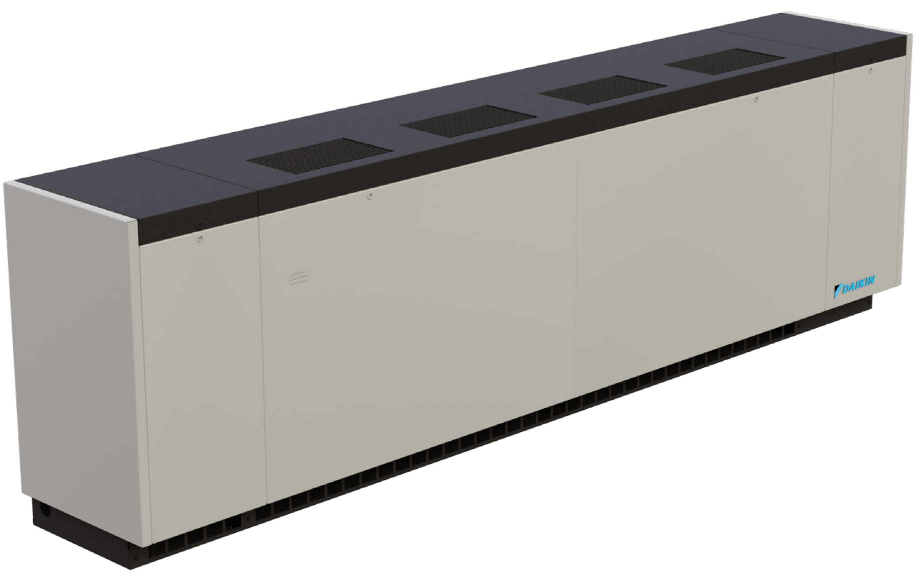
Catalog 1664-2

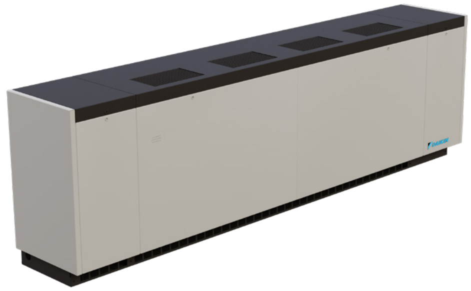
Classroom Unit Ventilator

Model AEQ Self-Contained Air Source Heat Pump Floor Unit
Size 024 (2 Ton) to 054 (4.5 Ton)

MicroTech® and Electromechanical Controls (Design K)



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.

The Right Amount of Fresh Air and 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 closely match comfort requirements and reduce operating costs.

Precise Temperature and Dehumidification Control

Daikin Applied unit ventilators feature 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 air design that contributes to even heat transfer and uniform discharge air temperatures into the classroom.

Low Installation Costs

New construction installations are easily accomplished with Daikin Applied unit ventilators because they avoid the added cost and space required for expensive ductwork. Retrofit installations are also economical because new units fit the same space occupied by existing ones. Factory installed MicroTech® controls provide easy, low cost integration into the building automation system of your choice.

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.

Easy to Maintain, Modular Design

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

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.

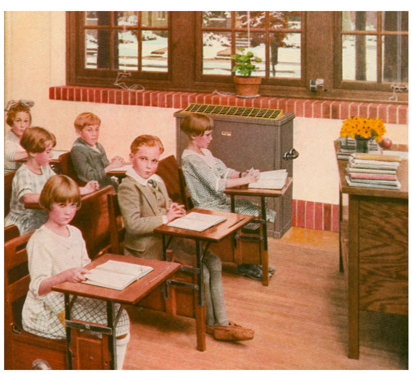
MicroTech Control for Superior Performance, Easy Integration

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. 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.

AHRI Performance Data

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow	Cooling Performance		Heating Performance	
				Total Capacity	Efficiency	Total Capacity	Efficiency
			CFM	Btu/h	EER	Btu/h	COP
024	Full	High	1000	21000	9.8	20900	3.1
036	Full	High	1250	39000	10.4	37300	2.7
044	Full	High	1500	45000	10.9	42200	3.0
054	Full	High	1500	51100	10.3	51400	2.9

Notes: Cooling conditions: Indoor 80°F db/67°F wb-Outdoor; 95°F db/75°F wb and high-speed fan.
Heating conditions: Indoor 70°F db/59°F wb-Outdoor; 47°F db/43°F wb and high-speed fan.



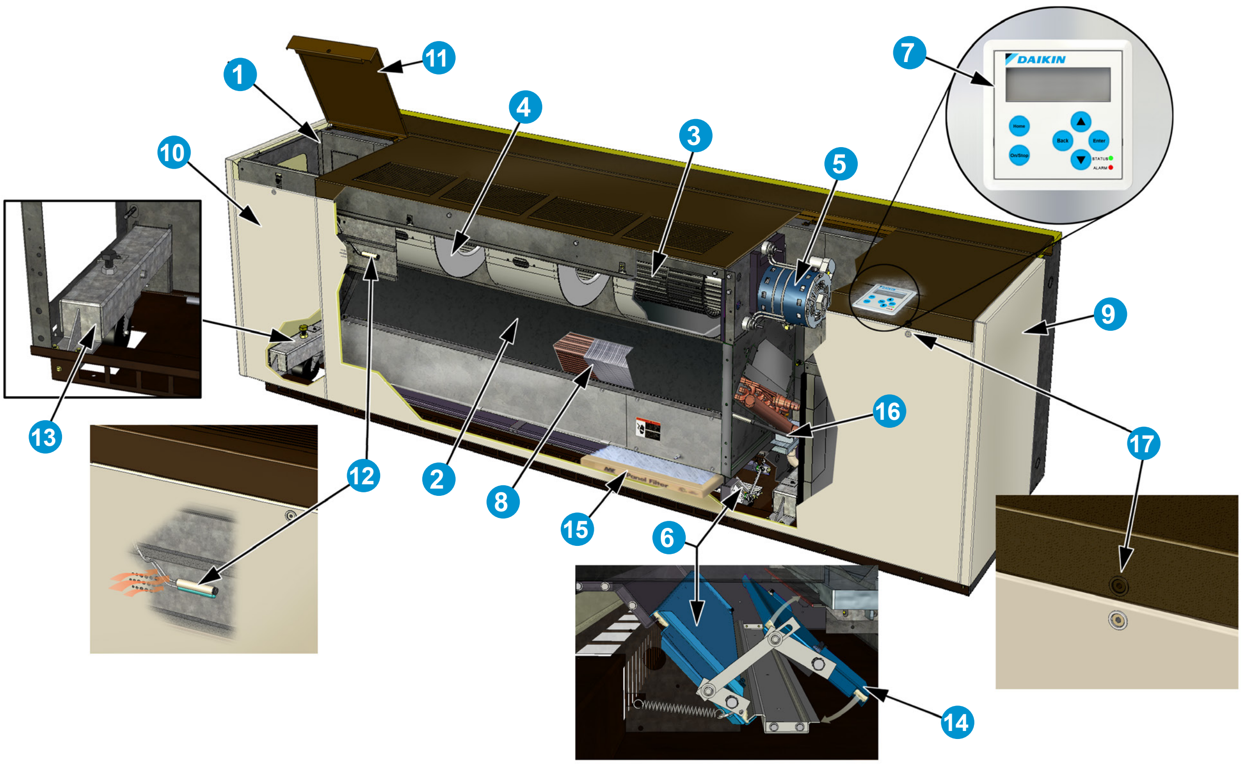
Since 1917

... and setting the standard today

Air Source Self-Contained Unit Ventilator

Our model AEQ is a vertical, floor standing unit that utilizes refrigerant for cooling and heating. The model AEQ is just right for new construction and for retrofit applications.

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



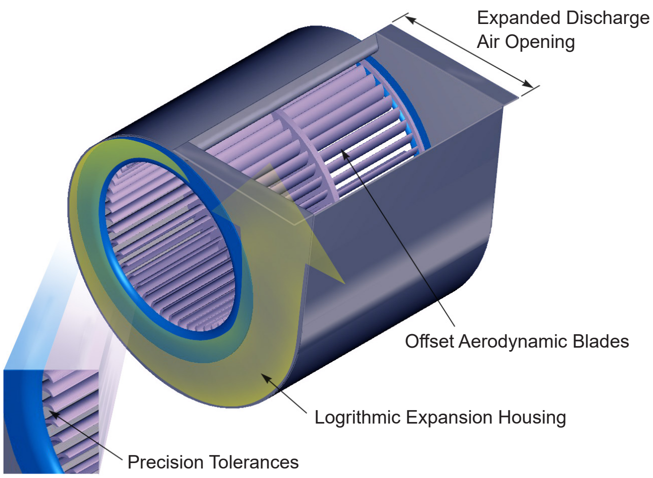
1. **Welded one-piece chassis** offers superior strength, durability, and vibration reduction.
2. **Unique draw-thru design** provides uniform air distribution across the coil for even discharge air temperatures.
3. **Quiet, aerodynamic fans** utilize GentleFlo technology for exceptionally quiet unit 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** provide 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**

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:

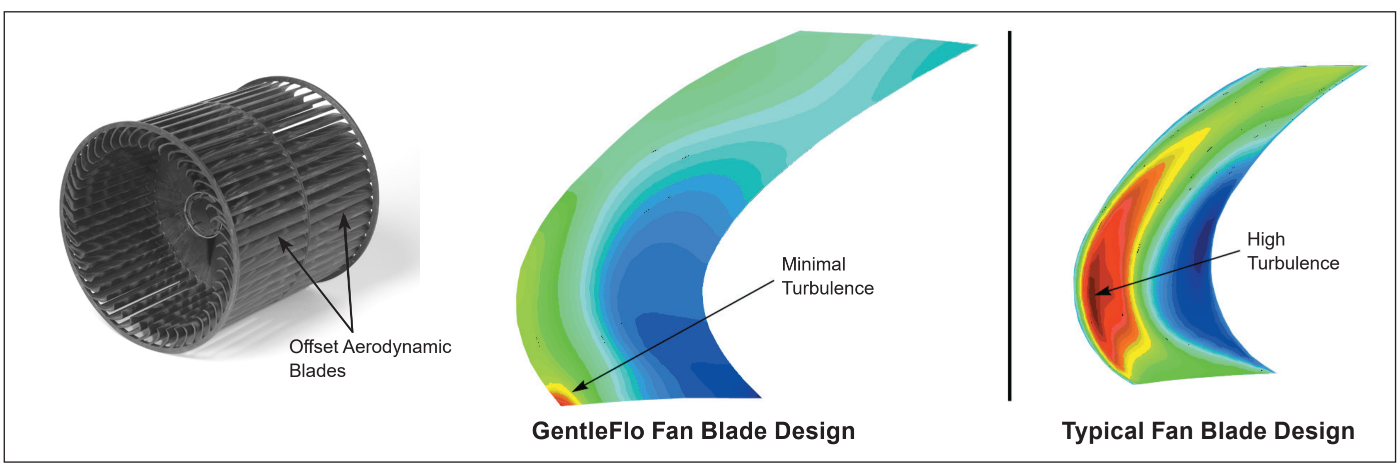
- Fan wheels are large, wide and rotate at a low speed to reduce fan sound levels. They are impact-resistant and carefully balanced to provide consistent performance.
- Offset, aerodynamic fan wheel blades move air efficiently (Figure 1).
- Precision tolerances help reduce flow and pressure turbulence,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



The Right Amount of Fresh Air and 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.

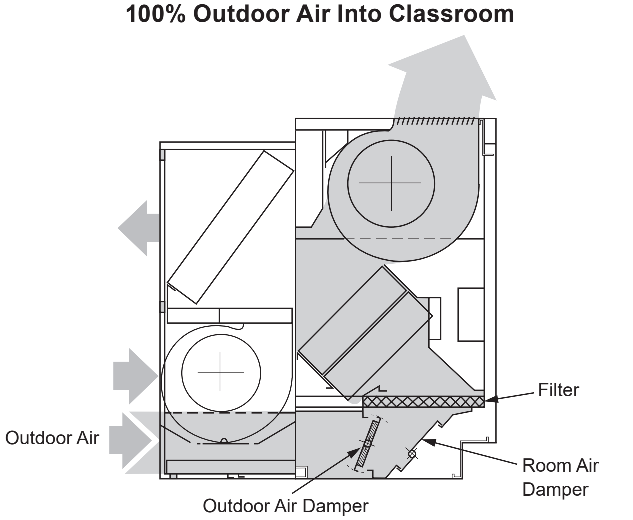
This means that you can be confident that your school is meeting ventilation standards for Indoor Air Quality and that your students are receiving adequate air to be attentive to instruction. At the same time, you are saving money in early morning hours, between classes or after hours when classrooms 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 control, 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

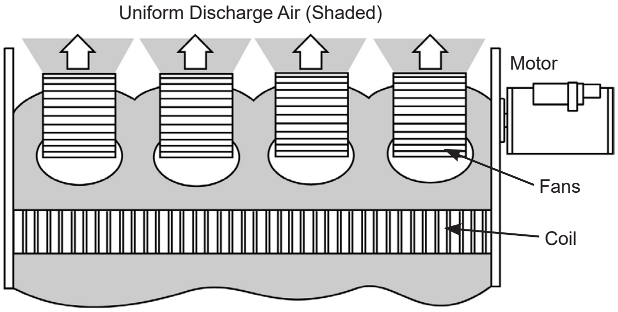
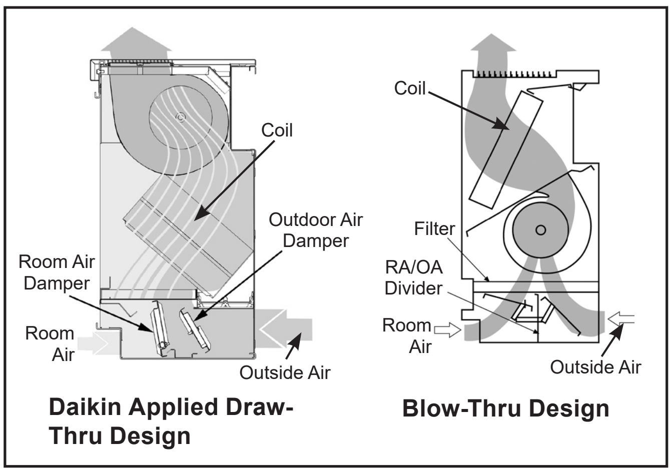


Figure 5: Draw-Thru Vs. Blow-Thru Design



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 Construction & Retrofit Applications

New construction installations are easily accomplished with the Daikin Applied AEQ air source heat pump unit ventilator because of the avoided added cost and space required for expensive duct work. This is important in existing buildings and also in new construction where floor-to-floor heights can be reduced, saving on overall building costs. Further savings can be realized because air source heat pump self-contained unit installations use less space than units that require water supply and return piping.

Retrofit installations are economical because new units typically fit the same space occupied by existing ones.

Controls Flexibility

Multiple control options offer easy, low cost integration of Daikin Applied unit ventilators into the building automation system of your choice (See "MicroTech Controls" on page 47).

MicroTech controls come with on-board BACnet MS/TP communications, or 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:

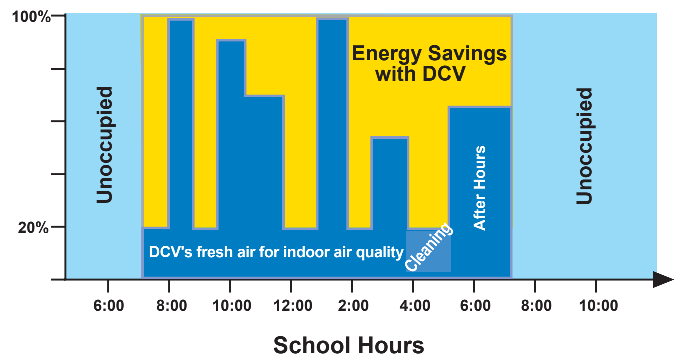
- They provide individual classroom control and comfort.
- They can be cycled on when the room is occupied and cycled off when it is not.
- They bring in fresh air from directly outside the classroom for high indoor air quality.
- During most of the school year, they use outdoor air to keep classrooms 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

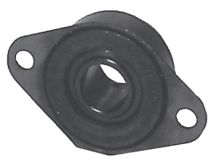
Daikin Applied unit ventilators are designed to provide easy access for maintenance and service personnel to all serviceable components. Most maintenance tasks are easily handled by a single person.

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).

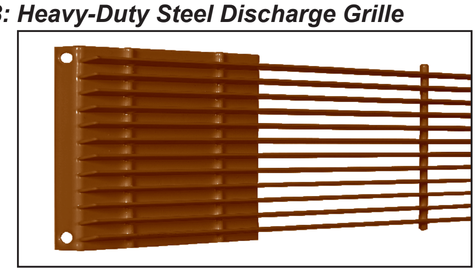
Figure 7: Permanently Lubricated Long-Life Motor Bearing



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.

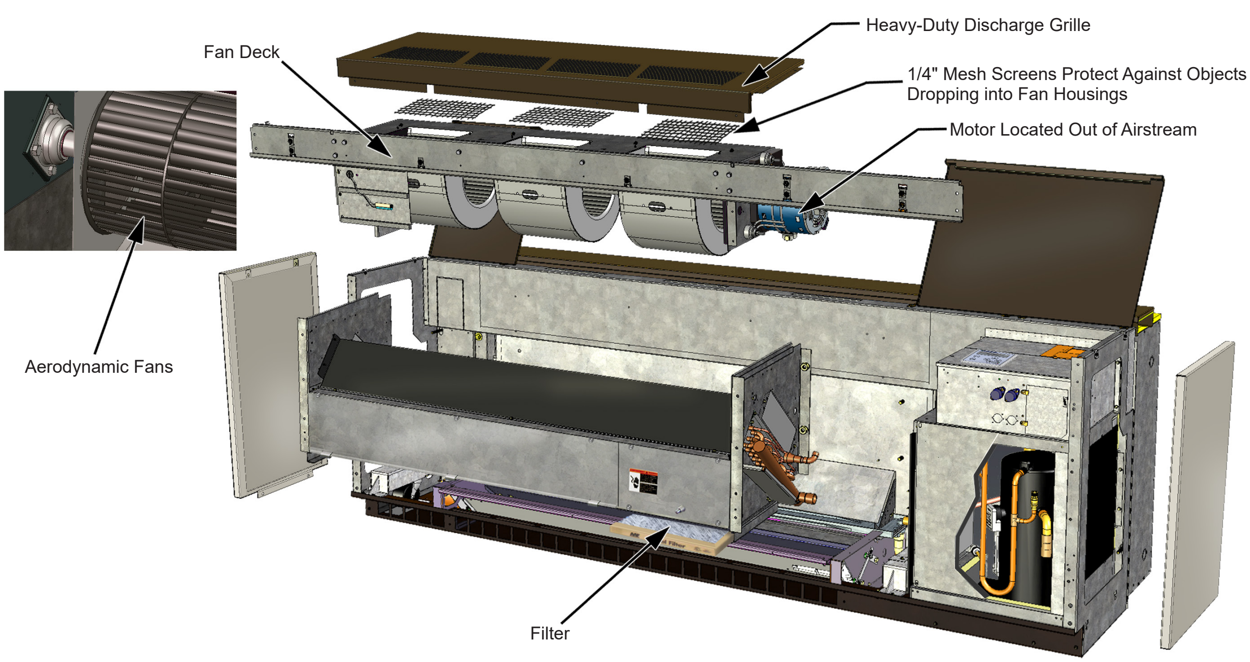
Figure 8: Heavy-Duty Steel Discharge Grille



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 9) 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.

Figure 9: Accessible Design



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 (See Figure 11).

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 (See 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 044 and 054.

