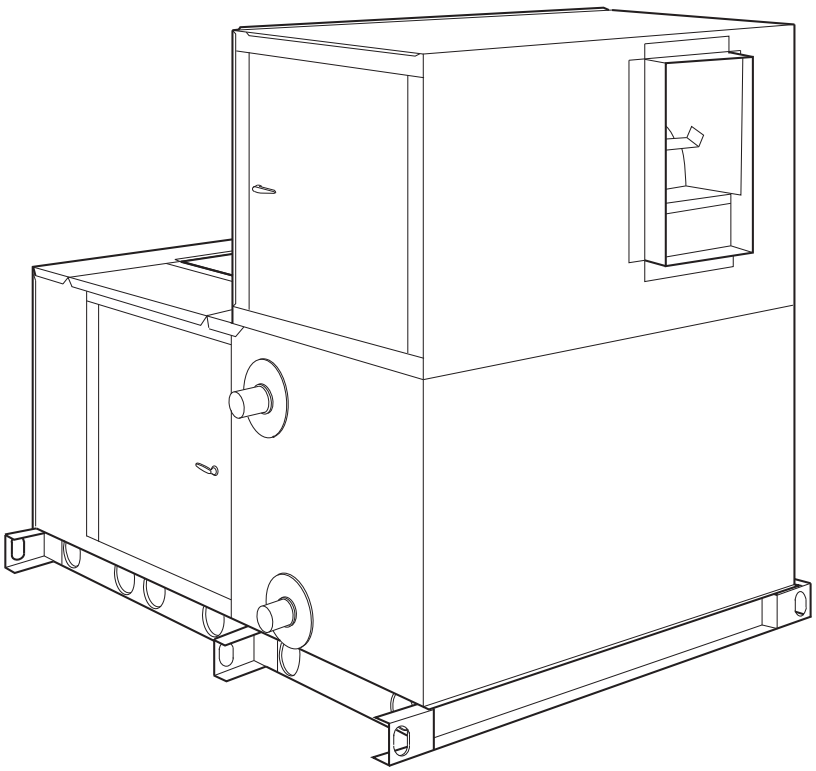
Product Data

39LA,LB,LC,LD,LF,LG,LH03-25 Indoor Air Handlers

Nominal 1,800 to 15,000 cfm



Carrier 39L Series air handlers offer:

- Horizontal and vertical draw-thru arrangements for heating, cooling, ventilation, and VAV (variable air volume) applications
- Small footprint assures rigging ease and reduced space requirements
- High-efficiency fan minimizes surging and turbulence and reduces operating costs
- Exclusive Nu-Fin coil surface provides peak heat transfer
- Optional double wall construction

Features/Benefits

Carrier delivers the air handler components for many stringent specification requirements. The 39L Series air handlers are compact and fully assembled; they combine versatility with economical, dependable performance.

Dependable performance

Galvanized steel panels ensure structural integrity under all operating conditions. Double-walled hinged access doors also enhance structural stability and provide fast, easy access.

Sloped, double-wall stainless steel drain pan controls condensate and is self-draining; complies with ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 62.1.

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Features/Benefits (cont)

Internally mounted motors and drives are installed and aligned at the factory. Because they are contained in a cooled, filtered, dehumidified airstream, motor bearings and belts have less wear and require less servicing. Internal mounting also reduces installation time, shipping damage, and vandalism.

Precision-balanced fan wheels limit vibration and eliminate abnormal stress on bearings and other components.

Rugged pillow-block bearings are securely fastened to the solid steel fan shafts with split collets and clamp locking devices. Bearings are rated at 200,000 hours average life.

Mixing boxes and filter mixing boxes have parallel blades to provide thorough, efficient air mixing. Dampers are sectioned and have maximum blade lengths of 50 in. to prevent excess blade warping and ensure tight closure.

Economy

Carrier's 39L air handlers may save money. Factory assembled, prealigned drives and fans reduce field installation expense.

Small envelope size is easy to rig and ensures economical use of building space. Quicker, easier installation and set up reduce start-up costs.

Hinged access doors on most sections ease service and promote regular maintenance, saving time and money.

Coil flexibility

The 39L units offer a wide selection of coils for cooling, heating, preheat with cooling, or cooling with reheat application. Standard 39L coils have galvanized steel casings; inlet and outlet connections are always on the same end, regardless of circuiting, and can be specified as right-hand or left-hand connections.

Chilled water, hot water, and direct expansion coils have non-ferrous headers designed to minimize pressure drop. All coils have $^1/_2$-in. OD copper tubes and Nu-Fin fins that are mechanically bonded to the coils for enhanced heat transfer. Aluminum or copper fins are available with spacings of 8, 11, or 14 fins-per-inch. Copper-fin coils also have stainless steel casings.

Chilled water coils — Large face area coils are available with 4 or 6 rows, and small face area coils are available with 4, 6, or 8 rows. Both large and small face area coils offer quarter, half, full, or double circuits for maximum thermal performance with minimum pressure drop. Quarter circuits are available only with 4-row coils; double circuits are available with 4, 6, or 8-row coils.

Direct expansion (DX) coils — Large face area coils are available with 4 or 6 rows, and small face area coils are available with 4, 6, or 8 rows. Both large and small face area coils offer quarter, half, full, or double circuits for maximum thermal performance with minimum refrigerant pressure drop. Availability of a given circuit type depends on unit size. For full design flexibility, all direct expansion coils have at least 2 splits; a coil can be matched with 1 or 2 compressors for independent refrigerant systems.

Hot water coils — Hot water (U-bend) coils provide heating capability for a complete range of applications. One-row coils are offered with half circuits, and 2-row coils are offered with both half and full circuits.

Steam coils — Inner Distributing Tube (IDT) steam coils have 1-in. OD copper tubes and aluminum or copper plate fins with 6, 9, or 12 fins-per-inch. The steam coils have a broad operating pressure range; up to 175 psig at 400 F and up to 300 psig at 300 F. Steam coils are especially suited to applications where subfreezing air enters the air handler, or where uniform temperature of the existing air is required.

Electric heat coils — Electric heat coils can be ordered for factory installation into the Carrier preheat-electric (PHE) section. The PHE section is equipped with full-support slide tracks for easy field service. All electric heaters are suitable for both constant volume (CV) and VAV applications.

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AHRI certification

The Air-Conditioning, Heating and Refrigeration Institute (AHRI) is a voluntary, nonprofit organization comprised of the manufacturers of air conditioning, refrigeration, and heating products. More than 90% of the air conditioning and refrigeration machinery and components manufactured in the United States is produced by members of AHRI.

Carrier 39L air handlers are rated in accordance with AHRI Standard 430, which is the industry standard for central station air-handling units. Certification by participating manufacturers of units within the scope of this program requires that the ratings and performance of any central station unit certified to AHRI be established in accordance with the AHRI Standard.

The following items are not within the scope of the AHRI Central Station Air Handlers Certification program:

- sound ratings
- electric heating coil ratings.

Coils installed in the Carrier 39L air handlers are rated in accordance with AHRI Standard 410.





Model number nomenclature

39L A 25 HC –A– – APW – A 9

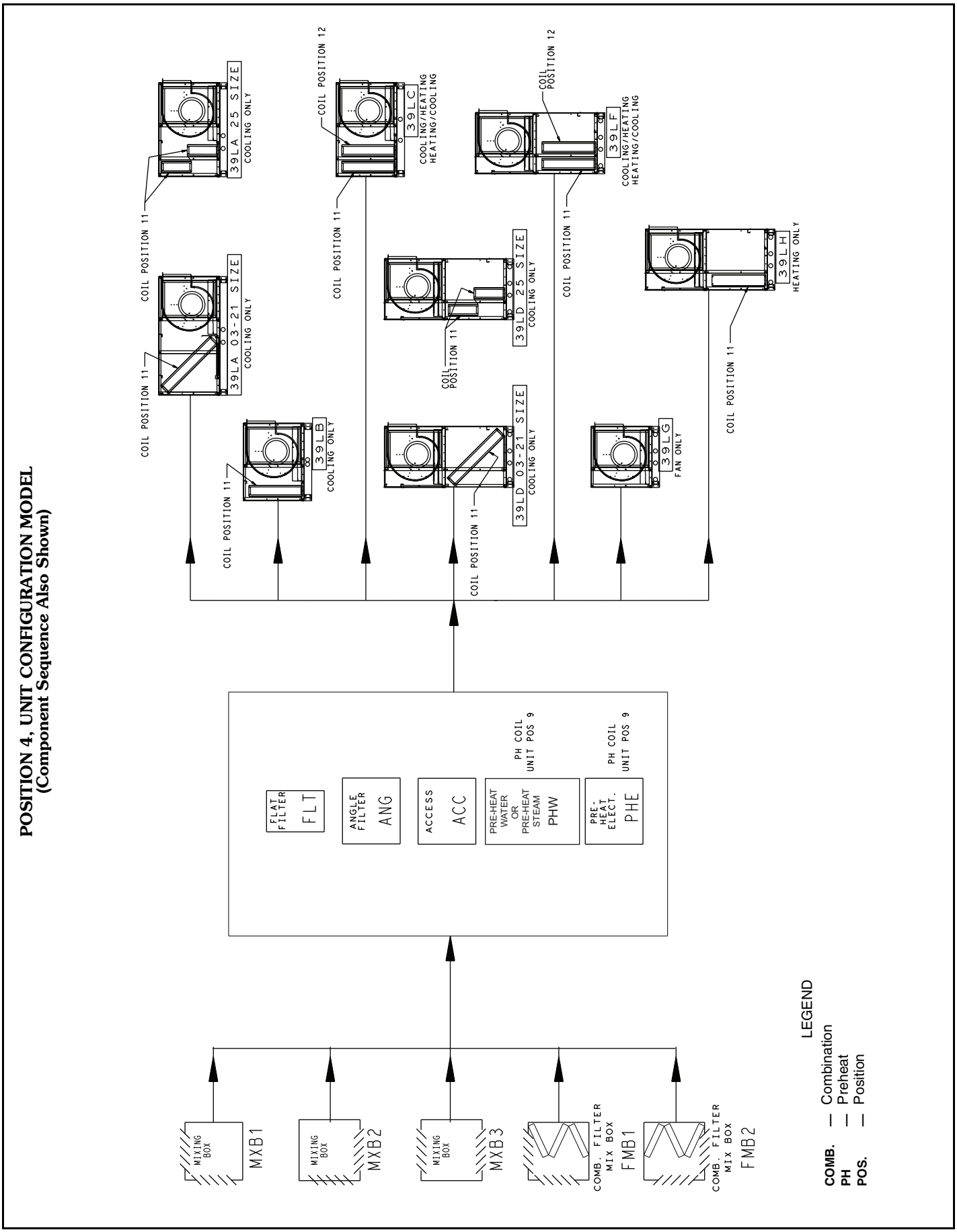
Due to the complexity of the (18 position) 39L model number, use the "verify model number" function in the ***AHU*Builder®** software for a detailed model explanation. The description below can be used as a general model guide.

Pos. 1-3:	Unit Type – 39L Air Handler
Pos. 4:	Unit Model – fan/coil configuration. Refer to the diagram on page 4.
Pos. 5-6:	Unit Size – Ranges from 03 to 25.
Pos. 7-8:	Draw-Thru Options – Includes the sections that will make up the unit
Pos. 9-12	Coil Type and Arrangement – Describes the coil type (chilled water, DX, heating only etc.), fins, rows and circuit information.
Pos. 13-15	Fans – Describes fan discharge, fan speed, and motor information.
Pos. 16	Controls – Describes the control offering (CV, VAV) and the components that they include.
Pos. 17	Additional options – Allows designation of insulation type, suspension and unit hand.
Pos. 18	Special Order – Allows copper fin coils and/or .025 in. wall tubes

Quality Assurance

ISO 9001:2008-certified processes.
MEA (Materials and Acceptance) number: 131-89-E

Model number nomenclature (cont)



Application data

Central station air handler

The central station air handler is a heating, ventilating, or air-conditioning unit that is centrally located in, or on, a building or structure and from which air is distributed to desired areas through a system of ducts.

The 39L factory packaged unit

Individual components, such as fans, coils, and filters, are assembled at the factory.

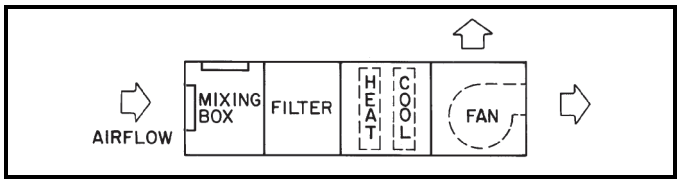
Packaged equipment is less costly than field-fabricated equipment and does not require assembly.

The basic air-handling unit consists of a fan section and a coil section. Other components, such as filter sections, air-mixing boxes, access sections, and damper sections, may also be provided.

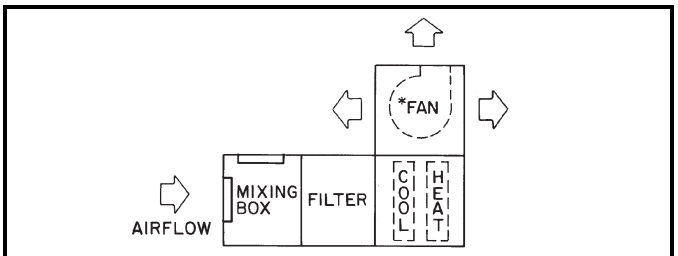
Central station configurations

Draw-thru units

Horizontal



Vertical (indoor unit only)



*Fan discharge may be horizontal or upblast.

Fans

The 39L central station air handlers use belt-driven centrifugal fans. A centrifugal fan is one in which the air flows radially through the impeller. Centrifugal fans are classified according to fan wheel and blade construction. The 39L fan is selected as a double width, double inlet (DWDI) with forward curved blades.

Laws of fan performance

Fan laws are used to predict fan performance under changing operating conditions or by fan size. They are applicable to all types of fans.

The fan laws are stated below. The symbols used in the formulas represent the following variables:

CFM — Volume rate of flow through the fan.
RPM — Rotational speed of the impeller.
P — Pressure developed by the fan.
Hp — Horsepower input to the fan.
D — Fan wheel diameter. The fan size number can be used if it is proportional to the wheel diameter.
W — Air density, varying directly as the barometric pressure and inversely as the absolute temperature.

Application of these laws is limited to cases where fans are geometrically similar.

FAN LAWS

VARIABLE	CONSTANT	LAW	FORMULA
SPEED (RPM)	Air Density Fan Size Distribution System	Airflow varies directly with the Speed.	$\frac{CFM_1}{CFM_2} = \frac{RPM_1}{RPM_2}$
		Pressure varies as the square of the Speed.	$\frac{P_1}{P_2} = \left(\frac{RPM_1}{RPM_2}\right)^2$
		Horsepower varies as the cube of the Speed.	$\frac{Hp_1}{Hp_2} = \left(\frac{RPM_1}{RPM_2}\right)^3$
FAN SIZE (D)	Air Density Tip Speed	Capacity and Horsepower vary as the square of the Fan Size.	$\frac{CFM_1}{CFM_2} = \frac{Hp_1}{Hp_2} = \left(\frac{D_1}{D_2}\right)^2$
		Speed varies inversely as the Fan Size.	$\frac{RPM_1}{RPM_2} = \frac{D_2}{D_1}$
		Pressure remains constant.	$P_1 = P_2$
	Air Density Wheel Speed	Capacity varies as the cube of the Size.	$\frac{CFM_1}{CFM_2} = \left(\frac{D_1}{D_2}\right)^3$
		Pressure varies as the square of the Size.	$\frac{P_1}{P_2} = \left(\frac{D_1}{D_2}\right)^2$
		Horsepower varies as the fifth power of the Size.	$\frac{Hp_1}{Hp_2} = \left(\frac{D_1}{D_2}\right)^5$
AIR DENSITY (W)	Pressure Fan Size Distribution System	Speed, Capacity, and Horsepower vary inversely as the square root of Density.	$\frac{RPM_1}{RPM_2} = \frac{CFM_1}{CFM_2} = \frac{Hp_1}{Hp_2} = \left(\frac{W_2}{W_1}\right)^{1/2}$
	Airflow Fan Size Distribution System	Pressure and Horsepower vary with Density.	$\frac{P_1}{P_2} = \frac{Hp_1}{Hp_2} = \frac{W_1}{W_2}$
		Speed remains constant.	$RPM_1 = RPM_2$

Application data (cont)

Fan selection criteria

System requirements — The major factors that influence fan selection are airflow, external static pressure, fan speed, brake horsepower, and sound level. Additional system considerations include the fan control method, overloading, and non-standard air density. Fan selection for air-conditioning service usually involves choosing the smallest fan that provides an acceptable level of performance, efficiency and quality.

Pressure considerations — The static pressure is the resistance of the combined system apart from the fan. Contributors to static pressure include other components in the air handler, ductwork, and terminals. The static pressure is dependent on the airflow through the system, which is determined by the air conditioning requirements. As shown in the second fan law in the table on the preceding page, the static pressure varies as the square of the airflow (cfm). This ratio between pressure and airflow determines the system curve for any air-handling system.

The static pressure used to select a fan should be the pressure calculated for the system at design airflow. If the static pressure is overestimated, the amount of increase in horsepower and air volume depends upon the steepness of the fan curves in the area of selection.

