.0	36600	20600	0.915	39700	40.0	16200	2.427	7900	2.0
	8.0	8.8	20.3	36800	20600	0.830	39600	44.3	17300	2.479	8800	2.0
40	4.0	2.0	4.5	36000	20400	1.158	40000	31.1	20400	2.547	11700	2.3
	6.0	4.6	10.7	36200	20500	1.074	39900	33.7	21500	2.599	12600	2.4
	8.0	8.5	19.7	36400	20500	0.990	39800	36.8	22600	2.651	13500	2.5
50	4.0	1.9	4.4	34900	20000	1.315	39400	26.5	26000	2.746	16600	2.8
	6.0	4.5	10.4	35100	20100	1.231	39300	28.5	27100	2.798	17500	2.8
	8.0	8.3	19.1	35300	20200	1.146	39200	30.8	28200	2.850	18500	2.9
60	4.0	1.9	4.3	33500	19500	1.484	38600	22.6	31500	2.958	21400	3.1
	6.0	4.4	10.2	33700	19600	1.400	38500	24.1	32700	3.010	22400	3.2
	8.0	8.1	18.7	33900	19700	1.315	38400	25.8	33800	3.062	23300	3.2
70	4.0	1.8	4.2	32000	18800	1.680	37700	19.0	36800	3.170	26000	3.4
	6.0	4.3	10.0	32200	18900	1.596	37700	20.2	37900	3.222	26900	3.4
	8.0	7.9	18.3	32400	19000	1.512	37600	21.4	39000	3.274	27800	3.5
80	4.0	1.8	4.2	30500	18000	1.919	37100	15.9	41400	3.368	29900	3.6
	6.0	4.2	9.8	30700	18100	1.835	37000	16.7	42500	3.420	30800	3.6
	8.0	7.8	17.9	30900	18200	1.751	36900	17.6	43600	3.472	31700	3.7
90	4.0	1.8	4.1	29000	17200	2.215	36600	13.1	45100	3.539	33000	3.7
	6.0	4.2	9.6	29200	17200	2.131	36500	13.7	46200	3.591	33900	3.8
	8.0	7.6	17.7	29400	17300	2.047	36400	14.4	47300	3.643	34900	3.8
100	4.0	1.7	4.0	27400	16300	2.584	36200	10.6	Operation Not Recommended			
	6.0	4.1	9.5	27500	16300	2.500	36000	11.0				
	8.0	7.5	17.4	27700	16400	2.416	36000	11.5				
110	4.0	1.7	4.0	25400	15400	3.041	35800	8.4				
	6.0	4.1	9.4	25600	15400	2.957	35700	8.7				
	8.0	7.5	17.2	25800	15500	2.873	35600	9.0				

LEGEND					
Btu/h	British Termal Units per Hour	EWT	Entering Water Temperature	THA	Total Heat of Absorption
COP	Coefficient of Performance	ft of W.C.	Feet of Water Column	THR	Total Heat of Rejection
EAT	Entering Air Temperature	kW	Kilowatts	WPD	Waterside Pressure Drop
EER	Energy Efficiency Ratio	PSI	Pounds per square Inch		

Electrical Data

Table 34: ARQ & GRQ – Size 024

Volt/Hz/Phase	Voltage Range		Indoor Fan FLA	Compressor		Heating Option				Power Supply	
	Min.	Max.		RLA	LRA	Heat Type		Heater kW	Rated Heater Amps	MCA	Maximum Fuse
208/60/1	197	228	3.2	11.1	67.5	None		–	–	18.18	25
			3.2	11.1	67.5	Elec. Heat[1]	Low (3 elem.)	8.0	38.5	66.30	70
			3.2	11.1	67.5		High (6 elem.)	16.0	76.9	114.30	125
230/60/1	207	253	3.2	11.1	67.5	None		–	–	18.18	25
			3.2	11.1	67.5	Elec. Heat[1]	Low (3 elem.)	7.3	33.3	59.80	60
			3.2	11.1	67.5		High (6 elem.)	14.7	66.7	101.55	110
208/60/3	197	228	3.2	7.8	28.0	None		–	–	14.05	20
			3.2	7.8	28.0	Elec. Heat[1]	Low (3 elem.)	8.0	22.2	41.80	45
			3.2	7.8	28.0		High (6 elem.)	16.0	44.4	69.55	70
230/60/3	207	257	3.2	7.8	28.0	None		–	–	14.05	20
			3.2	7.8	28.0	Elec. Heat[1]	Low (3 elem.)	7.3	19.2	38.05	40
			3.2	7.8	28.0		High (6 elem.)	14.7	38.5	62.18	70
460/60/3	414	506	3.2	4.3	29.0	None		–	–	10.21	15
			3.2	4.3	29.0	Elec. Heat[1]	Low (3 elem.)	7.3	9.6	22.21	25
			3.2	4.3	29.0		High (6 elem.)	14.7	19.2	34.21	35

[1] Electric Heat Options are without Compressor and Outdoor Fan.

Legend			
FLA	Full Load Amps	**LRA**	Locked Rotor Amps
RLA	Rated Load Amps	**MCA**	Minimum Circuit Amps

Table 35: ARQ & GRQ – Size 040

Volt/Hz/Phase	Voltage Range		Indoor Fan FLA	Compressor		Heating Option				Power Supply	
	Min.	Max.		RLA	LRA	Heat Type		Heater kW	Rated Heater Amps	MCA	Maximum Fuse
208/60/1	197	228	3.2	20.5	126.0	None		–	–	29.93	50
			3.2	20.5	126.0	Elec. Heat[1]	Low (3 elem.)	10.0	48.1	90.05	100
			3.2	20.5	126.0		High (6 elem.)	20.0	96.2	150.18	175
230/60/1	207	253	3.2	20.5	126.0	None		–	–	29.93	50
			3.2	20.5	126.0	Elec. Heat[1]	Low (3 elem.)	9.2	41.7	82.05	90
			3.2	20.5	126.0		High (6 elem.)	18.4	83.3	134.05	150
208/60/3	197	228	3.2	10.2	82.0	None		–	–	17.05	25
			3.2	10.2	82.0	Elec. Heat[1]	Low (3 elem.)	10.0	27.8	51.80	60
			3.2	10.2	82.0		High (6 elem.)	20.0	55.5	86.43	90
230/60/3	207	257	3.2	10.2	82.0	None		–	–	17.05	25
			3.2	10.2	82.0	Elec. Heat[1]	Low (3 elem.)	9.2	24.1	47.18	50
			3.2	10.2	82.0		High (6 elem.)	18.4	48.1	77.18	80
460/60/3	414	506	3.2	4.6	56.0	None		–	–	10.58	15
			3.2	4.6	56.0	Elec. Heat[1]	Low (3 elem.)	9.2	12.0	25.58	30
			3.2	4.6	56.0		High (6 elem.)	18.4	24.1	40.71	45

[1] Electric Heat Options are without Compressor and Outdoor Fan.

Legend			
FLA	Full Load Amps	**LRA**	Locked Rotor Amps
RLA	Rated Load Amps	**MCA**	Minimum Circuit Amps

Table 36: ARQ & GRQ – Size 048

Volt/Hz/Phase	Voltage Range		Indoor Fan FLA	Compressor		Heating Option				Power Supply	
	Min.	Max.		RLA	LRA	Heat Type		Heater kW	Rated Heater Amps	MCA	Maximum Fuse
208/60/1	197	228	3.2	25.9	128.4	None		–	–	36.68	60
			3.2	25.9	128.4	Elec. Heat[1]	Low (3 elem.)	12.0	57.7	108.80	110
			3.2	25.9	128.4		High (6 elem.)	24.0	115.4	180.93	200
230/60/1	207	253	3.2	25.9	128.4	None		–	–	36.68	60
			3.2	25.9	128.4	Elec. Heat[1]	Low (3 elem.)	11.0	50.0	99.18	110
			3.2	25.9	128.4		High (6 elem.)	22.0	100.0	161.68	175
208/60/3	197	228	3.2	13.4	105.3	None		–	–	21.05	30
			3.2	13.4	105.3	Elec. Heat[1]	Low (3 elem.)	12.0	33.3	62.68	70
			3.2	13.4	105.3		High (6 elem.)	24.0	66.6	104.30	110
230/60/3	207	257	3.2	13.4	105.3	None		–	–	21.05	30
			3.2	13.4	105.3	Elec. Heat[1]	Low (3 elem.)	11.0	28.9	57.18	60
			3.2	13.4	105.3		High (6 elem.)	22.0	57.7	93.18	100
460/60/3	414	506	3.2	6.9	61.8	None		–	–	13.46	20
			3.2	6.9	61.8	Elec. Heat[1]	Low (3 elem.)	11.0	14.4	31.46	35
			3.2	6.9	61.8		High (6 elem.)	22.0	28.9	49.58	50

[1] Electric Heat Options are without Compressor and Outdoor Fan.

Legend			
FLA	Full Load Amps	**LRA**	Locked Rotor Amps
RLA	Rated Load Amps	**MCA**	Minimum Circuit Amps

Wiring Diagrams

Typical Electromechanical Wiring Diagrams

Figure 1: Typical Electromechanical Wiring Diagram - Thermostat Control with Normally Open Heat, 460V/60Hz/3Ph

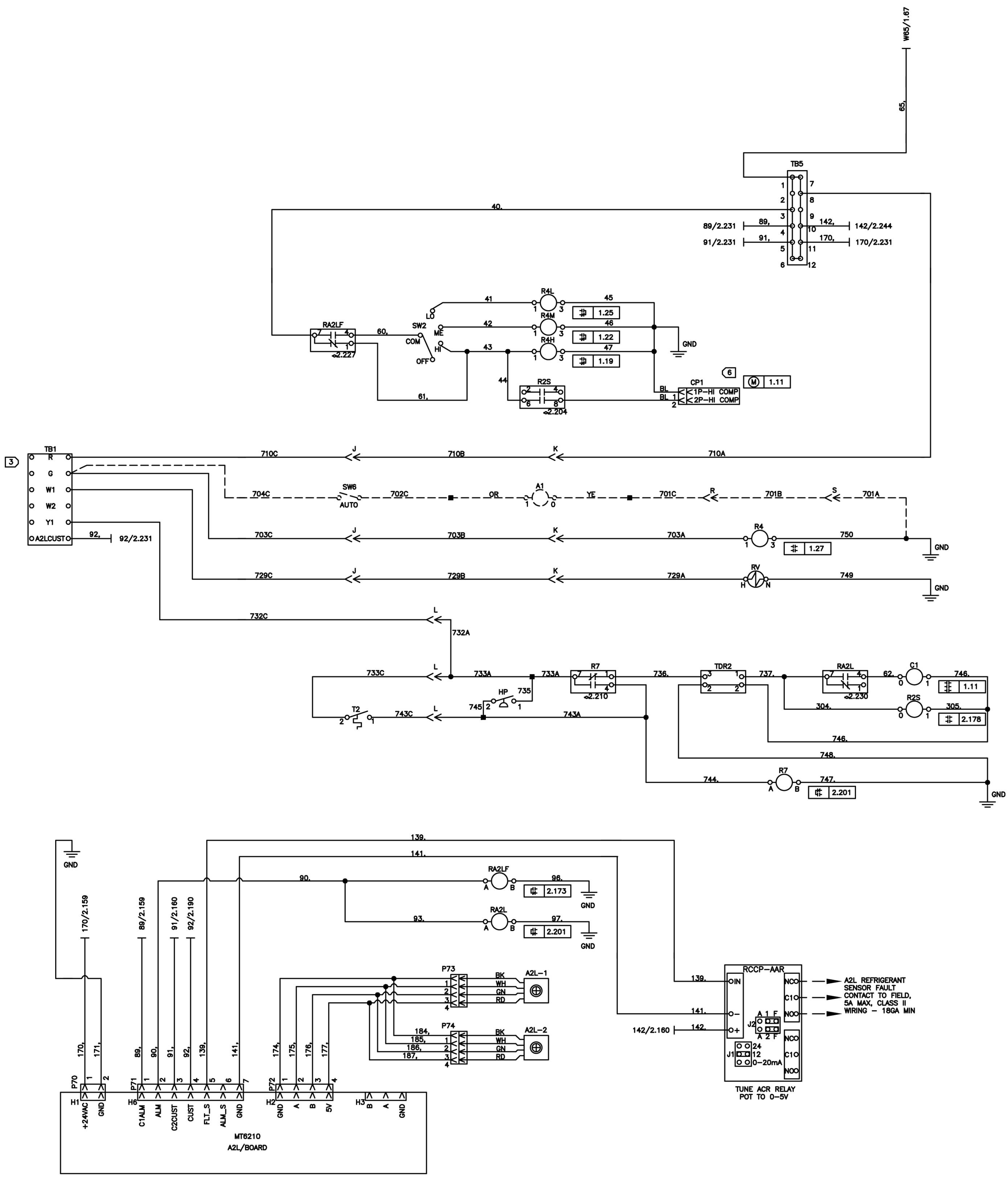
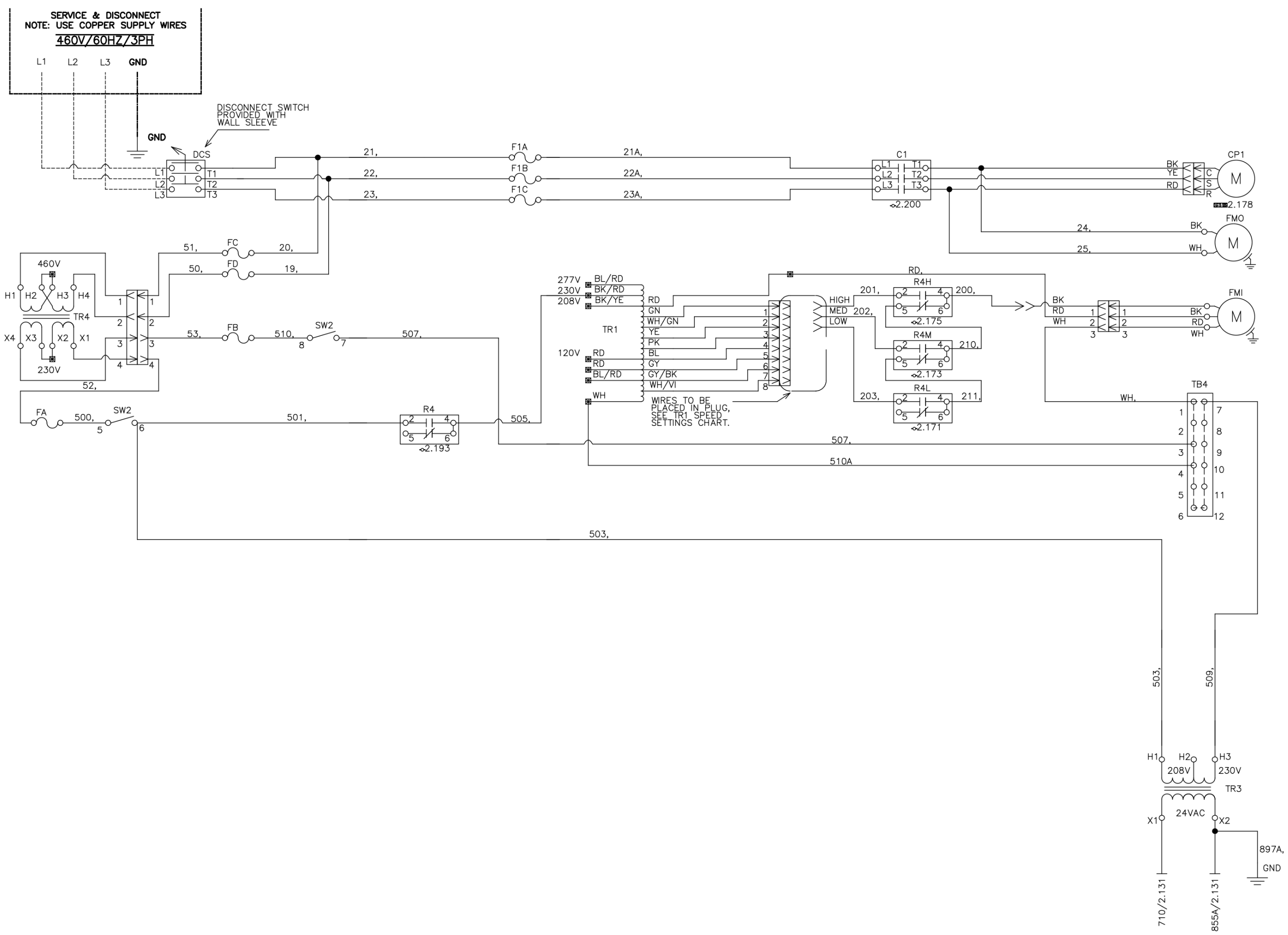


Figure 2: Typical Electromechanical Wiring Diagram - Thermostat Control with Normally Open Heat, 460V/60Hz/3Ph



Electric Heat Sequence:

NOTE 1: Backup relays R1, R2, and R3 are energized when power is applied.

NOTE 2: Main relays R10, R11, and R12 are energized when a 24 VAC source is connected to STG1, STG2, and STG3 on terminal strip.

NOTE 3: Electric heat can be staged by applying the 24 VAC to the stages (1, 2, and 3) at different time intervals.

Control Wiring Notes:

NOTE 1: All electrical installation must be in accordance with national and local electrical codes and job wiring schematic.

NOTE 2: Automatic temperature control supplier is responsible to ensure controls operate correctly and protect the unit.

NOTE 3: Numbers along the right of schematic designate the location of contacts by number.

NOTE 4: SW2 contacts 5, 6, and 7, 8 open only when SW2 is in off position.

NOTE 5: SW20 shown with face & bypass damper in full face position.

NOTE 6: 1K thermistor is positive temperature coefficient. 10K thermistor is negative temperature coefficient.

NOTE 7: Actuator 24 VAC for 2 to 10 VDC Control input. For 4 to 10 mA input control signal, add a 500 ohm resistor across WHT and BLK. Output signal of 2 to 10 VDC for position feedback.

NOTE 8: OH2 furnished on ceiling units only. Wire 514 connects to OH1 when OH2 is not furnished.

NOTE 9: Air flow switch (AF) used only on size 8000 units. Wire 583 connects to SW20 when AF is not furnished.

NOTE 10: Devices in legend may or may not be on unit.