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 10: Easy Access to Filter

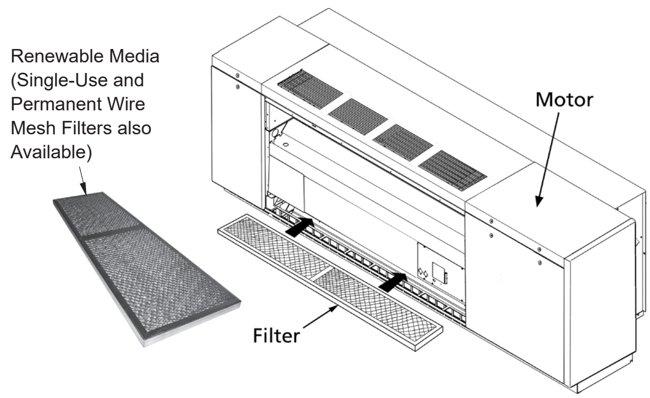
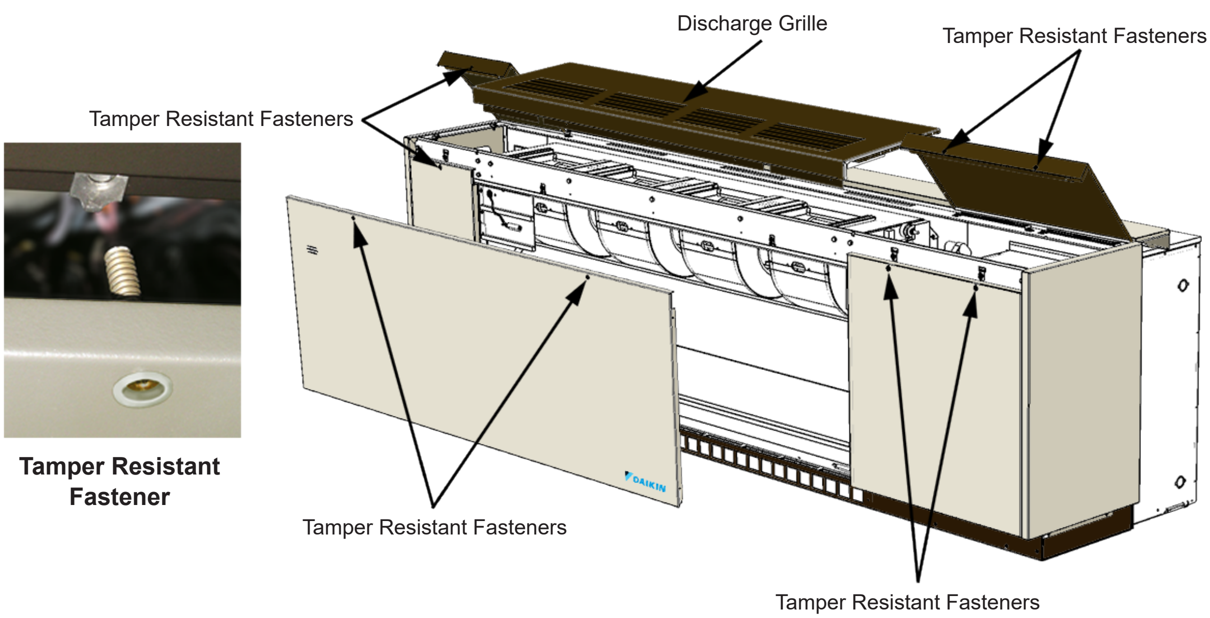


Figure 11: Easy Access with Tamper-Resistant Fasteners



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:

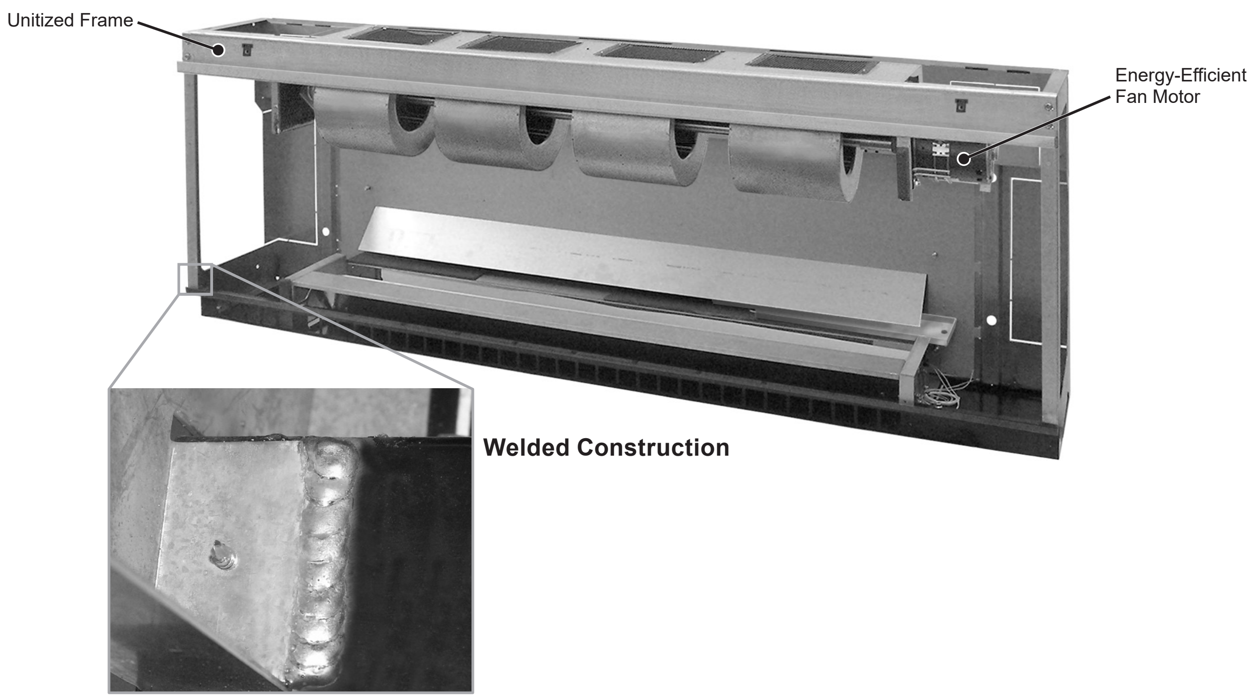
- A corrosion-resistant, galvanized-steel frame.
- Extra-strength, steel-bar discharge grille.
- Heavy-gauge-metal cabinet access panels and doors.
- An extra-strength pipe tunnel that stiffens the structure while adding aerodynamic air flow within the unit.
- Hidden reinforcement that provides additional 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.

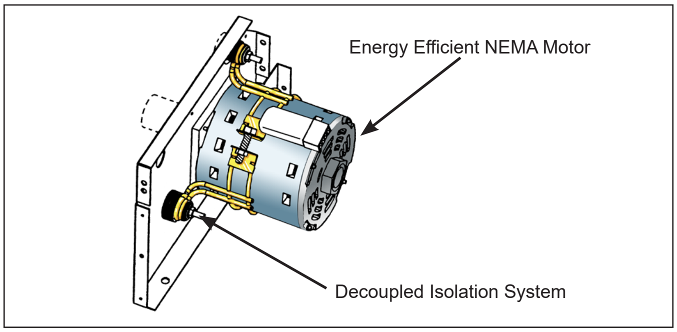
Figure 12: Heavy-Duty, Welded Chassis



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).

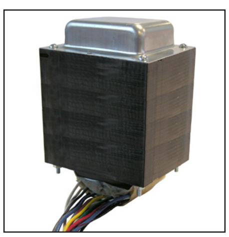
Figure 13: Energy-Efficient Fan Motor



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.

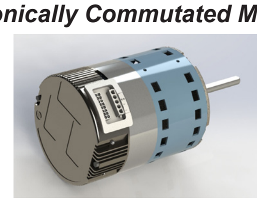
Figure 14: Multi-Tap Auto-Transformer



Electronically Commutated Motor (ECM)

The EC motor with almost no draw down of the unit's airflow (cfm) as static pressures increase. As a result, there is little need to oversize the unit to provide full air volume at high static pressures.

Figure 15: Electronically Commutated Motor (ECM)



- Self adjusting for constant torque for part load efficiency.
- Available with 3-speed or variable airflow operation.

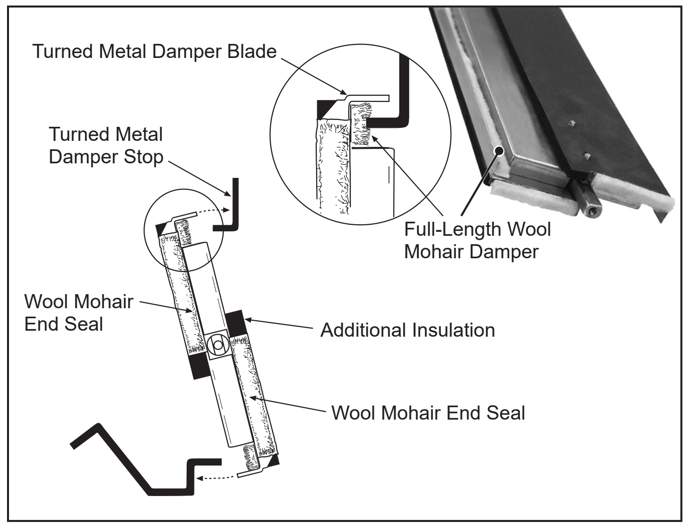
Durable Damper Design

All dampers in Daikin Applied unit ventilators use the turned-metal principle on their long closing edges (Figure 16). 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:

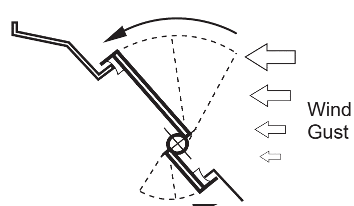
- Outdoor air dampers are made of galvanized steel to inhibit corrosion, with double-wall welded construction for rigidity and encapsulated insulation (Figure 16). Additional insulation is provided on the exterior of the outdoor air damper blade and on the outdoor air entry portion of the unit.

Figure 16: 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 17). 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 17: Room Air Damper Auto-Closed by Wind Gusts



Model Nomenclature

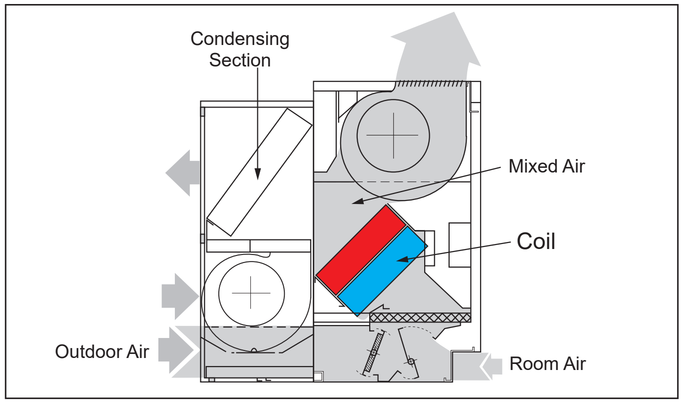
U	AEQ	K	024	H	G	12	Z	B1	AL	22	G	I	B	3
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Category	Code Item	Code Option	Code Designation & Description			
Product Category	1	1	U	Unit Ventilators		
Model Type	2	2-4	AEQ	Air Source Heat Pump		
Design Series	3	5	K	Design K		
Nominal Capacity	4	6-8	024	24,000	044	44,000
			036	36,000	054	54,000
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		
			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)		
			44	Electromechanical w/2-Position OA Damper for Remote Thermostat		
Discharge	10	16-17	AL	16-5/8″ Top Bar Grille		
Return Air/ Outside Air	11	18-19	22	Return Air Bottom Front/Outdoor Air Rear		
Power Connection	12	20	G	Box with Switch		
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		

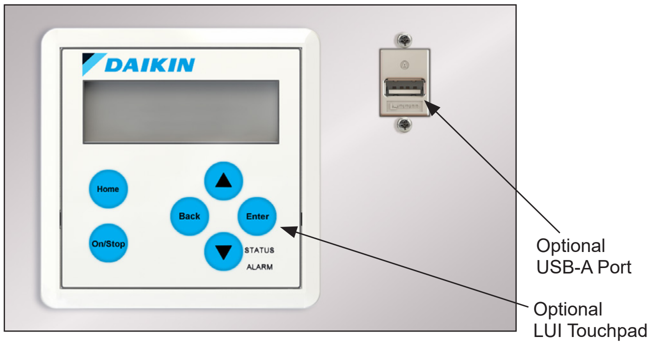
Control Features		Feature Selections							
Open Protocol	BACnet / Stand-Alone	•		•		•	•		
	LonMark		•		•			•	•
DCV	CO_2 Sensor			•	•		•		•
Factory Installed Keypad	LUI					•	•	•	•
		Control Code							
Economizer Control	Basic	B1	B5	B9	BD	BH	BL	BP	BT
	Expanded	E1	E5	E9	ED	EH	EL	EP	ET
	Leading-Edge	L1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

AEQ – Air Source Heat Pump

Model type AEQ units include a heat pump refrigeration circuit and supplemental electric heat. The full airflow is directed across the coils at all times. The refrigeration circuit is used as the primary source for cooling and heating. The electric heaters can be used to supplement the refrigeration heating output or provide all heat if compressor operation is not available. If the unit is equipped with a factory mounted humidity sensor or field connected humidistat, the electric heat may also be used for reheat in a dehumidification mode.



MicroTech Controls



Daikin Applied unit ventilators equipped with MicroTech 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 controls viable for the life of your Daikin Applied equipment.

Three Control Levels

MicroTech 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 unit 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 50).

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 54.

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 compare 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 compare 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 Ω 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 18: Optional CO_2 Sensor

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 (Figure 19) are typically used to finish off stand-alone floor units. Six-inch end panels, with kick plates, can be used to provide extra space needed for piping (Figure 20). All end panels are individually wrapped in plastic and boxed to help prevent damage during construction.

Figure 19: 1" End Panel

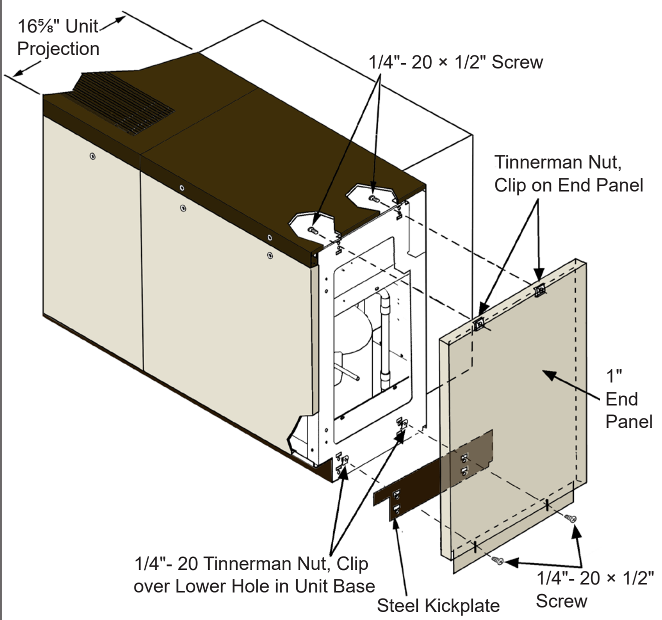
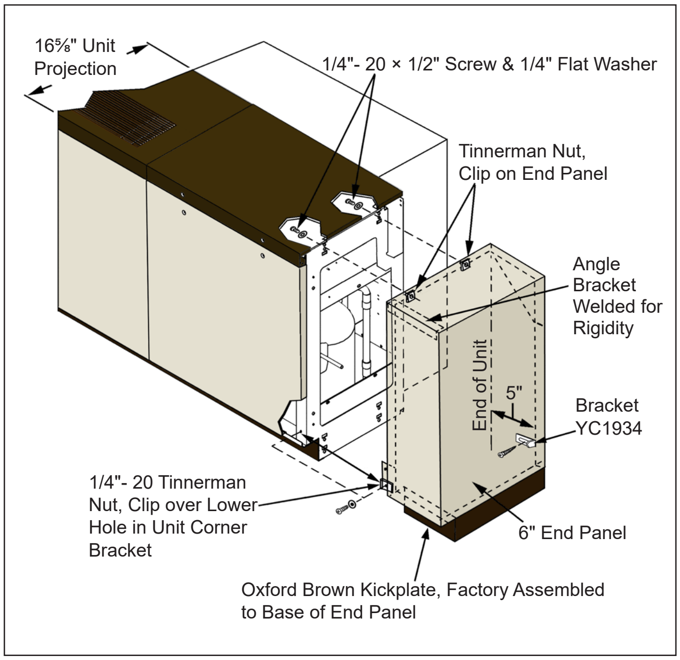
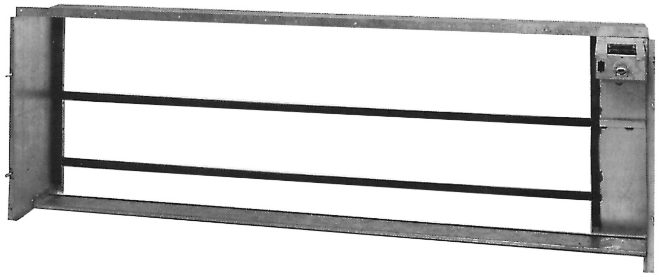


Figure 20: 6" End Panel



Wall Sleeves



The Daikin Applied wall sleeve and louver design is based on a "wet sleeve" concept. In brief, this means the design accommodates the penetration of some moisture into the rear outdoor section of the AEQ unit with provisions for containment and disposal of this moisture to the outdoors. Therefore, proper louver, splitter and wall sleeve installation is critical.

The wall sleeve must be installed before the AEQ self-contained unit ventilator can be placed. The recessed portion of the wall sleeve measures approximately 84", 96", or 108" wide by 28" high and may be recessed into the wall up to 11⅜" in depth. Consult approved Daikin Applied submittal drawings for the job to determine the proper amount of recess, if any, and recommended wall opening size.

The AEQ unit chassis attaches to the wall sleeve threaded studs using 4-nuts and washers.

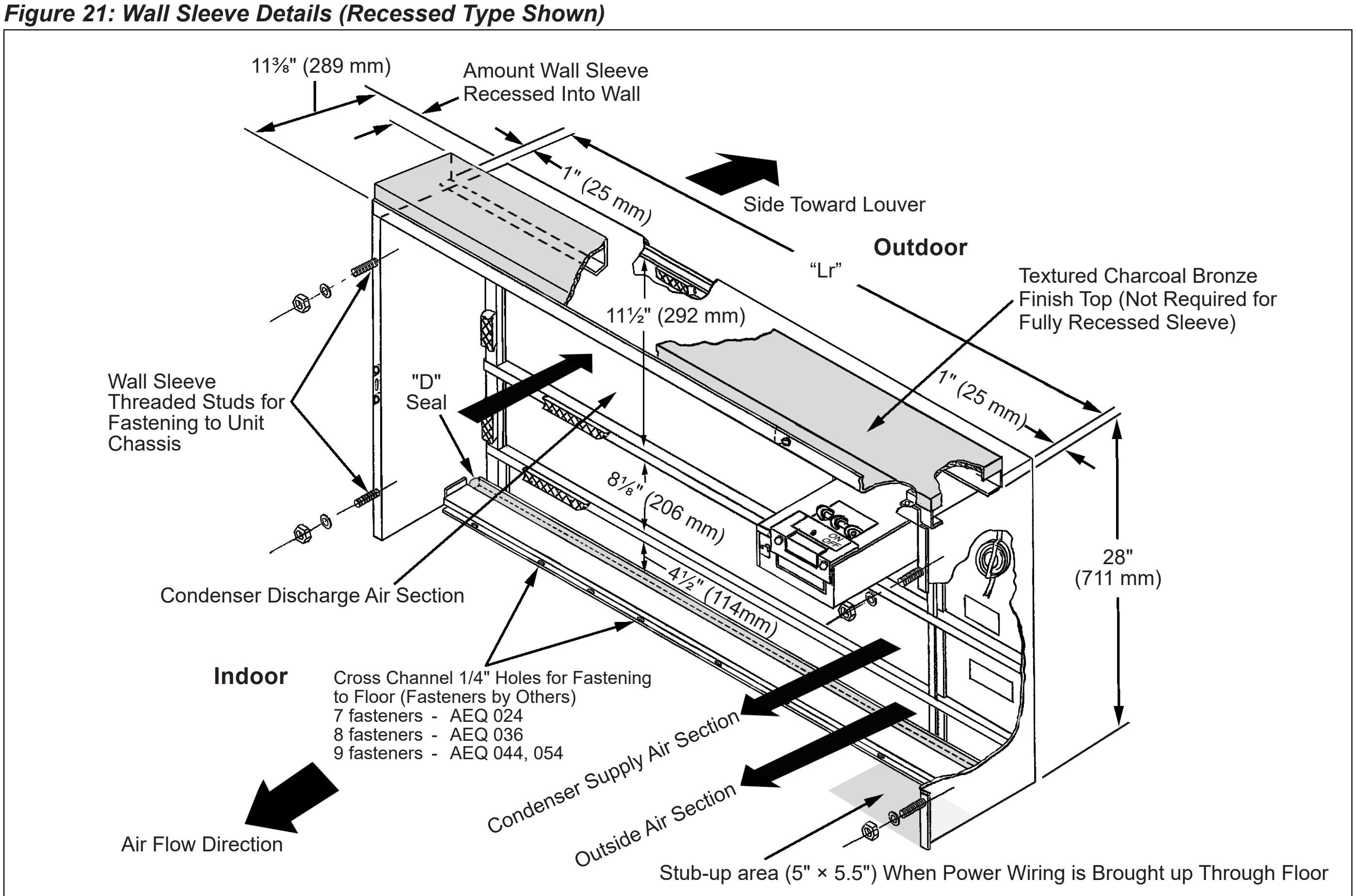
Table 1: Wall Sleeve Dimensions for Figure 21

Unit Size	Overall Length "L" (mm)	Sleeve Recess Length "Lr" (mm)
024	86 (2184)	84 (2145)
036	98 (2489)	96 (2450)
044, 054	110 (2794)	108 (2755)

Table 2: Recommended Rough-In Wall Opening

Unit Size	Recommended Wall Opening	
	Length (mm)	Height (mm)
024	84½" (2146)	28½ (724)
036	96½" (2451)	
044, 054	108½ (2756)	

Figure 21: Wall Sleeve Details (Recessed Type Shown)



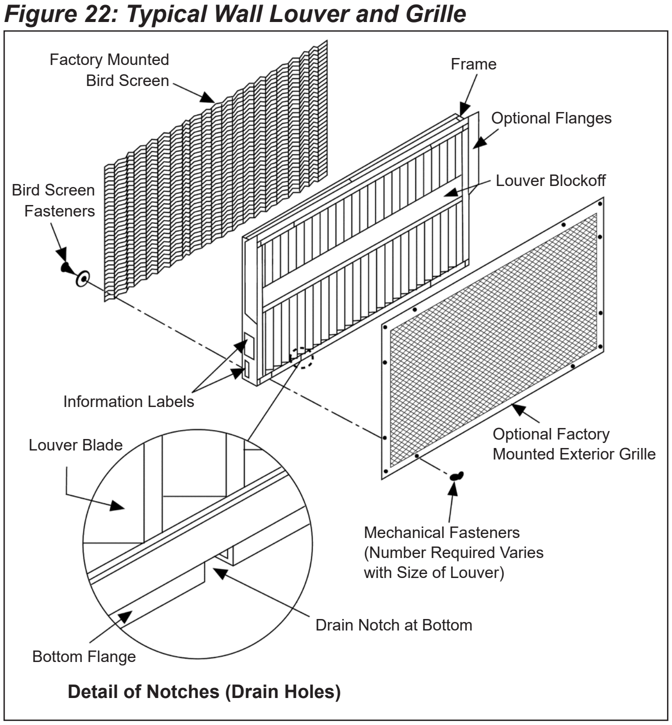
Wall Louvers & Grilles

The louver frame is divided in half horizontally, with make-up and discharge-air stream sections to reduce air recirculation within the vertical louver blade. The upper half of the louver has a blockoff on the exterior side to increase discharge air velocity and improve the throw of leaving air.