With forward-curved (FC) fans, if the actual static pressure of the system is less than the design static pressure, the fan has a tendency to deliver more air and draw correspondingly higher bhp (kW of energy). This higher current draw may overload the motor and trip circuit breakers. This is a common occurrence when FC centrifugal fans are operated before all the ductwork has been installed, or during the pull-down load on a VAV system.

Stability — Fan operation is stable if it remains unchanged after a slight temporary disturbance, or if the fan operation point shifts to another location on the fan curve after a slight permanent disturbance. Fan operation is unstable if it fluctuates repeatedly or erratically. There are 2 main types of unstable fan operation:

System surge is a cycling increase and decrease in system static pressure.

Fan stall is the most common type of instability, and it occurs with any type of centrifugal fan when the fan is starved for air.

Normally, the rotation of the fan wheel forces the air through the blade passageway from the low pressure to the high pressure side of the fan. If the airflow is restricted too much, however, there is not enough air to fill the space between the blades and the air distribution between the blades becomes uneven and erratic. Air can flow backwards through the wheel and the noise level is substantially increased. If the fan runs in this condition for a long time, wheel failure is likely to occur.

For a given speed, the operating point where a fan stalls is a function of the wheel geometry and wheel speed. In general, the stall point is within the range of 15 to 25% of the airflow obtained at free delivery.

Stability and VAV applications — Special considerations must be made for VAV systems. While the initial fan selection may be acceptable, its operating point could shift to a point of stall at minimum airflow and pressure conditions. The typical minimum airflow is half of the design cooling airflow, which is also often equal to the heating airflow. To determine and plot the minimum airflow versus static pressure, use the following equation. This equation solves for the static pressure at a specific airflow based on a minimum static pressure set point:

$$\left(\left(\frac{CFM_1}{CFM_{DESIGN}} \right)^2 X \quad (SP_{DESIGN} - SP_{MIN}) \right) + SP_{MIN} = SP_1$$

$$\left(\left(\frac{7{,}500}{15{,}000} \right)^2 X \quad (4 - 2) \right) + 2 = 2.50 \text{ in. wg}$$

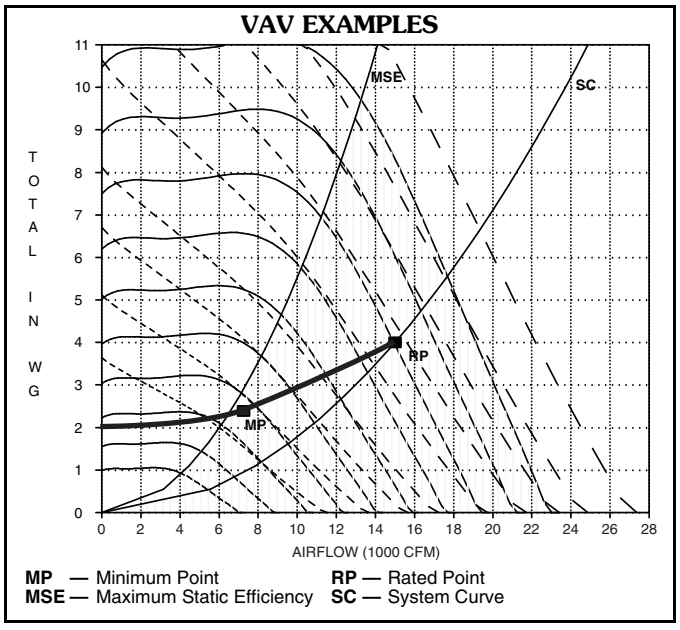
CFM — Airflow in Cubic Feet Per Minute
SP — Static Pressure

The table below illustrates a system with an airfoil fan wheel at a cooling design of 15,000 cfm and a system static pressure of 4 in. wg. The minimum airflow is 7,500 cfm with a minimum system static pressure set point of 2 in. wg. **The minimum static setpoint is based on zero airflow and does not coincide with the minimum design airflow.**

Example:

% AIRFLOW	CFM	SYSTEM AND FAN STATIC PRESSURE (in. wg)
100	15,000	4.00
90	13,500	3.62
80	12,000	3.28
70	10,500	2.98
60	9,000	2.72
50	7,500	2.50

As shown on the highlighted VAV curve, the minimum airflow and static pressure (MP) are both well within the acceptable operating conditions of the fan.



Sound considerations — The fan is one of the main sound sources in an air-conditioning system. Other sources of sound include the duct system and terminals, because they generate turbulence in the air flowing through them. Simply estimating fan sound does not give an accurate picture of total system sound, but because fan sound is a major component of system sound, fan sound should be minimized.

To minimize its sound generation, a fan must be correctly sized and should be selected to operate at or near peak efficiency. Oversized fans can generate much higher sound power levels than necessary, especially in VAV systems operating at low airflows. Undersized fans can also result in higher sound power levels because of increased fan speeds and the higher tip velocity of the air leaving the fan blades.

For VAV systems, the part load point at which the fan operates most of the time should be used to select a fan for lowest sound output.

Variable frequency drives (VFDs) are used to modulate fan volume. A VFD reduces the sound power level as the fan speed is reduced. At 50% load, the sound level is reduced approximately 15 dB compared to the sound level at 100% load. When using variable frequency drives, it is important to be sure that the static deflection of the vibration isolators is adequate. At very low fan speeds, the fan frequency may approach the natural frequency of the spring isolation. If this happens, the vibration levels can be amplified and resonant vibration conditions can occur.

When sound level is a major consideration, a blow-thru fan should be considered because of the reduced discharge sound level. This sound reduction is due to the sound absorption of the coil section downstream from the fan. Transition fittings and elbows can be reduced in size or eliminated, thereby eliminating a sound source.

To obtain projected sound data for a selected 39L unit, use the electronic catalog ***AHU*Builder®** program.

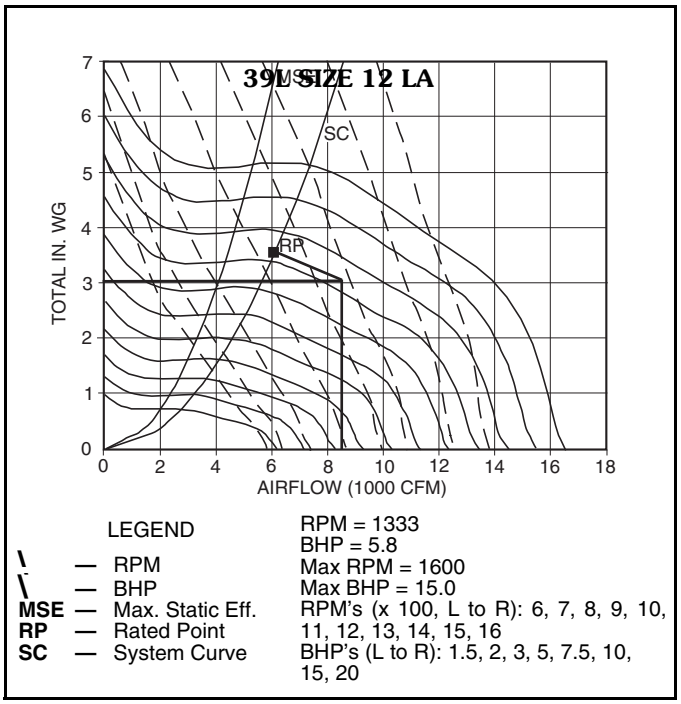
Dirty filtration considerations — Consider selecting an air handler with dirty filters so that, in theory, the unit will have enough horsepower to deliver the same amount of air when the filters are dirty. On a constant volume unit, that would only work if the unit contained an airflow measuring station and could adjust the flow accordingly via a VFD. Otherwise, the point of operation moves along the RPM line as the static pressure in the system changes.

What happens when the fan with sheaves selected for dirty filters is ordered? Three things:

1. The air balancer forces the selection of a smaller sheave because the airflow is too high. When the filters load up, airflow is reduced.
2. If an air balance is not performed, the cooling coil may exhibit moisture carryover due to the considerable increase in airflow.
3. The fan motor trips out on overload with the forward curve fan because of the increase in bhp.

Example:

Forward Curve Fan, 6,100 cfm, 1372 rpm, 5.8 bhp, selected with 100% 2 in. pleated filters. Dirty filters result in a Total Static Pressure (TSP) of 3.56 in.



Clean filters result in a TSP of 3.06 in.

Follow the 1372 rpm line down to 3.06 in.

Clean cfm will be 8,500 cfm. Also note that the horsepower goes from 5.8 bhp to about 9 bhp because the FC fan is an overloading type fan.

So, if dirty filters need to be taken into consideration, do one of the following:

1. Make the final fan selection with the **clean** filter rpm but use the motor horsepower requirement for **dirty** filters.
2. Make the final fan selection with the **dirty** filter rpm and use the motor horsepower requirement for **dirty** filters — **only if** the engineer plans on using a VFD and airflow measurement station or if it is a VAV system.

Fan, motor, and drive heat considerations — The work output of a fan and its motor and drive contribute directly to the airflow and pressure exiting the air handler. Not all of the energy output of the fan generates airflow, however. Fan motors are not 100% efficient, and their efficiency loss translates directly into heat that must be factored in when calculating the temperature rise across a fan section. Fans also add a certain amount of heat to the airstream due to the effects of compression and bearing friction. Finally, belt drives do not transmit all of the energy generated by the motor. Some of the energy is lost in the form of heat due to belt tension and the type and number of belts. Belt drive bhp losses range from 2 to 6 percent; a 3% loss is typical.

Because the 39L Series air handlers all have their fans, motors, and drives located within the airstream, heat losses from these components affect the power requirements, cooling load, and heating load.

Application data (cont)

Power losses in the motor and drive should be allowed for when determining the motor output (bhp), so that the motor can be correctly sized and so that the additional heat output can be subtracted from cooling capacity or added to heating capacity. A typical example follows:

Given Fan Operating Point:

13,224 cfm
9.6 Fan bhp
3.0% estimated drive loss

Calculate the required fan motor output (H_p) due to drive loss:

H_p = (Fan bhp) x (Drive Loss)
H_p = 9.6 x 1.03
H_p = 9.89 hp (select 10 Hp motor)

Calculate the total fan motor heat output (Q) according to motor efficiency:

Q = (Motor Output) ÷ (Motor Efficiency [Typical])
Q = 9.89 ÷ 0.86
Q = 11.5 hp

Convert horsepower to Btu per hour.

11.5 hp x 2545 = 29,268 Btuh

Calculate the increase in leaving-air temperature (ΔT) due to fan and motor heat and drive losses:

Q = 1.1 x cfm x ΔT
29,268 Btuh = 1.1 x 13,224 x ΔT
29,268 Btuh = 14,546.4 x ΔT
ΔT = 2.01 F (use to estimate coil requirements)

Fan application

Certain fans are more efficient in low static pressure systems, while others operate best in higher pressure systems. Some fan types are designed to handle very large air volumes while others are more efficient at lower volumes. The low cost 39L unit is designed for use with low static pressure systems and is only available with forward curve fans. For higher static applications, specify 39M unit.

Forward-curved (FC) fans are typically used for low to medium pressure applications (0 to 5 in. wg total static pressure [TSP]).

The FC fans are reasonably stable over a wide airflow (cfm) range at constant speed. Because of the relatively flat curve, FC fans tolerate modulation in airflow without large increases in static pressure. Most important, FC fans are lowest in first cost.

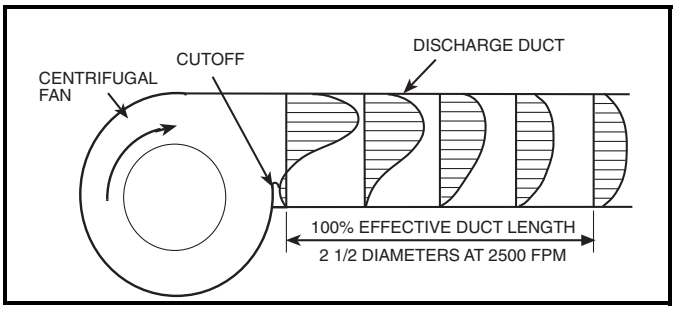
Duct design considerations

The discharge ductwork immediately downstream from the fan is critical for successful applications. Poorly designed ductwork can degrade fan performance and contributes to excessive pressure drop and noise.

The 39L Series forward-curved fans are tested as part of a system with straight discharge ductwork, and the fan ratings are based on this duct design. When designing ductwork in the field, it is important to use a straight discharge duct of the correct dimensions to obtain maximum fan performance. The straight section of ductwork helps the airflow to develop a uniform velocity profile as it exits the fan and allows the velocity pressure to recover into static pressure. See the figure above.

For 100% recovery of velocity pressure into static pressure, the straight portion of the discharge duct must be at least at least $2^1/_2$ times the discharge diameter in length for velocities of 2500 fpm or less. For each additional 1000 fpm, add one duct diameter to the length of the straight portion of the ductwork.

As an example of how to size the straight portion of duct, assume the fan has a 34 x 34 in. discharge outlet (8.03 sq ft). The equivalent diameter is 39 in., so the straight duct length required would be 8 ft long.



Fan control on variable air volume systems

Introduction

With their inherent characteristics of reducing airflow to meet demand, VAV systems can be a source of major energy savings, because fan brake horsepower (bhp) varies with the amount of air delivered.

The degree to which bhp savings are realized, however, is also affected by the type of fan volume control selected and the effectiveness of its application. Effective fan control assures proper duct pressure for the required control stability of the air terminals and provides quiet terminal unit operation when "riding the fan curve."

Consider the following when selecting a fan volume control method:

1. System parameters
   a. Airflow (cfm)
   b. Static pressure
   c. Percent volume reduction (turndown)
2. Fan type and selection point
   a. Design point efficiency
   b. Part load efficiency (especially the point where the fan will be operating most of the time)
   c. Part load stability
3. Ease of control installation and use
4. Motor selection
   a. Higher bhp inputs due to efficiency of VAV control method
   b. Compatibility with VAV control
5. Sound levels
   a. Fan-generated sound
   b. Terminal sound
   c. Control-generated sound
   d. System sound (ducts, fittings)
6. Initial cost and operating cost
7. Reliability and ease of maintenance

System parameters

Before a fan type or control is selected, the system must be analyzed at both the design point and part load. The fan is likely to be operating at part load a large percentage of the time.

Methods of fan air-volume control

- "Riding the fan curve" with terminal throttling (forward curved fans)
- Variable frequency drives (VFDs)

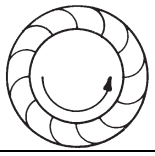
A short description of these control methods follows. A summary comparison table is provided at the end of the section.

Forward-curved (FC) fans with terminal throttling (riding fan curve) — This is the simplest, most reliable, and most economical first-cost method of air volume control on VAV systems, since no accessories are required. This type of VAV control can be used on forward-curved fans with flat pressure characteristics and in systems where static pressure changes at the terminals are moderate. Air volume reduction is produced solely by throttling of terminal units in response to load reduction. As the units throttle, system resistance changes.

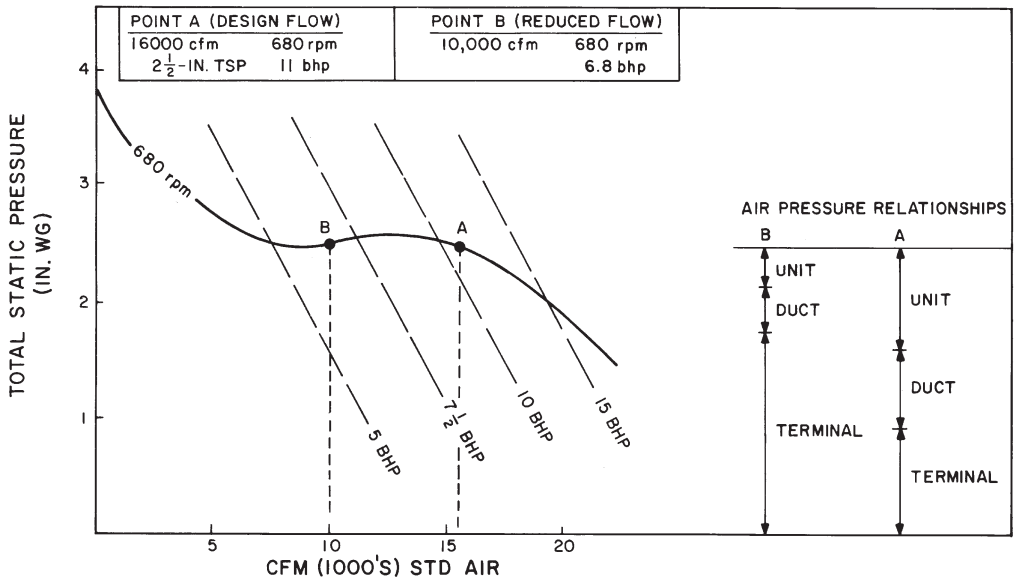
The chart below, Forward-Curved Fan with Air Terminal Throttling, illustrates the reduction in bhp and airflow at constant speed. Point A is the peak airflow operating point. Note the required bhp at this airflow. As airflow is reduced by terminal throttling, move along the fan constant rpm curve to point B. Note the lower cfm and bhp values at B.