Wiring Schematics Legend for "Typical Electromechanical Wiring Diagrams"

Legend					
A1	Actuator (Optional)	**OHM**	E.H. Man Reset - Overheat Stat	**SW1**	Switch - Disconnect
A2L-1	A2L Sensor	**R1-R3**	Relay Electric Heat (Backup)	**SW2**	Switch - On-Off & Fan Speed
A2LB	A2L Mitigation Board	**R4**	Relay - Fan Coil (24 VAC)	**SW5**	Switch - Emergency Heat
C1	Compressor Contactor	**R7**	Relay - Compressor Lockout	**SW6**	Switch - Rocker SPDT
CAP1	Capacitor Run	**R8-9**	Relay - Emergency Heat	**T2**	Thermostat EH Relay - 0A Temp>20°
CEH1-3	Electric Heat Contactor	**R10-R12**	Relay – Electric Heat	**T4**	Thermostat Low Temp 28°
CP1	Motor Compressor 2-Stage	**R2S**	Relay - High (2nd) Stage Compr	**T5**	Thermostat Defrost
CO2	Sensor - Indoor Air CO2	**R3B**	Relay - Defrost/EH Coil (24 VAC)	**T6**	Thermostat - Freeze Stat
CS	Current Sensor (Hawkeye 800)	**R4L**	Relay– Fan Low Speed	**T7**	Thermostat Changeover 60°
DCS	Switch - Unit Power	**R4M**	Relay– Fan Medium Speed	**T8**	Thermostat - Cooling Lockout 59° F
DF	Dead Front Switch	**R4H**	Relay – Fan High Speed	**TB1**	Terminal Block - 24VAC+
EH1-6	Heater - Electric	**R11A**	Relay - Defrost	**TB4**	Terminal Board
EH10	Heater - Outdoor Drain Pan	**RA1**	Relay - Actuator/Valve	**TB-DE**	Terminal Board for DE Contactor
F1A/F1B	Fuse - Compressor	**RA2L**	Relay A2L	**TBE**	Terminal Block - Electric Heat
F2A/F3C	Fuse - Electric Heat	**RAT**	Sensor - Room Air Temperature	**TR1**	Transformer - Motor Speed
FA/FB	Fuse– Control, Load	**RCCP**	Transducer AAR	**TR3**	Transformer - 208 / 230 V-24 V, 75 VA
FC/FD	Fuse– Control, Transformer	**REH**	Relay - H1 Fan 3rd Stg EH	**TR4**	Transformer - 460 V–230 V
FMI	Motor - Room Fan	**RT4**	Relay 24 VAC	**TR5**	Transformer - 208 / 230 V-24 V
FMO	Motor Outdoor Air	**RT6**	Relay - Freeze Stat	**TS**	Terminal Strip for EH
OH1	Thermostat - Overheat	**RV**	Reversing Valve	**V1**	Valve - Heat EOC (Accessory)
OH2	Thermostat - Overheat	**S2**	Sensor - DA (TAC 01-2085-001)	**V2**	Valve - Cool EOC (Accessory)

Legend - Symbols	
– – –	Accessory or field mounted component
⏚	Ground
⊠	Wire nut / splice
●	Overlap point - common potential wires
L1/1.20	Wire link (wire link ID / page # . line #)

Motor Size	SW2 Term	TR1 Speed Settings			
		750	**1000**	**1250**	**1500**
1/4 HP .00-0.20 ESP	**High**	PK	YE	WH/GN	GN
	Med	GY	GY	PK	YE
	Low	GY/BK	GY/BK	GY	PK

Figure 3: Electromechanical Controls – A2L Leak Mitigation

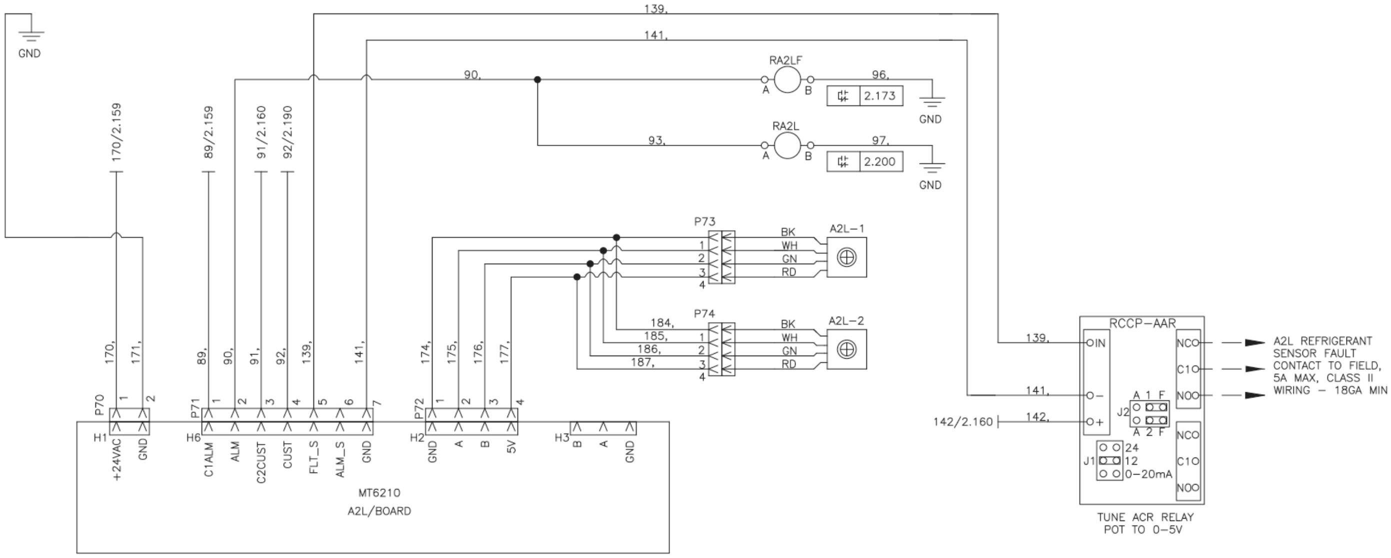
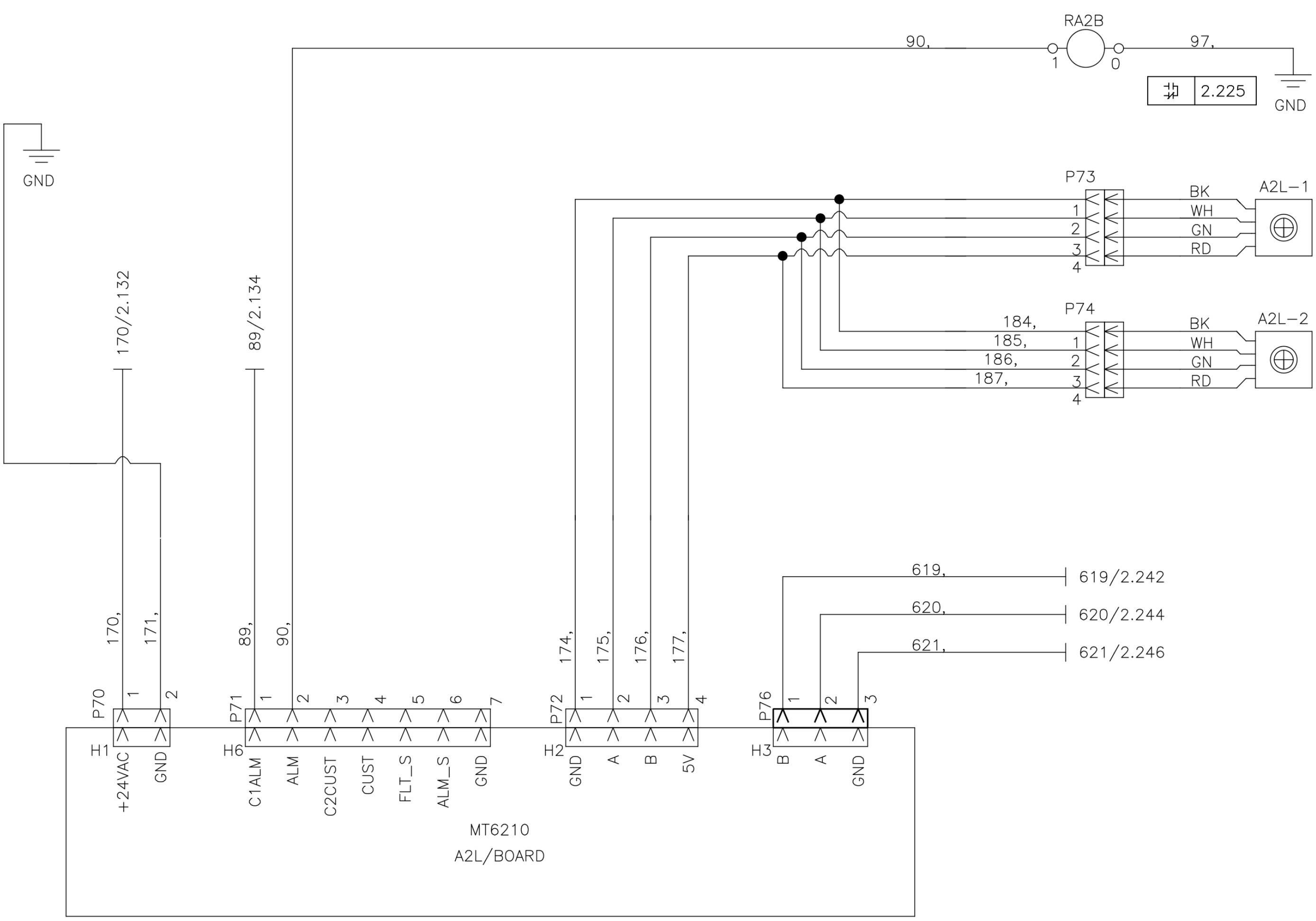


Figure 4: MicroTech Controls – A2L Leak Mitigation



Typical MicroTech Wiring Diagrams

Figure 5: Typical MicroTech Wiring Diagram - 460V/60Hz/3Ph

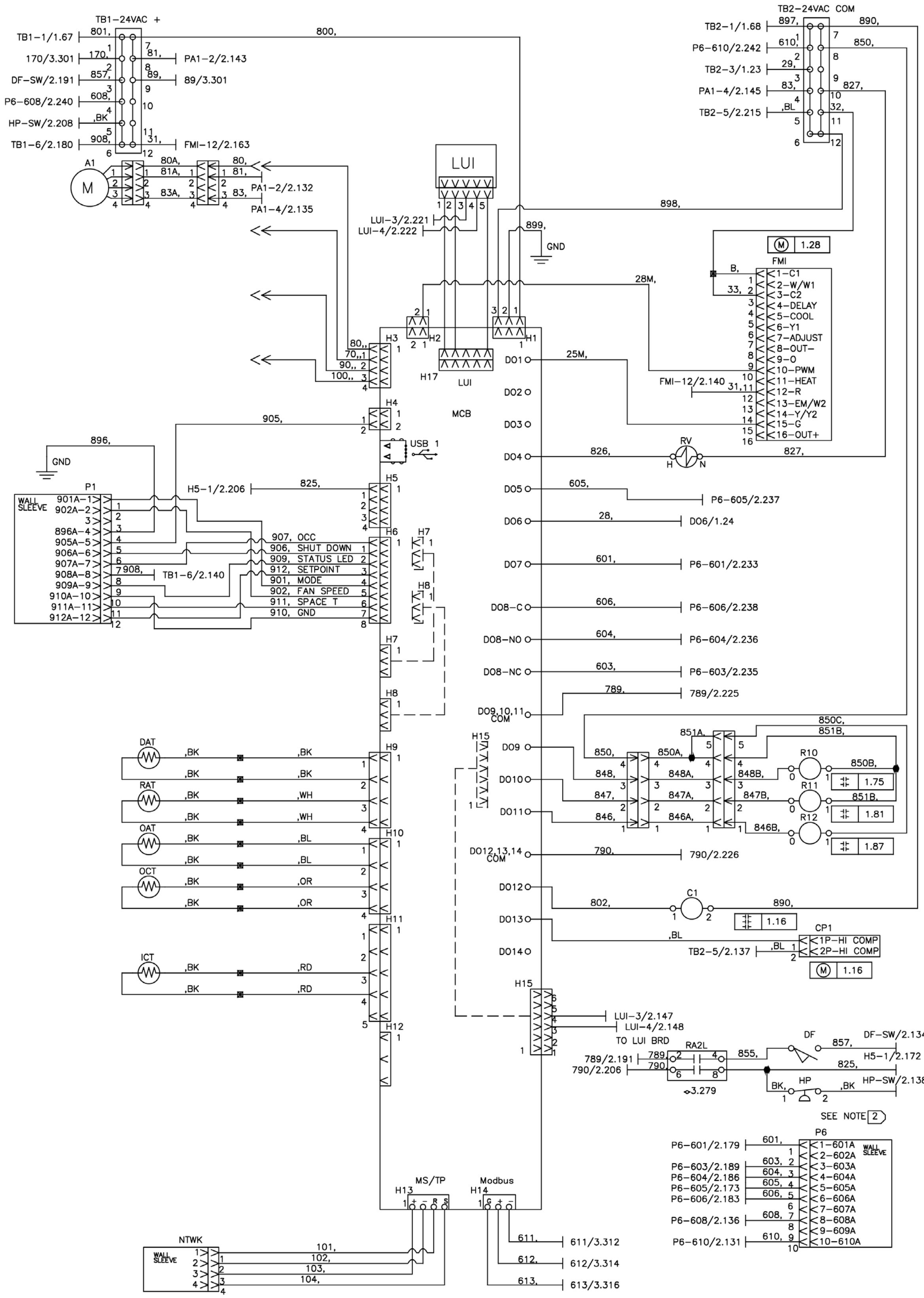
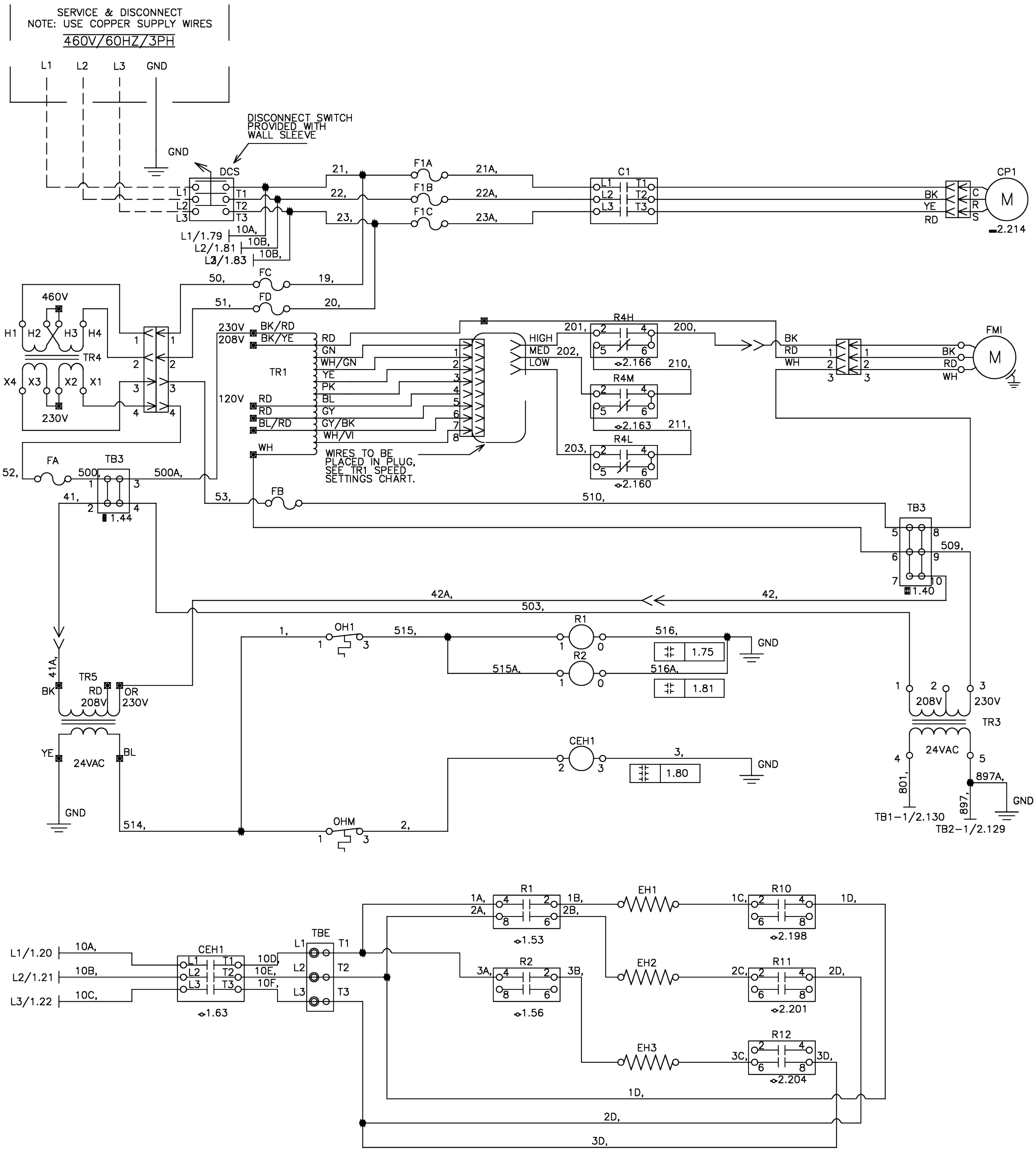


Figure 6: Typical MicroTech Wiring Diagram - Service and Disconnect - 460V/60Hz/3Ph



Wiring Schematics Legend for "Typical MicroTech Wiring Diagrams"

Legend			
A1	Actuator- Outdoor Air	**OH**	Sensor - Outdoor Humidity
A2	Actuator- Face & Bypass	**OH1**	Thermostat - Overheat
A2L1-2	A2L Refrigerant Sensor	**OH2**	Thermostat - Overheat
BPT	Sensor - Braze Plate DX Coil Refrigerant Temperature	**OHM**	E.H. Man Reset - Overheat Stat
C1	Compressor Contactor	**PL1**	LED Occupancy / Fault Status
CAP1	Capacitor Run	**R1-R3**	Relay Electric Heat (Backup)
CEH1-3	Electric Heat Contactor	**R10-R12**	Relay – Electric Heat
CP1	Motor Compressor 2-Stage	**R28**	Relay - Outdoor Motor Air
CO2	Sensor - Indoor Air CO2	**R32**	Relay - Drain Pan Heater
DAT	Sensor - Discharge Air Temperature	**R4H**	Relay – Fan High Speed
DCS	Switch - Unit Power	**R4L**	Relay– Fan Low Speed
DF	Dead Front Switch	**R4M**	Relay– Fan Medium Speed
EH1-6	Heater - Electric	**RA2L**	Relay A2L
EH10	Heater - Outdoor Drain Pan	**RAT**	Sensor - Room Air Temperature
EWT	Sensor - Entering Water Temperature	**RCCP**	Transducer AAR
F1A/F1B	Fuse - Compressor	**RV**	Reversing Valve
F2A/F3C	Fuse - Electric Heat	**SRT**	Sensor - Suction Line
FA/FB	Fuse– Control, Load	**T6**	Thermostat - Freeze Stat
FC/FD	Fuse– Control, Transformer	**TB1**	Terminal Block - 24VAC+
FMI	Motor - Room Fan	**TB2**	Terminal Block – 24VAC Gnd
FMO	Motor Outdoor Air	**TB3**	(A, B) Terminal Block – Main Power
HP	High Pressure Switch	**TBE**	Terminal Block - Electric Heat
ICT	Sensor - Indoor DX Coil Temperature	**TR1**	Transformer - Motor Speed
IH	Sensor - Indoor Humidity	**TR3**	Transformer - 208 / 230V-24V, 75VA
LWT	Sensor - Leaving Water Temperature	**TR4**	Transformer - 460V–230V
MCB	Main Control Board	**TR5**	Transformer - 208 / 230V-24V
MT6210	A2L Control Board	**V1**	Valve - Heat EOC (Accessory)
NTWK	Network Connection	**V2**	Valve - Cool EOC (Accessory)
OAT	Sensor - Outdoor Air Temperature	**VC**	Valve - Cool (Accessory)
OCT	Sensor - Outdoor DX Coil Temperature	**VH**	Valve - Heat (Accessory)

Legend - Symbols	
– – –	Accessory or field mounted component
⏚	Ground
⊠	Wire nut / splice
●	Overlap point - common potential wires
L1/1.20	Wire link (wire link ID / page # . line #)

NOTE 1: All electrical installation must be in accordance with national and local electrical codes and job wiring schematic.

NOTE 2: External wiring options - see IM for the different configured options, wiring to be minimum 18 gauge, 90°C.