The vertical louver can be ordered with flanges that are attached on the outside of all four sides of the louver, resulting in a vertical dimension of 30" (762 mm). Weep holes exist behind the bottom flange of the louver. A diamond pattern expanded aluminum wire mesh (bird screen) is provided on the interior surface of the louver.

The vertical louver is fabricated from 6063-T5 aluminum. The single piece blade has a turned edge along the entering and leaving surface to reduce visibility of the outdoor coil and fan section, and adds rigidity to the blade. The 72-degree offset bend near the middle of the blade creates an air-path turn that minimizes moisture carryover, with a total blade depth of 2¼" (57 mm) in direction of airflow.

Figure 22: Typical Wall Louver and Grille



The louver is available in the following colors:

- Natural aluminum finish (paintable 6063-T5 aluminum)
- Autumn brown - thermosetting urethane powder coat paint electrostatically applied and oven-cured to provide correct chemical cross-linking.
- Dark bronze - thermosetting urethane powder coat paint electrostatically applied and oven-cured to provide correct chemical cross-linking.
- Clear anodized aluminum finish

Figure 23: Vertical Blade Louver Outside View, Without Flange

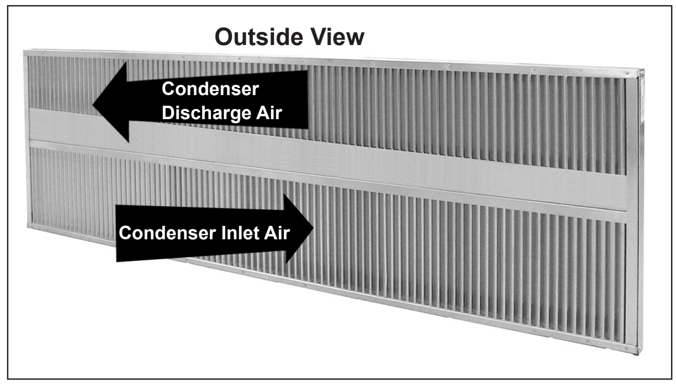
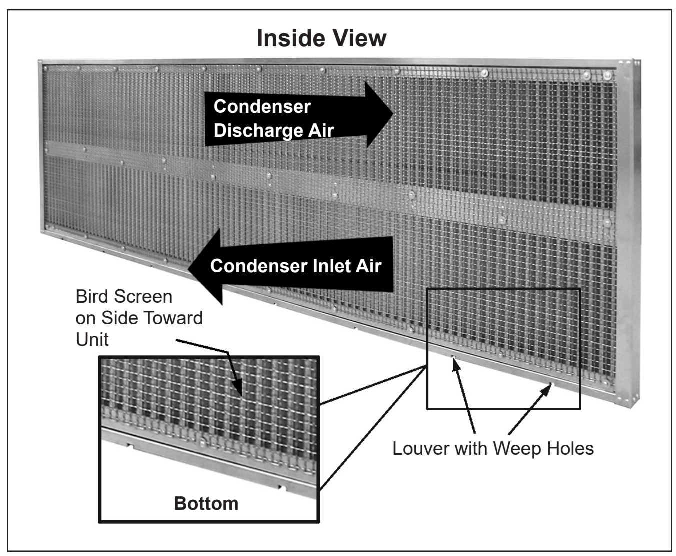


Figure 24: Vertical Blade Louver Inside View, Without Flange



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 25). 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 25: VentiMatic Shutter

Back (Outdoor Side) Front (Indoor Side)

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.

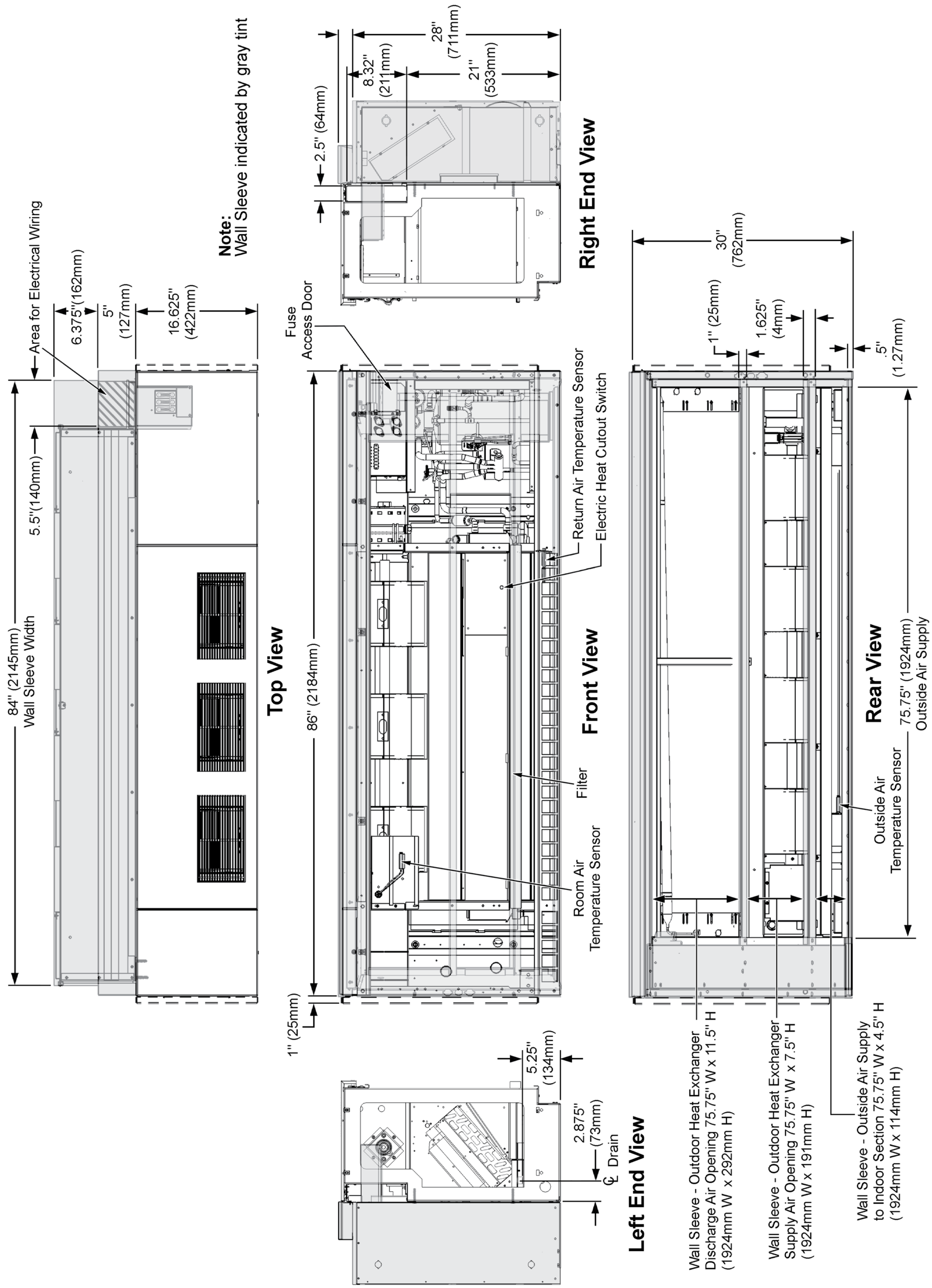
Since it is not powered, VentiMatic shutter operation is inherently silent. Unlike other non-powered vents, it opens at an extremely low positive pressure (0.005"). Its shutter flaps are made of temperature-resistant glass fabric impregnated with silicone rubber for flexibility and long life. This fabric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

Physical Data

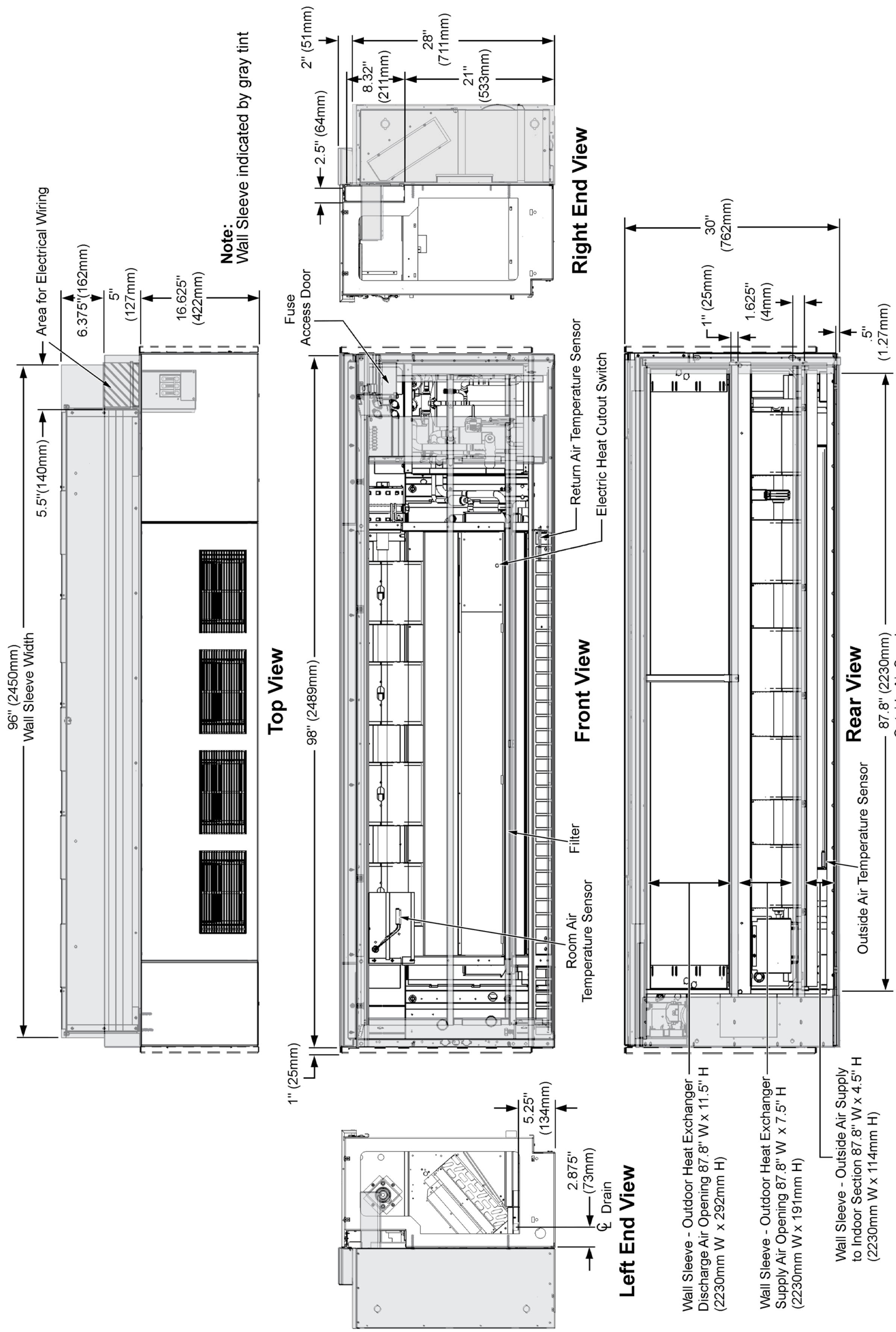
Table 3: AEQ General Data

			024	036	044	054
Fan Data	Nominal CFM (L/s)	High Speed	1000 (472)	1250 (590)	1500 (708)	1500 (708)
		Medium Speed	750 (354)	1000 (472)	1050 (496)	1050 (496)
		Low Speed	650 (307)	800 (378)	850 (401)	800 (378)
	Number of Fans		3	4	4	4
	Size	Diameter - in (mm)	8.12 (206)	8.12 (206)	8.12 (206)	8.12 (206)
		Width- in (mm)	8.25 (210)	8.25 (210)	8.25 (210)	8.25 (210)
Fan Motors	Room Fan Motor Horsepower (Type)		1/4 (PSC)	1/4 (PSC)	1/4 (PSC)	1/3 (ECM)
	Outdoor Fan Horsepower (Type)		1/3 (PSC)	3/4 (ECM)	3/4 (ECM)	3/4 (ECM)
Filter Data	Nominal Size	in	10 x 48½ x 1	10 x 60½ x 1	10 x 36½ x 1	10 x 36½ x 1
		(mm)	254 x 1232 x 25	254 x 1537 x 25	254 x 927 x 25	254 x 927 x 25
	Area - ft^2 (m^2)		3.37 (.31)	4.2 (.39)	5.08 (.47)	5.08 (.47)
	Quantity		1	1	2	2
Shipping Weight	lbs (kg)		850 (386)	1060 (481)	1080 (490)	1080 (490)
Refrigerant Charge (R-32)	oz (lbs)		106 (6.63)	156 (9.75)	114 (7.13)	111 (6.94)

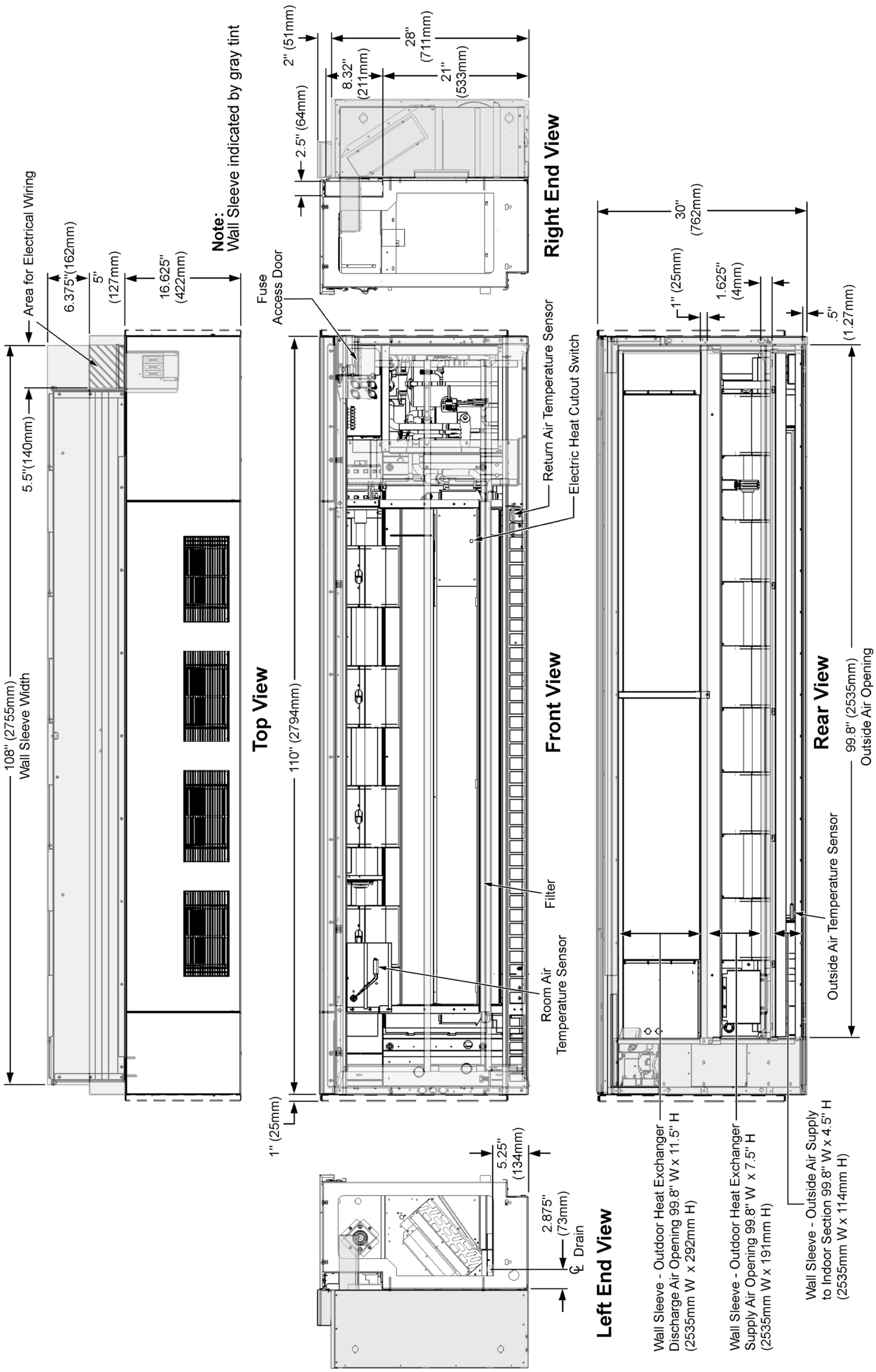
Unit Dimensions – Size 024



Unit Dimensions – Size 036



Unit Dimensions – Sizes 044, 054



End Panels

Figure 26: 1" (25 mm) End Panel Dimensions

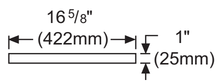
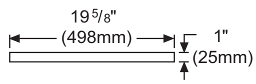
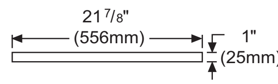
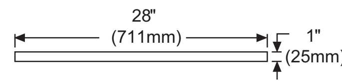
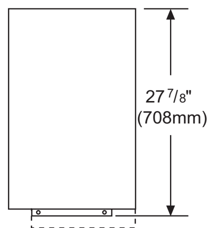
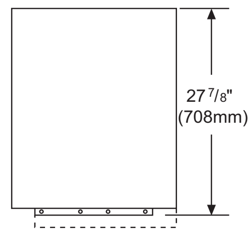
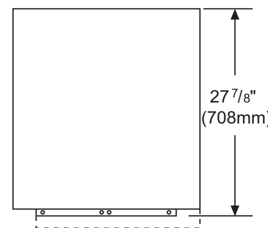
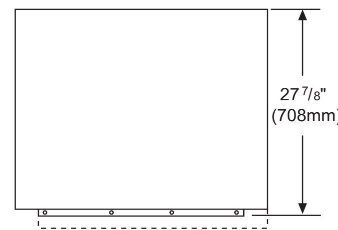
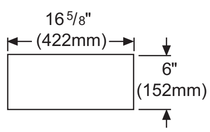
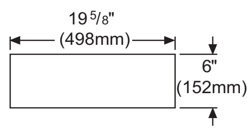
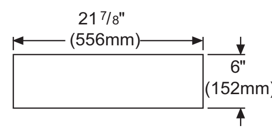
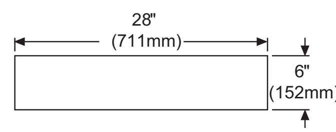
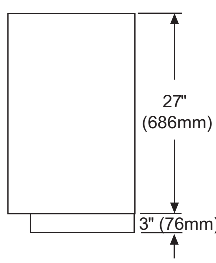
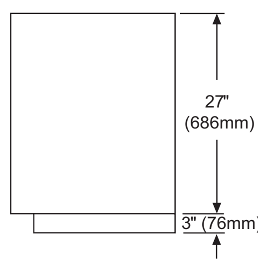
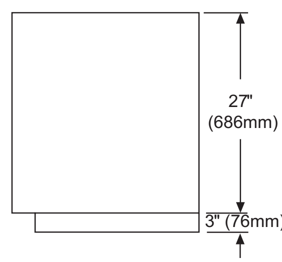
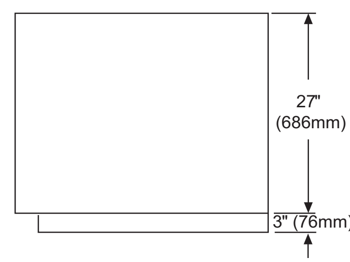
All Dim. in inches	16⅝" (422 mm) Deep End Panels	19⅝" (498 mm) Deep End Panels	21⅞" (556 mm) Deep End Panels	28" (711 mm) Deep End Panels
Top View				
End View with No Cut-Out				

Figure 27: 6" (152 mm) End Panel Dimensions

Top View				
End View with No Cut-Out				

Wall Intake Louvers & Grilles

Louvers are available with a vertical blade configuration, constructed of heavy-gauge (unpainted, painted, or clear anodized) aluminum.