At reduced airflow conditions, the total system static pressure may undergo little or no change although air pressure loss through the air-handling unit decreases. This means that duct pressure increases as pressure loss across the terminal unit increases. For low-static and medium-static pressure systems, this increase in duct pressure should not result in noticeable sound level changes. However, at higher design static pressures, sound levels and duct leakage may increase and the control method should be reviewed to determine if it is feasible.

FAN TYPE AND APPLICATION

TYPE	CHARACTERISTICS	APPLICATION
Forward-Curved (FC) Side View 	• Double-width, double-inlet (DWDI) construction. • Best at low or medium pressure (approximately 0 to 5 in. wg). • Horsepower increases continuously with increase in air quantity (overloads) as static pressure decreases. • Runs at relatively low speed, typically 400 to 1200 rpm. • Blades curve toward direction of rotation.	For low to medium pressure air-handling applications.

FORWARD-CURVED FAN WITH AIR TERMINAL THROTTLING VARIATIONS IN BHP AT CONSTANT RPM



Application data (cont)

Variable frequency drives — Variable frequency drives (VFDs) are used to modulate the fan motor speed in response to air volume requirements. To vary the motor speed, a VFD changes the input frequency and line voltage into a wide range of frequency and voltage outputs, while maintaining a constant ratio of frequency to voltage.

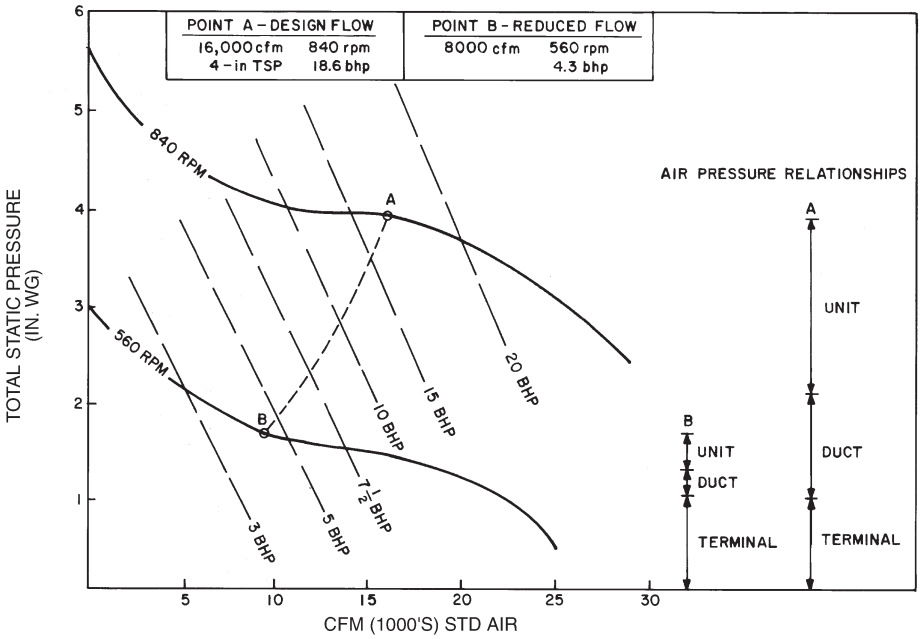
Variable frequency drives convert input ac power to dc power and then convert the dc power to a different ac power output using an inverter. The inverter creates the ac output by rapidly switching the polarity of the voltage from positive to negative. Power output from the VFD is not a smooth sine wave, but has many "steps" in the wave form. This type of power output can cause a standard fan motor to exceed its rated temperature range. The stepped power output also results in motor efficiency losses that must be considered when calculating the energy savings offered by the VFD.

Because of the stepped power output generated by VFDs, fan motors rated for inverter duty are recommended. If a standard motor is used with a VFD, the motor should not be operated at the full service factor.

Variable frequency drives can be an effective way to control air volume and save energy. They can provide greater reduction in fan bhp than throttling with either fan discharge dampers or inlet guide vanes. At reduced load requirements, fan speed is reduced proportionately, with resulting lower airflow, lower static pressure, lower bhp requirements, and lower sound levels.

As the load decreases in a VAV system and the terminal units throttle, duct static pressure increases. A static pressure sensor in the duct system detects the pressure increase and initiates a fan speed change through the VFD. Fan speed is reduced until the duct sensor detects a satisfactory duct pressure.

VARIABLE FREQUENCY FAN SPEED CONTROL



FAN SUMMARY COMPARISON

TYPE OF CONTROL	FIRST-COST RANK	TURNDOWN RANGE (Normal)*	SOUND GENERATION RANK†	ENERGY-SAVINGS RANK	APPLICATION RANGE — NORMAL FOR AIR COND.	COMMENTS
FC Fan Terminal Throttling (Riding Fan Curve)	1 (Lowest Cost)	60-70%	4	4	TSP 0″ to 4.5″ Cfm 3,000 to 15,000	For moderate turndown systems with a flat fan curve and low to medium static pressure and cfm range.
FC Fan with 2-Speed Motor	4	(Not Applicable)	2	3	TSP 0″ to 4.5″ Cfm 3,000 to 15,000	For systems with predictable 2-load situations in low to medium static pressure range. Controls are more complicated. Starters are more costly.
FC Fan With Variable Frequency Drive	2	10-15%	1 (Quietest)	1 (Best)	TSP 0″ to 4.5″ Cfm 3,000 to 15,000	For high turndown, low to medium static pressure systems. Best energy savings. Fast payback. Fan generates least sound.

LEGEND
FC — Forward Curved
TSP — Total Static Pressure

*Percentage of modulation of the design airflow.
†Including part load.
NOTE: Rank is based on a relative scale of 1 to 4. Some methods have comparable rating.

The Variable Frequency Fan Speed Control chart illustrates the results of fan speed reduction as operation shifts from Point A to Point B. If duct pressure begins to fall due to terminal units opening, the duct sensor signals the VFD to increase fan speed.

This method of air volume control permits fan speed reduction down to as low as 10% of the design speed. With FC fans riding the fan curve at the lower rpm, airflow may be as low as 10% of peak design, **as long as motor rpm is not less than $^1/_6$ of motor synchronous speed.**

The method may be applied to any size VAV system with any type of fan. It is particularly cost effective on systems with high turndown requirements where the full speed reduction capability can be used.

Unit control arrangements with Carrier Direct Digital Controls

Supply fan control

Supply fan control is used to match the supply fan delivery to the airflow required by the load in a variable air volume system. This is done by maintaining a constant static pressure in the supply duct at a point approximately $^2/_3$ of the distance from the supply fan discharge.

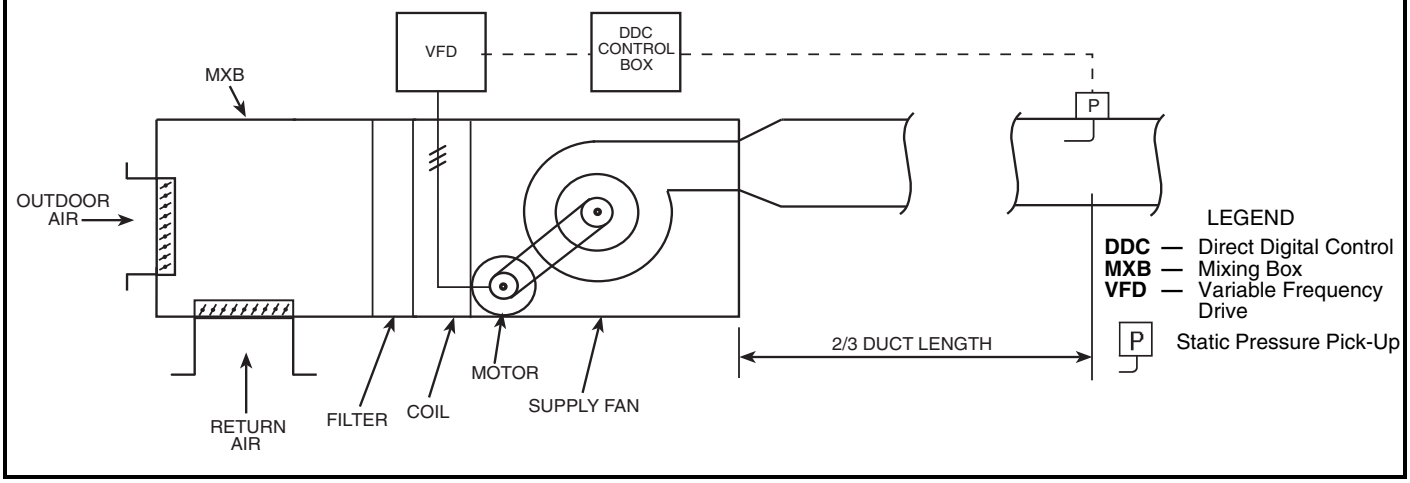
The *Air*Manager™ processor uses a control loop to provide the capability. This processor measures the static pressure at the pick-up probe, compares it to the desired set point, and modulates the fan volume control device. See the Supply Fan Control figure. The volume control device can be a factory-installed or field-installed variable frequency drive (VFD).

The VFD offers advantages such as operating more efficiently in most applications, thus saving energy. The VFD also provides the ability to maintain control over a much larger airflow range (it has a higher turn-down ratio). The following guideline should be used to ensure proper control:

- Variable frequency drives should not be operated at below 10% of the maximum for which the fan was selected, regardless of the fan type.

For supply fan applications, the *Air*Manager processor option maintains the duct static pressure at a desired set point between 0.2 and 4.5 in. wg to within ±0.1 in. wg throughout the fan control range. In applications where over 100 ft of pneumatic tubing is required, the transducer must be removed from the control box and remotely mounted near the static pressure pickup.

SUPPLY FAN CONTROL



Application data (cont)

Indoor air quality (IAQ) applications

The CO_2 demand-controlled ventilation override increases the minimum ventilation level in order to maintain the CO_2 level at or below the maximum level per person. Features include the ability to save energy by ventilating only to the actual rate required, rather than the maximum design occupancy rate. When combined with Product Integrated Controls, the feature automatically adapts and changes ventilation quantity without operator set point adjustments. The feature has user-selectable values for minimum mixed-air temperature override, maximum damper ventilation override position, and supply air tempering (when hot water/steam heat is used).

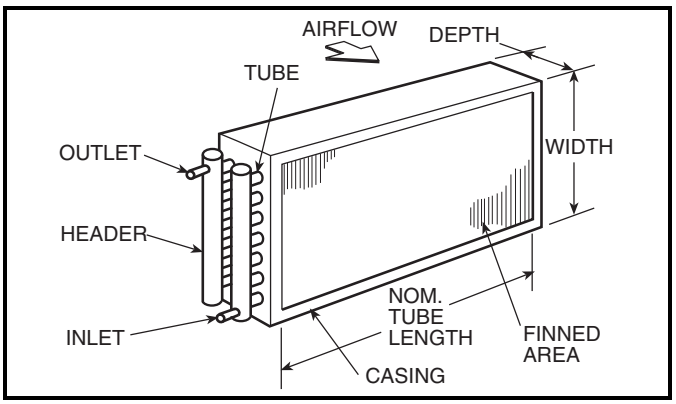
Coils

Coil definitions

A coil, as the term is used with air-handling equipment, is a heat exchange device. A heating or cooling medium passes through the coil, where it either rejects heat to or absorbs heat from the airstream passing over the coil, depending upon the relative temperatures of medium and airstream.

Tube — The tube is a small-diameter pipe through which the heating or cooling medium passes as it rejects or absorbs heat. Coil tubes are generally constructed of copper but may be made of other metals.

Fin — The coil fin is a thin metal plate attached to the tube to improve the heat transfer efficiency from medium to airstream. Typically, it is made of either aluminum or copper.



Header — The header is a pipe of large diameter to which several tubes are connected. It serves as a distributor of the heating or cooling medium to the tubes. Headers are typically of non-ferrous metal or steel.

Casing — The supporting metal structure for tubes and header is called a casing. It is usually made of galvanized steel but can be made of other materials (stainless steel).

Inlet and outlet — These are pipe stubs on the header where the heating or cooling medium enters and leaves the coil.

In water coils, the supply inlet is the pipe stub located on the side where the air leaves the coil. The outlet is the stub on the entering air side of the coil. Such an arrangement is known as counterflow.

In steam coils, the inlet is always the higher stub so that condensate will drain out of the lower stub.

Finned area or face area — The working area of the coil is defined as the width times length of the finned area through which air passes. This finned or face area does not include the extra dimensions for the casing.

Face velocity — This is the air velocity in fpm across the finned or face area of a coil. It is determined by dividing the air volume in cfm by the coil face area in square feet.

$$\text{Face Velocity (fpm)} = \frac{\text{Air Volume (cfm)}}{\text{Coil Face Area (sq ft)}}$$

The first step in selecting an air handler size is to determine the maximum allowable face velocity.

This maximum is determined by the specifier and is based primarily on the following criteria:

1. Avoidance of moisture carryover into the ductwork (applies to cooling coils only).
2. Air pressure drop across the coil.
3. Heat transfer efficiency.

The maximum safe air velocity without moisture carryover into the ductwork depends on the type and spacing of the finned surface, the amount of moisture on the coil, and the geometry between coil and fan inlet or ductwork. Since coil moisture conditions vary, and coil versus duct geometry varies (for example, between draw-thru, blow-thru, vertical, or horizontal units), the specified maximum face velocity should allow for these variations.

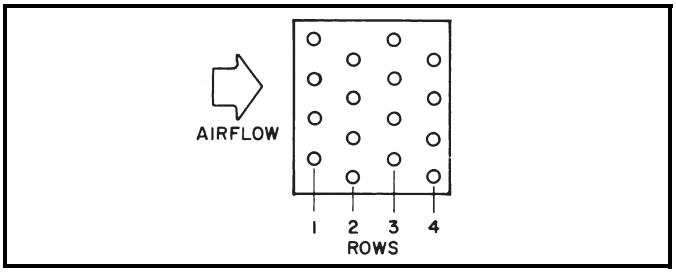
Fan horsepower is also affected by face velocity, since the air resistance across the coil varies roughly as the square of the face velocity.

For the above reasons, the maximum specified face velocity is normally a conservative figure (on the low side). Suggested design face velocities are as follows:

COIL TYPE	FACE VELOCITY RANGE
Cooling	400 to 550 fpm
Heating	400 to 800 fpm

In variable air volume (VAV) applications, the system generally operates below peak air volume for extended periods. In such cases, the design face velocity is commonly selected at the higher end of the suggested range.

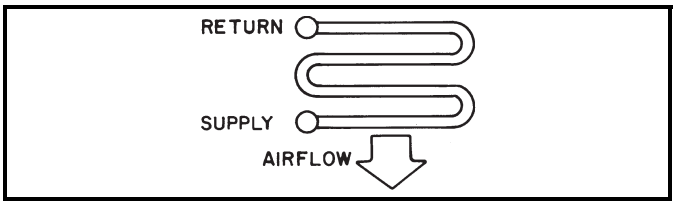
Tube face — This is the number of tubes in any one coil row.



Above is a 4-row coil with a 4-tube face. Note that tubes are staggered in adjacent rows.

Cooling coils are typically available in 4, 6, 8, and 10-row configurations. Tubes should have an outside diameter (OD) of $1/2$ in. to maximize heat transfer at minimum water flows. Coils should be sized for the most efficient use of water. Water temperature differences of 12 to 16° F are typical and represent optimum selection points.

Pass — Pass refers to the part of the circuit that passes through the airstream once.



Note that this is a 4-pass circuit.

Direct expansion (DX) coils — Direct expansion coils can have two intertwined refrigerant circuits. In addition, quarter, half, full and double circuiting configurations are offered to allow optimum system performance and oil return at full and part-load operation.

Circuiting selection should result in a circuit loading of 0.8 to 2.0 tons per circuit at design load. Circuit loading must be evaluated at minimum load to ensure that it does not drop below 0.6 tons per circuit. Solenoid valves may be used, if necessary, to shut off the refrigerant supply to individual expansion valves to maintain adequate coil circuit loading.

Compressor minimum unloading and TXV quantity is necessary to determine minimum tonnage per circuit.

Minimum Unloading Equation:

$$\frac{(\text{Tons/Circuit}) \times (\text{Minimum Unloading}) \times (\text{Total no. of TXVs})}{\text{no. of TXVs Active}}$$

Example:

Condensing Unit:	38ARS012
Minimum Unloading:	33%
Coil:	6 row, 11 FPI, Half Circuit
Coil Tons/Circuit:	1.68
Total TXVs:	2

In the first example we will determine the tons/circuit when both TXVs are active and the compressor is unloaded to its minimum of 33%.

$$= \frac{(1.68\ \text{Tons/Circuit}) \times (33\%\ \text{Minimum Unloading}) \times (2\ \text{TXVs})}{2\ \text{TXVs Active}}$$

$$= \frac{(1.68) \times (.33) \times (2)}{2}$$

= .55 tons/circuit at minimum unloading: UNACCEPTABLE

If we install a liquid line solenoid valve before one of the TXVs and close it so that only one TXV is active when the compressor is unloaded to its minimum of 33%, we see the following:

$$= \frac{(1.68\ \text{Tons/Circuit}) \times (33\%\ \text{Minimum Unloading}) \times (2\ \text{TXVs})}{1\ \text{TXV Active}}$$

$$= \frac{(1.68) \times (.33) \times (2)}{1}$$

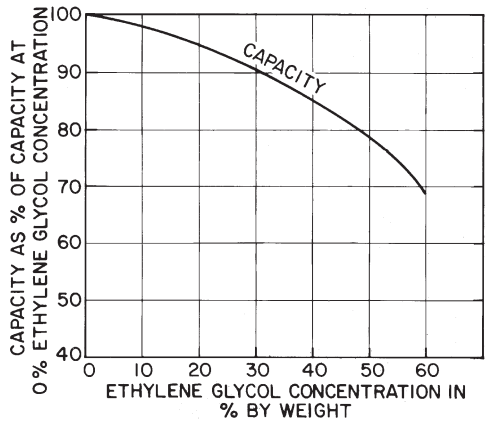
= 1.10 tons/circuit at minimum unloading: ACCEPTABLE

Ethylene glycol

The effects of ethylene glycol usage on coil capacity and pressure drop can be determined from the ***AHU*Builder®** program. For a quick estimate of these effects, however, use the chart below.