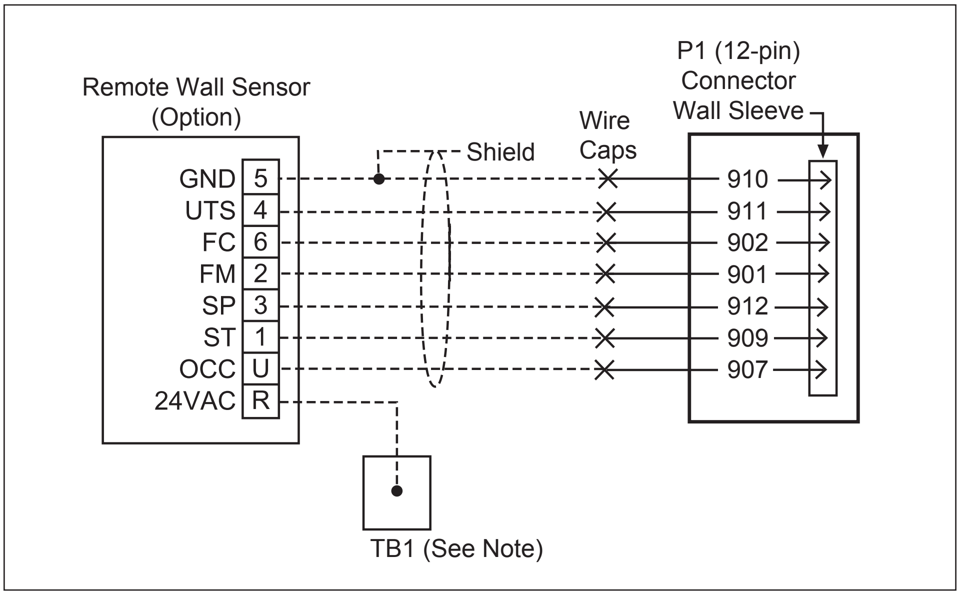
NOTE 3: EC motors are factory programmed for specified airflow. Contact Daikin Applied for replacement.

NOTE 4: Cap extra wire. Switch wire 42A to red wire for 208V operation.

NOTE 5: Devices in legend may or may not be on unit.

Typical Wall Sensor Diagrams

Figure 39: Wall-Mounted Temperature Sensor Wiring



Note: *The "R" terminal is used only with sensor part numbers 910247458 (6-button) and 910247448 (4-button).*

Power & Control Field Wiring

Figure 40: External Input Wiring Examples with or without Daisy Chaining of Units

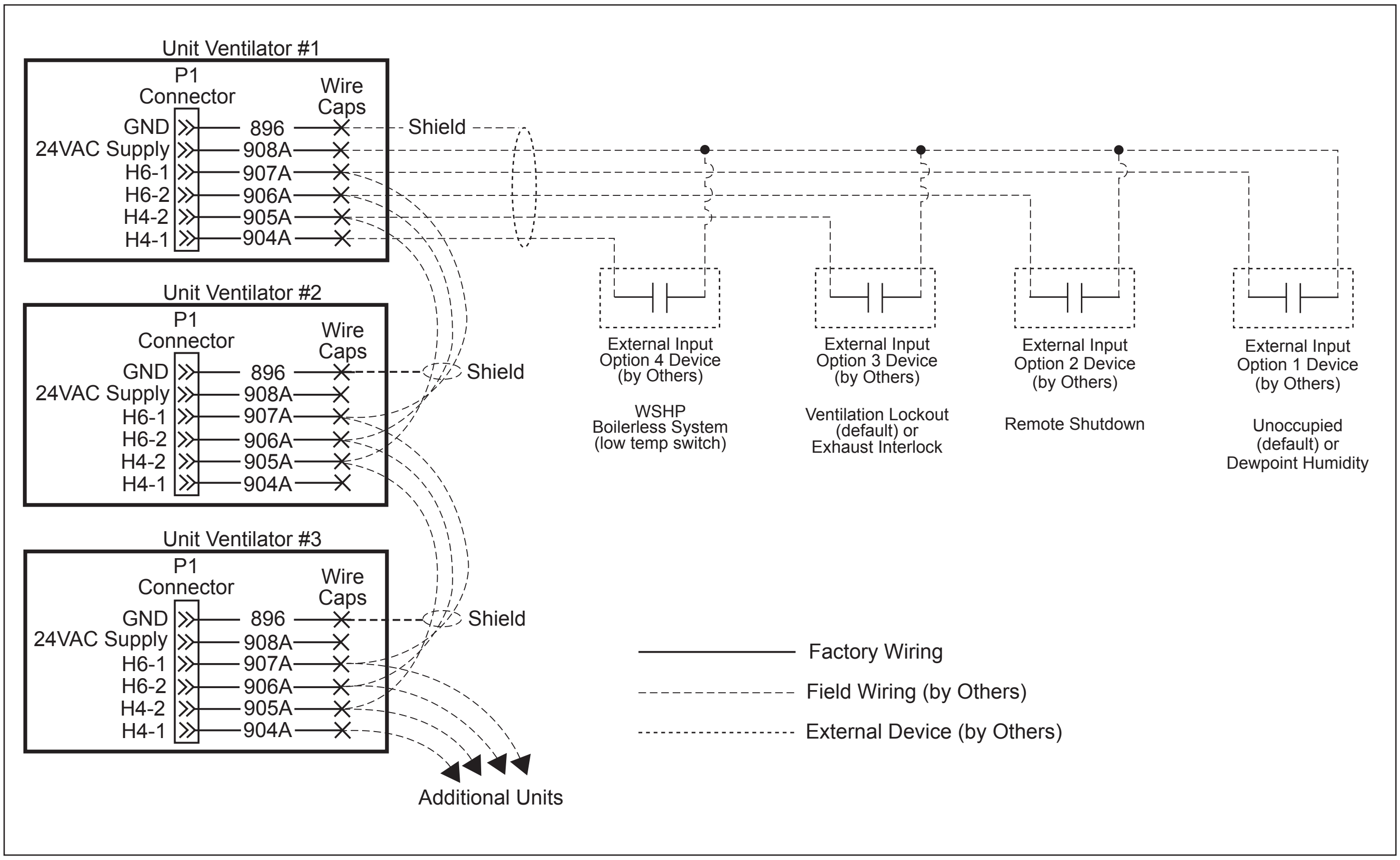


Figure 41: External Output Wiring - Single Unit

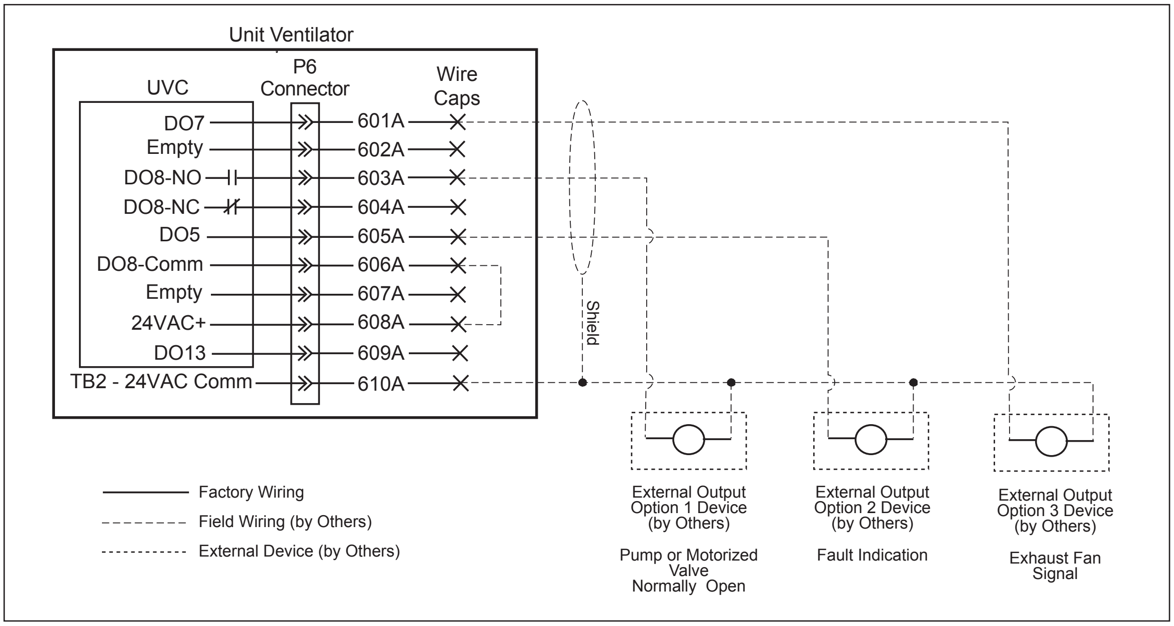
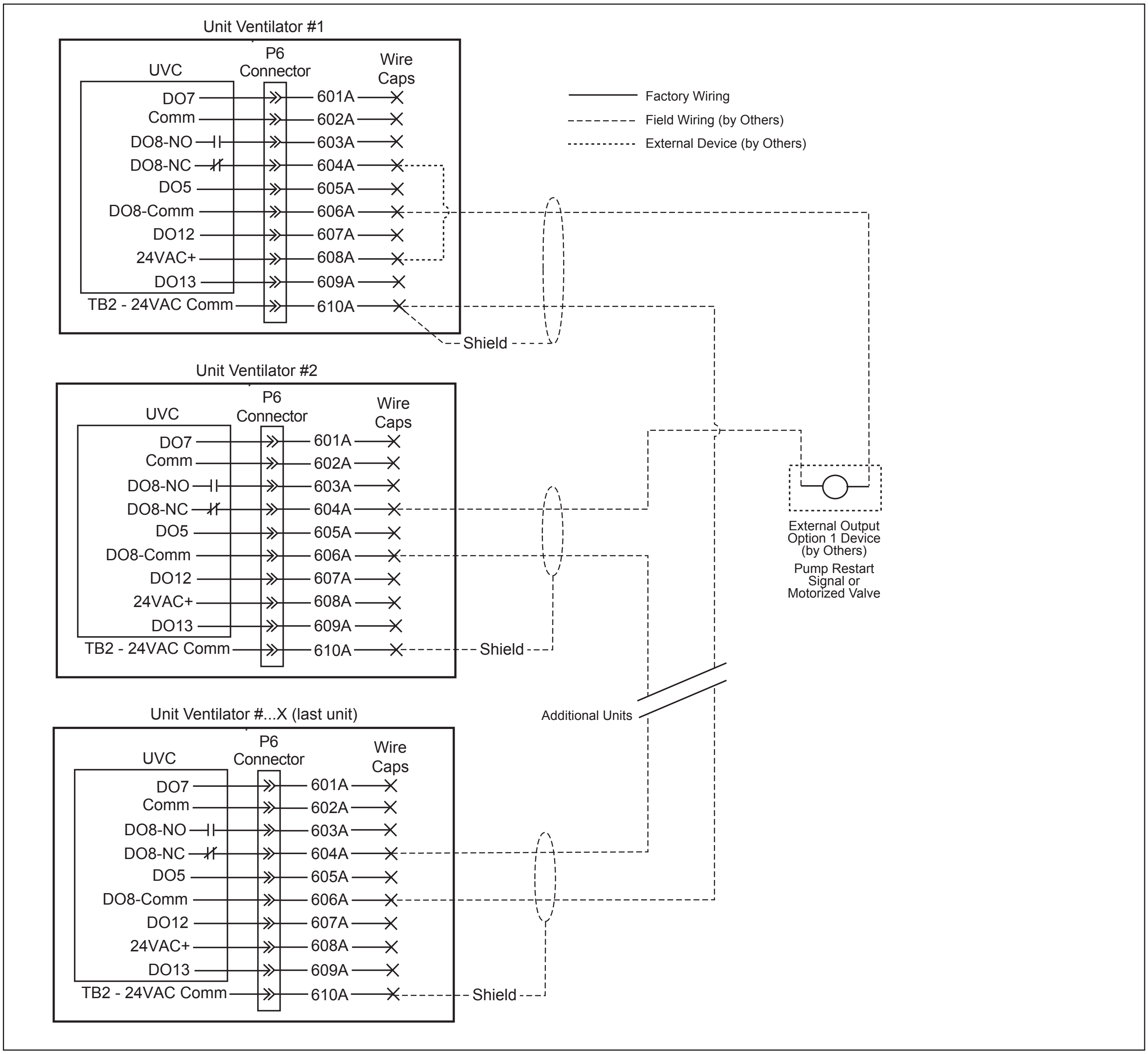


Figure 42: External Output Wiring - Multiple Units Shown



Control Modes and Functions

Daikin Applied unit ventilators equipped with MicroTech unit controllers can be programmed to operate in a variety of modes based on the current situation in the room and the status of the unit ventilator. Changes in mode can be triggered manually, via network signals, by sensor readings, or by date and time. External inputs and outputs can be used to change modes, communicate data to network controls or change the functional operation of the unit.

Occupancy Modes

MicroTech controls can be set up to change modes based on room occupancy. Four different occupancy modes are provided, as described below:

Occupied Mode

This is the normal daytime operation mode. The controller maintains a room set point using the outside air capability and other functions.

Note: *For non-school applications, the unit can also be configured to cycle the fan in response to the room load. In this case, the fan would normally be in the Off Mode until heating or cooling is required. The outside air damper is always closed when the fan is off. When the fan starts, the outside air damper opens to the required position, usually minimum position.*

Unoccupied Mode

This is the night setback operating mode, in which the unit responds to a new room set point and cycles to maintain the condition. The fan comes on when heating or cooling is needed and runs until the load is satisfied. The outdoor air damper is closed during this mode. When a cooling load is satisfied by a refrigerant system, the compressor is de-energized and the unit ventilator indoor fan continues to run for a fixed period of time to remove coldness from the evaporator coil. This reduces the potential for low refrigerant temperatures to exist on the evaporator coil.

Stand by Mode

In this mode, the unit maintains the occupied mode set point temperature with the outdoor air damper closed. The fan runs continuously unless it is configured to cycle in response to the load.

Bypass Mode

This is a tenant override operating mode initiated by using the optional LUI or by depressing the tenant override switch on the optional room sensor. The unit is place back into occupied mode for a predetermined time (default 120 minutes). This time can be set in 1-minute increments from 1 minute to 240 minutes through the unit ventilator service tool or a network.

Economizer Modes

Economizer operation is facilitated by the outdoor air damper, which automatically adjusts the above-minimum outside air position to provide free cooling when the outdoor air temperature is appropriate. Three levels of economizer control are available:

Basic Economizer Operation: The MicroTech controller compares the inside and outside temperatures. If the temperature comparison is satisfactory, then free-air economizer operation is used to cool the space. Reheat units also come configured with an indoor humidity sensor.

Expanded Economizer Operation: In addition to comparing inside and outside temperatures, outdoor relative humidity is measured to calculate outside air enthalpy. If the enthalpy set point is not exceeded, and the temperature comparison is satisfactory, then free economizer operation is used to cool the space. This helps to minimize the entrance of humid outside air.

Leading-Edge Economizer Operation: The MicroTech controller compares both indoor and outdoor temperatures and indoor and outdoor relative humidities. Then it calculates both inside and outside air enthalpy to determine if free economizer operation can cool the space with non-humid outside air. This is a true enthalpy economizer—a first for unit ventilators.

Night Purge Mode

Under this mode, the unit is configured to purge the room space for one hour for various reasons (odor or fume removal, drying, etc.). During Night Purge the outside air damper is open full and the fan is run on high speed. No “normal” heating or cooling takes place (the emergency heat set point is maintained) and the exhaust fan, if the room is so equipped, is signaled to turn on.

Emergency Heat Mode

If the unit is left in a mode that does not normally allow heating (such as Off, Fan Only, Cool, or Night Purge) and the room temperature falls below 55°F, the unit will heat the space to above 55°F and then return to the previously set mode of operation. This mode of operation can be field configured and/or be disabled.

External Input Functions

The unit ventilator controller is provided with four (4) binary inputs that allow a single set of dry contacts to be used as a signal to it, and two (2) binary inputs that allow a 24 VAC signal. Input signal choices are described below. Multiple units can be connected to a single set of dry contacts.

Note: *Not all of the functions listed can be used at the same time. The unit ventilator controller is provided with configuration parameters that can be adjusted to select which function will be used for these inputs where multiple functions are indicated below.*

Unoccupied Input Signal

This input signals the unit ventilator controller to go into unoccupied or occupied mode. When the contacts close, the unit ventilator controller goes into unoccupied mode; when the contacts open, it goes into occupied mode. Additional variables can affect occupancy mode and override this binary input. See "Occupancy Modes" on page 66.

Remote Shutdown Input Signal

This input signals the unit ventilator controller to go into shutdown mode. When the contacts close, the controller goes into shutdown mode; when the contacts open, it returns to normal operation.

Ventilation Lockout Input Signal

This input signals the unit ventilator controller to close the outdoor air damper. When the contacts close (ventilation lockout signal) the controller closes the outdoor damper; when the contacts open, it returns to normal outdoor damper operation.

Exhaust Interlock Input Signal

This input signals the unit ventilator controller that an exhaust fan within the space has been energized. The controller then repositions the outdoor air damper to a user-adjustable minimum position. When the contacts close (exhaust fan on signal) the controller uses the value defined by the Exhaust Interlock OA Damper Min Position Setpoint as the new minimum outdoor air damper position regardless of the indoor air fan speed. When the contacts open, it returns to normal outdoor damper operation.

External Output Functions

The unit ventilator controller is provided with three (3) binary outputs to perform the functions described below. These are relay type outputs that supply 24 VAC.

Note: *Not all of the functions listed can be used at the same time. The unit ventilator controller is provided with configuration parameters that can be adjusted to select which function will be used for these outputs when multiple functions are indicated below.*

Fault Signal

This relay output provides one set of Normally Open (NO) (reversible through keypad/software), 24 VAC contacts that can be used to signal a fault condition. When a fault exists, the unit ventilator controller energizes this relay output. When the fault or faults are cleared, it de-energizes this relay output.

Exhaust Fan On/Off Signal

This relay output provides one set of Normally Open (NO) (reversible through keypad/software), 24 VAC contacts that can be used to signal the operation of an exhaust fan. When the outdoor air damper opens more than the Energize Exhaust Fan OA Damper Setpoint, the relay output will signal the exhaust fan on (contacts closed). When the outdoor damper closes below this setpoint, the relay output will signal the exhaust fan off (contacts open).

Auxiliary Heat Signal

This relay output provides one set of Normally Open (NO) (reversible through keypad/software), 24 VAC contacts that can be used to operate an auxiliary heat device. The unit ventilator controller by default is configured to operate a NO auxiliary heat device (de-energize when heat is required) such as a wet heat valve actuator with a spring setup to open upon power failure. However, the Auxiliary Heat Configuration variable can be used to set the controller to use an NC auxiliary heat device (energize when heat is required) such as electric heat.

Advanced Control Options

MicroTech controls make possible a number of advanced control options that can quickly pay for themselves in saved energy costs and more comfortable classrooms, as described below.

Part Load Variable Air Control

Part Load Variable Air control can be used in conjunction with face and bypass damper temperature control to automatically adjust the unit ventilator fan speed based upon the room load and the room-temperature PI control loop. This MicroTech control option provides higher latent cooling capabilities and quieter operation during non-peak load periods by basing indoor fan speed upon room load.

During low-load or normal operation (about 60% of the time) the fan will operate on low speed. When the load increases to an intermediate demand, the fan will automatically shift to the medium-speed setting. Under near-design or design-load conditions, the fan will operate on high speed. A built-in, 10-minute delay helps minimize awareness of fan speed changes. Low-speed fan operation under normal operating conditions, in conjunction with our GentleFlo fan technology contributes to a very quiet classroom environment.