- The louver is divided in half horizontally to prevent condenser air recirculation.
- A bird screen is provided on the leaving air side of the intake louver.
- 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.
- An optional (factory-mounted) heavy-duty lattice exterior grille is available with horizontal and vertical lines that “line up” with the louver blades to present an aesthetic appearance.
- Louvers are available in both horizontal and vertical blade configurations.

Figure 28: Typical Wall Louver and Grille

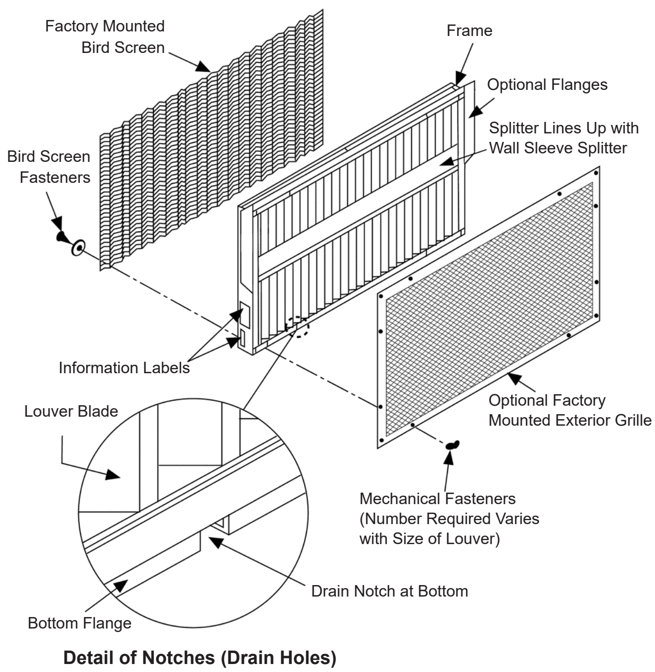


Figure 29: Vertical Blade Louver, Without Flange

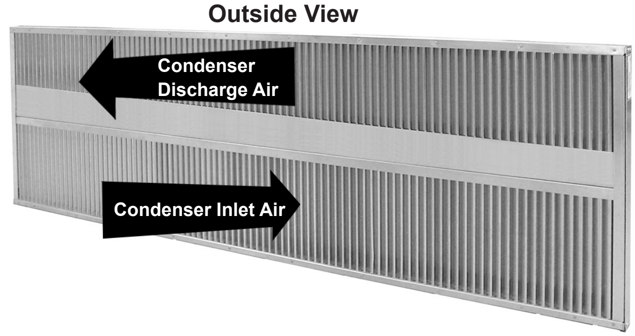


Figure 30: Grille Detail

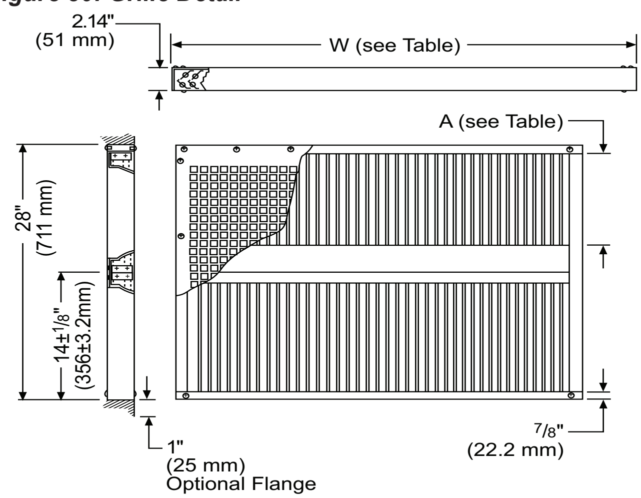
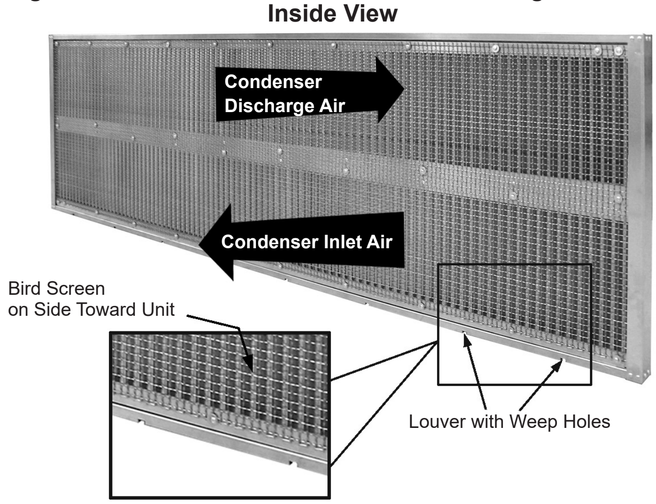


Table 4: Wall Louver Dimensions (W)

Unit Size	Louver Size (Height x W)	Discharge Air Opening (A)
024	28" × 84" (711 × 2134)	9" (229 mm)
036	28" × 96" (711 × 2438)	9" (229 mm)
044, 054	28" × 108" (711 × 2743)	7" (178 mm)

Note: All dimensions are approximate and subject to change without notice. Refer to approved submittal prints for rough-in details and construction purposes, and for recommended wall opening size.

Figure 31: Vertical Blade Louver, Without Flange



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 32: VentiMatic Shutter Assembly with Optional Grille

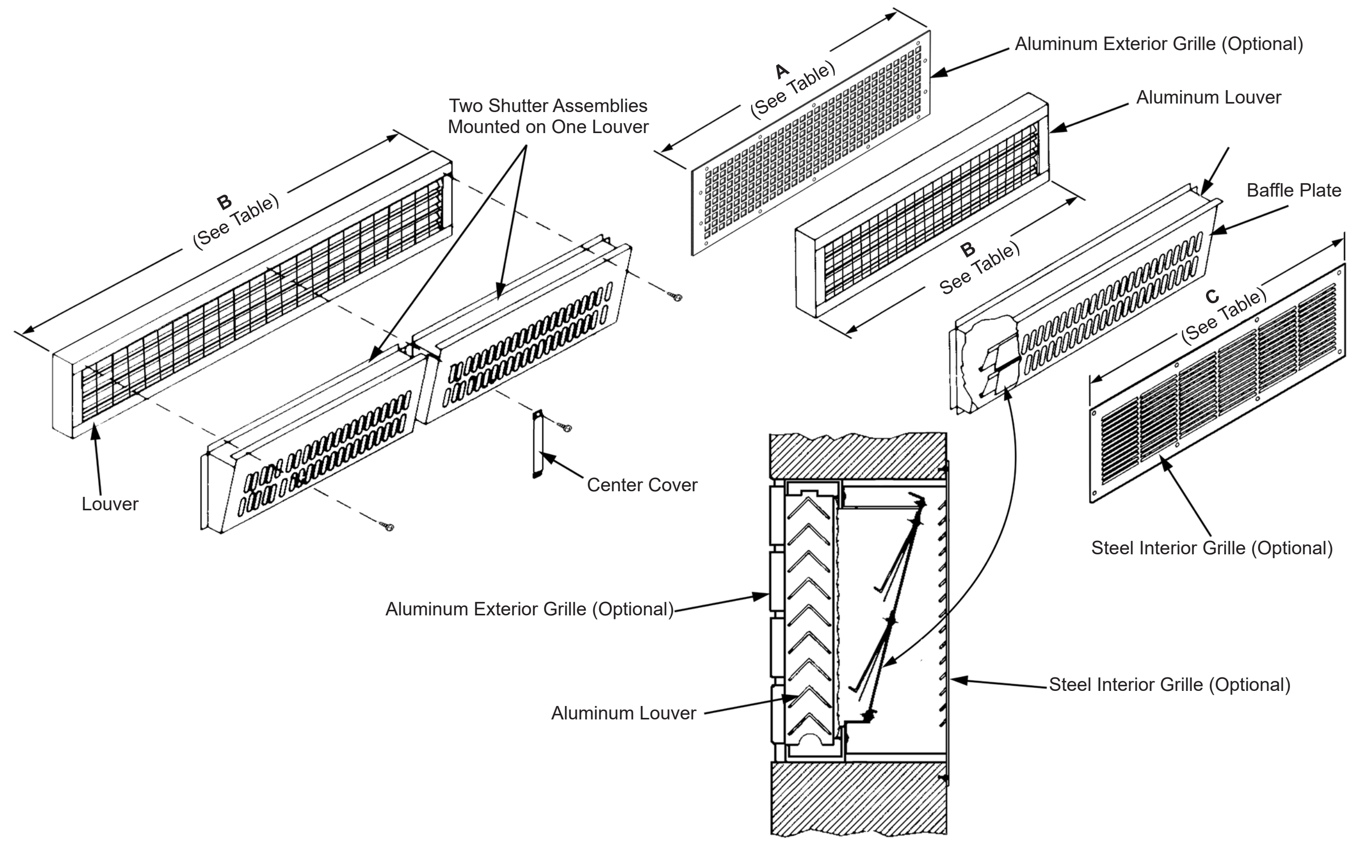


Table 5: VentiMatic Shutter Assembly Dimensions & Maximum Air Capacities

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

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.

Table 6: Cooling Capacity Selection Table

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow		Total Capacity	Sensible Capacity	Efficiency	Outdoor Temp
			CFM	L/s	Btuh	Btuh	EER	DB / WB
024	Full	High	1000	472	21000	15900	9.8	95/75
	Part	Med	750	354	18600	13500	16.4	82/65
	Part	Low	650	307	18100	13200	16.8	82/65
036	Full	High	1250	590	39000	25600	10.4	95/75
	Part	Med	1000	472	33200	21100	16.3	82/65
	Part	Low	800	378	30700	19400	15.7	82/65
044	Full	High	1500	708	45000	30300	10.9	95/75
	Part	Med	1050	496	36800	24000	17.4	82/65
	Part	Low	850	378	33100	20600	16.5	82/65
054	Full	High	1500	708	51100	35100	10.3	95/75
	Part	Med	1050	496	43500	27100	17.4	82/65
	Part	Low	800	378	40900	25300	16.6	82/65

Note: Cooling Conditions: Indoor 80°F db/67°F wb

Table 7: Heating Capacity Selection Table

Unit Size	Compressor Capacity	Fan Speed	Nominal Airflow		Total Capacity	Efficiency	Outdoor Temp
			CFM	L/s	Btuh	COP	DB / WB
024	Full	High	1000	472	20900	3.1	47/43
	Part	Med	750	354	25500	4.4	62/56.5
	Part	Low	650	307	24900	4.1	62/56.5
036	Full	High	1250	590	37300	2.7	47/43
	Part	Med	1000	472	42200	3.5	62/56.5
	Part	Low	800	378	40000	3.1	62/56.5
044	Full	High	1500	708	42200	3.0	47/43
	Part	Med	1050	496	36400	3.0	62/56.5
	Part	Low	850	378	35400	2.8	62/56.5
054	Full	High	1500	708	51400	2.9	47/43
	Part	Med	1050	496	36100	2.7	62/56.5
	Part	Low	800	378	33700	2.3	62/56.5

Note: Heating Conditions: Indoor 70°F db/59°F wb

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 8: Outdoor Air Ventilation Sensible Cooling Capacities 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
036	1250	27.1 MBH	20.3 MBH
044, 054	1500	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 9 gives the recommended number of room air changes per hour.

Table 9: 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, 1250 and 1500 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) = 37.8 MBH
- Minimum sensible capacity (SC) = 23.9 MBH
- Minimum outdoor air = 20%
- Room volume = 9,000 cubic feet
- Desired number of air changes per hour = 8

Step 3: Determine Air Quantity Required

"Equation 1: CFM For Given Rate Of Circulation" on page 30 indicates that to obtain eight room volumes per hour, a unit capable of delivering 1200 CFM standard air must be used, as follows:

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

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

This indicates that a size 036 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:

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

$$\text{EDB} = 76(0.8) + (96)(0.2) = 80°\text{F}$$

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 10 on page 32). Enthalpy (H) is calculated as follows:

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

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

Referring to Table 10 on page 32, EWB for 31.58 btu/lb = 67°F

Look Up Capacities

Look up the Total and Sensible cooling capacity for a Size 036 unit at High Fan Speed from "Cooling Capacity Selection Table" on page 29. Interpolation between the values for Outdoor DB = 90°F and 100°F, at Entering Air Temperature DB/WB = 80/67, will yield the following results.

- 39.7 MBH (TC)
- 26.5 MBH (SC)

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

$$\text{LDB} = \text{EDB} - \frac{\text{SC(Btuh)}}{\text{CFM} \times 1.085} = 80 - \frac{26500}{1250 \times 1.085} = 60.4°\text{F}$$

$$\text{LWBH} = \text{EWBH} - \frac{\text{TC(Btuh)}}{\text{CFM} \times 4.5} = 31.62 - \frac{39700}{1250 \times 4.5} = 24.6$$

From "Cooling Capacity Selection Table" on page 29:

LWB at 24.6 H = 57.1°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 10: 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

Capacity Data

AEQ – Size 024

Table 11: Size 024 (1000 SCFM) – 2nd Stage High Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				16700	1.787	2.7
30					17700	1.826	2.8
40	24600	17300	2.128	11.6	20000	1.919	3.1
50	24800	17600	1.905	13.0	22700	2.013	3.3
60	24500	17500	1.805	13.6	25600	2.087	3.6
70	23800	17200	1.807	13.2	28900	2.120	4.0
80	22900	16800	1.894	12.1	32400	2.091	4.5
90	21600	16200	2.047	10.6	36100	1.979	5.3
100	20200	15500	2.246	9.0	Operation Not Recommended		
110	18700	14800	2.473	7.6			
115	17900	14400	2.592	6.9			

Note: Capacity Data at Full Load

Table 12: Size 024 (750 SCFM) – 1st Stage Medium Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				14700	1.354	3.2
30					15800	1.393	3.3
40	20600	14200	1.340	15.4	18100	1.486	3.6
50	20800	14400	1.117	18.6	20700	1.580	3.8
60	20500	14400	1.016	20.2	23600	1.653	4.2
70	19800	14100	1.018	19.4	26900	1.686	4.7
80	18900	13700	1.105	17.1	30400	1.658	5.4
90	17600	13100	1.258	14.0	34200	1.546	6.5
100	16200	12400	1.457	11.1	Operation Not Recommended		
110	14700	11700	1.685	8.7			
115	13900	11300	1.803	7.7			

Note: Capacity Data at Part Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

Table 13: Size 024 (650 SCFM) – 1st Stage Low Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				14100	1.424	2.9
30					15200	1.463	3.0
40	20000	13800	1.288	15.5	17500	1.556	3.3
50	20200	14000	1.065	19.0	20100	1.650	3.6
60	19900	14000	0.964	20.6	23000	1.723	3.9
70	19300	13700	0.966	20.0	26300	1.756	4.4
80	18300	13300	1.053	17.4	29800	1.728	5.1
90	17100	12700	1.206	14.2	33600	1.616	6.1
100	15700	12000	1.405	11.2	Operation Not Recommended		
110	14100	11300	1.633	8.6			
115	13300	10900	1.751	7.6			

Note: Capacity Data at Part Load

AEQ – Size 036

Table 14: Size 036 (1250 SCFM) – 2nd Stage High Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				31100	3.735	2.4
30					32100	3.802	2.5
40	49800	31200	2.170	22.9	35500	3.935	2.6
50	47500	30100	2.462	19.3	39900	4.078	2.9
60	45600	29000	2.731	16.7	44900	4.239	3.1
70	43700	28100	2.996	14.6	50100	4.428	3.3
80	41900	27100	3.274	12.8	55500	4.656	3.5
90	40000	26100	3.584	11.2	61200	4.933	3.6
100	38000	25100	3.942	9.6	Operation Not Recommended		
110	35700	23800	4.367	8.2			
115	34400	23200	4.611	7.5			

Note: Capacity Data at Full Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

Table 15: Size 036 (1000 SCFM) – 1st Stage Medium Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				26000	2.935	2.6
30					27000	3.002	2.6
40	41500	25400	0.870	47.7	30400	3.135	2.8
50	39200	24200	1.162	33.7	34800	3.278	3.1
60	37300	23200	1.431	26.1	39800	3.439	3.4
70	35400	22300	1.696	20.9	45000	3.628	3.6
80	33600	21300	1.974	17.0	50400	3.856	3.8
90	31700	20300	2.284	13.9	56100	4.133	4.0
100	29700	19300	2.642	11.2	Operation Not Recommended		
110	27400	18000	3.067	8.9			
115	26100	17400	3.311	7.9			

Note: Capacity Data at Part Load

Table 16: Size 036 (800 SCFM) – 1st Stage Low Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				23800	3.235	2.2
30					24800	3.302	2.2
40	39000	23600	0.790	49.3	28200	3.435	2.4
50	36700	22500	1.082	33.9	32600	3.578	2.7
60	34800	21500	1.351	25.8	37600	3.739	2.9
70	32900	20500	1.616	20.4	42800	3.928	3.2
80	31100	19600	1.894	16.4	48200	4.156	3.4
90	29200	18600	2.204	13.3	53900	4.433	3.6
100	27200	17500	2.562	10.6	Operation Not Recommended		
110	24900	16300	2.987	8.3			
115	23600	15600	3.231	7.3			

Note: Capacity Data at Part Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

AEQ – Size 044

Table 17: Size 044 (1500 SCFM) – 2nd Stage High Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				35400	3.925	2.6
30					36500	3.966	2.7
40	60000	38200	1.906	31.5	40500	4.080	2.9
50	56700	36400	2.403	23.6	45800	4.231	3.2
60	53800	34800	2.827	19.0	51700	4.418	3.4
70	51200	33400	3.205	16.0	57800	4.636	3.7
80	48700	32200	3.565	13.7	63800	4.883	3.8
90	46300	30900	3.932	11.8	70100	5.155	4.0
100	43700	29600	4.336	10.1	Operation Not Recommended		
110	40800	28200	4.802	8.5			
115	39300	27400	5.067	7.8			

Note: Capacity Data at Full Load

Table 18: Size 044 (1050 SCFM) – 1st Stage Medium Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				26700	2.975	2.6
30					27800	3.016	2.7
40	48600	30200	0.381	127.6	31800	3.130	3.0
50	45300	28400	0.878	51.6	37100	3.281	3.3
60	42400	26800	1.302	32.6	43000	3.468	3.6
70	39800	25500	1.680	23.7	49100	3.686	3.9
80	37300	24200	2.040	18.3	55100	3.933	4.1
90	34900	23000	2.407	14.5	61400	4.205	4.3
100	32300	21700	2.811	11.5	Operation Not Recommended		
110	29400	20200	3.277	9.0			
115	27900	19400	3.542	7.9			

Note: Capacity Data at Part Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

Table 19: Size 044 (850 SCFM) – 1st Stage Low Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				24600	3.375	2.1
30					25700	3.416	2.2
40	44900	26900	0.281	159.8	29700	3.530	2.5
50	41600	25100	0.778	53.5	35000	3.681	2.8
60	38700	23500	1.202	32.2	40900	3.868	3.1
70	36100	22200	1.580	22.8	47000	4.086	3.4
80	33600	20900	1.940	17.3	53000	4.333	3.6
90	31200	19700	2.307	13.5	59300	4.605	3.8
100	28600	18300	2.711	10.6	Operation Not Recommended		
110	25700	16900	3.177	8.1			
115	24200	16100	3.442	7.0			

Note: Capacity Data at Part Load

AEQ – Size 054

Table 20: Size 054 (1500 SCFM) – 2nd Stage High Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				42000	5.055	2.4
30					44400	5.027	2.6
40	63700	41100	3.007	21.2	50000	5.139	2.9
50	60900	39800	3.291	18.5	56300	5.418	3.0
60	58500	38600	3.594	16.3	63000	5.801	3.2
70	56400	37600	3.927	14.4	70100	6.224	3.3
80	54400	36700	4.304	12.6	77500	6.624	3.4
90	52300	35700	4.735	11.0	85100	6.935	3.6
100	49800	34500	5.233	9.5	Operation Not Recommended		
110	46900	33200	5.810	8.1			
115	45100	32400	6.131	7.4			

Note: Capacity Data at Full Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

Table 21: Size 054 (1050 SCFM) – 1st Stage Medium Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				31300	3.905	2.3
30					33700	3.877	2.5
40	53200	31700	1.122	47.4	39300	3.989	2.9
50	50400	30400	1.406	35.9	45600	4.268	3.1
60	48000	29300	1.709	28.1	52300	4.651	3.3
70	45900	28300	2.042	22.5	59400	5.074	3.4
80	43900	27300	2.419	18.2	66800	5.474	3.6
90	41800	26300	2.850	14.7	74400	5.785	3.8
100	39300	25100	3.348	11.7	Operation Not Recommended		
110	36400	23800	3.925	9.3			
115	34600	23000	4.246	8.1			