The chart is based on 6-row/14-fin coil performance with the only variable being ethylene glycol concentration by weight.

ETHYLENE GLYCOL EFFECTS



NOTE: Use the percentage of ethylene glycol concentration for burst protection, not freeze-up protection.

Filters

Air is contaminated in varying degrees by soil, organic matter, spores, bacteria, smoke, dust, and fumes.

Air cleaning and filtration devices are required in order to create a clean work environment, reduce cleaning costs, and extend the life of machinery or equipment.

Filter ratings

Filters are rated according to efficiency and dust-holding capacity.

The most commonly accepted method of testing filter efficiency is per ASHRAE Standard 52. Previously used methods include AFI (American Filter Institute) and NBS (National Bureau of Standards) methods. Absolute, or HEPA (High-Efficiency Particulate Air) filters, because of the unusually small particles involved, are tested by the DOP (Dioctylphthalate particle) test.

Filter dust-holding capacity is directly related to filter life. The filter is replaced when the amount of dirt and dust it contains builds up air resistance to an unacceptable level.

Air resistance build-up is measured by a filter air-resistance gage.

Selection procedure

Size selection

This catalog has been designed to provide a quick and accurate means of selecting and specifying a central station air-handling unit. Start with the information you have, required airflow and preferred coil face velocity, to select a nominal unit size. Contact your Carrier sales representative for the ***AHU*Builder®** program. Next, refer to the component descriptions on pages 20-37.

NOTE: Carrier's ***AHU*Builder** program provides exact coil and performance data certified to both the AHRI 410 and the AHRI 430 standards. In addition to standard outputs, the programs provide coil moisture carryover information. When information from the computer selection programs is not available, use the following general guidelines for velocity limits to avoid moisture carryover.

FINS PER INCH	COIL MOISTURE BLOWOFF LIMITS (fpm)		
	ALUMINUM	COPPER	E-COAT
8	550	500	475
11	550	425	400
14	550	375	350

NOTES:
1. See ***AHU*Builder** program for specific limitations.
2. Data shown is for general use in high latent conditions.
3. Coils with e-coated fins exhibit the same limitations as copper fins.
4. Units apply to clean, properly maintained coils.

General features:

- Provides "true" selection for all air-handling units coils and fans. Required capacity and/or entering and leaving conditions may be specified with the program determining performance ratings for all applicable coil configurations. User-specified performance rating for a particular configuration or for specified performance criteria
- Guaranteed projection of unit size vs airflow without water carryover problems
- Minimized specifying input criteria — fixed or rarely changing parameters user specified as defaults and separated from main input screen
- Displayed output mode of coil performance ratings allow side-by-side comparison of user-defined performance ratings values (4 calculated values for each coil), or complete performance ratings of all coils in a spreadsheet format.
- Detailed summary reports including cooling, heating, fan, acoustic, and physical performance data can be generated in different formats. Fully featured on-line help system contained within the program
- Easier to use than previous generation systems
- Uses AHRI approved method, reduces engineering expense

Special features — Allows user to continually monitor and modify input/output. Provides processing for special application:

- Ethylene glycol or brine
- Altitude

Steam heating coil selection

I Determine design heating requirements from job specifications.

Example is for heating and ventilating type unit. Given:

Heating Load (GTH) . . . . . 374,220 Btuh
Air Quantity . . . . . 4,950 cfm
Entering-Air Temperature (t_{a1}) . . . . . −10 F
Leaving-Air Temperature (t_{a2}) . . . . . 60 F
Steam Pressure (ps) . . . . . 15 psig
Maximum Air Face Velocity . . . . . 800 fpm
Coil Type Required . . . . . Steam distributing tube
Unit Type . . . . . Draw-thru

II Determine size of heating and ventilating unit.

Consider the following before selecting unit.

A. Heating and ventilating units may be selected at higher air face velocities (approximately 700 fpm to 1000 rpm) than air-conditioning units since water carry-over is not a consideration. In selecting a heating coil for an air-conditioning unit, the face velocity and minimum unit size are predetermined by the cooling coil selection.

→ B. Maximum air face velocity or minimum unit size may be specified for determining unit size. If not, it is recommended that the unit be sized using a face velocity from 700 to 1000 rpm. Higher air velocities can be used; however, excessive air friction may result.

Unit Selection cfm

$$\text{Coil Min Face Area (sq ft)} = \frac{\text{cfm}}{\text{Max Air Face Velocity}}$$

$$= \frac{4950 \text{ cfm}}{800 \text{ cfm}}$$

$$= 6.19 \text{ sq ft}$$

From the Coils table, page 32, select a 39L08 unit with steam distributing tube coil area of 6.22 sq feet.

Calculate:

Face velocity = (4950 cfm)/(6.22 sq ft)
= 796 fpm or 800 fpm

III Calculate actual air temperature rise through coil and actual leaving-air temperature.

(When steam pressure is 5 psig, omit this step and follow procedure in Steam Coil Selection, Note 2 in Step IV.)

A. Assume a coil row depth and fin series: 1 row and fin series 9.

B. Enter the Steam Coil Ratings table, page 18 at an entering-air temperature (t_{a1}) of 0° F and coil face velocity of 800 fpm. Find leaving-air temperature (t_{a2}) of 64.7 under Ldb column. This t_{a2} is valid only when the entering-air temperature is 0° F and steam pressure is 5 psig. To correct to the specified entering-air temperature of −10 F and steam pressure of 15 psig, it is necessary to adjust the t_{a2} value of 64.7 F using correction of 1.144 from Air Temperature Constants table, on page 18.

$$\text{Actual Air Temp Rise (ATR)} = \text{Air Temp Rise from Steam Coil Ratings Table (at 0° F and 5 psig)} \times \text{ATR Constant}$$

$$= 64.7 \text{ F} \times 1.144$$

$$\text{ATR} = 74.0 \text{ F}$$

$$\text{Actual Leaving Air Temp } (t_{a2}) = \text{Entering Air Temp } (t_{a1}) + \text{ATR}$$

$$= -10 \text{ F} + 74.0 \text{ F}$$

$$t_{a2} = 64.7 \text{ F} > 60 \text{ F required}$$

IV Calculate grand total heat (GTH) of coil.

(See Steam Coil Selection Notes 1 and 2.)

$$\text{Actual Coil Capacity} = 1.1 \times \text{cfm} \times \text{ATR}$$

$$= 1.1 \times 4{,}950 \times 74.0$$

$$= 402{,}930 \text{ Btuh} > 374{,}220 \text{ Btuh required}$$

Steam Coil Selection Notes:

1. When coil selection has a coil capacity only slightly in excess of that required, it is a valid selection. If calculated capacity is less or considerably greater than that required, make a new selection.
2. For applications with steam pressure of 5 psig, the actual leaving-air temperature (ldb) may be read from steam rating tables without calculation of actual air temperature rise (ATR). Enter the Steam Coil Ratings table at specified entering-air temperature, assumed row depth and fin series. Under the specified coil face velocity column find actual (ldb) (t_{a2} in example) and corresponding MBtuh/sq ft. Interpolate as required. Calculate grand total heat (GTH) with formula below.

GTH = MBtuh/sq ft x Coil Face Area (sq ft)

V Determine air friction.

Enter Steam Coil Air Friction table, page 17, at row depth and fin series (1 row, fin series 9). Under Coil Face Velocity column (800) read the air friction value = 0.38 in. wg.

Selection procedure (cont)

Electric heat selection procedure

I Determine electric heat requirements based on size of selected unit.

Given:

Air Quantity . . . . . 3,000 cfm
Entering-Air Temperature . . . . . .54 F
Leaving-Air Temperature . . . . . .77 F
Maximum Air Velocity . . . . . .650 fpm
Electric Service 460-v, 3-ph, 60-Hz
Unit Type . . . . . Horizontal Draw-Thru

II Determine heating load.

Heating Load = 1.1 x Cfm x Air Temp Rise
= 1.1 x 3,000 x 23
= 75,900 Btuh (75.9 MBtuh)

III Verify unit size.

Size of the electric heating coil face area is usually predetermined by the selection of the air-handling unit and the cooling coil. However, the heater size must be checked to assure that the minimum face velocity is provided for the heater.

$$\text{Minimum Face Area} = \frac{3{,}000}{650 \text{ Fpm}}$$

$$= 4.6 \text{ sq ft}$$

$$\text{Actual Face Velocity} = \frac{3{,}000}{4.9 \text{ sq ft}} \quad \text{(Actual Coil Face Area)}$$

$$= 615 \text{ Fpm}$$

IV Determine kilowatt equivalent of heating load.

$$\text{kW Heating Load} = \frac{75.9 \text{ MBtuh}}{3.413 \text{ MBtuh/kW}}$$

$$= \frac{75.9}{3.413}$$

$$= 22.2 \text{ kW}$$

V Determine unit electric heater size.

Select the heater which has a kW rating closest to but greater than the required kW and is available at the required voltage.

VI Determine capacity of electric heater.

Capacity = 23 kW x 3.413
= 78.5 MBtuh

VII Calculate air temperature rise.

$$\text{Air Temp Rise} = \frac{78{,}500 \text{ Btuh}}{1.1 \text{ x } 3{,}000 \text{ Cfm}}$$

$$= 23.8 \text{ F}$$

VIII Calculate the actual leaving-air temperature.

Leaving Air Temp = Ent Air Temp + Air Temp Rise
= 54 + 23.8
= 77.8 F

IX Determine air friction loss of electric heating coil.

Enter Electric Heating Coil Air Friction table, page 17, and find (by interpolation) air friction loss of electric heater at 615 fpm to be 0.02 in. wg.

X Voltage variations.

Variations from the rated voltage of the electric heating coils can significantly affect the coil's rated output. The effects of voltage variation can be determined by the following formula.

$$kW_a = kW_r \times \left(\frac{V_a}{V_r}\right)^2$$

kW_a = Actual kW Output From Coil
kW_r = Rated kW Output From Coil
V_a = Actual Voltage at Coil
V_r = Rated Voltage at Coil

Air-handling selection guide

1. Unit size = Coil face area (ft^2) = design cfm/max face velocity

   Example: 12,000 cfm/500 fpm = 24 → Size 25
2. Consider your system and choose the appropriate component sections.
3. Determine overall unit dimensions and weight. The height and width for any given unit size is the same for all component sections.
4. Finalize your selections using Carrier's latest version of the ***AHU*Builder®** program. ***AHU*Builder** is a comprehensive selection tool designed to help customers make the proper air handler choice quickly and efficiently.

Performance data

Air friction data

COOLING COIL AIR FRICTION (in. wg)

ROWS	FINS	FACE VELOCITY (fpm)				
		300	400	500	600	700
4	8	0.15	0.25	0.37	0.51	0.66
	11	0.19	0.31	0.45	0.61	0.79
	14	0.23	0.36	0.52	0.70	0.90
6	8	0.23	0.38	0.55	0.76	1.00
	11	0.29	0.46	0.67	0.91	1.18
	14	0.34	0.55	0.79	1.06	1.36
8*	8	0.30	0.50	0.74	1.02	1.33
	11	0.38	0.62	0.90	1.22	1.57
	14	0.46	0.73	1.05	1.41	1.81

*Not available for 39LA, LB, or LD units.

NOTE: All values are for dry coils.

HEATING COIL AIR FRICTION (in. wg)

ROWS	FINS	FACE VELOCITY (fpm)								
		300	400	500	600	700	800	900	1000	1100
1 or 2	8	0.08	0.13	0.19	0.26	0.34	0.43	0.53	0.64	0.75
	11	0.09	0.15	0.22	0.30	0.39	0.50	0.61	0.72	0.85
	14	0.12	0.19	0.27	0.37	0.47	0.59	0.71	0.85	0.99

STEAM COIL AIR FRICTION (in. wg)

ROW DEPTH	FINS	FACE VELOCITY (fpm)									
		300	400	500	600	700	800	900	1000	1100	1200
1	6	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.25	0.29	0.34
	9	0.07	0.11	0.17	0.22	0.30	0.38	0.46	0.55	0.65	0.76
	12	0.12	0.18	0.27	0.37	0.47	0.58	0.72	0.85	1.01	1.15

ELECTRIC HEATING COIL AIR FRICTION

FACE VELOCITY (fpm)	AIR FRICTION (in. wg)
300	0.01
350	0.01
400	0.01
450	0.01
500	0.02
550	0.02
600	0.02
650	0.03
700	0.03
750	0.03
800	0.04
850	0.04
900	0.04
950	0.05
1000	0.05
1050	0.06
1100	0.06
1150	0.07
1200	0.08
1250	0.08
1300	0.09
1350	0.09
1400	0.10
1450	0.11
1500	0.12

FILTER AIR FRICTION (in. wg)

FILTER TYPE	VELOCITY (fpm) THROUGH FILTER								
	250	300	350	400	450	500	550	600	650
ANGLE									
Initial	0.02	0.03	0.05	0.05	0.06	0.07	0.08	0.11	0.12
Final	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
FLAT (2 in.)									
Initial	0.08	0.11	0.14	0.19	0.22	0.28	0.32	0.35	0.40
Final	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
FLAT (4 in.)									
Initial	0.09	0.12	0.15	0.19	0.22	0.28	0.30	0.35	0.40
Final	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90

NOTES:
1. Filters are field-supplied.
2. Do not exceed filter manufacturer's velocity limits when selecting filters.
3. Filters having cardboard-type frames are usually not suitable for use in high velocity (flat) sections.

MIXING BOX AIR FRICTION

APPROACH VELOCITY* (fpm)	400	600	800	1000	1200	1400	1600	1800	2000
AIR FRICTION (in. wg)	0.02	0.05	0.10	0.15	0.22	0.31	0.40	0.50	0.62

*Velocity through one mixing box damper (wide open).

Performance data (cont)

Steam heating coil performance

AIR TEMPERATURE CONSTANTS*

STEAM PRESSURE (psig)	SATURATED TEMP (F)	LATENT HEAT (Btuh/lb)	ENTERING AIR TEMPERATURE (F)												
			–20	–10	0	10	20	30	40	50	60	70	80	90	100
0	**212.0**	**970.3**	1.021	0.977	0.933	0.889	0.845	0.801	0.757	0.713	0.669	0.625	0.581	0.537	0.493
2	**218.5**	**966.2**	1.050	1.006	0.962	0.918	0.874	0.830	0.786	0.742	0.698	0.654	0.610	0.566	0.522
5	**227.1**	**960.6**	1.088	1.044	1.000	0.956	0.912	0.868	0.824	0.780	0.736	0.692	0.648	0.604	0.560
10	**239.4**	**952.6**	1.142	1.098	1.054	1.010	0.966	0.922	0.878	0.834	0.790	0.746	0.702	0.658	0.614
15	**249.8**	**945.7**	1.188	1.144	1.100	1.055	1.011	0.967	0.923	0.879	0.835	0.791	0.747	0.703	0.659
20	**258.8**	**939.5**	1.227	1.183	1.139	1.095	1.051	1.007	0.963	0.919	0.875	0.831	0.787	0.743	0.699
25	**266.8**	**934.0**	1.263	1.219	1.175	1.130	1.086	1.042	0.998	0.954	0.910	0.866	0.822	0.778	0.734
30	**274.0**	**928.9**	1.294	1.250	1.206	1.162	1.118	1.074	1.030	0.986	0.942	0.898	0.854	0.810	0.766
35	**280.6**	**924.2**	1.323	1.279	1.235	1.191	1.147	1.103	1.059	1.015	0.971	0.927	0.883	0.839	0.795
40	**286.7**	**920.0**	1.350	1.306	1.262	1.218	1.174	1.130	1.086	1.042	0.998	0.954	0.910	0.866	0.822
50	**297.7**	**911.9**	1.398	1.354	1.310	1.266	1.222	1.178	1.134	1.090	1.046	1.002	0.958	0.914	0.870
60	**307.3**	**904.6**	1.441	1.397	1.353	1.309	1.265	1.221	1.177	1.133	1.089	1.045	1.001	0.957	0.913
70	**316.0**	**898.0**	1.479	1.435	1.391	1.347	1.303	1.259	1.215	1.171	1.127	1.083	1.039	0.995	0.951
80	**323.9**	**891.9**	1.514	1.470	1.426	1.382	1.338	1.294	1.250	1.206	1.162	1.118	1.074	1.030	0.986
90	**331.1**	**886.1**	1.546	1.502	1.458	1.414	1.370	1.326	1.282	1.238	1.194	1.150	1.106	1.062	1.018
100	**337.9**	**880.7**	1.576	1.531	1.487	1.443	1.399	1.355	1.311	1.267	1.223	1.179	1.135	1.091	1.047
125	**352.9**	**868.3**	1.641	1.597	1.553	1.509	1.465	1.421	1.377	1.333	1.289	1.245	1.201	1.157	1.113
150	**365.9**	**857.2**	1.699	1.655	1.611	1.567	1.523	1.479	1.435	1.391	1.346	1.302	1.258	1.214	1.170
175	**377.4**	**847.0**	1.749	1.705	1.661	1.617	1.573	1.529	1.485	1.441	1.397	1.353	1.309	1.265	1.221

*Based on:

$$\frac{\text{Saturated Temp (F)} - t_{a1}}{227.1}$$

Used as an air temperature rise correction multiplier for rated air temperature rise (ATR). Actual coil capacity = coil capacity (tabular) x steam air temperature rise constant.