Demand-Controlled Ventilation (Optional)

Daikin Applied unit ventilators can be equipped to use input from a CO_2 controller to ventilate the space based on actual occupancy instead of a fixed design occupancy. This Demand Controlled Ventilation (DCV) system monitors the amount of CO_2 produced by students and teachers so that enough fresh outdoor air is introduced to maintain good air quality. The system is designed to achieve a target ventilation rate (e.g., 15 cfm/person) based on actual occupancy.

By using DCV to monitor the actual occupancy pattern in a room, the system can allow code-specific levels of outdoor air to be delivered when needed. Unnecessary over-ventilation is avoided during periods of low or intermittent occupancy.

With DCV you can be confident that your school is meeting ventilation standards for Indoor Air Quality and that your students are receiving adequate air to be attentive to instruction. At the same time, you are saving money in early morning hours, in between classes, or after hours when classrooms are heated and cooled but not always fully occupied.

As Simple as a Thermostat

Demand Controlled Ventilation is easy to apply. When DCV is ordered, a CO_2 sensor is mounted on the unit and configured for operation. The system does the rest. If desired, the ventilation control setpoint can be adjusted through the MicroTech controller.

Acceptance by Codes And Standards

ASHRAE Standard 62-2004 Ventilation for Indoor Air Quality recognizes CO_2 based DCV as a means of controlling ventilation based on occupancy. The ASHRAE standard has been referenced or adopted by most regional and local building codes. This standard references ventilation on a per-person basis.

Using CO_2 control will sometimes lower the absolute amount of outside air delivered into a room but will maintain the per-person rate. For example, if a classroom is designed for 30 students, the ventilation rate is 450 cfm (30 students × 15 cfm/student). However, when there are only ten students in the classroom, the CO_2 control will adjust ventilation to 150 cfm (10 students × 15 cfm/student). A minimum base ventilation rate (typically 20% of design levels) is provided when in the occupied mode. This provides outdoor air to offset any interior source contamination while allowing for proper space pressurization.

DX System Control

The unit ventilator controller is configured to operate the compressor as secondary (mechanical) cooling when economizer cooling is available, and as primary cooling when economizer cooling is not available. Additional DX control features include:

Compressor Cooling Lockout: The unit ventilator controller is configured to lock out compressor cooling when the entering fluid temperature falls below the compressor cooling lock out setpoint. Below this temperature setpoint, compressor operation is not allowed.

Minimum On And Off Time: The unit ventilator controller is provided with minimum-on and minimum-off timers to prevent adverse compressor cycling (3-minutes default).

Compressor Start Delay Variable: This variable is intended to be adjusted as part of the start-up procedure for each unit. It is used to prevent multiple unit compressors from starting at the same time after a power failure or after an unoccupied-to-occupied changeover. Each unit should be configured at start-up with a slightly different (random) delay, or groups of units should be provided with different delays.

System Components

The main components of the MicroTech system are:

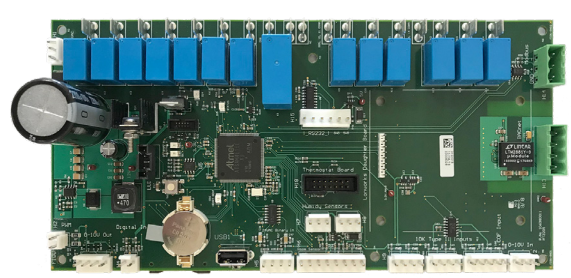
- A Unit Ventilator Controller (UVC) with on-board BACnet MS/TP communications
- Optional Local User Interface (LUI)
- Optional LonWorks plug-in network communication module

In addition, unit ventilators equipped with Daikin Applied factory controls feature factory-mounted sensors and actuators for system control and feedback.

Unit Ventilator Controller

The MicroTech UVC is a DDC, microprocessor-based controller designed to provide sophisticated comfort control of an economizer-equipped Daikin Applied unit ventilator. In addition to normal operating control, it provides alarm monitoring and alarm-specific component shutdown if critical system conditions occur. Each UVC is factory wired, factory programmed and factory run-tested for the specific unit ventilator model and configuration ordered by the customer.

Figure 43: MicroTech Control Board



Local User Interface (Optional)

An optional built-in LUI touch pad with digital LED Display is located in the right hand compartment below the top right access door. The LUI features a 4 x 20 OLED digit display, 4 keys, and 2 individual LED indicators. In addition to the Operating Mode States and Fan Functions, the Touch Pad will digitally display:

- The room set point temperature.
- The current room temperature.
- Any fault code for quick diagnostics at the unit.

Figure 44: User Interface Touch Pad

The User Interface has individual touch-sensitive printed circuit board mounted buttons, and comes with a built-in menu structure (Password Protected) to change many of the common operating variables.

Four Operating Mode States

Four different user operating mode states can be chosen on the LUI:

- **Heat:** Heating and economizer operation only.
- **Cool:** Cooling and economizer operation only.
- **Fan Only:** Fan only operation.
- **Auto:** The unit automatically switches between heating, cooling and economizer operation to satisfy the room load conditions. The current unit state is also displayed.

Four Fan States

Four fan states are provided on all units: high, medium, low, and Auto speed modulation. The Auto speed function (part load, variable air) varies the fan speed automatically to meet the room load whether the unit is in heating, cooling or economizer mode.

All this is accomplished with a standard, single-speed NEMA frame motor. A built-in 10-minute delay helps minimize awareness of speed changes. During low-load or normal operation (about 60% of the time) the fan will operate at low speed. The low speed operation, along with GentleFlo fan technology, contributes to a very quiet classroom environment.

When the load increases to an intermediate demand, the fan automatically shifts to the medium speed setting. At near-design or design-load conditions the fan will operate on high speed.

With four fan states and GentleFlo fan technology, there is no need to oversize units or worry about uncomfortable conditions.

Communication Types

On-board BACnet communication or an optional Lon communication module provide control and monitoring information to your building automation system without the need for costly gateways.

MicroTech Controller with on-board BACnet MS/TP

The MicroTech controller allows the UVC to inter-operate with systems that use the BACnet (MS/TP) protocol with a conformance level of 3. It meets the requirements of the ANSI/ASHRAE 135-2008 standard for BACnet systems.

LonWorks SCC Communication Module

This module supports the LonWorks SCC (Space Comfort Communication) profile number 8500-10. Unit controllers are LonMark certified with this optional LonWorks communication module.

MicroTech Control Sensor and Component Locations

A2L Refrigerant Detection and Mitigation Sensors

Unit mounted A2L refrigerant sensors are installed in the base of each end pocket. They are used to detect a refrigerant leak for initiating leak mitigation control.

The factory mounted MT6210 A2L Mitigation Controller monitors the A2L sensors and indicates a refrigerant leak or refrigerant sensor failure should one occur.

Figure 45: MicroTech Sensor and Component Locations

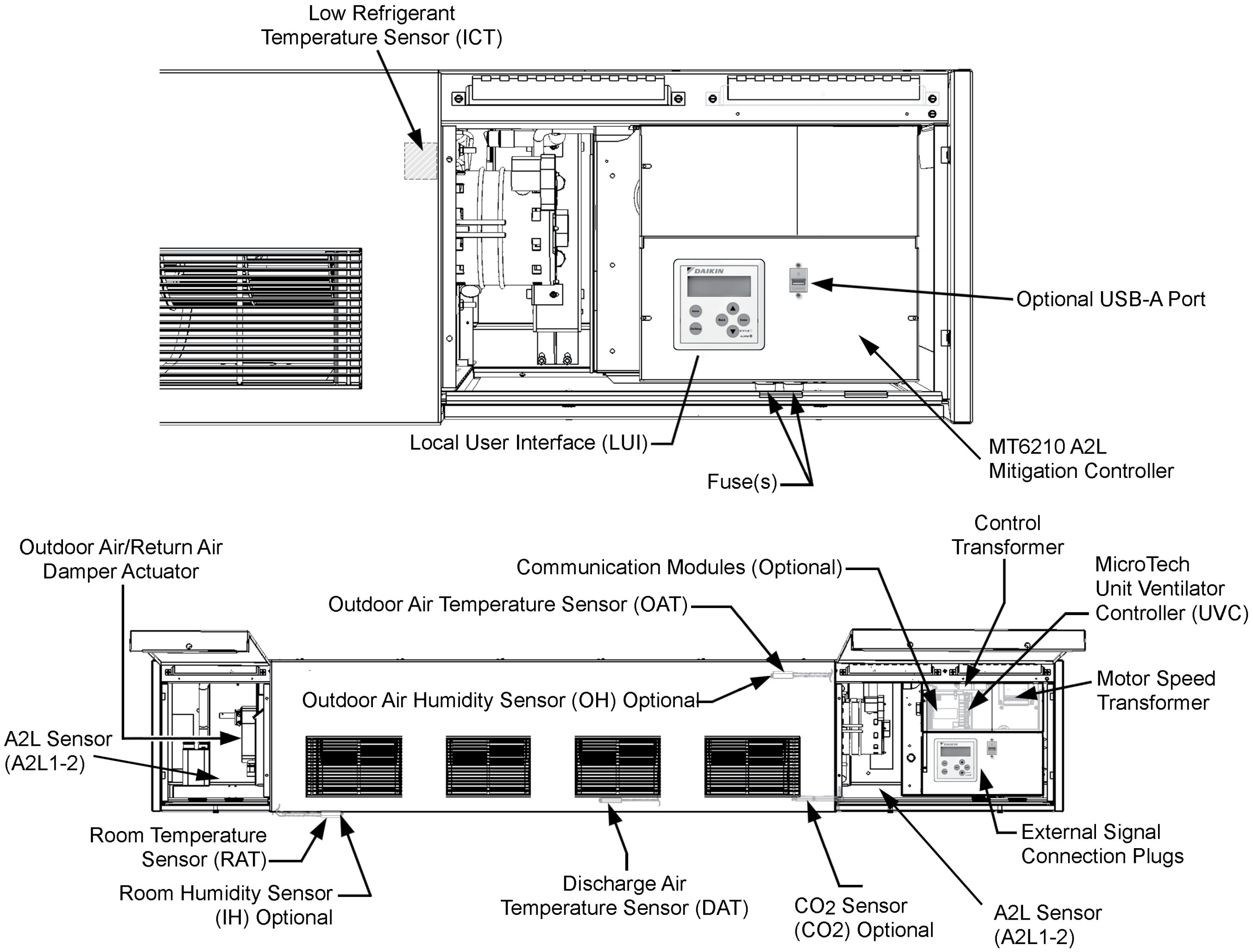


Figure 46: Unit Main Power “On-Off” Switch (SW1)

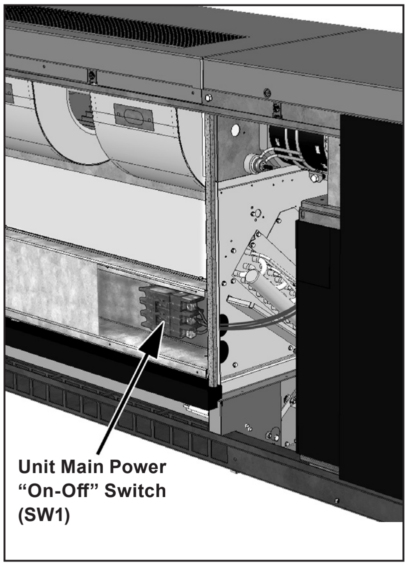
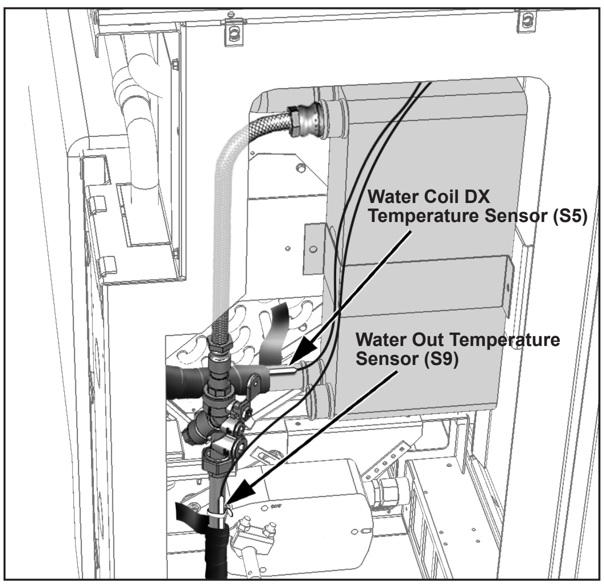


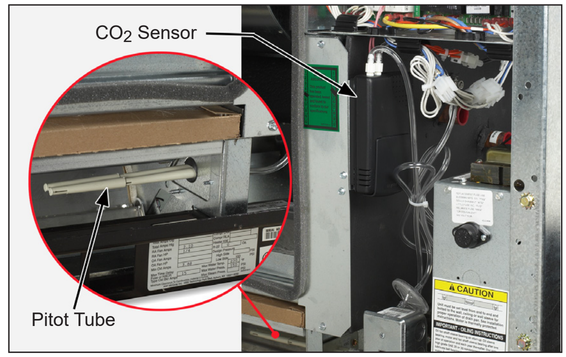
Figure 47: Water Out & Water Coil DX Temperature Sensors



CO_2 Sensor for Demand Controlled Ventilation

On units equipped for Demand Controlled Ventilation (DCV) the UVC is configured to use a 0-2000 PPM, 0-10 VDC, single beam absorption infrared gas sensor. CO_2 sensors are available as unit mounted only. An air collection probe (pitot tube and filter) is installed in the return air of the unit (Figure 48).

Figure 48: CO_2 Sensor for Demand Control Ventilation



Room Temperature Sensors used with MicroTech Unit Controls

Digitally Adjustable Display Sensor – 910247458

The display sensor is used in conjunction with MicroTech equipped units. This digitally adjustable sensor displays room temperature, fan speed (AUTO/HIGH/MEDIUM/ LOW), system mode (HEAT/COOL/AUTO/OFF), ALARM, override and occupancy.

Digitally Adjustable Display Sensor – 910247448

The display sensor is used in conjunction with MicroTech equipped units. The sensor has a digital display for temperature, occupancy, alarm, setpoint and status indication. Controls include four buttons for setpoint, occupied/unoccupied request, and override reset.

Basic Room Sensor With Cool to Warm – 910247453

The basic room sensor with adjustment (cool to warm) is used in conjunction with MicroTech equipped units. The sensor has an output for temperature, and LED status indication and includes an override reset button.

Basic Room Sensor – 910247450

The basic room sensor is used in conjunction with MicroTech equipped units. The sensor has an output for temperature, and LED status indication and includes an override reset button.

Table 37: Room Temperature Sensors for BAS Operation

Room Temperature Sensors used with Unit Ventilator – Building Automated System (BAS) Operation		**Digitally Adjustable Display Sensor**	**Digitally Adjustable Display Sensor**	**Basic Room Sensor With Cool to Warm Adjust**	**Basic Room Sensor**
					
		Part No. 910247458	**Part No.** 910247448	**Part No.** 910247453	**Part No.** 910247450
Feature					
Setpoint Adjustment		Digitally Adjustable	Digitally Adjustable	Cool to Warm	None
Display	Room Temperature & Setpoint	●	●		
Operating Modes	System	Heat-Cool-Auto-Off-			
	Fan	Auto-High-Medium-Low			
	Occupancy	LCD Display of Occupied-Unoccupied Icon	LCD Display of Occupied-Unoccupied Icon		
Annunciation	Status LED	LCD Display of Unit Status	LCD Display of Unit Status	●	●
	LCD Alarm Display	●	●		
Reset	Alarm	●	●	●	●
	Setback Override	●	●	●	●

Table 38: Network Operation -Typical Data Points[1]

Read/Write Attributes	Read Only Attributes	Read/Write Setpoint Attributes	Typical Alarms
• Application Mode • Compressor Enable • Emergency Override • Energy Hold Off • Heat/Cool Mode • Occupancy Override • Outdoor Air Humidity • Outdoor Air Temperature • Reset Alarm • Reset Filter Alarm • Source (Water In) Temperature • Space CO_2 • Space Humidity • Space Temperature • Economizer Enable • Heating Setpoint Shift • Cooling Setpoint Shift	• Binary Input Status • Binary Output Status • UV Software Application Version • Compressor Run Time • Chiller Water Valve Position • Discharge Air Temperature • Discharge Air Temperature Setpoint • Effective Setpoint • Fan Speed • F & BP Damper Position • Outdoor Air Damper Position • Space Fan Runtime • Unit Ventilator Controller State • Water-Out Temperature • WH or CW/HW Valve Position • OA Minimum Position	• Econ. IA/OA Enthalpy Differential Setpoint • Econ. IA/OA Temp. Differential. Setpoint • Econ. Outdoor Air Enthalpy Setpoint • OAD Min. Position Low-Speed Setpoint • OAD Min. Position Med.-Speed Setpoint • Occupied Cooling Setpoint • Occupied Heating Setpoint • Space CO_2 Setpoint • Space Humidity Setpoint • Standby Cooling Setpoint • Unoccupied Cooling Setpoint • Unoccupied Heating Setpoint	• Indoor Air Temperature Sensor Failure • DX Pressure Fault • Indoor Air Coil DX Temperature Sensor Failure • Outdoor Air Temperature Sensor Failure • Discharge Air Temperature Sensor Failure • Outdoor Air Coil DX Temperature Sensor Failure (or) • Water Coil DX Temperature Sensor Failure • Water-Out Temperature Sensor Failure (or) • Water-In Temperature Sensor Failure • Space Humidity Sensor Failure • Outdoor Humidity Sensor Failure • Space CO_2 Sensor Failure • Source Temperature (Water-In) Inadequate Indication • Change Filter Indication

[1] **Not** all data points or alarms listed will be available in all unit ventilator configurations. Humidity and CO_2 points require the use of optional sensors.

Actuators

Face and Bypass Damper Actuator

On units equipped with face and bypass damper control, the UVC is configured to operate a proportional, direct-coupled, face and bypass damper actuator. To increase accuracy, the controller has an overdrive feature for the 0% and 100% positions and a periodic (12-hour) auto-zero PI control loop for each modulating actuator.

Figure 49: Face and Bypass Damper Actuator

Outdoor Air/Return Air Damper (OAD) Actuator

The UVC is configured to operate a proportional, direct-coupled actuator for the outdoor air damper. This actuator provides spring-return operation upon loss of power for positive close-off of the outdoor air damper. To increase actuator positioning accuracy, the UVC is provided with an overdrive feature for the 0% and 100% positions and a periodic (12- hour) auto-zero PI control loop for each modulating actuator.

Figure 50: Outdoor Air Damper Actuator

2-Position End-of-Cycle Valve Actuators (Optional)

On units equipped with 2-way or 3-way, end-of-cycle (EOC) valves, the UVC is configured to operate 2-position End-Of-Cycle (EOC) valve actuators (Figure 51). Spring return actuators are used for all End of Cycle (EOC) valves. All wet heat and heat/ cool EOC valves are normally open, and all cooling EOC valves are normally closed.

Figure 51: End of Cycle Valve Actuator

Modulating Valve Actuators (Optional)

On units equipped with modulating valves, the UVC is configured to operate proportional actuators for modulating 2-way and 3-way valves (Figure 52).

Figure 52: Modulating Valve Actuators

2-Way Valve **3-Way Valve**

A Wide Variety of Input, Output & Alarm Data Points Available

A wide variety of data is available from Daikin Applied unit ventilators when equipped with MicroTech controllers in a network situation. They provide a clear picture of just what's happening in each classroom and notify your building automation system of alarm conditions regardless of the protocol you select. Table 38 below shows a list of inputs, outputs and alarm functions available.