Note: Capacity Data at Part Load

Table 22: Size 054 (850 SCFM) – 1st Stage Low Fan

Entering Air Temperature Outdoor DB °F	Cooling - EAT Indoor DB/WB °F - 80/67° F				Heating - EAT Indoor DB/WB °F - 70/59° F		
	Total (Btu/h)	Sensible (Btu/h)	Power Input (kW)	EER	Total (Btu/h)	Power Input (kW)	COP
25	Operation Not Recommended				29400	4.153	2.1
30					31800	4.125	2.3
40	50600	29900	1.087	46.6	37400	4.237	2.6
50	47800	28600	1.371	34.9	43700	4.516	2.8
60	45400	27400	1.674	27.1	50400	4.899	3.0
70	43300	26400	2.007	21.6	57500	5.322	3.2
80	41300	25500	2.384	17.3	64900	5.722	3.3
90	39200	24500	2.815	13.9	72500	6.033	3.5
100	36700	23300	3.313	11.1	Operation Not Recommended		
110	33800	22000	3.890	8.7			
115	32000	21200	4.211	7.6			

Note: Capacity Data at Part Load

LEGEND			
Btu/h	British Termal Units per Hour	**EER**	Energy Efficiency Ratio
COP	Coefficient of Performance	**kW**	Kilowatts
DB	Dry Bulb	**WB**	Wet Bulb
EAT	Entering Air Temperature		

AEQ – Size 024

Volt/Hz/ Phase	Voltage Range Min.	Voltage Range Max.	Indoor Fan FLA	Outdoor Fan FLA	Compressor RLA	Compressor LRA	Heating Option Heat Type		Heater kW	Rated Heater Amps	Power Supply MCA	Power Supply Maximum Fuse
208/60/1	197	228	3.2	2.8	11.1	67.5	Elec. Heat[1]	Low (3 elem.)	8.0	38.5	69.10	70
			3.2	2.8	11.1	67.5		High (6 elem.)	16.0	76.9	117.10	125
230/60/1	207	253	3.2	2.8	11.1	67.5	Elec. Heat[1]	Low (3 elem.)	7.3	33.3	62.60	70
			3.2	2.8	11.1	67.5		High (6 elem.)	14.7	66.7	104.35	110
208/60/3	197	228	3.2	2.8	7.8	28.0	Elec. Heat[1]	Low (3 elem.)	8.0	22.2	44.60	45
			3.2	2.8	7.8	28.0		High (6 elem.)	16.0	44.4	72.35	80
230/60/3	207	253	3.2	2.8	7.8	28.0	Elec. Heat[1]	Low (3 elem.)	7.3	19.2	40.85	45
			3.2	2.8	7.8	28.0		High (6 elem.)	14.7	38.5	64.98	70
460/60/3	414	506	3.2	1.5	4.3	29.0	Elec. Heat[1]	Low (3 elem.)	7.3	9.6	23.71	25
			3.2	1.5	4.3	29.0		High (6 elem.)	14.7	19.2	35.71	40

1 Electric Heat Options are with Compressor and Outdoor Fan.

AEQ – Size 036

Volt/Hz/ Phase	Voltage Range Min.	Voltage Range Max.	Indoor Fan FLA	Outdoor Fan FLA	Compressor RLA	Compressor LRA	Heating Option Heat Type		Heater kW	Rated Heater Amps	Power Supply MCA	Power Supply Maximum Fuse
208/60/1	197	228	3.2	6.3	20.5	126.0	Elec. Heat[1]	Low (3 elem.)	10.0	48.1	96.35	100
			3.2	6.3	20.5	126.0		High (6 elem.)	20.0	96.2	156.48	175
230/60/1	207	253	3.2	5.7	20.5	126.0	Elec. Heat[1]	Low (3 elem.)	9.2	41.7	87.75	90
			3.2	5.7	20.5	126.0		High (6 elem.)	18.4	83.3	139.75	150
208/60/3	197	228	3.2	6.3	10.2	82.0	Elec. Heat[1]	Low (3 elem.)	10.0	27.8	58.10	60
			3.2	6.3	10.2	82.0		High (6 elem.)	20.0	55.5	92.73	100
230/60/3	207	253	3.2	5.7	10.2	82.0	Elec. Heat[1]	Low (3 elem.)	9.2	24.1	52.88	60
			3.2	5.7	10.2	82.0		High (6 elem.)	18.4	48.1	82.88	90
460/60/3	414	506	3.2	3.1	6.0	56.0	Elec. Heat[1]	Low (3 elem.)	9.2	12.0	28.68	30
			3.2	3.1	6.0	56.0		High (6 elem.)	18.4	24.1	43.81	45

1 Electric Heat Options are with Compressor and Outdoor Fan.

AEQ – Size 044

Volt/Hz/ Phase	Voltage Range Min.	Voltage Range Max.	Indoor Fan FLA	Outdoor Fan FLA	Compressor RLA	Compressor LRA	Heating Option Heat Type		Heater kW	Rated Heater Amps	Power Supply MCA	Power Supply Maximum Fuse
208/60/1	197	228	3.2	6.3	25.9	128.4	Elec. Heat[1]	Low (3 elem.)	12.0	57.7	115.14	125
			3.2	6.3	25.9	128.4		High (6 elem.)	24.0	115.4	187.26	200
230/60/1	207	253	3.2	5.7	25.9	128.4	Elec. Heat[1]	Low (3 elem.)	11.0	50.0	104.88	110
			3.2	5.7	25.9	128.4		High (6 elem.)	22.0	100.0	167.38	175
208/60/3	197	228	3.2	6.3	13.4	105.3	Elec. Heat[1]	Low (3 elem.)	12.0	33.3	68.93	70
			3.2	6.3	13.4	105.3		High (6 elem.)	24.0	66.6	110.55	125
230/60/3	207	253	3.2	5.7	13.4	105.3	Elec. Heat[1]	Low (3 elem.)	11.0	28.9	62.88	70
			3.2	5.7	13.4	105.3		High (6 elem.)	22.0	57.7	98.88	100
460/60/3	414	506	3.2	3.1	6.9	61.8	Elec. Heat[1]	Low (3 elem.)	11.0	14.4	34.59	35
			3.2	3.1	6.9	61.8		High (6 elem.)	22.0	28.9	52.72	60

1 Electric Heat Options are with Compressor and Outdoor Fan.
FLA = Full Load Amps RLA = Rated Load Amps LRA = Locked Rotor Amps MCA = Minimum Circuit Ampacity

AEQ – Size 054

Volt/Hz/ Phase	Voltage Range		Indoor Fan FLA	Outdoor 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	3.0	6.3	30.2	178.0	Elec. Heat[1]	Low (3 elem.)	12.0	57.7	120.28	125
			3.0	6.3	30.2	178.0		High (6 elem.)	24.0	115.4	192.41	200
230/60/1	207	253	2.8	5.7	30.2	178.0	Elec. Heat[1]	Low (3 elem.)	11.0	50.0	109.85	125
			2.8	5.7	30.2	178.0		High (6 elem.)	22.0	100.0	172.35	175
208/60/3	197	228	3.0	6.3	16.9	140.0	Elec. Heat[1]	Low (3 elem.)	12.0	33.6	73.56	80
			3.0	6.3	16.9	140.0		High (6 elem.)	24.0	66.6	114.81	125
230/60/3	207	253	2.8	5.7	16.9	140.0	Elec. Heat[1]	Low (3 elem.)	11.0	28.9	66.85	70
			2.8	5.7	16.9	140.0		High (6 elem.)	22.0	57.7	102.85	110
460/60/3	414	506	2.8	3.1	8.2	54.7	Elec. Heat[1]	Low (3 elem.)	11.0	14.4	35.79	40
			2.8	3.1	8.2	54.7		High (6 elem.)	22.0	28.9	53.92	60

1 Electric Heat Options are with Compressor and Outdoor Fan.

FLA = Full Load Amps RLA = Rated Load Amps LRA = Locked Rotor Amps MCA = Minimum Circuit Ampacity

MicroTech Wiring Diagram – Typical

Figure 33: Typical MicroTech Controls Wiring Diagram - 230V/60Hz/3Ph

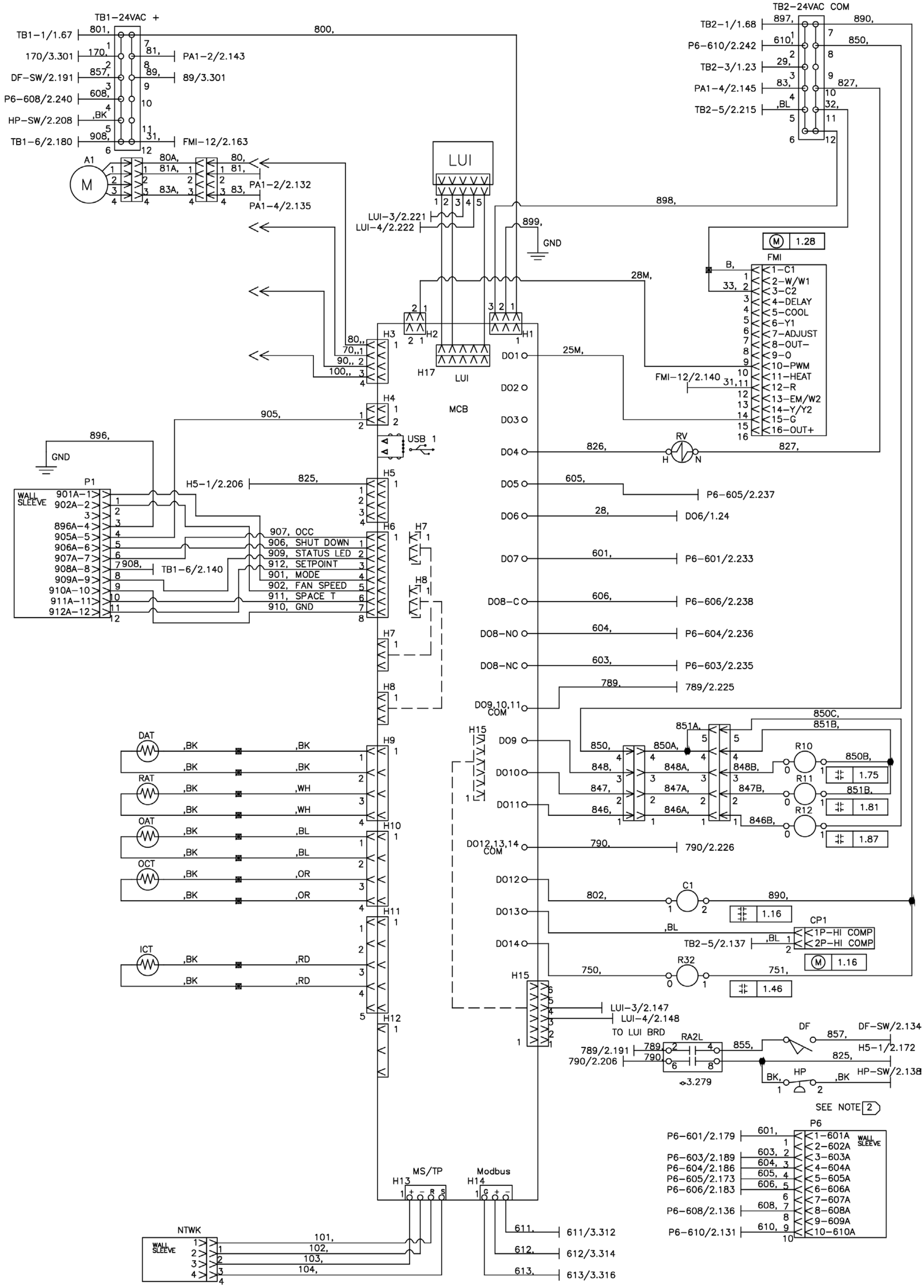


Figure 35:Typical MicroTech Wiring Diagram - Service and Disconnect - 230V/60Hz/3Ph

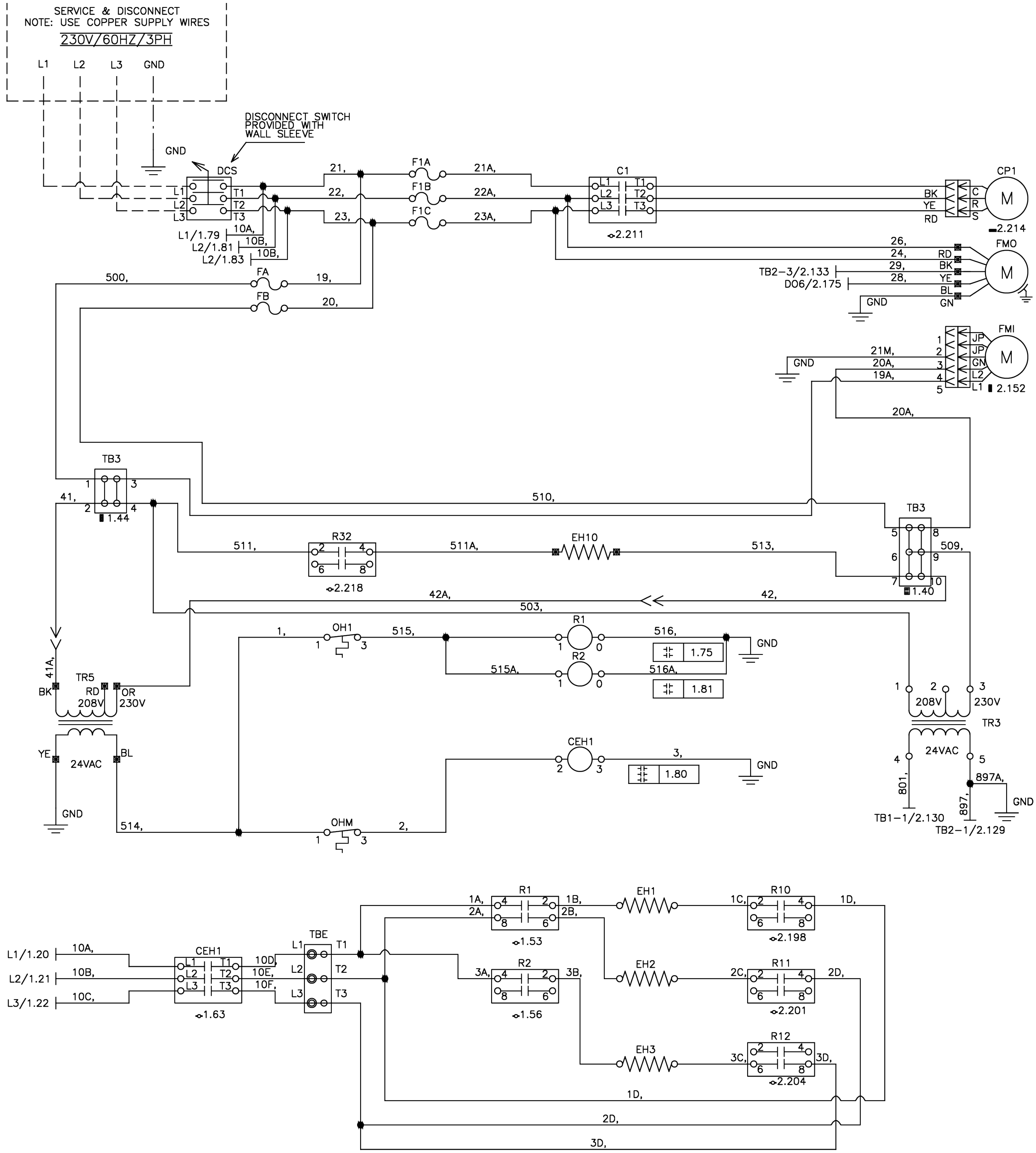
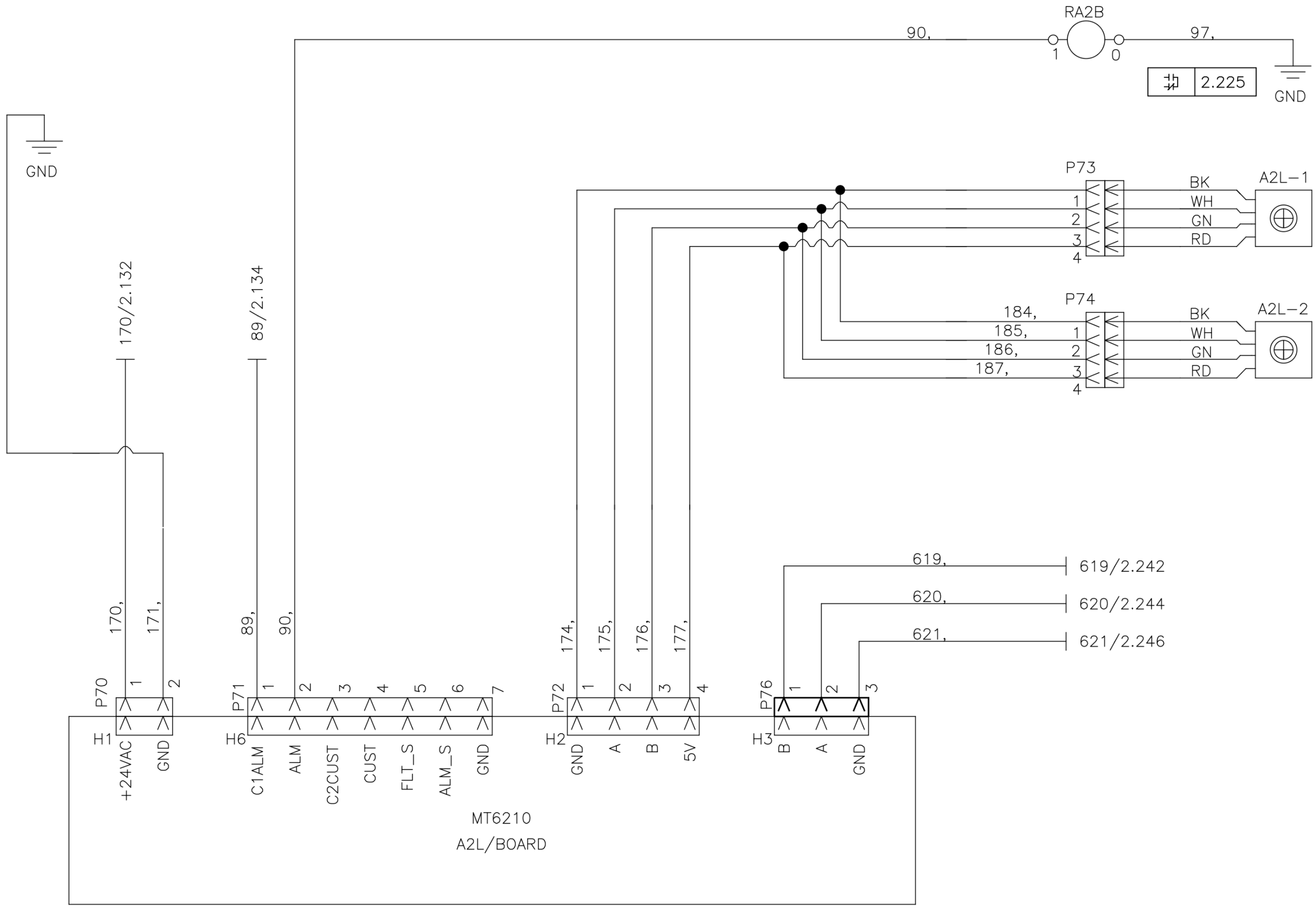


Figure 36: MicroTech Controls – A2L Leak Mitigation



Wiring Schematics Legend for "MicroTech Wiring Diagram – Typical"

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.

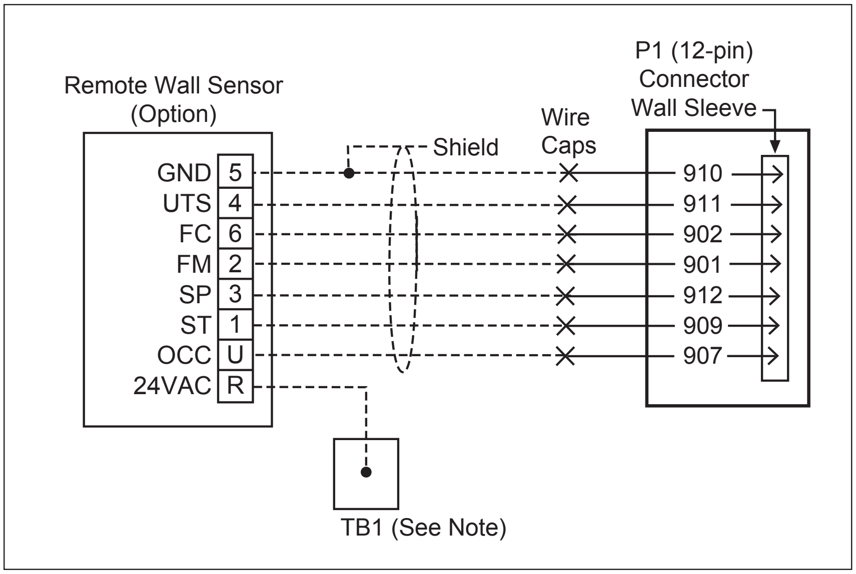
NOTE 3: EC motors are factory programmed for specified airflow. Contact Daikin Applied for replacement.