STEAM COIL RATINGS

ENTERING AIR TEMP (F)	FINS PER IN.	HEATING COIL FACE VELOCITY (fpm std air)													
		400		500		600		700		800		1000		1200	
		Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft	Ldb (F)	MBtuh/ sq ft
–20	**6**	51.2	30.9	42.5	34.0	36.8	37.1	31.9	39.5	28.2	41.9	22.5	45.2	19.0	50.9
	9	84.0	45.2	71.4	49.7	62.8	54.0	56.1	57.9	50.4	61.2	42.3	67.7	36.3	73.5
	12	109.5	56.3	95.1	62.6	85.8	69.0	76.9	73.7	71.2	79.3	60.3	87.3	52.2	94.1
–10	**6**	58.3	29.7	50.0	32.6	44.5	35.6	39.8	37.9	36.2	40.2	30.8	44.3	27.5	48.9
	9	89.8	43.4	77.7	42.7	69.4	51.8	63.0	55.6	57.6	58.8	49.7	64.9	44.1	70.5
	12	114.2	54.0	100.5	60.1	91.5	66.2	82.9	70.7	77.5	76.1	67.1	83.8	59.2	90.3
0	**6**	65.4	28.4	57.5	31.2	52.2	34.1	47.7	36.3	44.3	38.5	39.1	42.5	35.9	46.8
	9	95.6	41.6	84.0	45.7	76.1	49.6	69.9	53.2	64.7	56.3	57.2	62.2	51.8	67.5
	12	119.0	51.7	105.8	57.5	97.2	63.4	89.0	67.7	83.8	72.9	73.8	80.2	66.3	86.5
10	**6**	72.5	27.2	64.9	29.9	59.9	32.6	55.6	34.7	52.3	36.8	47.3	40.6	44.3	44.7
	9	101.4	39.7	90.3	43.7	82.7	47.4	76.9	50.9	71.9	53.8	64.7	59.5	59.5	64.6
	12	123.8	49.5	111.2	55.0	102.9	60.6	95.1	64.8	90.1	69.7	80.6	76.7	73.4	82.7
15	**6**	76.1	26.6	68.7	29.2	63.8	31.8	59.5	33.9	56.4	36.0	51.5	39.7	48.5	43.7
	9	104.3	38.8	93.5	42.7	86.1	46.3	80.3	49.7	75.4	52.6	68.4	58.1	63.4	63.1
	12	126.1	48.3	113.8	53.7	105.8	59.2	98.1	63.3	93.3	68.1	83.9	74.9	76.9	80.8
20	**6**	79.6	25.9	72.4	28.5	67.6	31.1	63.5	33.1	60.4	35.1	55.6	38.7	52.7	42.7
	9	107.2	37.9	96.6	41.6	89.4	45.2	83.8	48.5	79.0	51.3	72.2	56.7	67.2	61.6
	12	128.5	47.2	116.5	52.5	108.6	57.8	101.2	61.8	96.4	66.5	87.3	73.2	80.5	78.9
25	**6**	83.2	25.3	76.1	27.8	71.5	30.3	67.4	32.3	64.4	34.3	59.8	37.8	56.9	41.7
	9	110.1	37.0	99.8	40.6	92.7	44.2	87.2	47.4	82.6	50.1	75.9	55.4	71.1	60.1
	12	130.9	46.0	119.2	51.2	111.5	56.4	104.2	60.3	99.6	64.9	90.7	71.4	84.0	77.0
30	**6**	86.8	24.7	79.9	27.1	75.3	29.6	71.4	31.5	68.4	33.4	63.9	36.9	61.1	40.6
	9	113.0	36.1	102.9	39.6	96.0	43.1	90.7	46.2	86.2	48.8	79.7	54.0	74.9	58.6
	12	133.3	44.9	121.8	49.9	114.4	55.0	107.3	58.8	102.7	63.2	94.1	69.6	87.6	75.1
40	**6**	93.9	23.4	87.3	25.7	83.0	28.1	79.3	29.9	76.5	31.7	72.2	35.0	69.6	38.6
	9	118.8	34.2	109.2	37.6	102.7	40.9	97.6	43.8	93.3	46.4	87.1	51.3	82.7	55.6
	12	138.0	42.6	127.2	47.4	120.1	52.2	113.3	55.8	109.0	60.0	100.8	66.1	94.6	71.3
50	**6**	101.0	22.2	94.8	24.4	90.7	26.6	87.2	28.3	84.5	30.0	80.5	33.1	78.0	36.5
	9	124.6	32.4	115.5	35.6	109.3	38.7	104.5	41.5	100.5	43.9	94.6	48.5	90.4	52.7
	12	142.8	40.3	132.5	44.9	125.8	49.4	119.4	52.8	115.3	56.8	107.6	62.6	101.7	67.5
60	**6**	108.1	20.9	102.3	23.0	98.4	25.1	95.1	26.7	92.6	28.3	88.7	31.2	86.4	34.4
	9	130.3	30.6	121.8	33.6	116.0	36.5	111.5	39.2	107.6	41.4	102.1	45.8	98.1	49.7
	12	147.6	38.1	137.9	42.3	131.5	45.6	125.5	49.8	121.7	53.6	114.3	59.0	108.8	63.6
70	**6**	115.2	19.7	109.7	21.6	106.1	23.6	103.0	25.1	100.6	26.6	97.0	29.4	94.8	32.4
	9	136.1	28.8	128.1	31.6	122.6	34.3	118.4	36.8	114.8	38.9	109.6	43.0	105.8	46.7
	12	152.3	35.8	143.2	39.8	137.2	43.9	131.6	46.9	128.0	50.4	121.1	55.5	115.9	59.8
80	**6**	122.4	18.4	117.2	20.2	113.8	22.1	110.9	23.5	108.7	24.9	105.3	27.5	103.2	30.3
	9	141.9	26.9	134.4	29.6	129.3	32.1	125.3	34.5	121.9	36.5	117.1	40.3	113.5	43.7
	12	157.1	33.5	148.5	37.3	143.0	41.1	137.7	43.9	134.3	47.2	127.8	52.0	123.0	56.0

LEGEND

Ldb — Leaving Air, Dry Bulb
MBtuh — Btuh in Thousands

NOTES:

1. Calculate condensate flow rate (W) — lb/hr for saturated steam applications as follows:

$$W = \frac{\text{rated MBtuh ft}^2 \text{ x 1000 x tabulated coil face area (sq ft)}}{\text{rated latent heat of vaporization (Btuh/lb)}}$$

2. Rating conditions are as follows:

Steam Pressure:	5.0 Psig
Saturated Steam Temp:	227.1 F
Latent Heat:	960.7 Btu/lb

ELECTRIC HEATER DATA

UNIT SIZE 39L	HEATER AREA (sq ft)	NO. OF CONTROL STEPS*	HEATER COIL kW	NOMINAL COIL FACE VELOCITY (fpm)	TEMP RISE (F)	208/3/60 VOLTS				240/3/60 VOLTS				480/3/60 VOLTS				380/3/50 VOLTS			
						Total FLA	MCA†	No. Sub-Ckt	MOCP	Total FLA	MCA†	No. Sub-Ckt	MOCP	Total FLA	MCA†	No. Sub-Ckt	MOCP	Total FLA	MCA†	No. Sub-Ckt	MOCP
03	2.2	3	9	500	26	25	31	1	35	22	27	1	30	11	14	1	20	14	17	1	20
			15	500	44	42	52	1	60	36	45	1	50	18	23	1	25	23	29	1	30
			17.2	500	50	48	60	1	60	41	52	1	60	21	26	1	30	26	33	1	35
06	3.7	6	8	500	14	22	28	1	30	19	24	1	25	10	12	1	20	12	15	1	20
			10	500	17	28	35	1	35	24	30	1	35	12	15	1	20	15	19	1	20
			17	500	29	47	59	1	60	41	51	1	60	20	26	1	30	26	32	1	35
			19.9	500	34	55	69	2	70	48	60	1	60	24	30	1	30	30	38	1	40
			27	500	47	75	94	2	100	65	81	2	90	33	41	1	45	41	51	1	60
			29.8	500	51	83	104	2	110	72	90	2	90	36	45	1**	45	45	57	1	60
			36	500	62	100	125	3††	150	87	108	2	110	43	54	1**	60	55	68	2**	70
08	5.1	6	15	500	19	42	52	1	60	36	45	1	50	18	23	1	25	23	29	1	30
			25	500	31	69	87	2	90	60	75	2	80	30	38	1	40	38	48	1	50
			35	500	44	97	122	3	125	84	105	2	110	42	53	1	60	53	67	2	70
			39.9	500	50	111	139	3	150	96	120	3	125	48	60	2	70	61	76	2	80
			43.2	500	54	120	150	3	175	104	130	3	150	52	65	2	70	66	82	2	90
			51	500	64	142	177	3	200	123	154	3	175	61	77	2	80	78	97	2	100
10	6.2	6	15	500	15	42	52	1	60	36	45	1	50	18	23	1	25	23	29	1	30
			25	500	26	69	87	2	90	60	75	2	80	30	38	1	40	38	48	1	50
			39.9	500	41	111	139	3	150	96	120	3	125	48	60	2	70	61	76	2	80
			47.3	500	49	131	164	3	175	114	142	3	150	57	71	2	80	72	90	2	90
			51.8	500	53	144	180	3	200	125	156	3	175	62	78	2	80	79	98	2	100
			59.8	500	62	—	—	—	—	—	—	—	—	72	90	2	100	91	114	2	125
12	7.3	6	19.9	500	17	55	69	2	70	48	60	1	60	24	30	1	30	30	38	1	40
			29.8	500	26	83	104	2	110	72	90	2	90	36	45	1	45	45	57	1	60
			39.9	500	35	111	139	3	150	96	120	3	125	48	60	2	70	61	76	2	80
			43	500	38	119	149	3	150	104	129	3	150	52	65	2	70	65	82	2	90
			51.8	500	45	144	180	3	200	125	156	3	175	62	78	2	80	79	98	2	100
			72	500	63	—	—	—	—	—	—	—	—	87	108	2	110	110	137	3††	150
15	10.0	6	19.9	500	13	55	69	2	70	48	60	1	60	24	30	1	30	30	38	1	40
			29.8	500	19	83	104	2	110	72	90	2	90	36	45	1	45	45	57	1	60
			39.9	500	25	111	139	3	150	96	120	3	125	48	60	2	70	61	76	2	80
			45	500	29	125	156	3	175	108	135	3	150	54	68	2	70	68	86	2	90
			51.8	500	33	144	180	3	200	125	156	3	175	62	78	2	80	79	98	2	100
			65	500	42	—	—	—	—	—	—	—	—	78	98	2	100	99	124	3	125
			86	500	55	—	—	—	—	—	—	—	—	104	129	3	150	131	164	3	175
18	11.74	6	19.9	500	11	55	69	2	70	48	60	1	60	24	30	1	30	30	38	1	40
			25.8	500	14	72	90	2	90	62	78	2	80	31	39	1	40	39	49	1	50
			35	500	19	97	122	3	125	84	105	2	110	42	53	1	60	53	67	2	70
			45	500	25	125	156	3	175	108	135	3	150	54	68	2	70	68	86	2	90
			51.8	500	28	144	180	3	200	125	156	3	175	62	78	2	80	79	98	2	100
			78	500	43	—	—	—	—	—	—	—	—	94	117	2	125	119	148	3	150
			94	500	51	—	—	—	—	—	—	—	—	113	141	3	150	143	179	3	200
21	14.21	6	19.9	500	9	55	69	2	70	48	60	1	60	24	30	1	30	30	38	1	40
			25.8	500	12	72	90	2	90	62	78	2	80	31	39	1	40	39	49	1	50
			35	500	16	97	122	3	125	84	105	2	110	42	53	1	60	53	67	2	70
			45	500	20	125	156	3	175	108	135	3	150	54	68	2	70	68	86	2	90
			51.8	500	23	144	180	3	200	125	156	3	175	62	78	2	80	79	98	2	100
			79.8	500	36	—	—	—	—	—	—	—	—	96	120	3	125	121	152	3	175
			92	500	41	—	—	—	—	—	—	—	—	111	138	3	150	140	175	3	175
			116	500	52	—	—	—	—	—	—	—	—	140	175	3	175	—	—	—	—
25	17.79	6	30	500	11	83	104	2	110	72	90	2	100	36	45	1	50	46	57	1	60
			39.9	500	14	111	139	3	150	96	120	3	125	48	60	2	70	61	76	2	80
			50	500	18	139	174	3	175	120	151	3	175	60	75	2	80	76	95	2	100
			65	500	23	181	226	4	250	157	196	4	200	78	98	2	100	99	124	3	125
			79.8	500	29	222	277	5	300	192	240	5	250	96	120	3	125	121	152	3	175
			96.5	500	35	268	335	6	350	232	291	5	300	116	145	3	150	147	183	4***	200
			110	500	39	—	—	—	—	265	331	6	350	132	166	3	175	167	209	4***	225
			145	500	52	—	—	—	—	—	—	—	—	175	218	4***	225	221	276	5†††	300

LEGEND

AHRI — Air Conditioning, Heating and Refrigeration Institute
FLA — Full Load Amps
MCA — Minimum Circuit Amps
MOCP — Maximum Overcurrent Protection
NEC — National Electrical Code

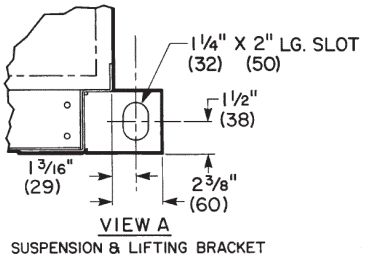
*Standard control steps are listed under the Control Step heading. "Free" additional steps of control are optionally available when the number of subcircuits exceeds the standard number of control steps.
†MCA = 1.25 x FLA; for proper wire sizing, refer to Table 310-16 of the NEC.
**2 control steps in this voltage.
††3 control steps in this voltage.
***4 control steps in this voltage.
†††5 control steps in this voltage.

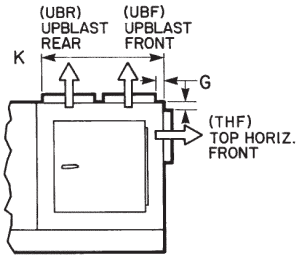
NOTES:
1. Subcircuits are internal heater circuits of 48 amps or less.
2. Electric heat performance is not within the scope of AHRI standard 430 certification.
3. To avoid damage due to overheating, minimum face velocity cannot fall below 350 fpm.

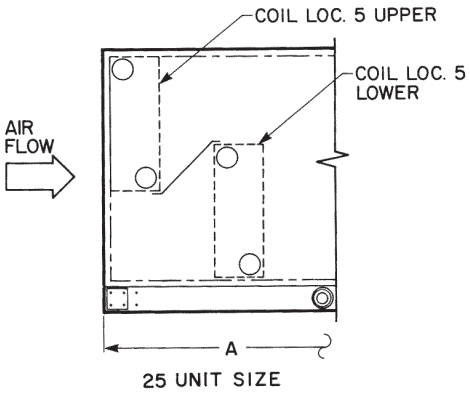
Physical data

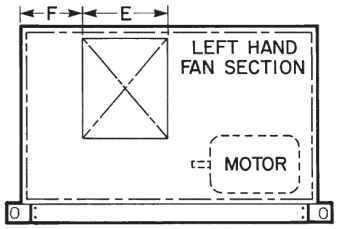
Dimensions

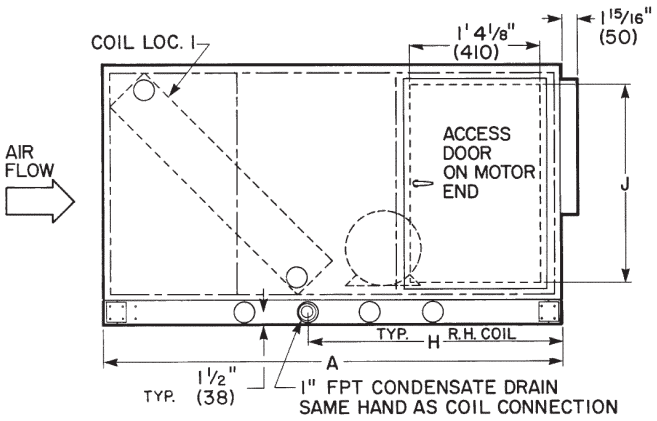
39LA UNIT

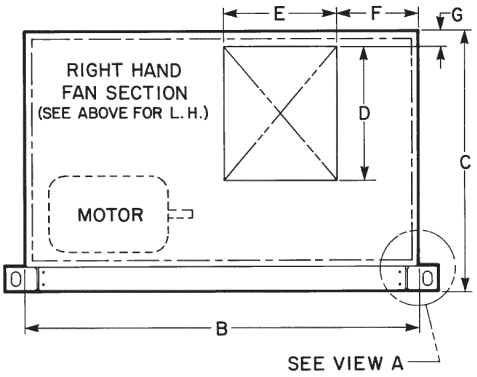












LEGEND

L.H. — Left Hand
R.H. — Right Hand

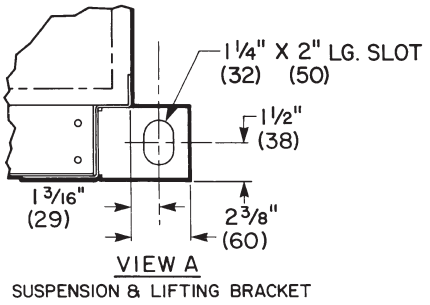
NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

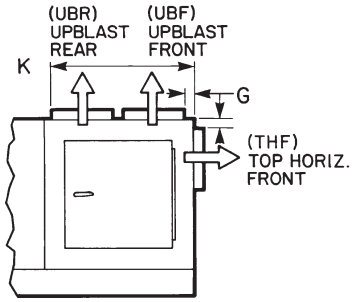
DIMENSIONS (ft-in.)