ServiceTools

ServiceTools for MicroTech unit ventilators is software for operation on a personal computer. This software provides representation of the sequence of operation and enables the service technician to:

- Monitor equipment operation
- Configure network communications
- Diagnose unit operating problems
- Download application code and configure the unit

This software is a purchased tool for service technicians and will run on PCs with Microsoft Windows, Windows 7 and newer operating systems.

This tool provides more capabilities than the unit's user interface touch pad and is highly recommended for startup and servicing. (It may be required for startup and/or servicing, depending upon unit integration and other requirements.) It does not replace BAS functions, such as system wide scheduling or sequencing, and it cannot serve as a Work Station Monitoring package. ServiceTools interfaces with the MicroTech controller using serial communications through a USB type A connector.

Setpoints and Configuration Parameters

The UVC can save a snapshot of all setpoints and configuration parameters in the controller. Those configurations and setpoints can be saved onto a SD flash memory card (32 GB MAX), ensuring the controller can be reverted to those settings at a later date. Additionally, the settings saved to a SD can be taken to another UVC and loaded into it. Certain parameters, such as BACnet addressing and location, can be optionally restored to prevent duplication.

Data Trending

Data can be written to an optional SD card inserted into the control unit. The parameters that can be trended through MicroTech can be found in OM 732. Six options for trending frequency are available:

- None
- Occupancy Change
- 1 Minute
- 10 Minutes
- Hourly
- Daily

A separate trend file will be created of each day. If a "Daily" trend is selected, the trend file will contain a header and 1 line of data. If an "Hourly" trend is selected, the trend file will contain a header and 24 lines of data. The last 3 alarms in the Alarm History are always recorded.

Application Considerations

Why Classrooms Overheat

Overheated classrooms occur every day in schools in every area of the country. The most serious result is their detrimental effect on students' ability to concentrate and learn. Research has determined that the ability to learn and retain knowledge decreases rapidly as the temperature exceeds recommendations. Overheated rooms also represent wasted fuel, resulting in excessive operating costs.

Correcting an overheating problem in an existing building is very difficult and expensive. It calls for redesign and alteration of the heating and ventilating system, necessitating considerable renovation. This potential problem should be recognized, understood and planned for when heating and ventilating systems are designed for new and existing buildings.

Schools Have Special Needs

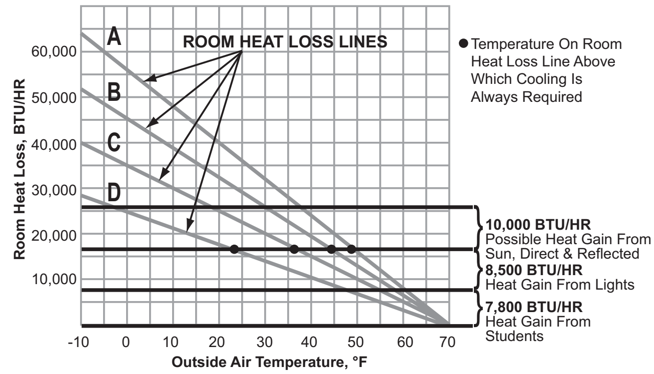
Schools have unique heating and ventilating needs, in large part because of their variable occupancy and usage patterns. Fewer cubic feet of space is provided per student in a school building than in any other type of commercial or public building. School classrooms are typically occupied only six hours a day, five days a week, for only three-fourths of the year, with time out for vacations. All in all, this represents approximately 15% of the hours in a year that a classroom is occupied.

To understand the overheating problem in schools, one must first realize that the excess heat comes from what is commonly termed "uncontrolled heat sources." To gain some perspective on how this affects heating and cooling decisions, let's take a look at a typical classroom in the northern section of the Midwestern United States.

Suppose we have a classroom that is 24 by 38 feet with 10-foot ceilings and 100 square feet of window area along the outside wall. At an outside temperature of 0°F and a desired room temperature of 72°F, let's assume the normal amount of heat loss from the room to the outside is 55,000 BTUs per hour.

As the outside temperature changes, so does the amount of heat that the room loses. This is represented in Figure 59 by Room Heat Loss Line A, which ranges from 55,000 BTUs per hour at 0°F outside air temperature to zero BTUs at 70°F. Obviously, if the heating system were the only source of heat in the classroom, the solution would be simple: The room thermostat would cause the heating system to supply exactly the amount of heat required to maintain the room at the thermostat temperature setting. In reality, the introduction of excess heat from a variety of uncontrolled sources makes the challenge considerably more complex.

Figure 53: Heat Gain Vs. Heat Loss in Occupied Classrooms



As Figure 53 illustrates, even in very cold weather an occupied classroom is more likely to require cooling than heating.

Heat From Students

Body heat generated by students in a classroom is one of the three primary sources of uncontrolled heat. In a typical classroom of 30 students, the amount of heat given off at all times will vary according to factors such as age, activity, gender, etc. A conservative estimate is 260 BTUs per hour per pupil. Multiply this by 30 and you get a total of 7,800 BTUs per hour added to the room by the students alone. This excess heat is noted in Figure 53 as "Heat Gain from Students."

Heat Gain From Lights

Heat emitted by the lighting system constitutes a second uncontrolled heat source. Artificial lighting is needed in most classrooms even during daylight hours to prevent unbalanced lighting and eye strain. A typical classroom requires approximately 2,500 watts of supplemental lighting to provide properly balanced lighting. Fluorescent lights add heat to the room at the rate of 3.4 BTU per watt per hour, or a total of 8,500 BTU per hour. This extra heat is represented in Figure 53 as "Heat Gain from Lights."

Add the heat gain from lighting to the 7,800 BTUs introduced by student body heat and we now have an extra 16,300 Btu/h being introduced into the classroom by uncontrolled sources. This heat gain remains constant regardless of the outdoor air temperature.

Solar Heat Gain

The sun is a third uncontrolled source of heat. And, because it is neither positive nor constant, calculating its contribution to the overall heat gain is difficult. Solar heat gain can be the worst offender of the three in classrooms with large windows. Indirect or reflected solar radiation is substantial even on cloudy days, even in rooms with north exposure, as a result of what is termed "skyshine." To get an idea of the potential effect of the sun, let's assume that the solar heat gain in our hypothetical classroom will peak at 240 Btu/h per square foot of glass area. If we then assume a glass area of 100 square feet and at least

100 Btu/h per square foot of glass for solar heat gain, we can calculate a very conservative estimate of 10,000 Btu/h heat gain through windows. If we add this to the heat from the lights and body heat, total heat gain adds up to 26,300 Btu/h from sources other than the heating and ventilating system. This is indicated in Figure 53 on page 75 by the top horizontal line, which intersects Room Heat Loss Line A at approximately 37°F. This is a reasonable estimate of the maximum uncontrolled heat gain that can be received in the typical classroom from these common heat sources.

The Analysis

From Figure 53 on page 75 it is evident that, at an outside temperature of 48°F or higher, the heat given off by 30 students and classroom lighting is sufficient to cause overheating. This is true even if the classroom is occupied at night when solar heat gain is not a factor. But, since classrooms are occupied during the day, solar addition provides heat in varying amounts even in classrooms with north exposures. Consequently, the heating and ventilating system in our typical classroom must provide cooling at all times when the outdoor temperature is above 48°F and at any time during colder weather when the solar heat gain exceeds room heat loss.

If we assume an average winter temperature of approximately 33°F in the region where our typical classroom is located, we know that, half of the time, both night and day, the outside temperature will be above 33°F. However, since it is generally warmer during the day, when school is in session, the heating and ventilating system will be required to provide cooling for this classroom during much of the time that the room is occupied.

In this example, we've assumed that our classroom had a room heat loss of 55,000 Btu/h at a design outdoor air temperature of 0°F (Room Heat Loss Line "A"). Bear in mind, however, that the recent trend in "energy-saving" building design often results in rooms with lower room heat loss, as indicated by Room Heat Loss Lines "B", "C" and "D." At 0°F design outdoor air temperature:

- Room "B" has a room heat loss of 45,000 Btu/h,
- Room "C" has a room heat loss of 35,000 Btu/h,
- Room "D" has a room heat loss of 25,000 Btu/h.

Note the lowering of the temperature above which cooling will always be required as the room heat loss decreases.

We've noted that cooling is always required in Classroom "A" when outdoor air temperatures exceed 48°F. In Classroom "B," "C," and "D" cooling is always required when outdoor temperatures exceed 44°, 36°and 23°F, respectively (Figure 53 on page 75).

Now that we understand the reason for classrooms overheating, the solution is simple: The heating and ventilating system must provide cooling to take care of the heat given off in the classroom by uncontrolled heat sources.

Cooling The Classroom

The Daikin Applied unit ventilator has become a standard for heating and ventilating systems in schools because it provides the solution for overheating classrooms. The unit ventilator cools as well as heats. During the heating season the outdoor air temperature is nearly always below the desired room temperature. It stands to reason then that the outside air should be used to provide the cooling necessary to keep classrooms down to thermostat temperature.

The classroom unit ventilator does just that. By incorporating an automatically controlled outdoor air damper, a variable quantity of outdoor air is introduced in the classroom, metered exactly to counteract overheating. Since our problem is more one of cooling than of heating, it is evident that more than just the room heat loss must be determined to design a good heating and ventilating system. The cooling requirements should be assessed as well, and the free-cooling capacity of the equipment specified along with the heating capacity required. If this is done, the optimum learning temperature can be maintained in each classroom.

Meeting IAQ Requirements

Good indoor air quality (IAQ), which is important in the home and at work, is no less important to students and faculty in schools. For the past several years, efforts to reduce energy costs in new school buildings have seen the use of tighter construction, sealed windows and heavier insulation. While these construction techniques have helped reduce energy costs, tightly sealed buildings, or envelopes, when combined with increased use of recirculated air, have led to a condition known as sick building syndrome.

In a poorly ventilated school building, fumes and vapors from plastics and other synthetics are often not properly exhausted, while mold, fungus, and bacteria are able to flourish. These conditions can cause various ailments, including nausea, smarting eyes, and coughing, as well as increased student absenteeism and diminished productivity.

For these reasons, the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) now has recommendations for minimum ventilations rates for various types of classrooms and no longer endorses the practice of little or no usage of outdoor air.

Following ASHRAE Control Cycle II

ASHRAE Cycle II is a very economical sequence of control because only minimum amounts of outdoor air are heated and free outdoor air—natural cooling—is available to offset the large internal heat gain associated with the dense occupancy of classrooms.

Daikin Applied unit ventilators are normally controlled according to ASHRAE Control Cycle II. ASHRAE control cycles apply only to heating, heating-and-ventilating, and free-cooling operation.

Under ASHRAE Cycle II, the outdoor air damper is closed during warm up of the room. As the room temperature approaches the thermostat setting, the outdoor air damper opens to a predetermined minimum percentage of outside air. The heating coil capacity controller then modulates to maintain the thermostat setting.

If the room temperature rises above the thermostat setting, the heating coil is turned off and the outdoor air damper opens beyond the minimum position to maintain the thermostat setting.

EXAMPLE: For a 60°F entering air mixture temperature and 70°F room temperature, with 30°F outdoor air temperature, 25% outdoor air will produce the 60°F mixture air temperature. When the outdoor air temperature drops to 10°F, 12.5% outdoor air will produce the 60°F mixture air temperature.

Night Setback

Substantial fuel savings can be realized by operating the unit ventilator system at a reduced room setting at night and during other unoccupied periods, such as weekends and holidays. Units with steam or hot-water coils will provide convective heat during the setback period. If the space temperature falls below the setting of the unoccupied thermostat, the unit fans will be brought on to provide additional heat. Units with electric heat coils do not provide convective heat. The electric coil and the unit fans will be brought on to maintain the thermostat setting.

Typical Temperature Control

In general, unit ventilators require the following basic DDC electrical components in order to operate on any of the standard unit ventilator ASHRAE cycles of control. The control components listed in this section are for familiarization purposes only and should not be construed as a bill of material.

Outdoor Air Damper Actuator

This is a modulating device under the control of the room and discharge sensors. It positions the outdoor air damper to admit the amount of outdoor air required at any given point in the control cycle. The room air damper is mechanically linked to the outdoor air damper, which permits the use of a single actuator. Electric actuators should be of the spring-return type so that the outdoor air damper closes whenever the electric power supply to the unit is interrupted.

Discharge Airstream Sensor

This device overrides the room sensor and modulates the outdoor air damper toward the closed position when the unit discharge air falls to a potentially uncomfortable temperature.

Electric Heat Step Control:

A modulating step controller, under control of the room sensor, steps individual electric heating elements on and off as required. Staging relays are sometimes used in lieu of a step controller.

Room Temperature Sensor

The room temperature sensor is a device that modulates the intensity of an electric signal to the controlled components within the unit to maintain the room sensor's comfort setting. Room sensors can be mounted on the wall or within the unit.

Room Temperature Sensor Chamber:

When the Room Temperature Sensor is to be mounted within the unit ventilator rather than on the wall, it is located behind a series of holes in the unit front panel with the sensing element sealed within the room temperature chamber. The room temperature chamber is a standard feature with units furnished with MicroTech controls.

DX Cooling Low Ambient Lockout:

This lockout must be used on DX systems to lock out the condensing unit when the outdoor air temperature is below 64°F (17.5°C). This device must be integrated into the control system so that the unit has full ventilation cooling capability during the lockout period.

DX Low Temperature Limit:

This limit must be used on DX cooling units to de-energize the compressor when the refrigerant falls below freezing. DX units with MicroTech controls have a factory-installed sensor on the return bend of the DX coil that provides a sample of the coil's temperature.

Two Stage Compressors

Our self-contained units with the two-stage compressor will run on lower fan speeds up to 70% of the time, improving comfort through better humidity control and quieter operation, while minimizing issues with over sizing. The unit is designed to operate in low compression mode while in medium and low fan speed. The reduced cooling/heating capacity in the medium and low fan speed will allow the system to run longer at moderate and low load conditions providing better humidity control. When the high capacity is needed the high speed will provide high compression and full capacity cooling/heating.

Long Lasting Electric Heating Coils

With our draw-thru design, electric coils are directly exposed to the air stream. They come with a built-in switch to de-energize the coil when the center front panel is removed. A unit-mounted disconnect switch is included. A continuous electric sensory element for high temperature is not required because the air is drawn smoothly and evenly across the coils, prolonging life. (Blow-thru designs use cal rods inserted into the tube of a fin tube coil that results in reduced heat transfer. The constant movement of the electric heating cal rod within the tube shortens life.)

ASHRAE Cycle II

We strongly recommend that ASHRAE Cycle II be implemented with all unit ventilators using controls by others. ASHRAE Cycle II is a very economical sequence since only the minimum amount of outside air is conditioned and free natural cooling is available.

During warm-up (any classroom temperature 3°F or more below heating setpoint), the outdoor air damper is closed and the unit conditions only room air. As room temperature approaches the heating setpoint the outdoor air damper opens to a position that permits a predetermined minimum amount of outside air to be drawn in. Unit capacity is then controlled as needed to maintain room setpoints. If room temperature rises above room cooling setpoint, and the outside air is adequate for economizer cooling, then the outdoor air damper may open above the minimum position to provide economizer cooling.

ASHRAE Cycle II requires that a minimum of three temperature measurements be made:

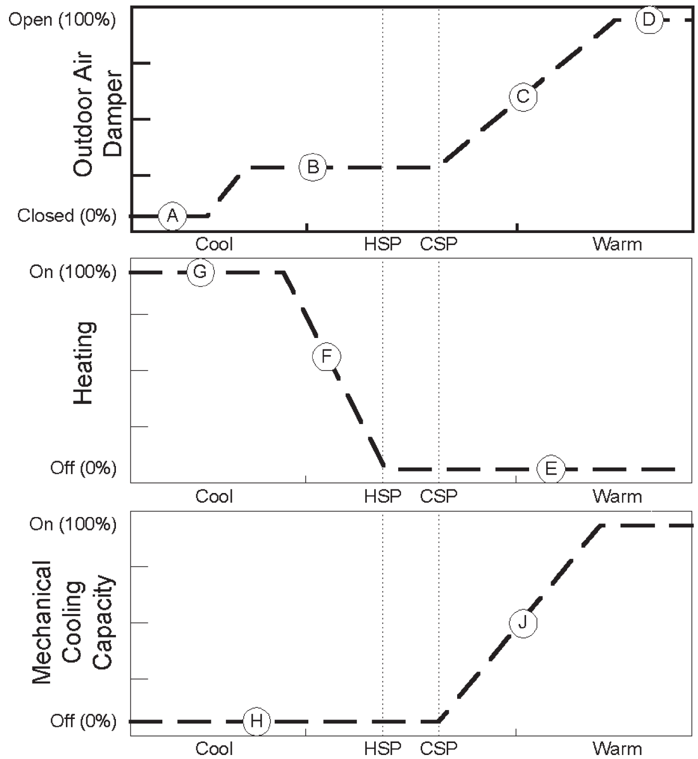
1. Classroom temperature.
2. Unit discharge air temperature.
3. Outdoor air temperature.

Additionally, the control sequence should incorporate a Discharge Air Low Limit function which requires a discharge air temperature sensor and can override classroom temperature control in order to maintain a discharge air temperature setpoint of 55°F.

When the discharge air temperature drops below 55°F, the discharge-air low-limit function will disable cooling (if enabled) and modulate the unit's heating capability as needed to maintain the 55°F discharge-air setpoint regardless of room temperature.

If the unit's heating capability reaches 100%, then the discharge air low-limit function will modulate the outdoor air damper toward closed to maintain the 55°F discharge air setpoint. Outdoor air temperature is used to determine when to use economizer as a first stage of cooling, and when to use mechanical or hydronic cooling as the first stage of cooling.

Figure 54: ASHRAE Cycle II Operation



Typical Outdoor Air Damper Operation

A Outdoor air damper closed.

B Outdoor air damper at minimum position.

C Economizer function is increasing the outdoor air damper position.

Note: *If outdoor air temperature is not adequate for free cooling, secondary mechanical cooling can be used in place of economizer cooling. A low discharge air function is used to help maintain comfort and provide additional equipment protection by preventing the discharge air from falling too low (typically 55°F), and may force the outdoor air damper toward closed to maintain the discharge air temperature regardless of room temperature.*

D Damper is at full open.

Typical Heating Operation

E Heating capability is closed (or off).

F Heating begins to modulate (or on).

G Heating capability has reached 100%.

Typical Mechanical Cooling Operation

H Mechanical cooling (DX) is closed (or off).

J Mechanical cooling (DX) has reached 100%.

Unit Installation

The floor unit ventilator is typically applied exposed on an outside wall below a window in the classroom. This allows fresh air (outdoor air) to be directly fed into the classroom after filtering or tempering. The floor unit is usually mounted flush against the wall with the fresh air opening in the back and the return air opening in the front. All units have a fully insulated back with gasketing for added protection.

Wall and Floor Considerations

It is critical to consider the floor and wall structures when installing floor-mounted unit ventilators. The following requirements apply:

- The unit must be securely mounted against an outside wall into which an opening is cut for an outdoor air intake louver.
- Placement of the outdoor air intake louver is critical for proper ventilation. It must be unobstructed, with no plants, trees or walls blocking the opening within 3 feet.
- Four pre-drilled holes are provided for securing the unit to the wall. Structural members must be available in the wall to support these attachments. Securing the unit to the wall compresses the unit back insulation and gasketing to help prevent air leaks and freezing of piping or coils.
- The floor must have sufficient strength to support the unit and prevent tipping.
- Space must be available under the floor to feed piping supply and return lines to the unit.