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 Sensors Diagram

Figure 37: Wall-Mounted Temperature Sensor Wiring for Wall Sensor



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

Power & Control Field Wiring

Figure 38: External Input Wiring Examples with or without Daisy Chaining of Units

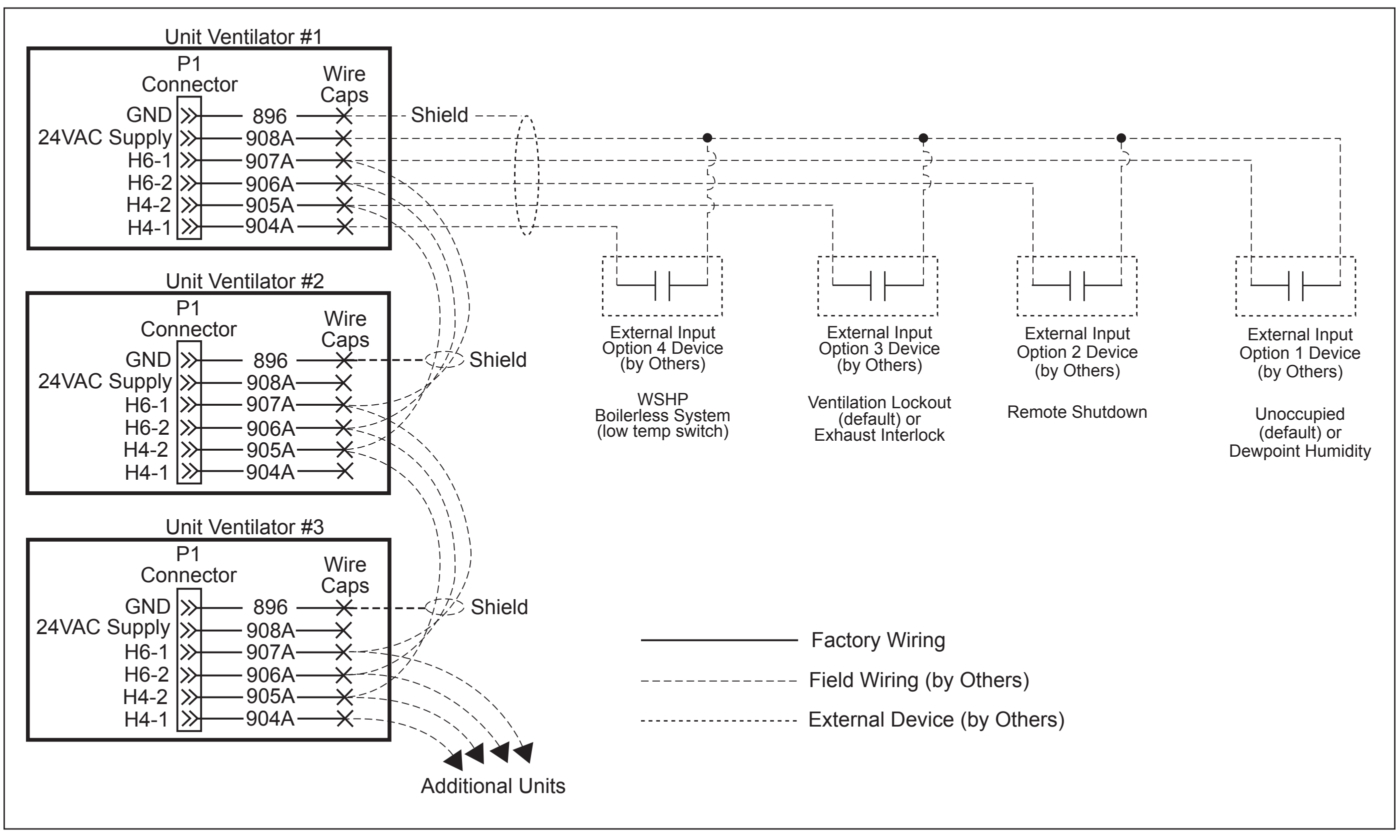


Figure 39: External Output Wiring - Single Unit

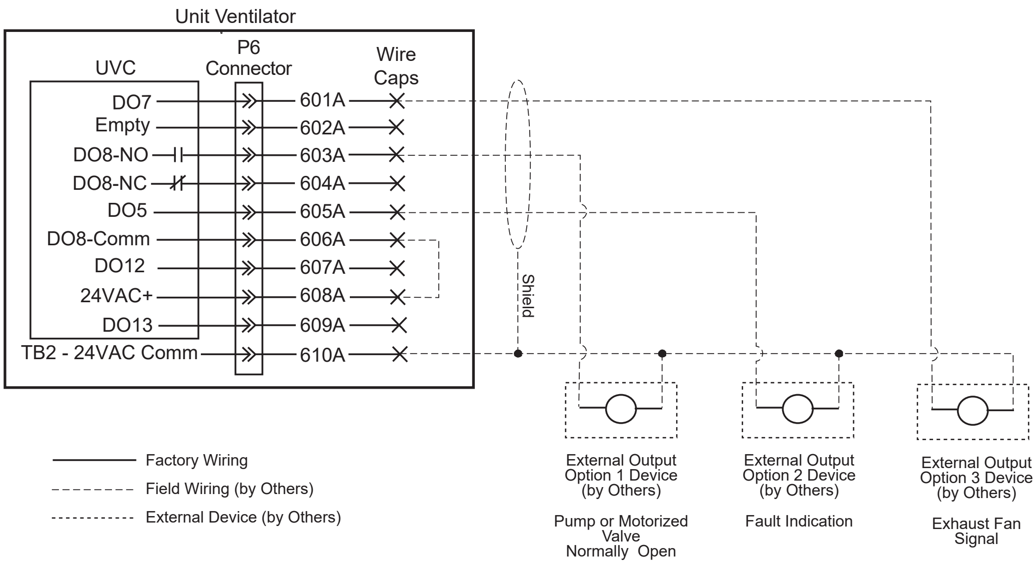
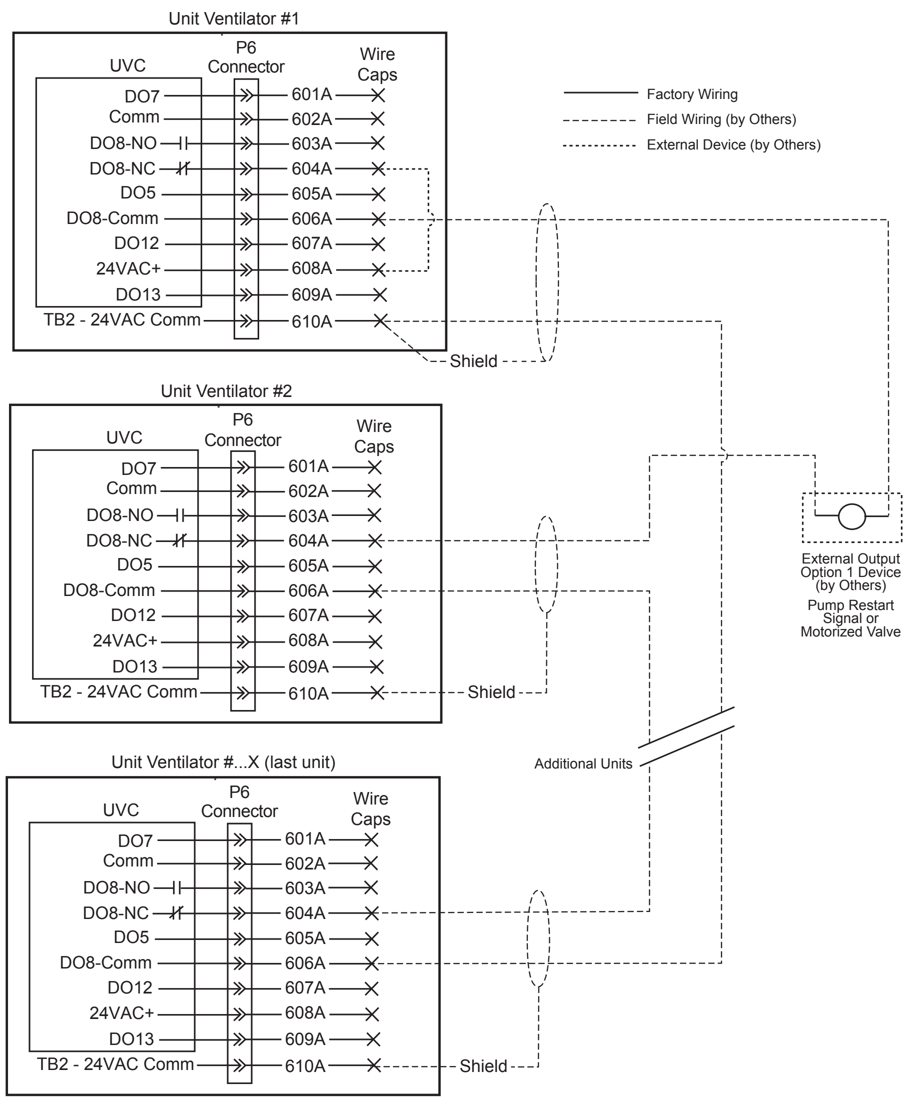


Figure 40: External Output Wiring - Multiple Units Shown



Control Modes and Functions

Daikin Applied unit ventilators equipped with MicroTech controls 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.

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 compare 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. 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 compare both indoor and outdoor temperatures and indoor and outdoor relative humidities to determine if free economizer operation can cool the space with non-humid outside air. This is a true enthalpy economizer.

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.

Freeze Prevention Mode

This mode helps protect the unit ventilator from freezing air conditions. Control functions vary depending on the type of temperature control used by the unit, as follows:

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 24VAC 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 47.

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 24VAC.

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) 24VAC 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) 24VAC 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) 24VAC 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 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.

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 outdoor air temperature falls below the compressor cooling lock out setpoint. Below this temperature setpoint only economizer cooling will be available.

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

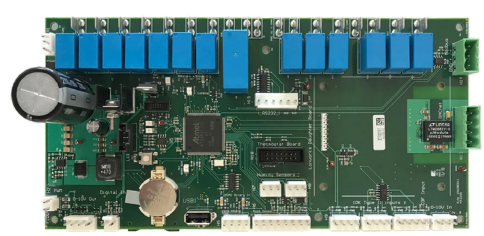
The main components of the MicroTech system are:

- A Unit Ventilator Controller (UVC) with on-board BACnet MS/TP communication.
- Optional Local User Interface (LUI).
- Optional LonWorks plug-in network communication module.
- In addition, unit ventilators equipped with MicroTech controllers 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 41: 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 digital 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 42: 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 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.

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 43).

Figure 43: CO_2 Sensor for Demand Control Ventilation

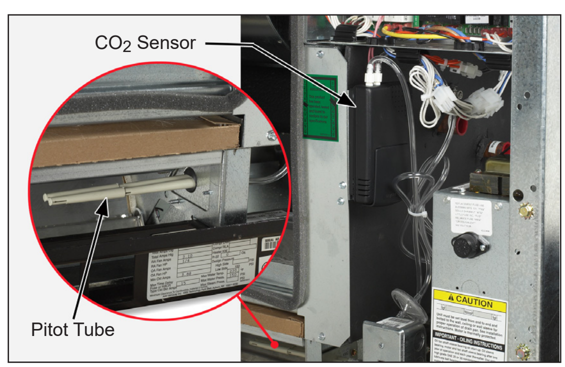
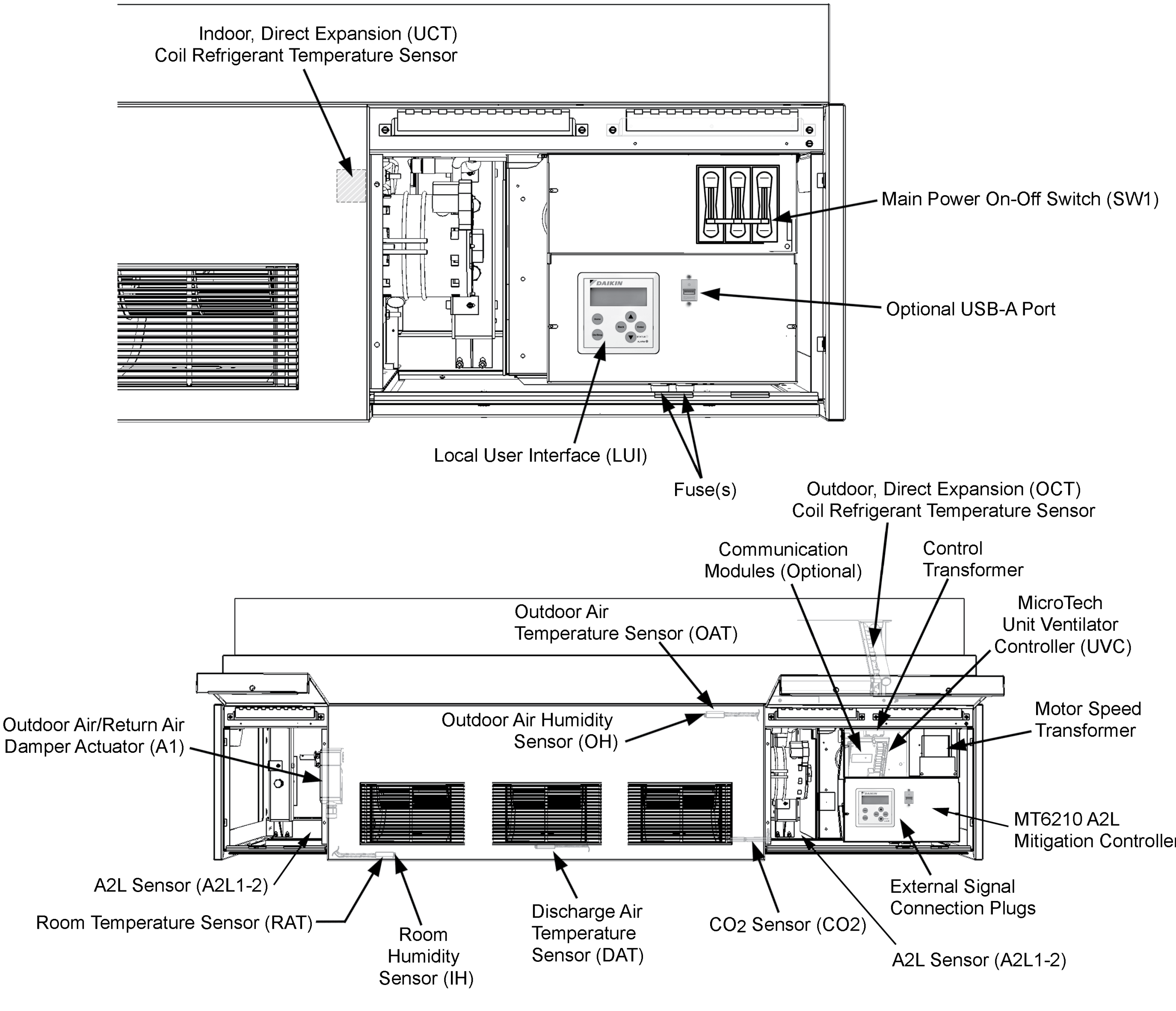


Figure 44: MicroTech Control Sensor and Component Locations



Room Temperature Sensors

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 23: 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	●	●	●	●

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 45: 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 46: 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 47). 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 47: 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 48).

Figure 48: 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 unit 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 24 below shows a list of inputs, outputs and alarm functions available.

Table 24: 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.

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 (max size of 32GB), 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.

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

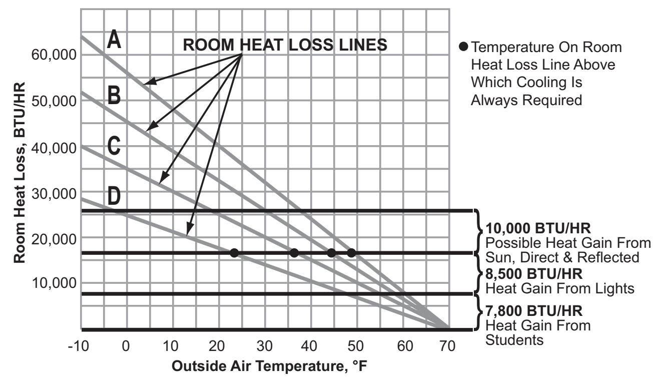
Schools have unique heating and ventilating needs, in large part because of their variable occupancy and usage patterns. Fewer cubic feet of space is provided per student in a school building than in any other type of commercial or public building. School classrooms are typically occupied only six hours 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 mid western 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 Btu per hour.

As the outside temperature changes, so does the amount of heat that the room loses. This is represented in Figure 49 by Room Heat Loss Line A, which ranges from 55,000 Btu per hour at 0°F outside air temperature to 0 Btu 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 49: Heat Gain Vs. Heat Loss In Occupied Classrooms



As Figure 49 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 Btu per hour per pupil. Multiply this by 30 and you get a total of 7,800 Btu per hour added to the room by the students alone. This excess heat is noted in Figure 49 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 49 as "Heat Gain from Lights."

Add the heat gain from lighting to the 7,800 Btu 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 49 on page 55 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 49 on page 55 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 49 on page 55).

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. (For more information on the ASHRAE Control Cycle II sequence, see Figure 50 on page 59.)

Under ASHRAE Cycle II, the outdoor air damper is closed during warmup 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. 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 Components

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.

Additional Components

Additional components may be required depending on the specific application. They include:

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. All units come with a factory mounted room temperature sensor.

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 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.

Coil Selection

All coils have their own unshared fin surfaces (some manufacturers use a continuous fin surface, sacrificing proper heat transfer). The result is maximum efficiency of heat transfer, which promotes comfort and reduces operating costs.

An air break between coils in all Daikin Applied units is used to enhance decoupling of heat transfer surfaces—providing full capacity output, comfort and reduced operating costs.

Direct expansion (DX) coils are constructed of aluminum fins with a formed, integral spacing collar. The fins are mechanically bonded to the seamless copper tubes by expansion of the tubes after assembly. Fins are rippled or embossed for strength and increased heat transfer surface.

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:

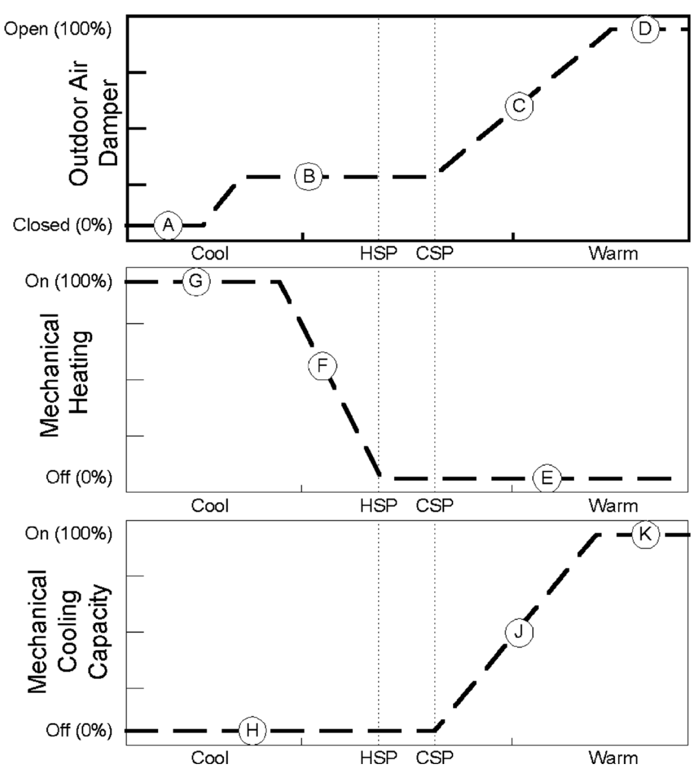
1. Classroom temperature.
2. Unit discharge air temperature.
3. Outdoor air temperature.

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 50: 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 Mechanical Heating Operation

E Heating (DX) 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

Carefully arrange the location and installation of each model AEQ unit to provide convenient service access for maintenance and, if necessary, removal of the unit. The installation consists of four basic elements in the following order:

1. **Louver**
2. **Galvanized Wall Sleeve**
3. **Horizontal Air Splitters by Others (if Required)**
4. **AEQ Self-Contained Unit Ventilator**

The louver brings in outdoor air for the condenser fan section and ventilation air to the classroom while providing a path for heated condenser air to exit.

The wall sleeve secures the unit, provides a watertight and air tight seal to the building and brings in electrical and control wiring (if required). It contains the unit main power disconnect switch which is located in the wall sleeve junction box. All field electrical connections are made inside this box.

Horizontal air splitters provide proper air paths and minimize air recirculation.

The AEQ self-contained unit ventilator provides comfort cooling and heating for the space. The AEQ unit is designed to be installed into or up against an exterior wall. The louver, air splitters (if required) and wall sleeve are installed before the AEQ unit is installed.

On many jobs, the louver and wall sleeve are shipped ahead of the unit itself. Installation instructions for these components are shipped with the individual components included in this publication.