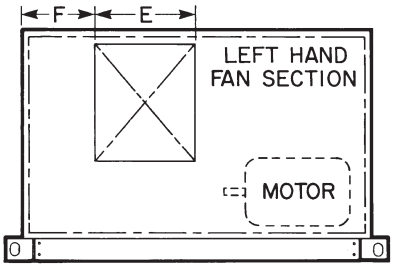
UNIT 39LA	A	B	C	D	E	F	G	H	J	K
03	3-4 15/16	3-1 7/8	2-0 1/4	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	1-11 1/2	1-4 3/4	1- 7 1/2
06	4-0 13/16	3-9 3/4	2-4 3/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	2- 3 7/16	1-8 11/16	1-11 1/2
08	4-8 11/16	4-1 11/16	2-8 1/8	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	2- 7 3/8	2-0 5/8	2- 3 7/16
10	4-8 11/16	4-9 9/16	2-8 1/8	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	2- 7 3/8	2-0 5/8	2- 3 7/16
12	4-8 11/16	5-5 1/16	2-8 1/8	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	2- 7 3/8	2-0 5/8	2- 3 7/16
15	6-0 7/16	5-5 1/16	3-4	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	3- 3 1/4	2-8 1/2	2-10 13/16
18	6-8 5/16	5-5 1/16	3-7 15/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	3- 7 3/16	3-0 7/16	3- 2 3/4
21	6-8 5/16	6-5 1/4	3-7 15/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	3- 7 3/16	3-0 7/16	3- 2 3/4
25	6-4 3/8	6-5 1/4	4-3 13/16	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	3- 7 3/16	3-8 5/16	3-10 1/16

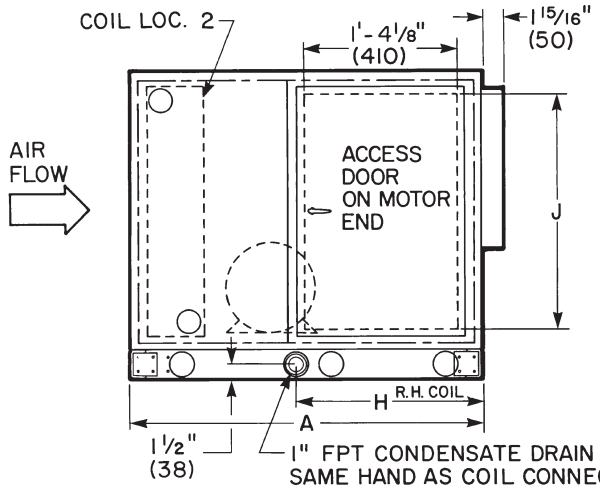
Dimensions (cont)

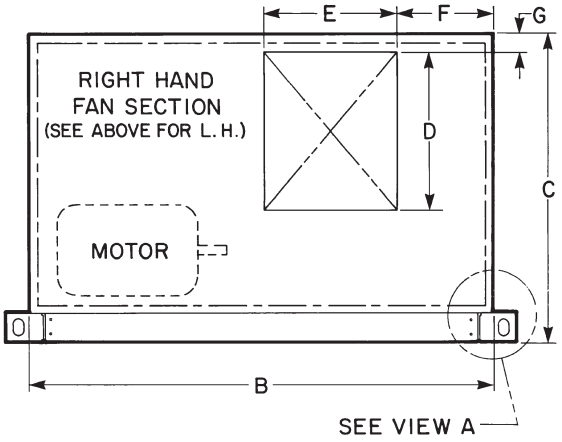
39LB UNIT











LEGEND

L.H. — Left Hand
R.H. — Right Hand

NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

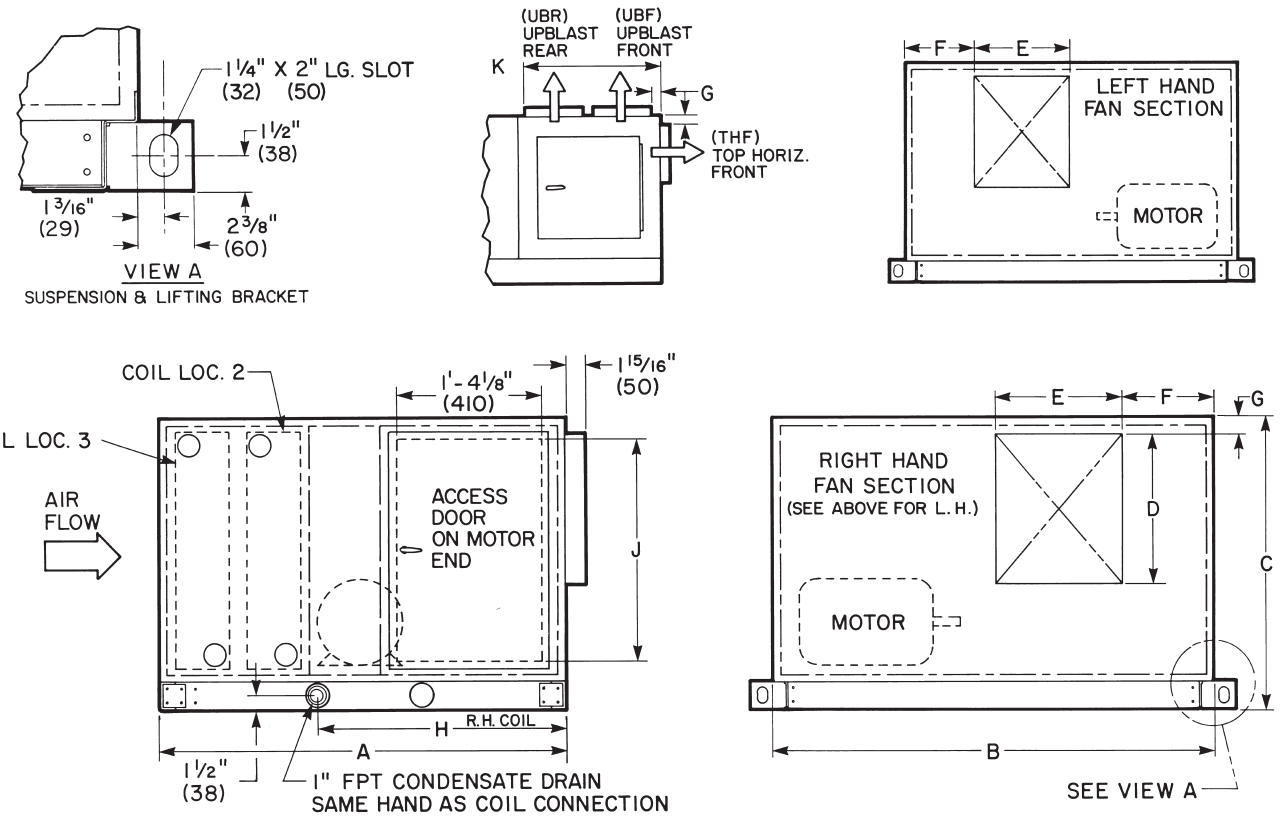
DIMENSIONS (ft-in.)

UNIT 39LB	A	B	C	D	E	F	G	H	J	K
03	2-5 1/8	3-1 7/8	2-0 1/4	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	1-11 11/16	1-4 3/4	1- 7 1/2
06	2-9 1/16	3-9 3/4	2-4 3/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	1- 3 3/4	1-8 11/16	1-11 1/2
08	3-1	4-1 11/16	2-8 1/8	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	1- 7 9/16	2-0 5/8	2- 3 7/16
10	3-1	4-9 9/16	2-8 1/8	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	1- 7 9/16	2-0 5/8	2- 3 7/16
12	3-1	5-5 1/16	2-8 1/8	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	1- 7 9/16	2-0 5/8	2- 3 7/16
15	3-8 7/8	5-5 1/16	3-4	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	2- 3 7/16	2-8 1/2	2-10 13/16
18	4-0 13/16	5-5 1/16	3-7 15/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	2- 7 3/8	3-0 7/16	3- 2 3/4
21	4-0 13/16	6-5 1/4	3-7 15/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	2- 7 3/8	3-0 7/16	3- 2 3/4
25	4-8 11/16	6-5 1/4	4-3 13/16	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	2-11 15/16	3-8 5/16	3-10 1/16

Physical data (cont)

Dimensions (cont)

39LC UNIT



LEGEND

L.H. — Left Hand
R.H. — Right Hand

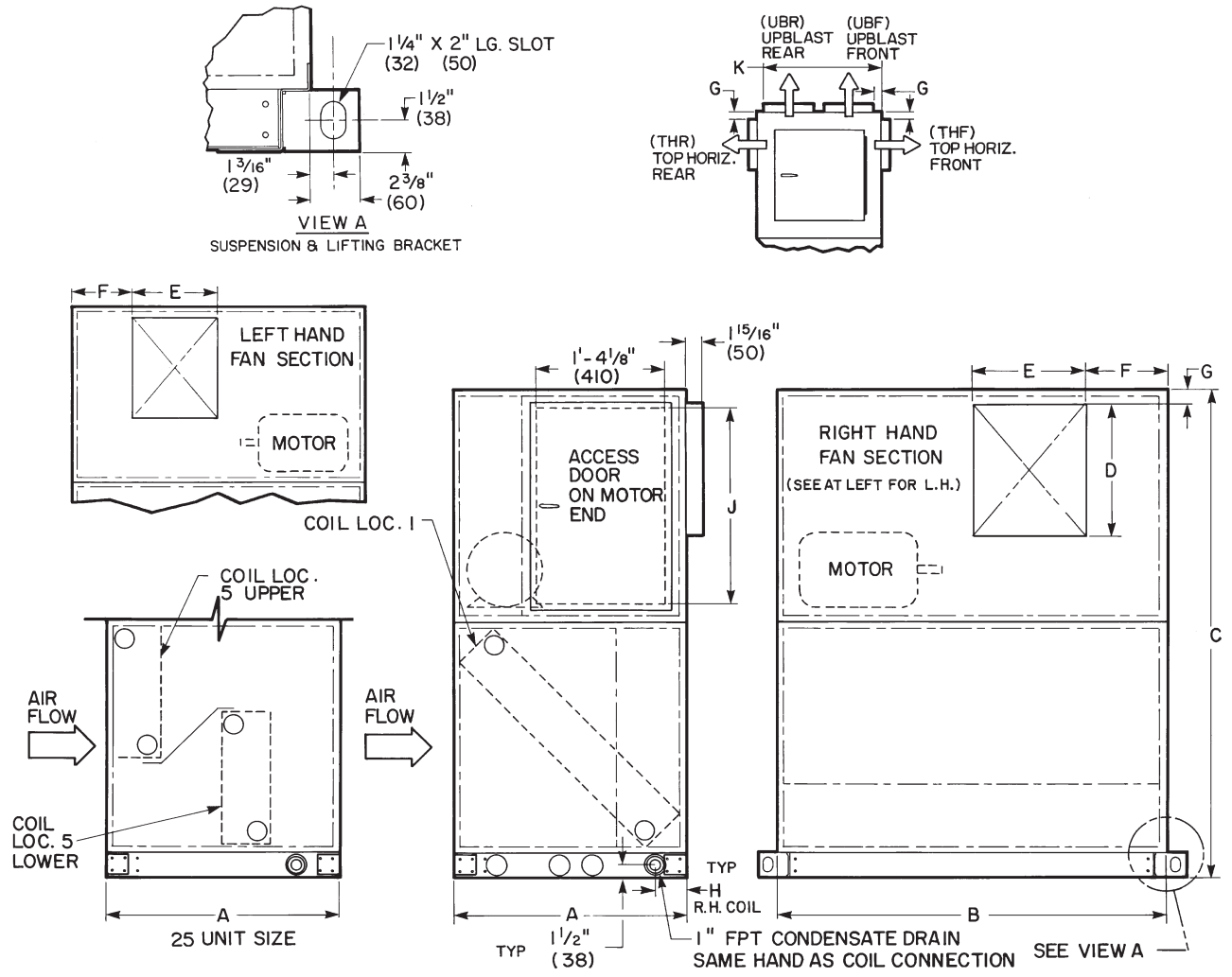
NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

DIMENSIONS (ft-in.)

UNIT 39LC	A	B	C	D	E	F	G	H	J	K
03	3-1	3-1 7/8	2-0 1/4	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	1-7 9/16	1-4 3/4	1- 7 1/2
06	3-4 15/16	3-9 3/4	2-4 3/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	1-11 1/2	1-8 11/16	1-11 1/2
08	3-8 7/8	4-1 11/16	2-8 1/8	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	2- 3 7/16	2-0 5/8	2- 3 7/16
10	3-8 7/8	4-9 9/16	2-8 1/8	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	2- 3 7/16	2-0 5/8	2- 3 7/16
12	3-8 7/8	5-5 1/16	2-8 1/8	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	2- 3 7/16	2-0 5/8	2- 3 7/16
15	4-4 3/4	5-5 1/16	3-4	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	2-11 5/16	2-8 1/2	2-10 13/16
18	4-8 11/16	5-5 1/16	3-7 15/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	3- 3 1/4	3-0 7/16	3- 2 3/4
21	4-8 11/16	6-5 1/4	3-7 15/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	3- 7 3/16	3-0 7/16	3- 2 3/4
25	5-4 9/16	6-5 1/4	4-3 13/16	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	3- 7 3/16	3-8 5/16	3-10 1/16

Dimensions (cont)

39LD UNIT



LEGEND

L.H. — Left Hand
R.H. — Right Hand

NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

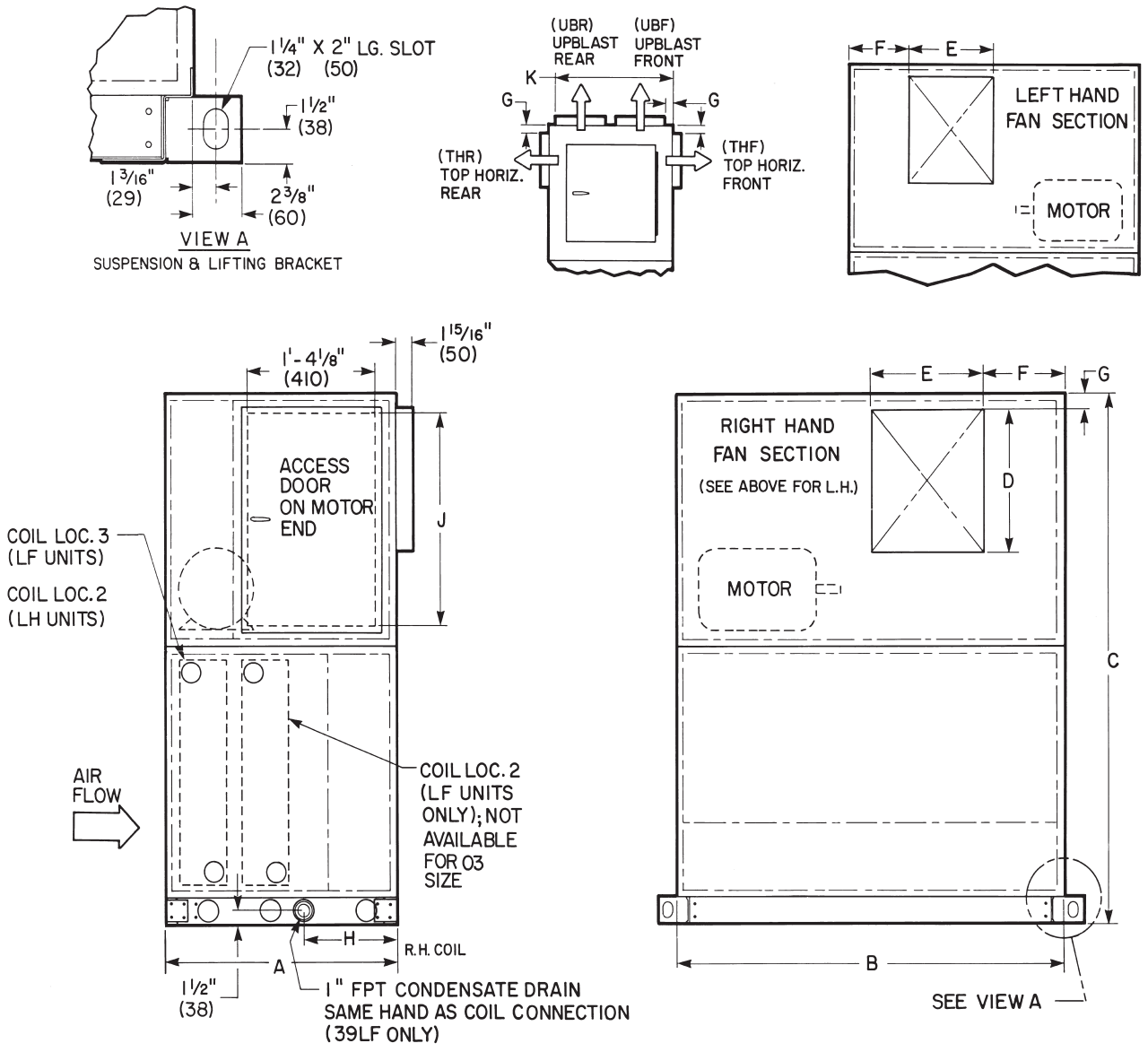
DIMENSIONS (ft-in.)