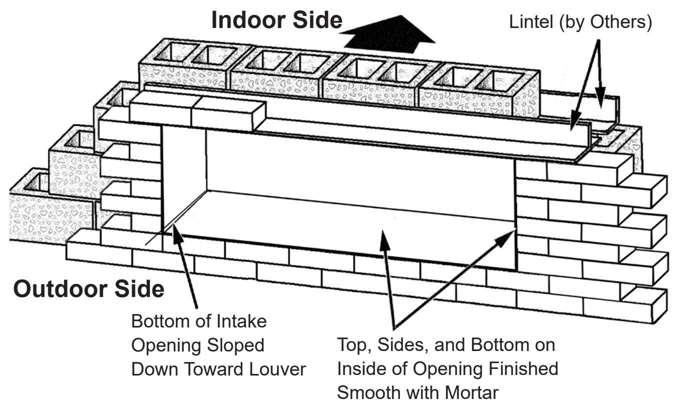
The following are general instructions for suggested applications. In all cases, good engineering practices and local codes must be followed.

Lintels

When brickwork is built up to the top of the intake, lintels must be used above the wall louvers. While the wall is still wet, finish the brick on the top, bottom and both sides of the intake opening with 1/2" cement mortar. With the standard location of the wall louver, the bottom of the intake opening must slope from the louver frame up toward the intake opening to a point 1" above the finished base of the unit.

If a metal sleeve connection is to be used between the unit ventilator and the wall louver, this sleeve must be installed after the unit ventilator is set, making a weather-tight connection to the unit ventilator cabinet. Turn the sleeve over the edge of the louver frame by proper peening before the louver is finally installed.

Figure 55: Typical Wall Opening with Lintels



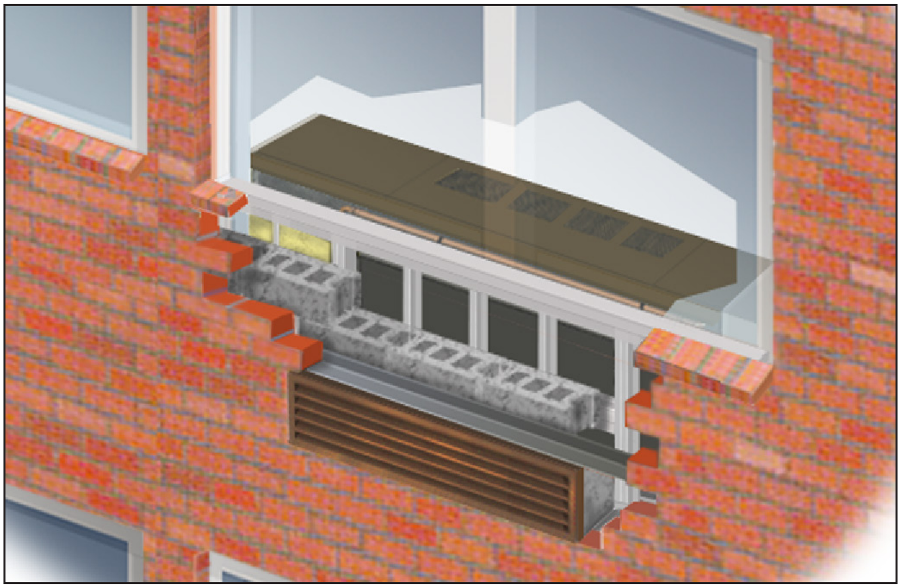
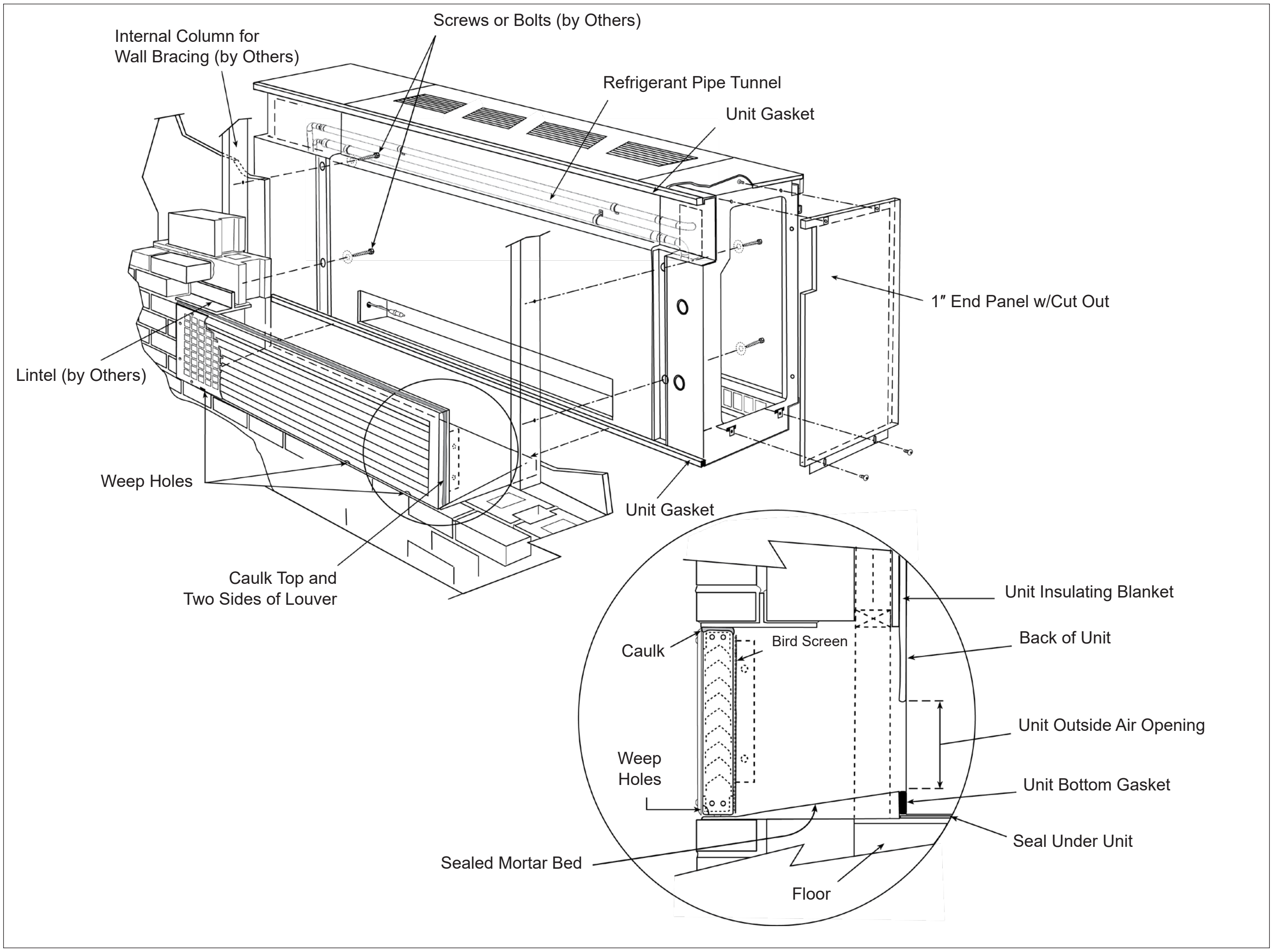


Figure 56: Typical Classroom Unit Ventilator Installation and Louver Details



Wall Louvers

The outdoor air wall louver is usually set directly back of the unit ventilator. The position of the wall louver is determined in general by the building construction. The top of the lower channel of the louver frame should be at least 1/2" below the level of the inlet to the unit ventilator.

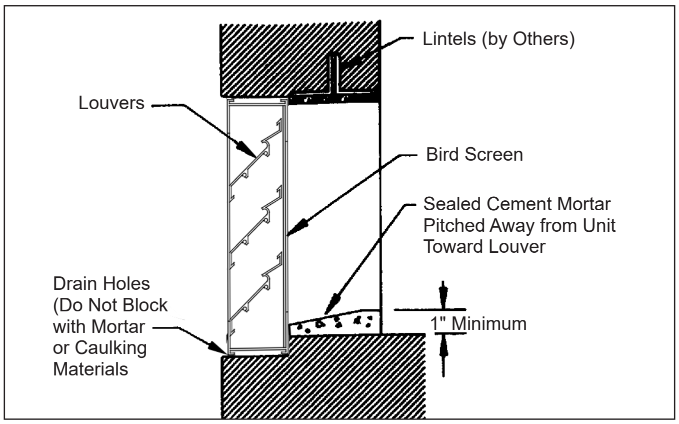
However, if a high intake opening is necessary, the top of this opening should be not more than 28" above the surface upon which the unit ventilator will set.

Recessed Wall Louvers

Set recessed wall louvers into the wall in a bed of mortar with the face of the louver frame set slightly inside the wall line. The complete wall louver frame must be level with the face plumb and the louver frame set so that the drain holes on the bottom are toward the outside of the building.

The mortar should seal the frame perimeter water-tight to help prevent leaks. Do not block drain holes in the frame with mortar (Figure 57).

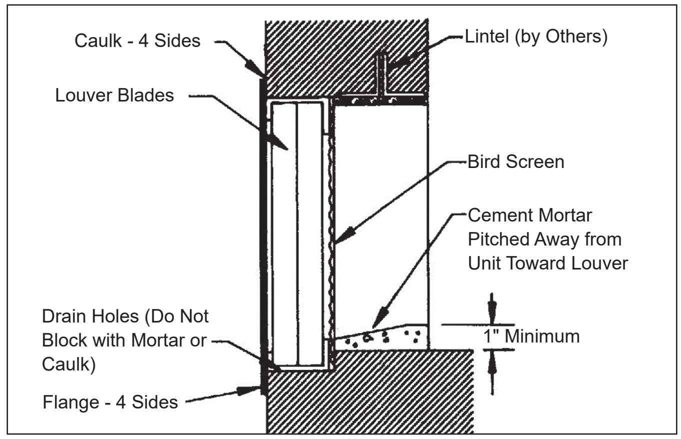
Figure 57: Recessed Wall Louver Installation Detail



Flanged Wall Louvers

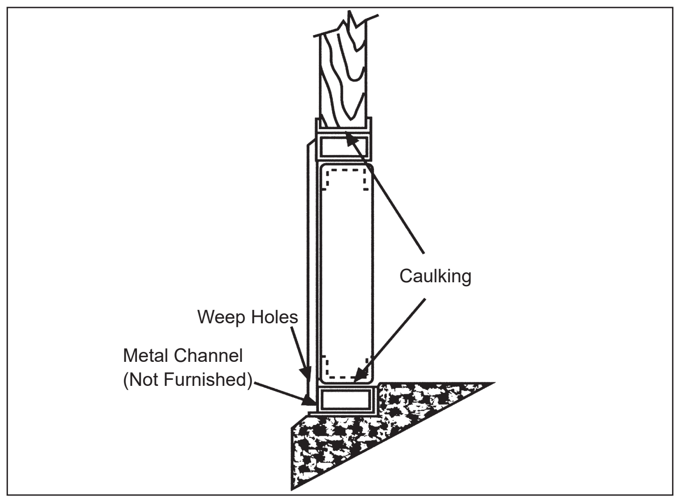
Set flanged wall louvers into the wall in a bed of mortar with the face of the louver frame flush with the wall line (Figure 58). The complete wall louver and frame must be set level. Do not block drain holes in the frame with mortar.

Figure 58: Flanged Wall Louver Installation Detail



Use appropriate fasteners to secure the louver through the flange into the adjacent wall. Caulk the entire perimeter of the flange. For panel wall construction applications, caulk and seal the top and vertical sides of the vertical blade louver. Be sure that the drainage holes are pointing outward and that a metal channel is used to drain moisture (Figure 59).

Figure 59: Panel Wall Louver Installation Detail



Interior Considerations

The interior wall surface behind the unit ventilator must be smooth and level. A wall that is slightly out of plumb can cause major problems with outside air leakage into the room and unit. This could cause drafts and potentially freeze coils.

Be certain that no gap is left between the unit and the outside air louver opening. Otherwise, outside air can leak into the room.

A rubberized, self-adhering membrane around the outside air opening can be used to seal any air or water leaks that might result from construction. Provide a seal under the unit to prevent air infiltration. In addition, seal the unit top and side perimeters to prevent unnecessary air infiltration due to uneven walls.

Indoor Air Exhaust Considerations

All outdoor air introduced by the unit ventilator must leave the room in some way. In some states, exhaust vents are required by law. In states where vents are not required by law, a decision must be made about how best to handle this problem.

The venting system chosen should have the ability to exhaust varying amounts of air equal to the amount of outside air introduced by the floor unit ventilator. A constant volume system, such as a powered exhaust, is unable to respond to changing conditions. It will either exhaust too much air, resulting in a negative pressure, which draws in more outdoor air than desired. Or, it will exhaust too little air, resulting in increased positive pressure, which restricts the amount of outside air being brought into the room.

The Daikin Applied VentiMatic shutter is a more economical solution to the problem. See "VentiMatic Shutter Room Exhaust Ventilation" on page 25 for information on this system and its proper installation.

VentiMatic Installation Considerations

Figure 60: VentiMatic Shutter Components

Louver Ships Assembled as One Piece

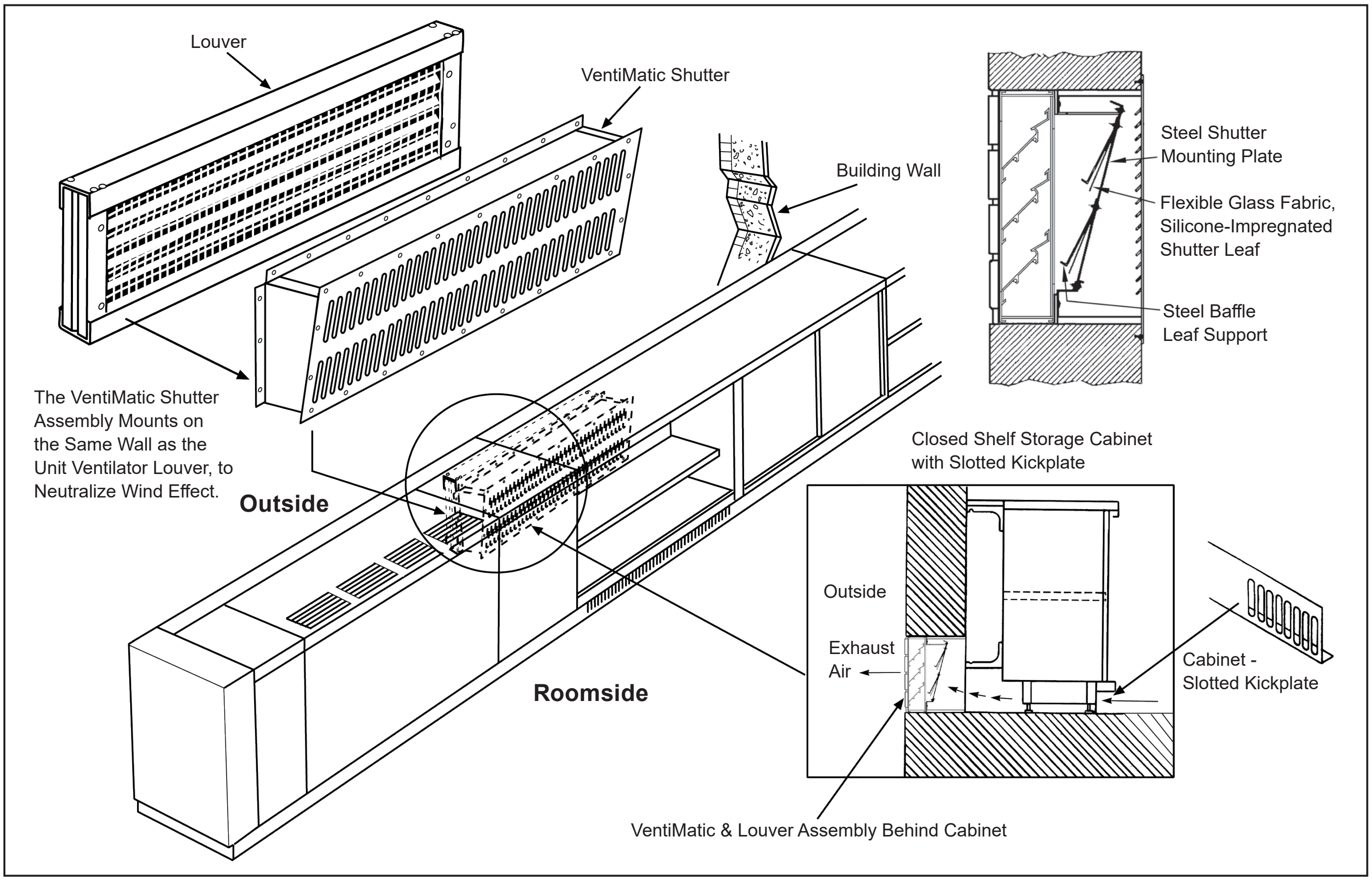
The VentiMatic Shutter should be mounted on the same wall as the unit ventilator. This neutralizes the effect of wind pressure forcing excess air into the room through the unit ventilator louver. That's because the wind press air flow that could occur with opposite-wall mounting.

The VentiMatic Shutter is generally mounted on an Daikin Applied wall louver (ordered separately) which is then used for exhaust (Figure 61). For large unit ventilators, two VentiMatic Shutters may be mounted side by side on the same wall louver to adequately promote exhaust air capacity. The size and appearance of wall louvers and grilles used for unit ventilators and for VentiMatic Shutters are identical and present an architecturally coordinated and pleasing installation.

An ideal method of integrating the VentiMatic Shutter with the unit ventilator is to locate the shutter behind a matching open-shelf or closed-shelf storage cabinet mounted next to the unit ventilator. For example, 48-inch-length wall louver can be accommodated behind a 4-foot-high storage cabinet. The cabinet should be ordered with a slotted-type kick plate to provide a concealed exhaust air path to the shutter. This combination will enable a complete, integrated, energy-efficient HVAC and room exhaust system

Note: *Storage cabinets are provided by others. Contact your Daikin Applied sales representative for options.*

Figure 61: VentiMatic Shutter Installation



Engineering Specifications

DAIKIN APPLIED UNIT VENTILATOR – MODELS ARQ AND GRQ

PART 1--GENERAL

1.01 WORK INCLUDED:

A. The contractor shall furnish and install packaged unit ventilator systems, of the capacities, performance, and configuration, as indicated in the unit schedule. Each unit shall be complete with factory furnished components and accessories as shown in the plans and as specified herein.

B. Electrical work required as an integral part of the temperature control work is indicated on the mechanical drawings and is the responsibility of the HVAC contractor to hire the services of a temperature control contractor and/or system integrator contractor to provide a complete system to perform the sequence of operation shown, or as described in this specification. The full sequence of operation must be provided and installed by this contractor for all trades.

1.02 SUBMITTALS:

A. Submit schedule for all types, sizes, and accessories. Schedule shall include certified performance data, room locations, and all operating data.

B. Submit shop drawings for all units including all dimensional information, construction details, installation details, required opening sizes, roughing locations for piping and electrical work, and accessory equipment. Equipment must meet specifications. Where deviations from the specifications exist, they must be identified.

C. Provide field wiring diagrams for all electrical power and temperature control field-wiring connections.

D. Submittals shall also include complete operating and maintenance instruction manuals and unit specific replacement parts lists.

1.03 QUALITY ASSURANCE:

A. Unit ventilators shall be listed by Underwriters Laboratories Inc. (U.L.) for the United States and Canada.

B. Motors shall conform to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards.

C. Unit ventilation rate to be certified and tested per International Standard ISO 13256-1.

D. Unit to be certified and labeled compliant with the seismic design provisions of the International Building Code (IBC) Chapter 16 and independent test agency requirements of Chapter 17.