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

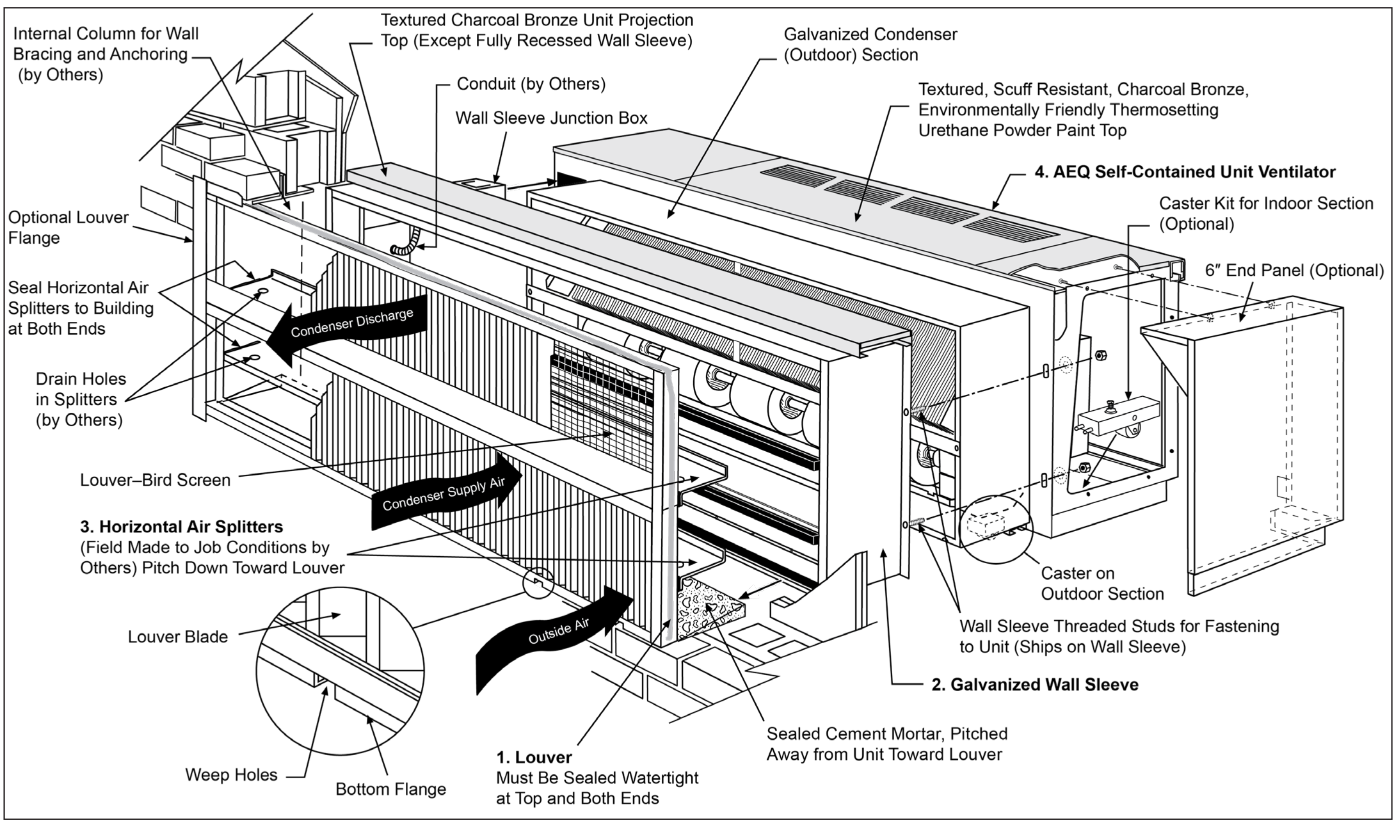
Condensate Piping

Daikin Applied AEQ unit ventilators are designed for condensate removal into a condensate disposal system. Do not connect the unit drain connection so that condensate exits to the outside and/or is exposed to freezing temperatures. Installer is responsible for any damage that might be caused from freezing condensate.

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.

Figure 51: Typical Self-Contained Unit Ventilator Installation



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.

Figure 52: Wall Penetrations Detail - Full Recess

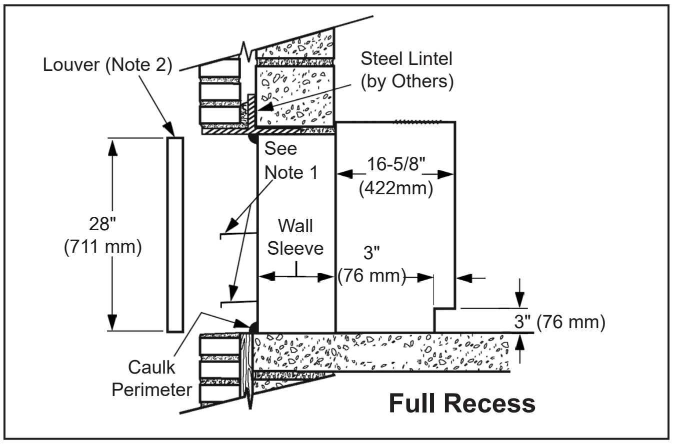


Figure 53: Wall Penetrations Detail - Partial Recess

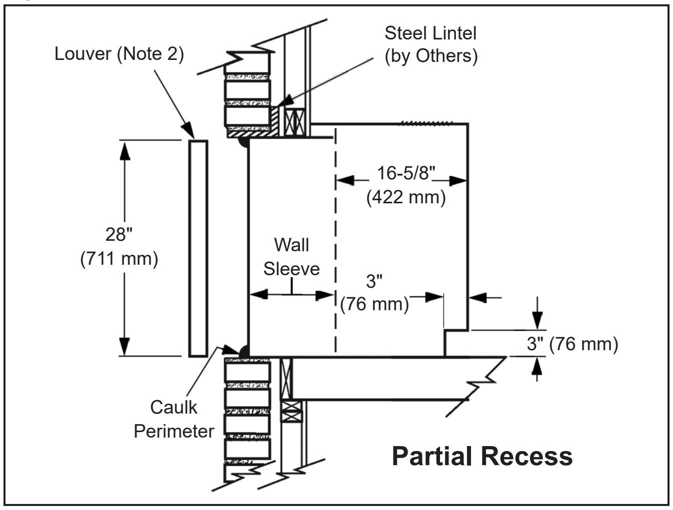
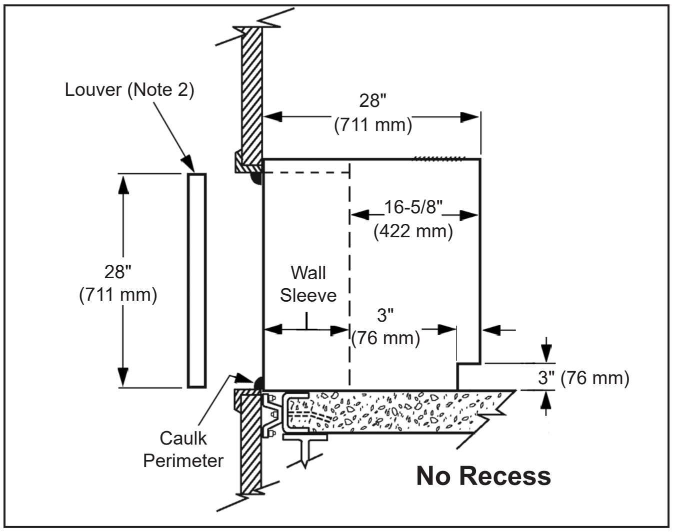


Figure 54: Wall Penetrations Detail - No Recess



Notes:

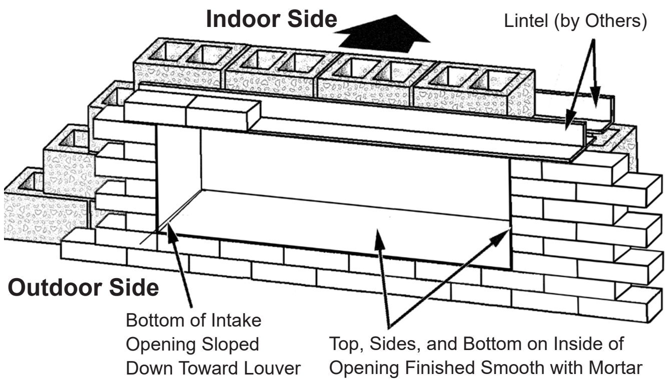
1. *Horizontal splitter (by others) must be installed whenever there is any space between the wall sleeve and the louver. It is necessary to seal the ends of the wall opening.*
2. *The top and two sides of the louver must be caulked water tight. The bottom edge of the louver must not be caulked, to allow for drainage.*
3. *Louvers may be recessed a maximum of 2" (51 mm) from the exterior face of the wall.*
4. *Drain must be flush with floor to allow unit installation and removal. Unit drain tube is 7/8" (22 mm) O.D. copper.*
5. *A field-supplied air seal should be applied to the exterior perimteter of the wall sleeve when unit is installed with no recess.*

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.

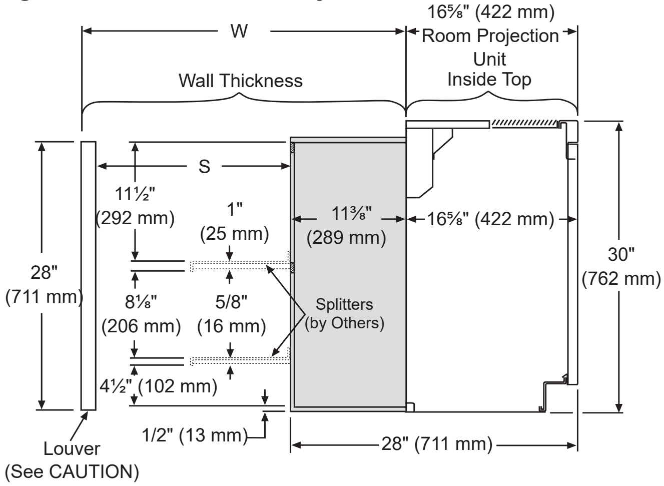
Figure 55: Typical Wall Opening with Lintels



Horizontal Splitters & Unit Recess Details

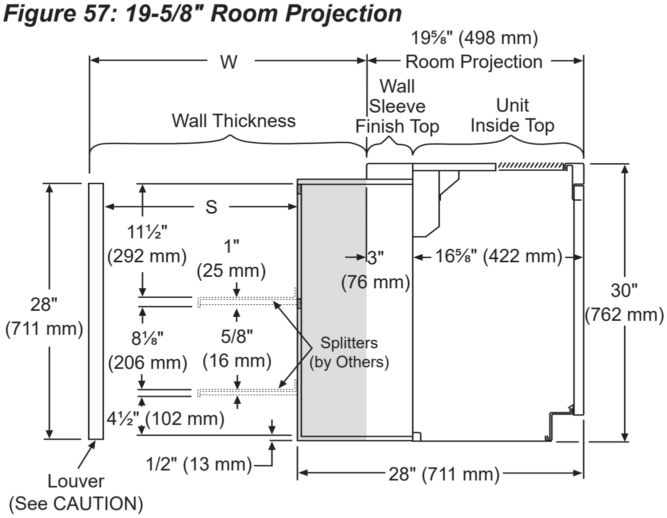
Horizontal splitter (by others) must be installed whenever there is space between the wall sleeve and the louver. Seal the ends of the wall opening to prevent water penetration and air leakage. Pitch the splitters toward the louver for water drainage

Figure 56: 16-5/8" Room Projection or Full Recess



Note: Shading indicates portion of unit wall sleeve recessed into wall opening.

Figure 57: 19-5/8" Room Projection

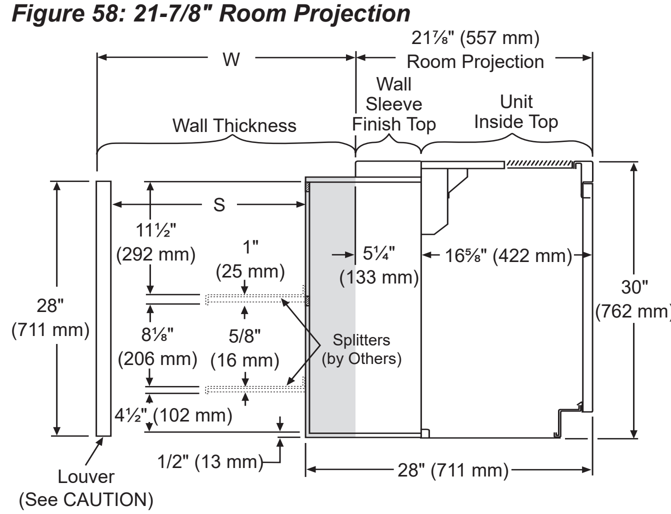


Note: *Shading indicates portion of unit wall sleeve recessed into wall opening*

⚠ CAUTION

Horizontal splitter (by others) must be installed whenever there is space between the wall sleeve and the louver. Seal the ends of the wall opening to prevent water penetration and air leakage. Pitch the splitters toward the louver for water drainage.

Figure 58: 21-7/8" Room Projection



Note: Shading indicates portion of unit wall sleeve recessed into wall opening.

Figure 59: 28" Room Projection

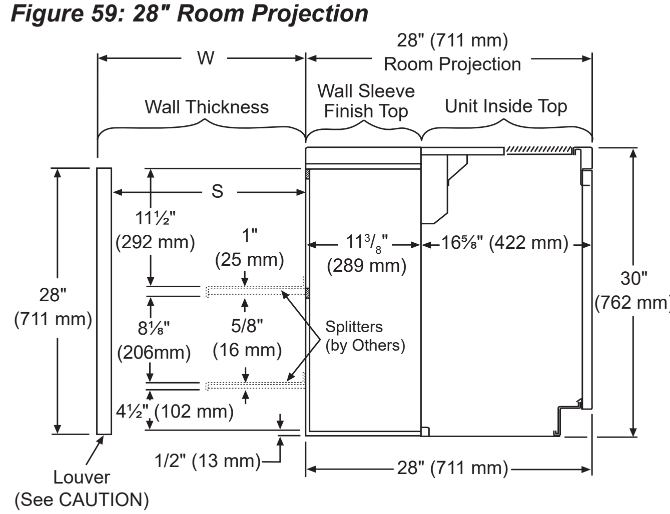


Table 25: Wall Thickness, Unit Projection Into Room

Wall Thickness "W"	Louver	Unit Projection into Room and Wall Sleeve Type			
		28"	21⅞"	19⅝"	16⅝"
		Figure 59	Figure 58	Figure 57	Figure 56
		Splitter Length from Wall Sleeve to Louer "S"			
2½"	2½"	0"			
4"	2½"	1½"			
6"	2½"	3½"			
8"	2½"	5½"			
8⅝"	2½"	6⅛"	0"		
10"	2½"	7½"	1⅜"		
10⅞"	2½"	8⅜"	2¼"	0"	
12"	2½"	9½"	3⅜"	1⅛"	
13⅞"	2½"			3"	0"
14"	2½"			3⅛"	1/8"
16"	2½"				2⅛"
18"	2½"				4⅛"
24"	2½"				10⅛"

Note: All dimensions are approximate and subject to change without notice. Actual building dimensions may vary.

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 "Accessories" on page 21 for information on this system and its proper installation.