UNIT 39LD	A	B	C	D	E	F	G	H	J	K
03	1-9 1/4	3-1 7/8	3-9 1/2	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	0- 3 13/16	1-4 3/4	1- 7 1/2
06	2-1 3/16	3-9 3/4	4-5 5/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	0- 3 13/16	1-8 11/16	1-11 1/2
08	2-5 1/8	4-1 11/16	5-1 1/4	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	0- 3 13/16	2-0 5/8	2- 3 7/16
10	2-5 1/8	4-9 9/16	5-1 1/4	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	0- 3 13/16	2-0 5/8	2- 3 7/16
12	2-5 1/8	5-5 1/16	5-1 1/4	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	0- 3 13/16	2-0 5/8	2- 3 7/16
15	3-1	5-5 1/16	6-4 15/16	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	0- 3 13/16	2-8 1/2	2-10 13/16
18	3-4 15/16	5-5 1/16	7-0 13/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	0- 3 13/16	3-0 7/16	3- 2 3/4
21	3-4 15/16	6-5 1/4	7-0 13/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	0- 3 13/16	3-0 7/16	3- 2 3/4
25	4-0 13/16	6-5 1/4	8-4 5/8	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	1-11 1/2	3-8 5/16	3-10 1/16

Physical data (cont)

Dimensions (cont)

39LF,LH UNIT



LEGEND

L.H. — Left Hand
R.H. — Right Hand

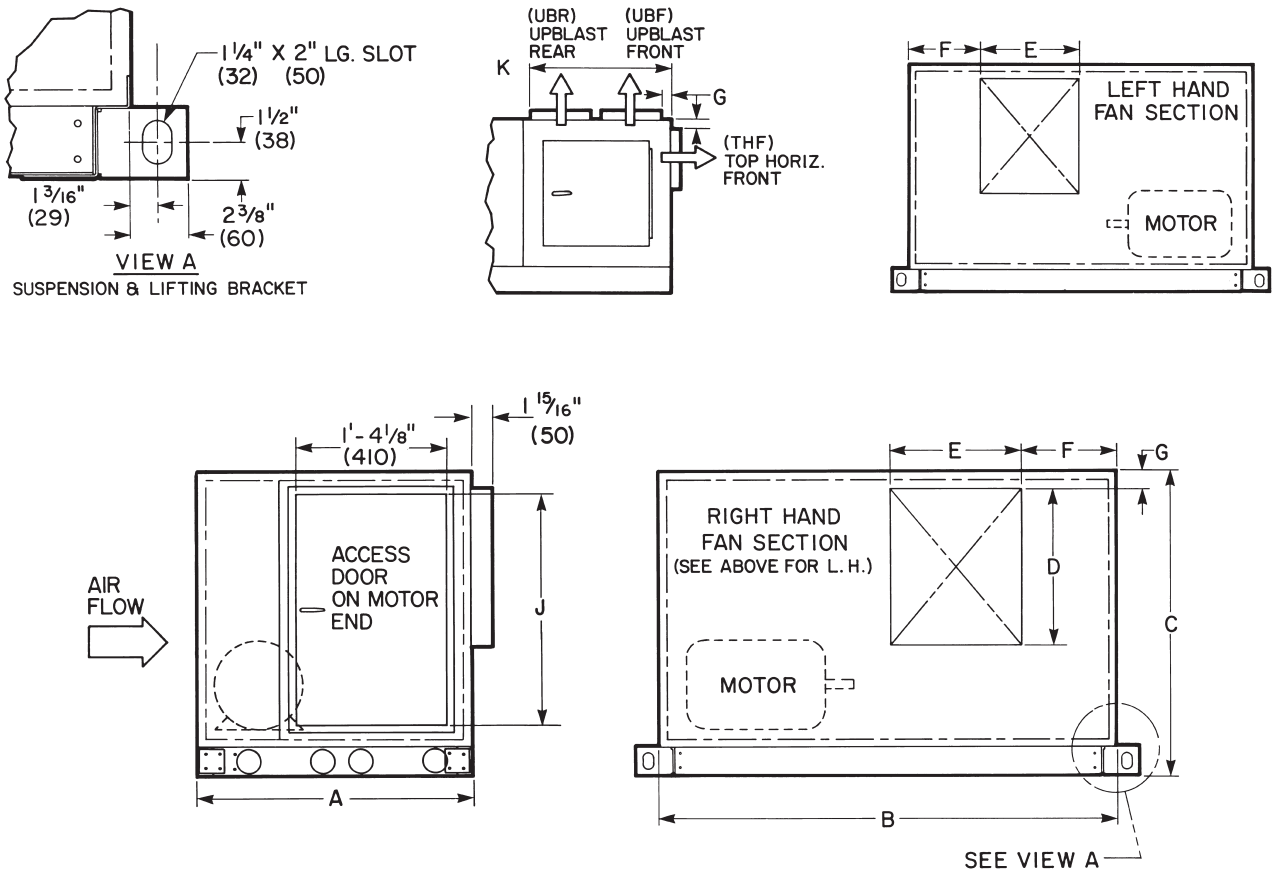
NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

DIMENSIONS (ft-in.)

UNIT 39LF,LH	A	B	C	D	E	F	G	H	J	K
03	1-9 1/4	3-1 7/8	3-9 1/2	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	0- 3 13/16	1-4 3/4	1- 7 1/2
06	2-1 3/16	3-9 3/4	4-5 5/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	0- 7 3/4	1-8 11/16	1-11 1/2
08	2-5 1/8	4-1 11/16	5-1 1/4	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	0-11 11/16	2-0 5/8	2- 3 7/16
10	2-5 1/8	4-9 9/16	5-1 1/4	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	0-11 11/16	2-0 5/8	2- 3 7/16
12	2-5 1/8	5-5 1/16	5-1 1/4	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	0-11 11/16	2-0 5/8	2- 3 7/16
15	3-1	5-5 1/16	6-4 15/16	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	0- 3 13/16	2-8 1/2	2-10 13/16
18	3-4 15/16	5-5 1/16	7-0 13/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	0- 3 13/16	3-0 7/16	3- 2 3/4
21	3-4 15/16	6-5 1/4	7-0 13/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	0- 3 13/16	3-0 7/16	3- 2 3/4
25	4-0 13/16	6-5 1/4	8-4 5/8	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	2-7 3/8	3-8 5/16	3-10 1/16

Dimensions (cont)

39LG UNIT



LEGEND

L.H. — Left Hand

NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

DIMENSIONS (ft-in.)

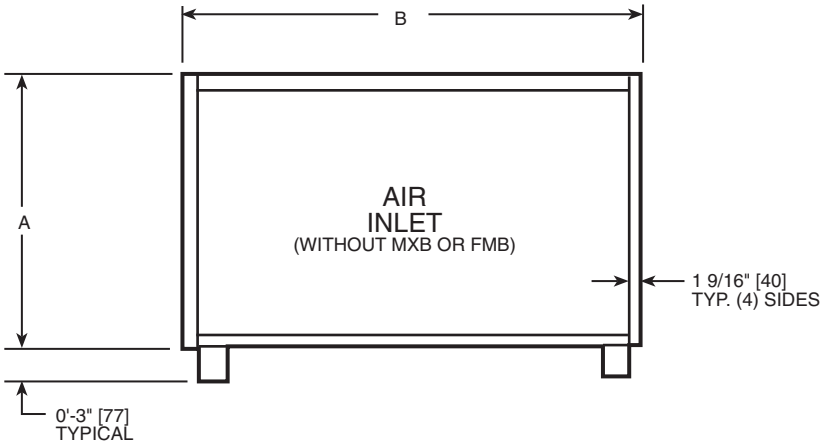
UNIT 39LG	A	B	C	D	E	F	G	H	J	K
03	1-9 1/4	3-1 7/8	2-0 1/4	1-2 3/16	0- 9 3/8	0- 7 9/16	0-1 3/4	—	1-4 3/4	1- 7 1/2
06	2-1 3/16	3-9 3/4	2-4 3/16	1-3 13/16	1- 0 5/16	1-10	0-1 3/4	—	1-8 11/16	1-11 1/2
08	2-5 1/8	4-1 11/16	2-8 1/8	1-4 1/2	1- 2	0-10 1/4	0-1 3/4	—	2-0 5/8	2- 3 7/16
10	2-5 1/8	4-9 9/16	2-8 1/8	1-8 1/2	1- 2 9/16	1- 1 3/4	0-1 3/4	—	2-0 5/8	2- 3 7/16
12	2-5 1/8	5-5 1/16	2-8 1/8	1-5 3/4	1- 6 1/2	1- 2	0-1 3/4	—	2-0 5/8	2- 3 7/16
15	3-1	5-5 1/16	3-4	2-0 1/2	1- 6 15/16	1- 3 3/8	0-2 1/4	—	2-8 1/2	2-10 13/16
18	3-4 15/16	5-5 1/16	3-7 15/16	2-5 5/8	1- 6 3/8	1- 3 5/8	0-2 1/4	—	3-0 7/16	3- 2 3/4
21	3-4 15/16	6-5 1/4	3-7 15/16	2-5 5/8	1-10 5/8	1- 6 5/8	0-2 1/4	—	3-0 7/16	3- 2 3/4
25	4-0 13/16	6-5 1/4	4-3 13/16	3-0 1/2	1- 9 3/8	1- 6 13/16	0-2 3/4	—	3-8 5/16	3-10 1/16

Physical data (cont)

39L AIR INLET WITHOUT MIXING BOX OR FILTER-MIXING BOX (MXB/FMB)

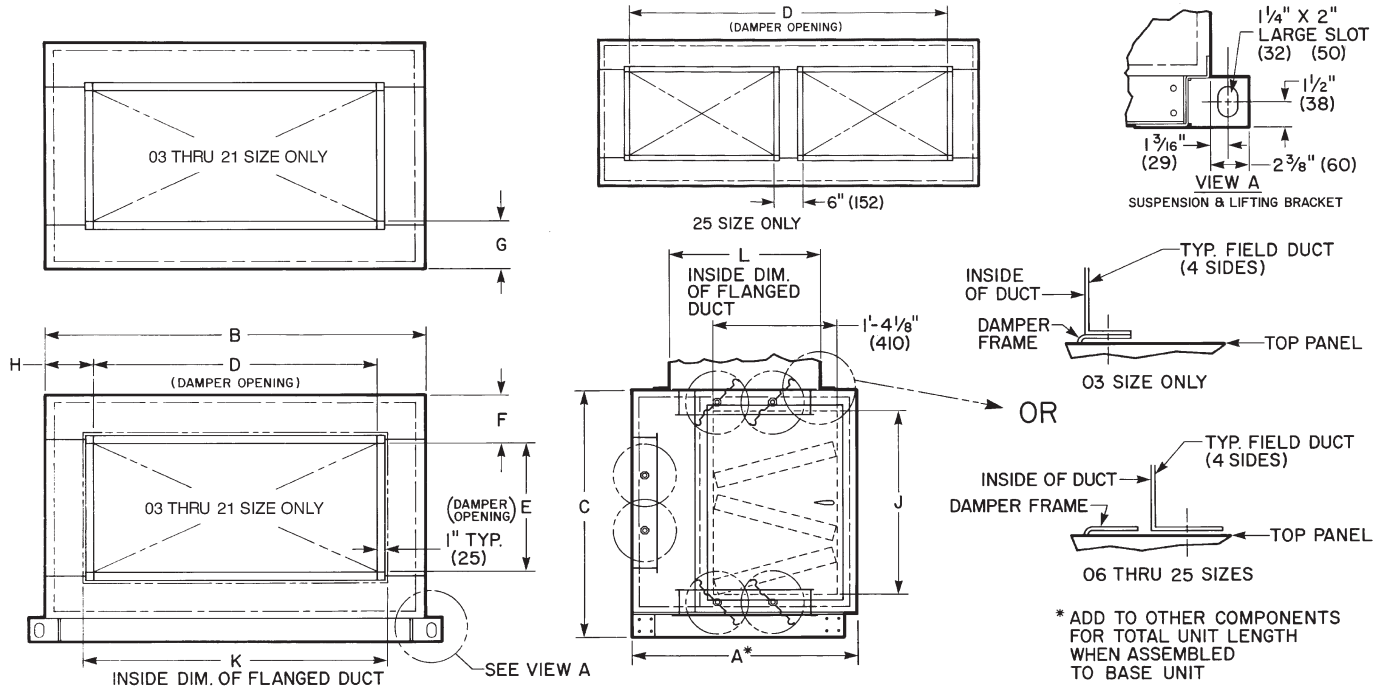
DIMENSIONS (ft-in.)

UNIT 39L-	A	B
03	1-9 1/4	3-1
06	2-1 3/16	3-8 7/8
08	2-5 1/8	4-0 13/16
10	2-5 1/8	4-8 11/16
12	2-5 1/8	5-4 9/16
15	3-1	5-4 9/16
18	3-4 15/16	5-4 9/16
21	3-4 15/16	6-4 3/8
25	4-0 13/16	6-4 3/8



FACTORY-INSTALLED OPTION COMPONENTS

MIXING BOX AND FILTER-MIXING BOX (MXB/FMB)



NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

DIMENSIONS (ft-in.)

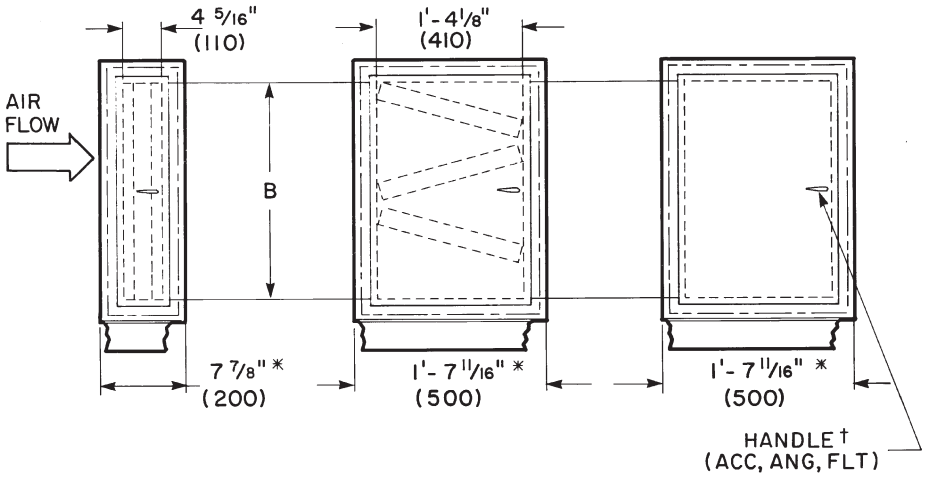
UNIT 39L-	A	B	C	D	E	F	G	H	J	K	L
03	2- 3 9/16	3-1 7/8	2-0 1/4	1- 5	1-5	0- 1 5/8	0-6 1/16	0-10 1/2	1-4 3/4	1-5 1/4	1- 5 1/4
06	2- 3 9/16	3-9 3/4	2-4 3/16	1-11	1-5	0- 4 1/8	0-6 1/16	0-11 3/8	1-8 11/16	2-1 1/4	1- 7 1/4
08	2- 3 9/16	4-1 11/16	2-8 1/8	3- 1	1-5	0- 6 1/16	0-6 1/16	0- 6 3/8	2-0 5/8	3-3 1/4	1- 7 1/4
10	2- 3 9/16	4-9 9/16	2-8 1/8	3- 5	1-5	0- 6 1/16	0-6 1/16	0- 8 5/16	2-0 5/8	3-7 1/4	1- 7 1/4
12	2- 3 9/16	5-5 7/16	2-8 1/8	3-11	1-5	0- 6 1/16	0-6 1/16	0- 9 1/4	2-0 5/8	4-1 1/4	1- 7 1/4
15	2- 3 9/16	5-5 7/16	3-4	3-11	1-9	0- 8	0-4 1/16	0- 9 1/4	2-8 1/2	4-1 1/4	1-11 1/4
18	2-11 7/16	5-5 7/16	3-7 15/16	3-11	2-3	0- 7	0-5	0- 9 1/4	3-0 7/16	4-1 1/4	2- 5 1/4
21	2-11 7/16	6-5 1/4	3-7 15/16	3-11	2-5	0- 6	0-4	1- 3 1/8	3-0 7/16	4-1 1/4	2- 7 1/4
25	2-11 7/16	6-5 1/4	4-3 13/16	5- 4	2-5	0- 9 7/16	0-4	0- 6 5/8	3-8 5/16	5-6 1/4	2- 7 1/4

FACTORY-INSTALLED OPTION COMPONENTS (cont)

(FLT)
FLAT FILTER

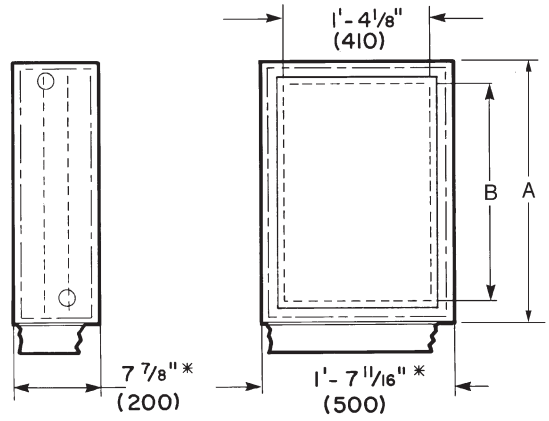
(ANG)
ANGLE FILTER

(ACC)
ACCESS SECTION



(PHW)
PREHEAT WATER

(PHE)
PREHEAT ELECTRIC



*Add to other components for total unit length when assembled to base unit.
†All FLT, ANG, and ACC doors are hinged and are on same side of unit as fan door (motor side).