PART 2--PRODUCTS

2.01 CABINET AND CHASSIS:

A. Unit frames shall be of unitized, welded construction, with structural elements aligned in an assembly jig prior to welding, to insure proper dimensions, rigidity, and squareness.

B. Internal sheet metal parts shall be constructed of galvanized steel to inhibit corrosion.

C. Exterior cabinet panels shall be fabricated from furniture grade steel of not less than 16 gauge steel with no sharp edges and no unsightly screw heads and shall receive an electrostatically applied, oven cured environmentally friendly thermosetting urethane powder paint finish to provide a high quality appearance. Finish color shall be as selected by Architect from manufacturer's standard colors.

D. The interior areas of the unit ventilator shall be insulated for sound attenuation and to provide protection against condensation of moisture on or within the unit. The unit shall be provided with an ultra-quiet sound package consisting of acoustically matched low speed fans to fan housing, sound barrier insulation material (non-fiberglass) adhered to the bottom underside of the unit top panel, sides of the fan section and sound absorbing insulation (non-fiberglass) material applied to the unit front panel.

E. Units shall be constructed so that testing and troubleshooting can be accomplished in the end pockets of operating units, without affecting the normal air flow patterns through the unit.

F. Each unit shall be provided with a non-fused power interrupt switch that disconnects the main power to the unit for servicing or when the unit is to be shut down for an extended period of time. The fan motor and controls shall have the hot line(s) protected by factory installed cartridge type fuse(s).

2.02 COILS

A. All air-to-refrigerant coils shall be installed in a draw through position to assure uniform air distribution over the full-face area of the coil, and an even unit discharge temperature.

B. All air-to-refrigerant cooling coils shall be constructed with copper tubes and mechanically bonded aluminum corrugated plate type fins. All coils shall have aluminum individual unshared fin surfaces. An air break shall exist between coils.

C. Air-to-refrigerant coils shall be supplied with factory-installed thermal expansion valves in lieu of capillary tubes to achieve evaporator performance and to protect the compressor from floodback of liquid refrigerant, venturi type refrigerant distributor and a refrigerant low temperature limit.

D. Electric heat coils shall be open wire (cal rods inserted into a tube shall not be acceptable). Electric heat coils shall have the following factory-installed safety devices or an automatic reset high temperature limit and a manual resetable high temperature limit that requires a maintenance operator to determine the cause of the trip.

2.03 FANS AND MOTOR

A. The fan and motor assembly shall be of a low-speed design to assure maximum quietness and efficiency.

B. Fans shall be double-inlet, forward-curved, centrifugal type with offset aerodynamic blades. Fans and shaft shall be statically and dynamically balanced as an assembly in the unit before shipment.

C. Fan housings shall be constructed of galvanized steel incorporating logarithmic expansion for quiet operation. Fan and motor assembly shall be of the direct drive type. Belt drive fans shall not be allowed.

D. Motors shall be 115 volt, single phase, 60 Hz, NEMA permanent split capacitor (PSC), plug-in type with auto reset internal thermal overload device designed specifically for unit ventilator operation. Motors shall be located out of the conditioned air stream.

E. Units shall have sleeve-type motor and fan shaft bearings and shall not require oiling more than annually.

F. Motor speed shall be controlled by factory-mounted multi-tap transformer for three (3) speeds, HIGH-MEDIUM-LOW-OFF (not accessible from the exterior of the unit). Fan motor and controls shall each have hot leg protected by a factory-installed cartridge fuse.

2.04 OUTDOOR & ROOM DAMPERS

A. Each unit shall be provided with separate room air and outdoor air dampers.

B. The room air damper shall be fabricated from aluminum, and be counterbalanced against backpressure to close by gusts of wind pressure, thereby preventing outdoor air from blowing directly into the room.

C. The outdoor air damper shall be two-piece, double wall construction fabricated from galvanized steel, with ½" thick, 1½ lb. density glass fiber insulation encapsulated between the welded blade halves for rigidity and to inhibit corrosion. The outdoor air damper shall have additional foam insulation on the exterior surface damper blade and on the ends of the outdoor air chamber. A single blade damper, which can be twisted and will leak air, will not be considered.

D. Dampers shall be fitted with blended mohair seals along all sealing edges. Pressure adhesive sponge neoprene or plastic clip-on brush type sealers for damper seals are not acceptable. Rubber type gasket using pressure adhesive for fastening to metal and exposed to the outside air is not acceptable.

E. Dampers shall use the turned-metal principle on long closing ends with no metal-to-metal contact for proper sealing.

F. The damper shaft shall be mechanically fastened to the blade, and shall operate in bearings made of nylon or other material, which does not require lubrication.

2.05 FILTER

A. Each unit ventilator shall be equipped with a one-piece filter located to provide filtration of the return air/outdoor air mixture, in lieu of separate filters for each air stream. The entire filter surface must be usable for filtration of 100% room air or 100% of outdoor air. The filter shall be easily accessible from the front, and removable in one piece without removal of the unit return air damper stop. The unit shall ship with a factory-installed 1" thick fiberglass, single-use type.

B. Spare filters shall be:

1. 1" thick fiberglass, single-use type OR
2. 1" thick permanent wire mesh washable OR
3. 1" thick permanent metal frames with replaceable media.

2.06 REFRIGERATION SYSTEM

A. The refrigeration section shall be constructed of galvanized steel and shall include a factory-sealed, factory-piped assembly consisting of a hermetically sealed compressor, a water-to-refrigerant heat exchanger, an air to refrigerant coil, reversing valve, and safety and operating controls. The reversing valve shall have a replaceable external solenoid coil which shall be energized only when space heating is required. The entire refrigeration system shall ship as an integral completed assembly, which shall be evacuated, charged and run-tested prior to shipment.

B. Standard range (ARQ) water source heat pumps shall operate with entering water temperatures down to 60°F and must be rated in accordance with ISO Standard 13256-1 conditions.

C. The air-to-refrigerant heat transfer coil shall include a thermostatic expansion valve with external equalizer and venturi type refrigerant distributor. A low refrigerant temperature sensor shall be factory-installed in a u-bend of the air-to-refrigerant heat transfer coil to protect the system during low refrigerant suction conditions.

D. Refrigerant shall be metered by a thermostatic expansion valve in lieu of capillary tubing to achieve evaporator performance and to protect the compressor from floodback of liquid refrigerant.

E. The unit shall be furnished and wired with compressor thermal/current overload and high-pressure cutout. Gauge ports shall be provided to allow reading of refrigerant pressures at the suction and discharge of the compressor. Compressor shall be equipped with internal pressure relief valve to protect against excessive pressure buildup.

F. The water to refrigerant coil shall be of plate heat exchanger type. It shall be constructed to be suitable for 300 pound water working pressure and 650 pound refrigerant pressure.

NOTICE

The water loop must be flushed prior to installation and operation of the unit ventilator. Install a 20-micron strainer in the water supply line of the water/refrigerant heat exchanger.

G. Units with three-phase power shall utilize three-phase compressors for balanced electrical compressor loads.

H. Single-phase units shall have permanent split capacitor (PSC) compressor motor.

I. Acoustic Treatment

1. The refrigeration system shall come with an Ultra Quiet configuration using the following: The compressor shall be mounted on neoprene compressor isolators for external vibration isolation. The compressor shall be connected by attenuation loops in both the suction and discharge lines to prevent transmission of vibration to other components within the section. Compressor enclosure panels shall be 16-gauge minimum and cross broken for additional rigidity to dampen vibration. Compressor jackets or compressors without their own enclosure cabinets shall not be acceptable. The complete interior of the compressor compartment shall be lined with a multi-functional material that serves as a sound barrier, an absorber of sound and also must act as a decoupler to the compressor enclosure. This multi-functional material shall have a mylar coating on the face to act as a sound reflector and to increase the strength of the material. Damping material shall be textured foam type. The exterior of the compressor compartment shall be coated with a high-density damping material to eliminate impact noise and vibration. The right end panel, right hand front panel, 36" (914 mm) of the right hand end of the center front panel and the hinged top access door shall be coated with a high-density material to eliminate noise and vibration. Insulated drain pan shall be positioned beneath the air-to-refrigerant coil. Drain connection shall be field reversible for left- or right-hand drain line.

J. Boilerless systems - Units shall utilize refrigerant reverse cycle operation for heating and cooling. The unit shall also be provided with an electric heating coil in the reheat position of the unit refrigerant coil for when the entering water temperature drops below 60°F (standard range) or 50°F (extended range). An automatic reset type high limit thermostat shall be provided to disconnect the heating elements through backup contactors if an overheat condition is detected.

K. A safety interlock switch shall be furnished to interrupt the electric heater operation when the unit front center access panel is opened or removed.

L. An emergency electric heat switch shall be furnished to allow the unit to be manually switched to electric resistance heating in case the reverse cycle heating system becomes inoperative. This shall permit the electric resistance heaters to operate as needed regardless of loop water temperature.

2.07 CONTROL COMPONENTS

A. Each unit ventilator shall be furnished with a factory installed and wired, microprocessor based DDC Unit Ventilator Controller (UVC), by the manufacturer of the unit ventilator, which is pre-programmed, factory pre-tested prior to shipment and capable of complete, stand-alone unit control or incorporation into a building-wide network using an optional plug-in communication module. The UVC shall be preprogrammed with the application code required to operate the unit using ASHRAE Cycle II. The unit control system shall include all required temperature sensors, input/output boards, main microprocessor modules, Local User Interface (referred to as LUI) Touch Pad with Digital LED Display, wiring, 24-volt power and direct coupled damper actuators. The UVC shall support up to 6 analog inputs, 12 binary inputs, and 9 binary outputs plus additional I/O points of 4 analog inputs and 8 binary outputs.

B. The Outdoor Air/Return Air Damper Actuator shall be direct coupled, floating point actuator that spring returns the outdoor air damper shut upon a loss of power.

C. A low refrigerant temperature sensor shall be factory-installed on a U-bend of the coil to protect the refrigerant system during low refrigerant suction conditions.

D. The LUI shall provide a unit mounted interface which indicates the current unit operating state, room temperature setpoint, and can be used to adjust the unit ventilator operating parameters (operating mode, fan speed and occupancy mode). The LUI shall have a digital display, 7 keys (1 key hidden for parameter menu access), 9 individual LED indicators and 4-level password protected security feature.

E. The unit controller shall monitor room conditions, and automatically adjust unit operations (fan speed, temperatures, etc.) to maintain pre-programmed temperature setting selection ranges and ventilation requirements. The control sequence shall be on the basis of ASHRAE Cycle II for normal classroom locations, but shall have exhaust fan interlock for override to bring in full outside air for laboratory/science room applications. The fan speeds shall be high constant, medium constant, low constant and auto, which shall vary the airflow in direct relation to the room load. The fan shall not change speeds in less than ten minutes in any one mode. Two constant fan speed operation shall not be acceptable.

F. Each Local User Interface (LUI) Touch Pad shall have a Digital LED Display status/fault indication.

G. Controls shall allow monitoring and adjustment from a portable IBM compatible PC using the applicable software. When using this PC and software, the unit shall be capable of reacting to commands for changes in control sequence and set points.

H. All units shall come equipped with a factory-mounted room temperature sensor located in a sampling chamber (front, center panel) where room air is continuously drawn through for fast response to temperature changes in the room. When using a remote wall-mounted temperature sensor the ability shall exist to simply disconnect the unit-mounted temperature sensor using the provided quick disconnect plug.

I. A discharge air temperature sensor shall be factory located on the second fan from the right to constantly sense unit discharge air temperatures. The unit's discharge air temperature sensor shall work in conjunction with the room temperature sensor to provide for stable discharge air temperatures, even in the event of rapid changes in outdoor air quantities.

J. An outdoor air temperature sensor shall be factory located in the outside air prior to the outside air damper to continually sense outdoor air temperature.

K. A tenant override switch shall be factory-mounted next to the Local User Interface (LUI) Touch Pad to provide a momentary contact closure that causes the unit to enter the "tenant override" operating mode for a set time period (adjustable) of 120 minutes. The tenant override switch shall cause a unit operating in the unoccupied mode (temperature set-back/set-up, and no outdoor ventilation) to return to the occupied mode for two hours (adjustable) and then the system shall automatically return to unoccupied mode. The room temperature sensor and override switch shall:

1. Both be unit mounted OR
2. Be an optional wall mounted temperature sensor, with integral tenant override capability.

L. The unit shall have three (3) multi-pin External Signal Connection Plugs factory provided and pre-wired with short wire whips that are capped for field wiring of:

1. A Remote Wall Mounted Temperature Sensor.
2. External Input Signals (by others): unoccupied, remote shutdown, ventilation lockout, dew point/ humidity, or exhaust interlock signals. (Available inputs may vary by unit model. Not all functions can be used at the same time).
3. External Output Options (by others): lights on/off, motorized water valve open/close, fault indication signal, pump restart, exhaust fan on/off or auxiliary heat signal. (Available outputs may vary by unit model. Not all functions can be used at the same time).

2.08 CONTROL FUNCTIONS

A. The Unit Ventilator Digital Controller (here after referred to as UVC) shall support ASHRAE Cycle II operation. The control cycle shall be used to maintain the required minimum amount of ventilation whenever possible, which can be increased during normal operation for economizer cooling , but can also be reduced to prevent excessively cold discharge air temperatures.

B. A discharge air temperature sensor shall be installed in all unit ventilators. The ASHRAE II control algorithm shall override room control and modify the heating, ventilating, and cooling functions (as available) to prevent the discharge air temperature from falling below the Ventilation Cooling Low Limit (here after referred to as VCLL) setpoint.

C. Description of Operation

1. The Unit Ventilator UVC shall use State Machine programming concepts to define and control unit ventilator operation. This shall eliminate the possibility of simultaneous heating and cooling, rapid cycling, etc., and simplify sequence verification during unit commissioning or troubleshooting.
2. Super States shall group two or more related states into a single control function such as cooling, or heating, etc. States shall be where all the actual work takes place. Thus within each state the UVC shall enable PI loops and other logic sequences required to control unit ventilator operation within that particular state, while other functions and PI-loops not needed during that state may be disabled. Transitions shall be the logic paths used to determine which State should be made active. These shall be the "questions" the UVC will continually consider/determine for which path is followed and which state is active.
3. The UVC States and Super States shall be used to define the "normal" unit modes, such as Off, Fan Only, Heat, Emergency Heat, Cool, Auto, Night Purge, and Dehumidification. The UVC shall support several "non-normal" unit modes such as Purge, Pressurize, De-pressurize, and Shutdown, which can be forced via a network connection and override typical UVC operation.

D. Modes of Operation

1. The UVC shall provide several "normal" Modes of unit operation, these shall include Off, Fan Only, Heat, Emergency Heat, Cool, Heat and Cool, Auto, and Night Purge.

E. Off Mode

1. An Off Mode shall be provided so that the UVC can be forced into a powered off condition. The Off mode shall be a "stop" state for the unit ventilator; it shall not be a power off state. The Local User Interface module (here after referred to as LUI) or a network connection shall be able to force the unit into the Off mode.
2. Non-normal unit modes (i.e. Purge, Pressurize, and De-pressurize modes) accessed via a network connection shall be able to force the UVC to perform "special" functions during which the UVC shall appear to be in the Off mode.

F. Fan Only Mode

1. A Fan Only Mode shall be provided so that the UVC can be forced into a Fan Only operation. The LUI or a network connection shall be able to force the unit into the Fan Only Mode.

G. Heat Mode

1. A Heat Mode shall be provided to force the UVC shall use primary heat (compressor heat) and secondary heat (electric) as needed to maintain

the effective heating setpoint. The LUI or a network connection shall be able to force the unit into the Heat mode.

2. When the Heat mode super state becomes active, the UVC shall automatically determine which UVC State to make active; Heat, Low Limit, or Cant Heat based upon the transitions for each of those states. The UVC shall remain in this super state until one of the transition out conditions become true.
3. The Heat State shall be the “normal” state that the UVC will go into when Heat mode is active. When the Heat State becomes active, the UVC shall continually calculate the Discharge Air Temperature Setpoint (here after referred to as DATS) required to maintain the effective heat setpoint (Space Temperature Setpoint). The calculated DATS shall not be allowed to go above Discharge Air High Limit (here after referred to as DAHL). The UVC shall use primary heat (compressor heat) and secondary heat (electric) as needed to maintain the current DATS.
4. A Low Limit Heat State shall be a “non-normal” state that shall become active if during Heat mode the unit reaches 100% heating and is unable to meet the current Discharge Air Temperature Setpoint required to maintain the effective heating setpoint.
5. The Cant Heat State shall be a “non-normal” state that the UVC can go into when Heat mode is active. Sensor faults, etc., during the Heat mode shall cause the UVC to make the Cant Heat State active. When the Cant Heat State becomes active, no heating or ventilation shall take place. The OA damper shall be closed.

H. Cool Mode

1. A Cool mode shall be provided to force the UVC into Cool Only operation. The Cool mode shall use primary cooling (economizer) and secondary cooling (mechanical compressor type) as needed to maintain the effective cooling setpoint. The LUI or a network connection shall be able to compel the unit into the Cool mode. Additionally, the UVC when set to Auto mode shall automatically compel the unit into the Cool mode as needed.
2. When the Cool mode becomes active, the UVC shall automatically determine which UVC state to make active, Econ, Econ Mech, Mech, DA Heat, Low Limit, Cant Cool, or Dehumidify based upon the transitions for each of those states.
3. An Econ State shall be provided as a “normal” state that the UVC can go into when Cool mode is active. The Econ State shall be typically active in the Cool mode when primary cooling (economizer) is available and adequate to meet the cooling requirements. When the Econ State becomes active, the UVC shall use economizer cooling as needed to maintain the effective cooling setpoint. The UVC shall monitor the DAT to ensure it does not fall below Ventilation Cooling Low Limit (here after referred to as VCLL) setpoint.
4. An Econ Mech State shall be provided as a “normal” state that the UVC can go into when Cool mode is active. The Econ Mech state shall typically be active in the Cool mode when primary cooling (economizer) alone is not adequate to meet the cooling requirements and both primary cooling and secondary cooling are available. When the Econ Mech State becomes active, the OA damper shall be set to 100% open, and the UVC shall use the units mechanical cooling capabilities as needed to maintain the effective cooling setpoint. The UVC shall monitor the DAT to ensure it does not fall below the Mechanical Cooling Low Limit (here after referred to as MCLL) setpoint.
5. A Mech State shall be provided as a “normal” state that the UVC can go into when Cool mode is active. The Mech State shall be typically active in the Cool mode when primary cooling (economizer) is not available and secondary cooling (compressor) is available. When the Mech State becomes active, the UVC shall use the unit's mechanical cooling capabilities as needed to maintain the effective cooling setpoint. The UVC shall be configured to operate the compressor as secondary (mechanical) cooling when the economizer is available, when the economizer is not available and the compressor is available then the UVC shall use the compressor when cooling is required. A compressor envelope shall be established using a sensor on the air-to-refrigerant and water-to-refrigerant coils to monitor refrigeration temperature conditions. This envelope shall protect the compressor from adverse operating conditions, which can damage or shorten compressor life by ending compressor operation if coil temperatures exceed the defined operating envelope.
6. A DA Heat State shall be provided as a “normal” state that the UVC can go into when Cool mode is active. The DA Heat State shall be typically active when reheat is required to maintain VCLL while maintaining the required OA damper position. When DA Heat State is active, then the UVC shall use the units heating capability as needed to maintain the VCLL setpoint. The Heat Timer (3-minutes fixed) shall begin counting. The UVC shall remain in this state until one of the transition out conditions become true, or until one of the super state transition out conditions becomes true.
7. A Low Limit State shall be provided as a “non-normal” state that the UVC can go into while Cool mode is active. The Low Limit state shall typically follows the DA Heat state when the UVC has reached 100% heat and still cannot maintain VCLL. When the Low Limit State becomes active, the Low Limit PI-loop shall override the OAD minimum position and adjust the OAD toward closed as necessary to maintain the DAT setpoint.