Wall Sleeve Arrangements

Figure 60: Recessed Wall Sleeve with Horizontal Air Splitters

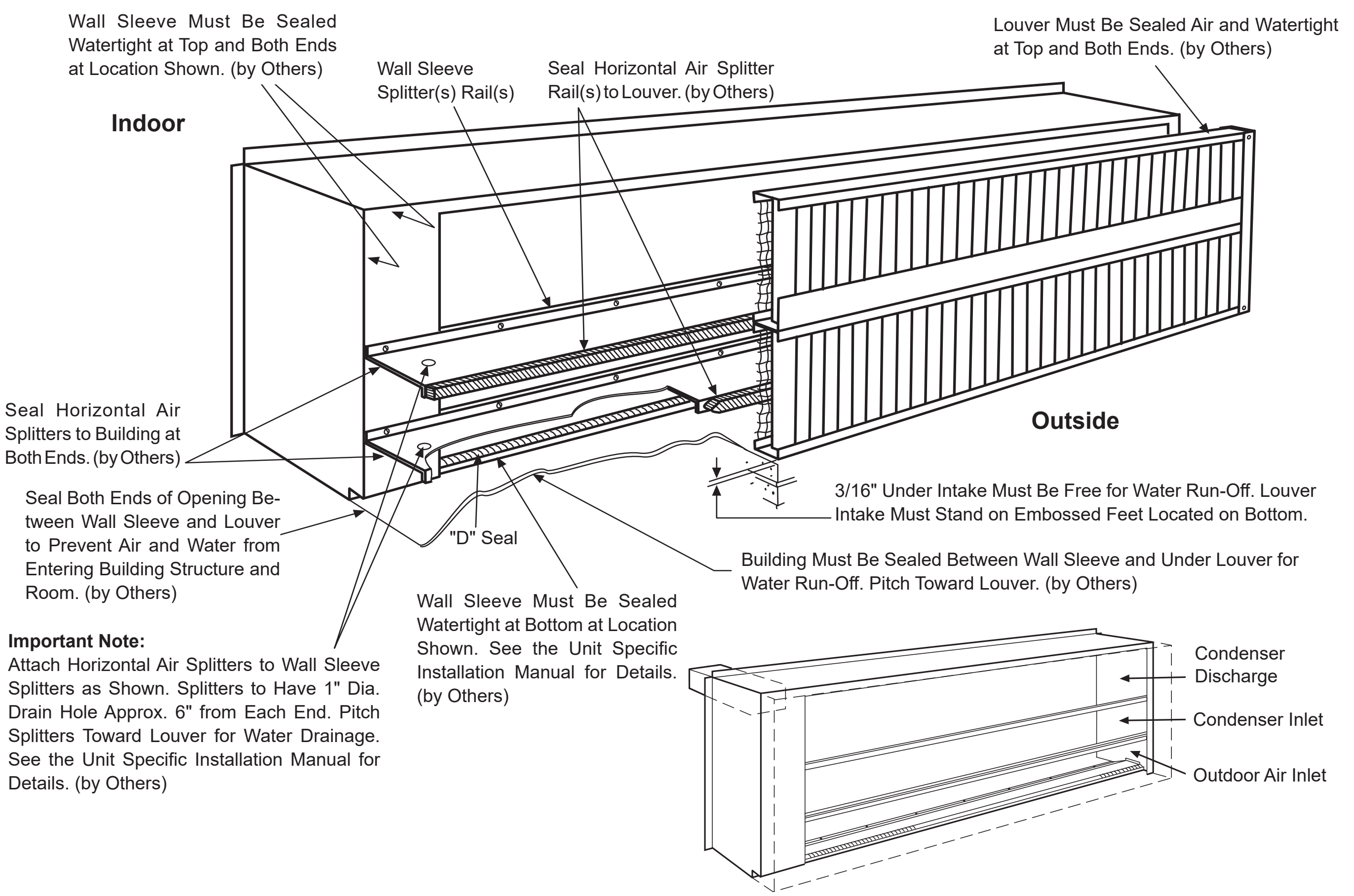


Figure 61: Sealing Full Projection Wall Sleeve and Horizontal Air Splitters

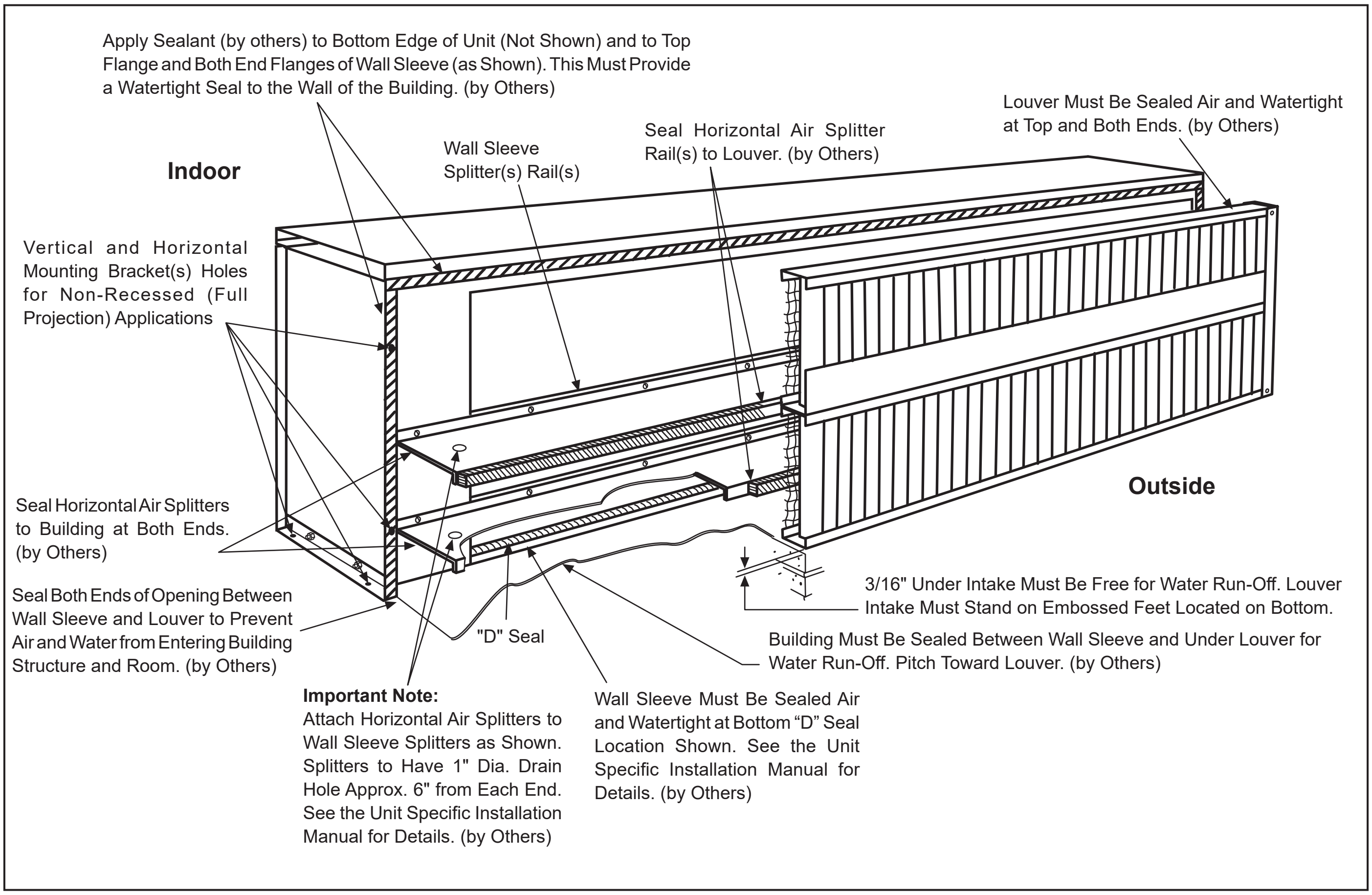


Figure 62: Recessed Wall Sleeve - Direct Sealing Wall Sleeve to Louver

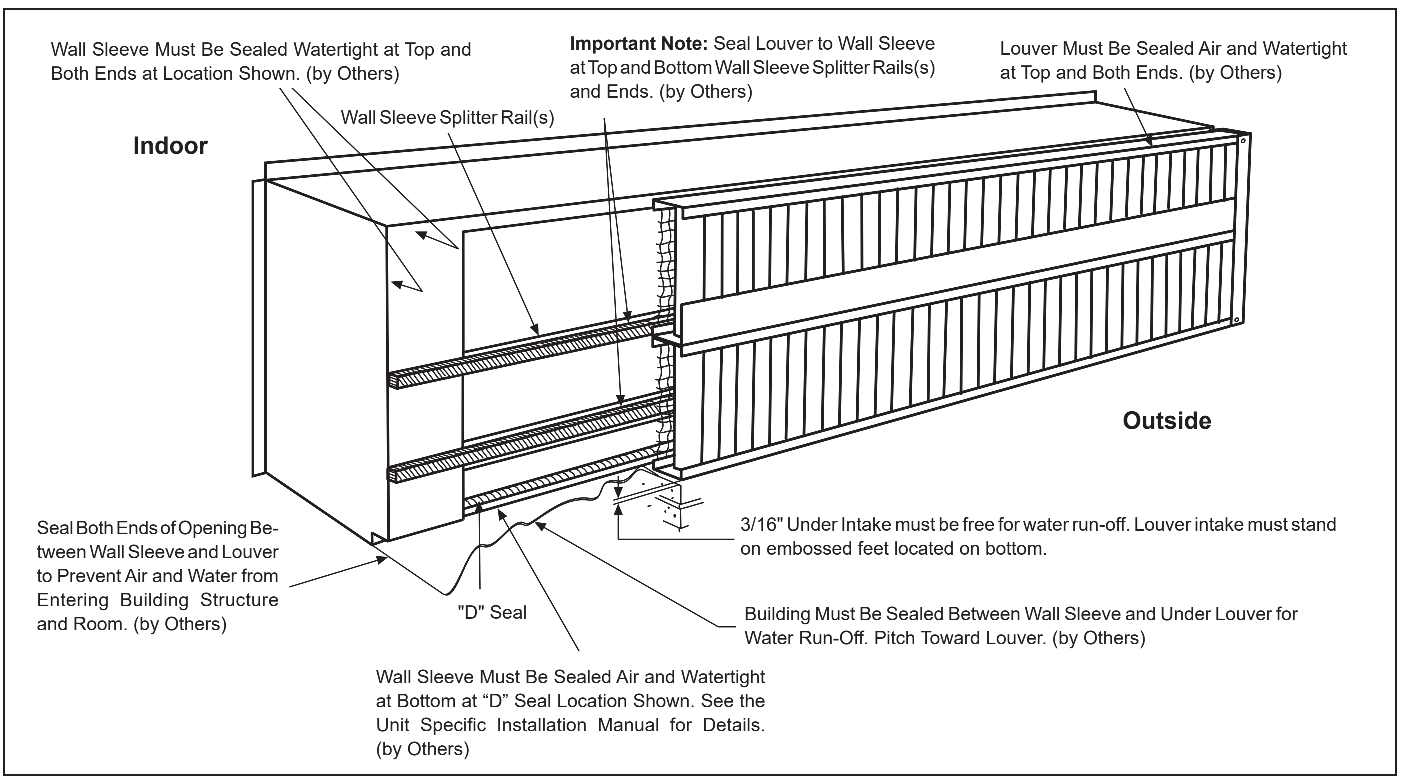


Figure 63: Sealing Full Projection Wall Sleeve to Louver Intake Without Horizontal Air Splitters

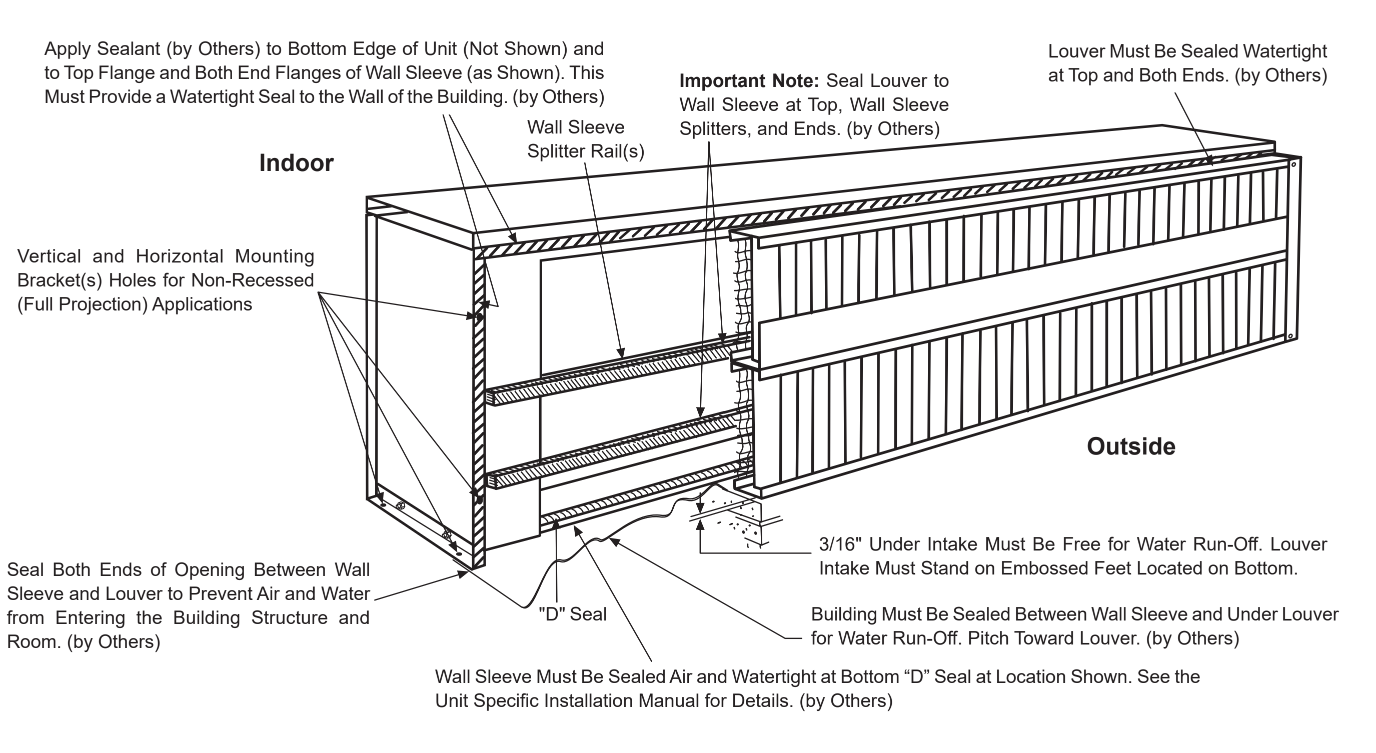
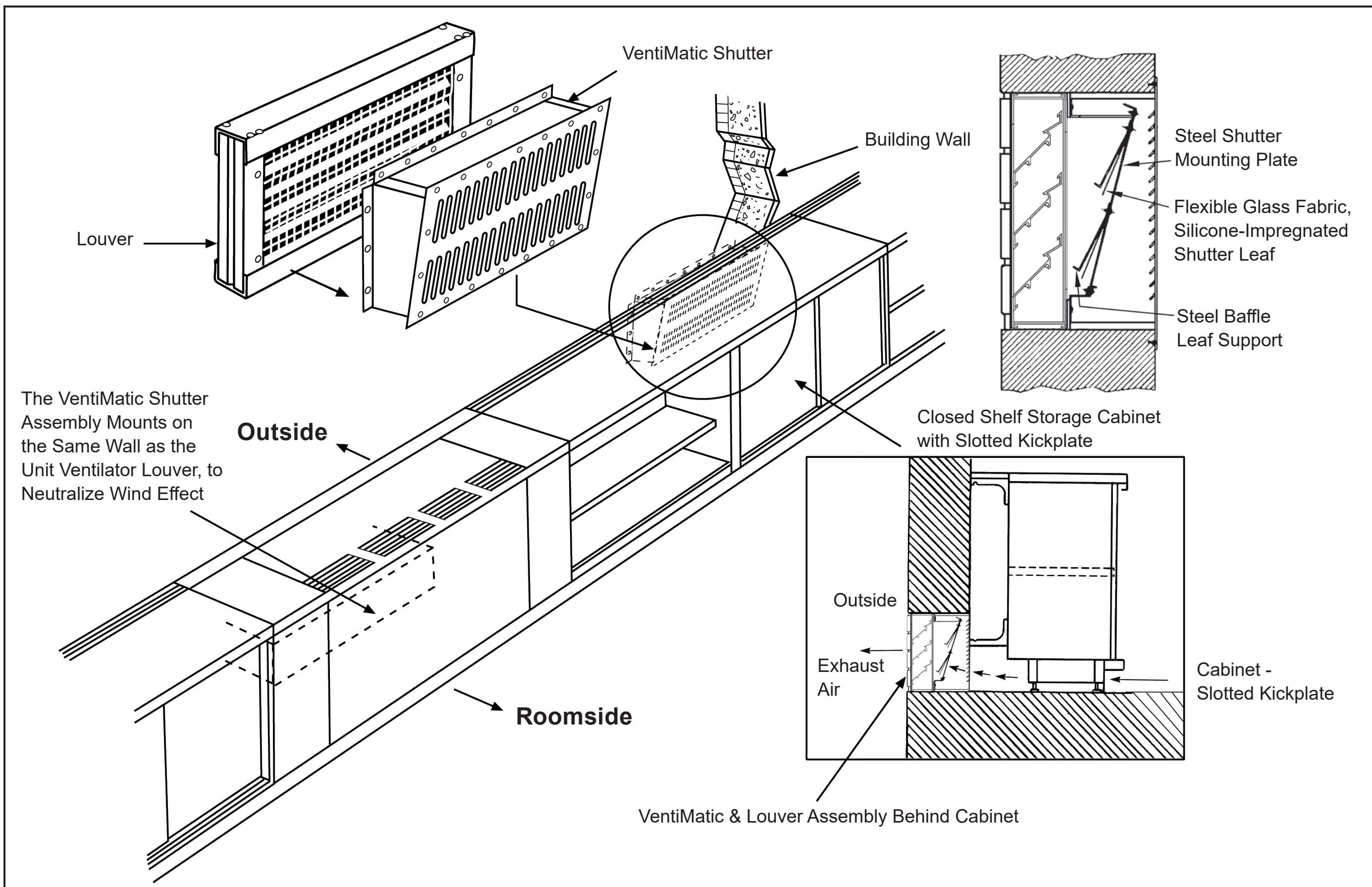


Figure 64: VentiMatic Shutter Installation



Engineering Specifications

DAIKIN APPLIED UNIT VENTILATOR – MODEL AEQ

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 Air Conditioning and Refrigeration Institute (ARI) standard 840.

D. Units 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 with no sharp edges and no unsightly screw heads and shall receive an electro-statically 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 airflow 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 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 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. 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 of 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. Indoor motor 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. All bearings shall be located out of the airstream. Bearings in the air stream are not acceptable.

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 glassfiber 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 useable 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, an outdoor section consisting of one condenser coil, multiple condenser fans with one motor, and an indoor evaporator coil with indoor fan section. 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. The condenser fan board and fan housings shall be constructed of galvanized steel. Condenser fan wheels shall be double inlet, forward curved centrifugal type. Condenser fan housings shall be constructed of galvanized steel and have pick up slots for slinging indoor condensate upon the condenser coil for evaporation. One long condenser fan wheel without a fan housing is not acceptable. Fan and motor assembly shall be of the direct drive type. Belt drive fans shall not be allowed.

C. The indoor refrigerant cooling 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 refrigerant indoor 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 outdoor condenser coils shall be constructed of copper tubes mechanically expanded to raised lanced aluminum plate fins mechanically bonded thereto and shall be positioned above a galvanized steel drain pan.

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

H. 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. In addition the refrigerant piping shall include braided copper tubing in the suction and discharge lines to further reduce the transmission of compressor pulsations. Straight compressor discharge lines without attenuation loops and/or braided copper flex-tubing are not acceptable. Compressor enclosure panels shall be 16-gauge minimum and crossbroken 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.

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. 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, wiring, 24 volt power and direct coupled damper actuators. The UVC shall support up to 4 analog inputs, 8 binary inputs, and 14 binary outputs plus 2 pulse width modulation outputs. The UVC shall have BACnet MSTP and a timeclock for stand-alone scheduling.

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

D. 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.

E. Optional unit mounted Local User Interface (LUI) Touch Pad shall have a Digital Display status/fault indication.

F. When network capable, network communication modules shall be communicate via plug-in communication modules the following typical points which may or may not be available based upon the unit type as a minimum to the Building Automation System:

1. Location
2. Equipment Type
3. Actual Room Temperature Output
4. Actual Room Humidity Output
5. Actual Room CO2 Output
6. Actual Outdoor Air Temperature Output
7. Actual Outdoor Air Humidity Output
8. Discharge Air Temperature Output
9. Discharge Air Temperature Setpoint Output
10. Effective Room Temperature Setpoint Output
11. Local Temperature Setpoint Output
12. Room Fan Speed Value Output
13. Room Fan Run Time Output
14. Face and Bypass Damper Position Output

15. Entering Water Temperature Output
16. Leaving Water Temperature Output
17. Wet Heat or CW/HW Valve Position Output
18. CW Valve Position Output
19. Compressor Run Time Output
20. Indoor Air DX Coil Refrigerant Temperature output
21. Outdoor Air Damper Position Output
22. UVC State Output
23. Heat/Cool Mode Output
24. Effective Occupancy Output
25. Energy Hold Off Output
26. Fault Value Output
27. No Fault Output
28. Binary Output(s) 1 Status Output
29. Binary Output(s) 2 Status Output
30. Binary Output(s) 3 Status Output
31. Binary Input + Status Output
32. Occupied Heating Setpoint
33. Occupied Cooling Setpoint
34. Unoccupied Heating Setpoint
35. Unoccupied Cooling Setpoint
36. Standby Heating Setpoint
37. Standby Cooling Setpoint
38. Effective Discharge Air Temperature Setpoint
39. Room CO2 Setpoint
40. Room Humidity Setpoint
41. Room Water In Temperature Differential Setpoint
42. Outdoor Air Damper Minimum Position High Speed Setpoint
43. Outdoor Air Damper Minimum Position Medium Speed Setpoint
44. Outdoor Air Damper Minimum Position Low Speed Setpoint
45. Economizer Outdoor Temperature Setpoint
46. Economizer Indoor Air/Outdoor Air Temperature Differential Setpoint
47. Economizer Outdoor Air Enthalpy Differential Setpoint
48. Unit Application Mode Input
49. Room Temperature Setpoint Input
50. Setpoint Offset Input
51. Setpoint Shift Input
52. Compressor Enable Input
53. Auxiliary Heat Enable Input
54. Economizer Enable Input
55. Occupancy Override Input
56. Emergency Override Input
57. Reset Filter Alarm Input
58. Reset Alarm Input

G. 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.

H. 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.

I. 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 controller will automatically monitor the remote sensor and disregard the unit-mounted sensor.

J. 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.

K. 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.

L. 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 un-occupied 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.

M. Night set-back/set-up control shall be provided by the internal time clock as described in the temperature control specification.

N. 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, dewpoint/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): 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 other logic sequences required to control unit ventilator operation within that particular state, while other functions 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 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 into Heat Only operation. The Heat mode shall use primary heat (wet heat) as needed to maintain the effective heating setpoint. The optional 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, or Low Limit 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 maintain a Discharge Air Temperature Setpoint (here after referred to as DATS) required to maintain the effective heat setpoint (Space Temperature Setpoint). The DATS shall not be allowed to go above Discharge Air High Limit (here after referred to as DAHL). The face and bypass damper shall be positioned to maintain the classroom temperature setpoint. The UVC shall use primary heat (wet heat) as needed to maintain the current DATS. The UVC shall monitor the wet heat coil leaving air temperature thermostat (if provided) in order to prevent coil freezing conditions (see Wet Heat Coil Leaving Air Temperature Thermostat).
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.

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 optional 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. 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.
3. 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.
4. 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 indoor and outdoor 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.
5. 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 CO2 Demand Controlled Ventilation function shall be active, if the unit is equipped for CO2 Demand Controlled Ventilation control, and the OAD shall be adjusted as needed to maintain the CO2 setpoint. 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.
6. 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 consist 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. Networked Setpoint Capability

1. The Space Temp Setpoint Input variable shall be used to allow the temperature setpoints for the Occupied and Standby modes to be changed via the network, the Unoccupied setpoints shall not effected by this variable.

P. Networked Setpoint Offset Capability

1. The Setpoint Offset Input variable shall be used to shift the effective Occupied and Standby temperature setpoints by adding the value of the Setpoint Offset Input variable to the current setpoints. The Unoccupied setpoints shall not be affected by this variable. This variable shall be typically bound to a supervisory network controller or to a networked wall module having a relative setpoint knob.

Q. Networked Space Temperature Sensor Capability

1. A networked Space Temperature Sensor shall be able to be interfaced with the Space Temp Input variable. When the Space Temp Input variable is used (valid value), it shall automatically override the hard-wired Space Temperature Sensor.

R. LUI Setpoint Offset Adjustment

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

S. 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.

T. 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.

U. 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.

V. 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.

W. 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 dewpoint/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) Dewpoint/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 dewpoint 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).

2.09 UNIT VENTILATOR OPTIONS/ACCESSORIES:

A. Wall Sleeve

1. Unit manufacturer shall provide a galvanized steel, one-piece wall sleeve that is to be set into the wall opening and butted up directly against the intake louver. The Wall Sleeve shall be provided for the following types of unit ventilator installation:

   a. 16 5/8" unit ventilator exposure into the classroom; OR

   b. 19 5/8" unit ventilator exposure into the classroom; OR

   c. 21 7/8" unit ventilator exposure into the classroom; OR

   d. 28" unit ventilator exposure into the classroom.

2. Where it is not possible to butt the wall sleeve against the wall intake louver, the contractor shall fabricate and install two (2) horizontal sheet metal baffles between louver and wall sleeve to provide an airtight separation between condenser discharge and condenser outside air, and condenser outside air and room outside air. The wall sleeve is to be permanently fastened in place and shall be suitably sealed, caulked, or grouted by the contractor around the entire perimeter to prevent air leakage.

3. The wall sleeve shall be fitted with an electrical junction box containing a main “on-off” switch. All field-wiring connections shall be made in this wall sleeve junction box.

4. It shall be the installing contractor’s responsibility to make the final load side power wiring connections between the wall sleeve junction box and the unit terminal block.

5. The wall sleeve with electrical junction box shall be cartooned separately and shipped to the jobsite preceding the unit ventilator.

B. Outdoor Air Intake Louver

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

   a. 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. The louver shall be divided in half horizontally across the louver to prevent condenser air recirculation. All louvers shall be 28" (711 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:

      i. unfinished capable of field painting; OR

      ii. manufacturer’s oven baked powder paint finish and color for selection by the Architect; OR

      iii. clear anodized finish.

   b. 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. The louver shall be divided in half horizontally across the louver to prevent condenser air recirculation. All louvers shall be 28" (711 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:

      i. unfinished capable of field painting; OR

      ii. manufacturer’s oven baked powder paint finish and color for selection by the Architect; OR

      iii. clear anodized finish.

2. [OPTIONAL] Intake Grille - 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.

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.

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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.

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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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