I. Auto Mode

1. An Auto mode shall be provided so that the UVC

can be set to automatically determine if heating, cooling or dehumidification is required. The Auto mode shall be the default start-up UVC mode. Auto mode shall be made up of the Heat and Cool modes. With the UVC set to auto mode, the UVC shall determine which mode (Heat or Cool) to use.

J. Emergency Heat Mode

1. An Emergency Heat mode shall be provided for situations where the UVC is in a mode that does not normally allow heating, such as Off, Cool, Fan Only, Night Purge, etc. If Emergency Heat mode is enabled and the space temperature falls below the EHS, the UVC shall automatically force itself into the Emergency Heat mode from Off, Cool, Night Purge, Fan Only, Purge, Pressurize, De-pressurize, and Shutdown. Additionally, the LUI or a network connection shall be used to force the unit into the Emergency Heat mode. Emergency Heat mode shall consists of two UVC states: Full Heat and Cant Heat.
2. A Full Heat State shall be provided as the "normal" state that the UVC will go into when Emergency Heat mode is active. When Emergency Heat (EHS) mode becomes active, the UVC shall go into 100% heating until the space temperature raises to the EHS plus a fixed differential (9°F / 5°C). In the Emergency Heat mode the space fan shall be set to high speed, and the OA damper will operate normally.
3. The Cant Heat State shall be a "non-normal" state that the UVC can go into when Emergency Heat mode is active. Sensor faults, etc., during the Heat mode shall cause the UVC to make the Cant Heat State active. When the Cant Heat State becomes active, no heating or ventilation shall take place. The OA damper shall be closed.

K. Night Purge Mode

1. A Night Purge mode shall be provided to quickly ventilate a space. Night purge shall be used to remove odor build up at the end of each day, or after cleaning, painting, or other odor generating operations occur within the space. Night Purge shall be full ventilation with exhaust mode, during which room comfort will be compromised. The LUI or a network connection shall be able to force the unit into the Night Purge mode.
2. When Night Purge mode becomes active, the UVC shall stop all normal heating and cooling as any new energy used to treat the incoming air would be wasted in the purging process. In the Night Purge mode the unit classroom air fan shall be set to high speed, the OA damper will be set to 100% open, and the Exhaust Fan binary output shall be set to On. If not set to another mode within 1-hour, the UVC shall force itself into the Fan Only mode. If the space temperature drops below the EHS, and the Emergency Heat function is enabled, the UVC shall be forced into the Emergency Heat mode.

L. Non-Normal Unit Modes

1. Additional UVC modes shall be provided that are considered non-normal unit modes. These shall include Pressurize, Depressurize, Purge, Shutdown and Energy Hold Off. These modes shall force the UVC to perform very specific and limited functions and shall be used with caution and only for short periods as needed. These modes shall be accessed only via a network connection.
2. In each of these non-normal UVC modes, if the space temperature drops below EHS, and the Emergency Heat function enables, the UVC shall be forced into the Emergency Heat Super State mode and then return once the Emergency Heat function is satisfied.
3. A Shutdown mode shall be provided that is the equivalent of the Off mode, but shall be an Off mode forced by a network connection. When in Shutdown mode the UVC shall stop all normal heating, cooling, ventilation (OA damper shall be closed), and fan operation. By default emergency heat shall not be used during the shutdown mode, however, the UVC can be configured (Emergency Heat Shutdown Configuration) to allow emergency heat operation during shutdown mode. The Shutdown mode shall be accessed via a network connection and a binary input to the UVC.
4. The UVC shall support an Energy Hold Off state, which when active forces the UVC to stop all normal heating, cooling and ventilation. This shall typically be used by a network connection to force the UVC to cease heating, cooling and ventilation when conditions exist where heating, cooling and ventilation are not required or desired. Energy Hold Off mode shall be similar to Shutdown mode except that Energy Hold Off always allows Emergency Heat if required. The Energy Hold Off mode shall be only accessed via a network connection.
5. The UVC shall in the Purge mode use the unit Classroom or Indoor Air Fan (here after referred to as IAF), OAD, and exhaust output as needed to purge the space. The UVC shall stop all normal heating and cooling but allow Emergency Heat if required. The purge mode shall be only accessed via a network connection.
6. The UVC shall in the Pressurize mode use the IAF, OAD, and exhaust output as needed to pressurize the space. The UVC shall stop all normal heating and cooling but shall allow Emergency Heat if required. The Pressurize Mode shall be accessed only via a network connection.
7. The UVC shall in the Depressurize mode use the IAF, OAD, and exhaust output as needed to depressurize the space. The UVC shall stop all normal heating and cooling but does allow Emergency Heat if required. The Depressurize Mode shall only be accessed via a network connection.

M. Occupancy Modes

1. The UVC shall be provided with four occupancy modes: Occupied, Standby, Unoccupied, and

Bypass. The Occupancy mode shall affect which heating and cooling temperature setpoints shall be used, IAF operation, and OAD operation. The Manual Adjust Occupancy and Networked Occupancy Sensor network variables, along with the Unoccupied and Tenant Override binary inputs, shall be used to determine the Effective Occupancy.

2. The Occupied mode shall be the normal daytime mode of UVC operation. During Occupied mode the UVC shall use the occupied heating and cooling setpoints, the OAD shall operate normally, and by default the IAF shall remain on. A Networked Occupancy Sensor shall be able to interfaced with the Occupancy Sensor Input variable to select occupancy modes. When the Occupancy Sensor Input variable is used, it shall automatically override any hard-wired unoccupied binary input signal.
3. The Unoccupied Occupancy mode shall be the normal nighttime mode of UVC operation. During Unoccupied mode the UVC shall use the Unoccupied heating and cooling setpoints, the OAD shall remain closed, and the IAF shall cycle as needed for heating or cooling. The IAF shall remain off when there is no need for heating or cooling. A Unit-mounted factory-installed electronic 24-hour/7-day Time Clock shall be provided when the unit operates in Stand-alone or no Network is available. This time clock shall be factory wired to the UVC Unoccupied binary input and shall be settable to automatically place the unit into Occupied and Unoccupied modes based upon its user-configured schedule.
4. The Standby mode shall be a non-normal daytime mode of UVC operation. During Standby mode the UVC shall use the standby heating and cooling setpoints, the OAD shall remain closed, and by default the IAF shall remain on.
5. The Bypass mode (also called Tenant Override) shall be the equivalent of a temporary occupied mode. Once the Bypass mode is initiated it shall remain in effect for a set period of time (120-minutes default). During the Bypass mode the UVC shall use the occupied heating and cooling setpoints, the OAD shall operate normally, and by default the IAF shall remain on. A Tenant Override Switch shall be factory installed in all floor-mounted units. This Tenant Override Switch shall be located near the LUI on the unit. The Tenant Override Switch shall provide a momentary contact closure that can be used by room occupants to temporarily force the UVC into the Bypass Occupancy mode from Unoccupied mode. The optional Remote Wall-mounted Sensors shall include a Tenant Override Switch. This Tenant Override Switch shall provide a momentary contact closure that can be used by room occupants to temporarily force the UVC into the Bypass Occupancy mode from Unoccupied mode. The optional Remote Wall-mounted Sensors shall each indicate a UVC status LED. This status LED shall aid in diagnostics by indicating the UVC Occupancy mode and Fault condition.

N. Space Temperature Setpoints

1. The UVC shall use the six occupancy-based temperature setpoints for heating and cooling, Occupancy mode, and the value of the Network variables Space Temp Setpoint Input, Setpoint Offset Input and Setpoint Shift Input as the basis to determine the Effective Setpoint Output. The UVC shall calculate the effective setpoint based upon the unit mode, the occupancy mode, and the values of several network variables. The effective setpoint shall then be used as the temperature setpoint that the UVC will maintain.

O. LUI Setpoint Offset Adjustment

1. The LUI shall be used to make adjustments to the value of the Setpoint Offset Input variable.

P. [OPTIONAL] Expanded Remote Wall-Mounted Sensor with +/- 3°F Adjustment

1. When the optional Remote Wall-mounted Sensor with +/- 3°F adjustment dial is used, the UVC shall effectively write the value of the setpoint adjustment dial to the Setpoint Offset Input variable.

Q. Water-to-Refrigerant Coil Leaving Water Temperature Sensor

1. A water temperature sensor shall be factory provided to detect low leaving water temperature conditions on the water-to-refrigerant.

R. Indoor Air Fan Operation

1. The UVC shall support a three-speed IAF with Low, Medium, and High speed. The UVC will calculate the effective fan speed and operation based upon the unit mode, the occupancy mode, and the values of several network variables.
2. The UVC shall be provided with a user selectable Auto Fan Mode feature. When in auto fan mode, the UVC shall use the space temperature PI loop to automatically adjust the fan speed as needed to maintain space temperature. This shall ensure that the UVC will maintain the lowest and quietest fan speeds whenever possible. When in Auto Fan Mode, a maximum of 6 fan-speed changes per hour shall be allowed (by default), this shall prevent frequent automatic fan speed changes from disturbing room occupants. During occupied, standby and bypass modes the IAF shall, by default, remain On. During unoccupied mode the IAF shall typically remain off and shall cycle with calls for heating and cooling. The UVC shall be provided with a Fan Cycling Configuration variable that can be used to force the IAF to cycle with calls for heating and cooling during the Occupied, Standby and Bypass Occupancy modes. When the fan is off, the OA damper shall be closed. This feature shall only be used when it is acceptable that normal ventilation is not required. When the IAF is set to cycle, or during the Unoccupied mode, or when the UVC is placed into Off mode, the UVC shall be configured to continue fan operation for a time period (30-seconds default) after heating or cooling is complete.

S. Outdoor Air Damper Operation

1. The UVC shall be configured for an Outdoor Air Damper operated by a floating-point actuator. The OA damper actuator shall contains a spring to ensure that the OA damper is closed upon lose of power. The OA damper shall be typically open to the current minimum position during the Occupied and Bypass occupancy modes, and closed during the Unoccupied and Standby Occupancy modes.
2. The UVC shall be configured to maintain three Outdoor Air Damper minimum positions based upon the operation of the IAF. This shall allow the ability for each unit to be job site configured to provide the amount of fresh air required to the space at each of the three IAF speeds.
3. The Economizer function shall be used by the UVC to determine if the OA is adequate for economizer (primary) cooling. When both the economizer and mechanical cooling are available, the economizer shall be used as primary cooling and the UVC shall add mechanical cooling only if the economizer is not adequate to meet the current cooling load (i.e. the OA damper reaches 100% and cooling is still required). The UVC shall be configured to support the economizer type of (default) for which the UVC shall use two configuration variables for the Temperature Comparison Economizer: Economizer OA Temp Setpoint and Economizer Temp Differential. The Economizer Temperature Differential shall compare the classroom air temperature to the OA temperature. If the difference is greater than the economizer temperature differential and the Economizer OAT is below the temperature setpoint then the Economizer function shall be energized.

T. Actuator Auto-Zero, Overdrive and Sync

1. The UVC at power-up shall auto-zero actuators (OA damper) before going into normal operation to ensure proper positioning, this may take as long as 150-seconds after power-up.
2. The UVC shall be configured such that whenever a floating-point actuator is commanded to go to 0% or 100%, the UVC shall overdrive the actuator one full stroke period past the 0% or 100% position to ensure proper positioning.
3. Additionally, the UVC shall be configured to sync all actuators once every 12-hours of operation.

U. External Binary Inputs (Inputs vary by model type. Not all functions can be used at the same time)

1. The UVC shall be provided with three (3) binary inputs that can provide the following functions. These inputs each shall allow a single set of dry-contacts (no voltage source) to be used as a signal to the UVC, multiple units can be connected to a single set of dry-contacts.
2. External Binary Input 1 shall be able to be configured as an Unoccupied (default) or dew point/humidity signal. The Unoccupied Input Signal shall allow a single set of dry-contacts to be used to signal the UVC to go into Unoccupied or Occupied mode. When the contacts close (Unoccupied) the UVC shall go into Unoccupied mode, when the contacts open (Occupied) the UVC shall go into Occupied mode. The (optional) Dew point/Humidity Input Signal shall allow a single set of dry-contacts to be used to signal the UVC to go into Active or Passive Dehumidification. When the contacts close (High Humidity) the UVC shall go into Dehumidification, when the contacts open (Low Humidity) the UVC shall stop dehumidification. The device used must incorporate its own differential dew point or differential humidity.
3. External Binary Input 2 shall only be used for remote shutdown. The Remote Shutdown Input Signal shall allow a single set of dry-contacts to be used to signal the UVC to go into Shutdown mode. When the contacts close (Shutdown) the UVC shall go into Shutdown mode, when the contacts open the UVC shall return to Normal operation. See Non-Normal Unit Modes.
4. External Binary Input 3 shall be able to be configured as a Ventilation Lockout (default) or Exhaust Interlock Signal. The Ventilation Lockout Input Signal input shall allow a single set of dry-contacts to be used to signal the UVC to close the OA damper. When the contacts close (Ventilation Lockout Signal) the UVC shall close the OA damper, when the contacts open the UVC shall return to normal OA damper operation. The Exhaust Interlock Input Signal input shall allow a single set of dry-contacts to be used to signal the UVC that an Exhaust Fan within the space has been energized, the UVC shall reposition the OA damper to a user adjustable minimum position (Exhaust Interlock OA Damper Min Position Setpoint). When the contacts close (Exhaust fan on signal) the UVC shall use the value defined by the Exhaust Interlock OA Damper Min Position Setpoint as the minimum OA damper position regardless of IAF speed, when the contacts open the UVC shall return to normal OA damper operation.
5. The UVC shall be provided with three (3) binary outputs that can provide the following functions (outputs vary by model type. Not all functions can be used at the same time). These outputs shall be relay type outputs that shall to be used with signal level voltages (24vac max) only. External Binary Output 1 output shall only be able to be used as a signal for Space Lights. The Lights On/Off Signal relay output shall provide one set of NO dry-contacts that shall be used to signal the operation of the Space Lights. When the UVC is in Occupied, Standby or Bypass Occupancy modes the relay output shall signal the lights on (contacts closed), when the UVC is in Unoccupied occupancy mode the relay output shall signal the lights off (contacts open). External Binary Output 2 shall only be able to be used as a fault signal. A Fault Signal relay output shall provide a NO, NC, and Common connections that can be used to signal a fault condition. When

a fault exists, the UVC shall energize this relay output, when the fault or faults are cleared the UVC shall de-energize this relay output. External Binary Output 3 shall only be able to be used to operate an Auxiliary Heat device (default) or signal Exhaust Fan operation. The Auxiliary Heat Signal relay output shall provide one set of NO dry-contacts that can be used to operate an Auxiliary Heat device. The UVC shall be by default configured to operate a NO Auxiliary Heat device (de-energize when heat is required) such as a wet heat valve actuator with a spring setup to open upon power failure. However, the Auxiliary Heat Configuration variable shall be able to be used to set the UVC to use a NC Auxiliary Heat device (energize when heat is required) such as electric heat. The Exhaust Fan On/Off Signal relay output shall provide one set of NO dry-contacts that can be used to signal the operation of an Exhaust Fan. When the OA damper opens more than the Energize Exhaust Fan OA Damper Setpoint then the relay output shall signal the Exhaust Fan on (contacts closed), when the OA damper closes below this setpoint the relay output shall signal the Exhaust Fan off (contacts open).

V. System Integrator/Controls Contractor

1. System Integrator/Controls contractor shall be responsible for the integration of all factory provided unit mounted controls and unit communications as required/specified for unit integration into the Building Automation System and proper unit operation.

2.09 UNIT VENTILATOR OPTIONS/ACCESSORIES

A. Outdoor Air Intake Louver

1. Outdoor air intake louver shall be provided by unit ventilator manufacturer except as otherwise noted on the drawings.

2. Masonry wall intake louver shall be constructed with vertical double brake type blades with weep holes in the louver frame and diamond pattern expanded aluminum bird screen on the interior side. Louver shall be fabricated of extruded aluminum 6063-T5. All louvers shall be 10 3/8” (264 mm) high by 2.14" (51 mm) thick. The louver length shall be the entire length of the unit outside section. The intake assembly and frame shall be 16 Ga. vertical chevron type aluminum blades in a 12 Ga. frame, with:

a. Unfinished capable of field painting OR

b. Manufacturer’s oven baked powder paint finish and color for selection by the Architect OR

c. Clear anodized finish.

3. Panel wall or masonry wall intake louver shall be constructed with vertical blade double brake type blades. Provide weep holes along face of bottom frame and diamond pattern expanded aluminum bird screen on the interior side. Louver shall be fabricated of extruded aluminum 6063-T5. All louvers shall 10 3/8” (264 mm) high by 2.14” (51 mm) thick. The louver length shall be the entire length of the unit outside section. Each intake louver assembly shall be furnished with a matching four-sided flange around the perimeter of the opening of same material and finish as louver. The intake assembly and frame shall be: 16 Ga. vertical blade double brake type aluminum blades in a 14 Ga. frame, with:

a. Unfinished capable of field painting OR

b. Manufacturer’s oven baked powder paint finish and color for selection by the Architect OR

c. Clear anodized finish.

B. [OPTIONAL] Intake Grille

1. Where indicated, each intake louver assembly shall be furnished with a decorative aluminum intake grille with square holes to match the louver opening, maximizing the air opening. The grille shall come with holes for mounting to building exteriors. The grille shall be of same material and finish as the louver.

C. VentiMatic Shutter (Room Exhaust)

1. Where indicated, the unit manufacturer shall provide a passive (non powered) "in-room" air pressure relief VentiMatic shutter, mounted on a separate wall louver to prevent excessive static pressure. The VentiMatic shutter shall be constructed of galvannealed steel with shutter dampers of woven glass fabric impregnated with silicone rubber.

D. Classroom Matching Accessories

1. Furnish and install in accordance with manufacturer's printed instructions, matching accessories; shelf cabinets, sink and bubbler cabinets, and filler sections, where indicated on the plans. Colors to match the unit ventilator. Cabinet and filler section top shall be finished with textured paint coating to match the unit ventilator top.

a. [OPTIONAL] Top Shelving to be made of Formica.

2. Shelving lengths to be scaled from drawings. Sinks to be stainless steel.

3. All cabinet sections to have adjustable kick plates, and leveling legs and slots for spline attachment to the unit ventilator matching edges.

2.010 BASIS OF DESIGN

A. By Daikin Applied.

B. Acceptable Alternates

1. With prior approval only, submit detailed listing of all variations in form, fit, or function, in addition to specified submittal data. Provide required information as specified in Section 01350.

Daikin Applied Training and Development

Now that you have made an investment in modern, efficient Daikin Applied equipment, its care should be a high priority. For training information on all Daikin Applied HVAC products, please visit us at www.DaikinApplied.com and click on Training, or call 540-248-9646 and ask for the Training Department.

Warranty

All Daikin Applied equipment is sold pursuant to its standard terms and conditions of sale, including Limited Product Warranty. Consult your local Daikin Applied representative for warranty details. Refer to Form 933-430285Y. To find your local Daikin Applied representative, go to www.DaikinApplied.com.

Aftermarket Services

To find your local parts office, visit www.DaikinApplied.com or call 800-37PARTS (800-377-2787). To find your local service office, visit www.DaikinApplied.com or call 800-432-1342.

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