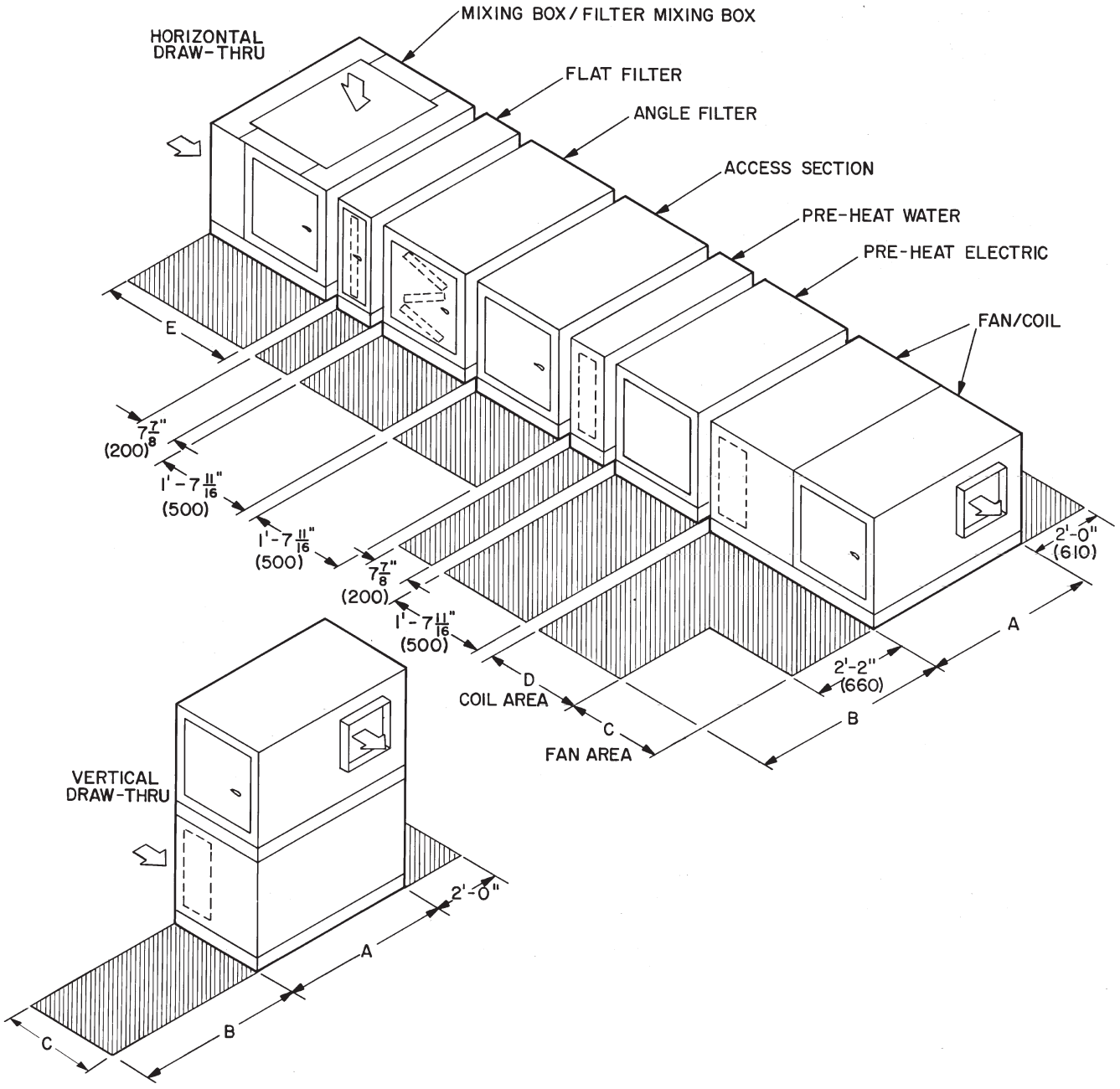
NOTES:
1. Hand is determined by the location of the fan drive and/or coil connection when viewed while facing the direction toward which air is flowing.
2. Dimensions in ( ) are in millimeters.

DIMENSIONS (ft-in.)

UNIT 39L-	A	DOOR OPENING B
03	2-0 1/4	1-4 3/4
06	2-4 3/16	1-8 11/16
08	2-8 1/8	2-0 5/8
10	2-8 1/8	2-0 5/8
12	2-8 1/8	2-0 5/8
15	3-4	2-8 1/2
18	3-7 15/16	3-0 7/16
21	3-7 15/16	3-0 7/16
25	4-3 13/16	3-8 5/16

Physical data (cont)

SERVICE AREA REQUIREMENTS

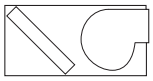
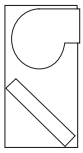


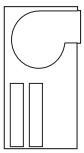
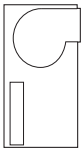
DIMENSIONS (ft-in.)

SIZE	A	B	C	D			E
				39LA	39LB	39LC	
03	3-1 7/8	3-1 3/4	1-9 1/4	1- 7 11/16	0-7 7/8	1-3 3/4	2- 3 9/16
06	3-9 3/4	3-9 5/8	2-1 3/16	1-11 5/8	0-7 7/8	1-3 3/4	2- 3 9/16
08	4-1 1/16	4-1 9/16	2-5 1/8	2- 3 9/16	0-7 7/8	1-3 3/4	2- 3 9/16
10	4-9 9/16	4-9 7/16	2-5 1/8	2- 3 9/16	0-7 7/8	1-3 3/4	2- 3 9/16
12	5-5 1/16	5-5 5/16	2-5 1/8	2- 3 9/16	0-7 7/8	1-3 3/4	2- 3 9/16
15	5-5 1/16	5-5 5/16	3-1	2-11 9/16	0-7 7/8	1-3 3/4	2- 3 9/16
18	5-5 1/16	5-5 5/16	3-4 15/16	3- 3 3/8	0-7 7/8	1-3 3/4	2-11 7/16
21	6-5 1/4	6-5 1/8	3-4 15/16	3- 3 3/8	0-7 7/8	1-3 3/4	2-11 7/16
25	6-5 1/4	6-5 1/8	4-0 15/16	2- 3 9/16	0-7 7/8	1-3 3/4	2-11 7/16

Space requirements

ROUGHING-IN DIMENSIONS (in.)

39L UNIT SIZE	39LA (Cooling) 			39LB (Cooling) 			39LC (Cooling/Heating) (Heating/Cooling) (Cooling Only) 			39LD (Cooling) 		
	L	W	H	L	W	H	L	W	H	L	W	H
03	41	38	24	29	38	24	37	38	24	21	38	46
06	49	46	28	33	46	28	41	46	28	25	46	53
08	57	50	32	37	50	32	45	50	32	29	50	61
10	57	58	32	37	58	32	45	58	32	29	58	61
12	57	65	32	37	65	32	45	65	32	29	65	61
15	73	65	40	45	65	40	53	65	40	37	65	77
18	80	65	44	49	65	44	57	65	44	41	65	85
21	80	77	44	49	77	44	57	77	44	41	77	85
25	76	77	52	57	77	52	65	77	52	49	77	101

39L UNIT SIZE	39LF (Cooling/Heating) (Heating/Cooling) (Cooling Only) 			39LG (Fan Only) 			39LH (Heating) 		
	L	W	H	L	W	H	L	W	H
03	21	38	46	21	38	24	21	38	46
06	25	46	53	25	46	28	25	46	53
08	29	50	61	29	50	32	29	50	61
10	29	58	61	29	58	32	29	58	61
12	29	65	61	29	65	32	29	65	61
15	37	65	77	37	65	40	37	65	77
18	41	65	85	41	65	44	41	65	85
21	44	77	85	41	77	44	41	77	85
25	49	77	101	49	77	52	49	77	101

LEGEND

L — Length
W — Width
H — Height

ACCESSORY AIRWAY LENGTH (in.)

39L UNIT SIZE	ANGLE FILTER	FLAT FILTER	ACCESS	PREHEAT (Water)	PREHEAT (Electric)	MIXING BOX	FILTER-MIXING BOX
03	20	8	20	8	20	28	28
06	20	8	20	8	20	28	28
08	20	8	20	8	20	28	28
10	20	8	20	8	20	28	28
12	20	8	20	8	20	28	28
15	20	8	20	8	20	28	28
18	20	8	20	8	20	35	35
21	20	8	20	8	20	35	35
25	20	8	20	8	20	35	35

Physical data (cont)

FANS

39L UNIT SIZE	03	06	08	10	12	15	18	21	25
WHEEL DIAMETER (in.)	9 1/2	12 5/8	12 5/8	15	15	18 1/8	20	20	25
MAX SPEED (rpm)	2500	2000	2000	1600	1600	1400	1300	1100	1000
SHAFT DIAMETER (in.)*	3/4	1 3/16	1 3/16	1 3/16	1 3/16	1 7/16	1 7/16	1 7/16	1 11/16
FAN SHAFT WT (lb)	4.8	8.9	8.9	10.4	11.6	17.9	17.9	20.2	27.7
FAN WHEEL WT (lb)	4.8	7.2	10	13	17	29	34	42	70
NO. OF FAN BLADES	43	43	43	51	51	48	53	53	56
MAXIMUM MOTOR HORSEPOWER† ODP	2	5	10	10	15	15	20	20	25
TEFC	2	5	5	10	10	10	15	20	25

LEGEND

ODP — Open Drip Proof
TEFC — Totally Enclosed Fan Cooled

*At fan sheave.
†See Motor and Drive Package Data table below for drive type limitations.

MOTOR AND DRIVE PACKAGE DATA*

39L UNIT SIZE	HP REF	MOTOR FRAME	FAN SHAFT DIAM. (in.)	CENTER LINE DISTANCE (in.)		MAX WIDTH SHEAVE (in.)		RPM RANGE		DRIVE AVAILABILITY			
										ODP		TEFC	
				Max	Min	ODP	TEFC	Max	Min	Fix	Var	Fix	Var
03	1/2†	56	3/4	6.8	5.5	3.8	3.8	1745	993	—	X	—	X
	3/4†	56		6.8	5.5	3.8	3.8	1934	1045	—	X	—	X
	1	143T		6.8	5.5	3.8	3.8	2143	1158	—	X	—	X
	1 1/2	145T		6.8	5.5	3.8	3.8	2375	1283	—	X	—	X
	2	145T		6.8	5.5	3.8	3.8	2500	1422	—	X	—	X
06	3/4†	56	1 3/16	9.25	8.25	5.0	5.0	1137	836	—	X	—	X
	1	143T		9.25	8.25	5.0	5.0	1260	836	—	X	—	X
	1 1/2	145T		9.25	8.25	5.0	5.0	1397	880	—	X	—	X
	2	145T		9.25	8.25	5.0	5.0	1548	926	—	X	—	X
	3	182T		8.2	7.0	5.0	5.0	1805	975	—	X	—	X
	5	184T		8.2	7.0	5.0	4.0	2000	1197	—	X	—	X
08	1 1/2	145T	1 3/16	11.25	9.5	5.0	5.0	1327	836	—	X	—	X
	2	145T		11.25	9.5	5.0	5.0	1470	836	—	X	—	X
	3	182T		9.8	8.4	5.0	5.0	1629	926	—	X	—	X
	5	184T		9.8	8.4	5.0	5.0	1900	1026	—	X	—	X
	7 1/2	213T		9.1	7.5	5.0	4.6	2000	1197	—	X	—	X
	10	215T		9.1	7.5	4.5	—	2000	1327	—	X	—	—
10	1 1/2	145T	1 3/16	11.25	9.4	4.9	4.9	1238	668	—	X	—	X
	2	145T		11.25	9.4	4.9	4.9	1372	668	—	X	—	X
	3	182T		9.8	8.3	4.9	4.9	1520	780	—	X	—	X
	5	184T		9.8	8.3	4.9	4.9	1600	820	—	X	—	X
	7 1/2	213T		9.1	7.4	4.9	4.9	1600	957	—	X	—	X
	10	215T		9.1	7.4	4.3	3.4	1600	1061	—	—	X	—

MOTOR AND DRIVE PACKAGE DATA* (cont)

39L UNIT SIZE	HP REF	MOTOR FRAME	FAN SHAFT DIAM. (in.)	CENTER LINE DISTANCE (in.)		MAX WIDTH SHEAVE (in.)		RPM RANGE		DRIVE AVAILABILITY			
										ODP		TEFC	
				Max	Min	ODP	TEFC	Max	Min	Fix	Var	Fix	Var
12	1 1/2	145T	1 3/16	11.25	9.4	5.7	5.7	1061	668	—	X	—	X
	2	145T		11.25	9.4	5.7	5.7	1238	668	—	X	—	X
	3	182T		9.8	8.3	5.7	5.7	1444	740	—	X	—	X
	5	184T		9.8	8.3	5.7	5.7	1600	779	—	X	—	X
	7 1/2	213T		9.1	7.4	5.7	5.7	1600	863	—	X	—	X
	10	215T		9.1	7.4	5.7	5.7	1600	1008	—	X	—	X
	15	254T		7.8	6.6	5.3	3.9	1600	1176	X	—	X	—
15	3	182T	1 7/16	13.5	11.4	6.4	6.4	1083	613	—	X	—	X
	5	184T		13.5	11.4	6.4	6.4	1264	613	—	X	—	X
	7 1/2	213T		12.6	10.4	6.4	6.4	1400	716	—	X	—	X
	10	215T		12.6	10.4	6.4	6.4	1400	794	—	X	—	X
	15	254T		11.4	9.4	6.1	5.4	1400	881	—	X	—	X
18	3	182T	1 7/16	15.6	13.3	6.3	6.3	906	514	—	X	—	X
	5	184T		15.6	13.3	6.3	6.3	1058	514	—	X	—	X
	7 1/2	213T		14.7	12.4	6.3	6.3	1235	570	—	X	—	X
	10	215T		14.7	12.4	6.3	6.3	1300	632	—	X	—	X
	15	254T		13.5	11.2	5.7	5.7	1300	738	—	X	—	X
	20	256T		13.5	11.2	4.7	4.7	1300	818	X	—	X	—
21	3	182T	1 7/16	15.6	13.3	6.2	6.2	798	430	—	X	—	X
	5	184T		15.6	13.3	6.2	6.2	1043	523	—	X	—	X
	7 1/2	213T		14.7	12.4	6.2	6.2	1100	579	—	X	—	X
	10	215T		14.7	12.4	6.2	6.2	1100	643	—	X	—	X
	15	254T		13.5	11.2	5.6	5.6	1100	715	—	X	—	X
	20	256T		13.5	11.2	4.5	4.5	1100	798	X	—	X	—
25	5	184T	1 11/16	17.9	16.1	4.8	4.8	729	380	—	X	—	X
	7 1/2	213T		17.6	15.4	4.8	4.8	909	445	—	X	—	X
	10	215T		17.6	15.4	4.8	4.8	959	470	—	X	—	X
	15	254T		17.1	14.4	4.8	4.8	1000	551	—	X	—	X
	20	256T		17.1	14.4	4.8	4.8	1000	617	X	—	X	—
	25	284T		16.1	13.2	4.8	4.8	1000	654	X	—	X	—

LEGEND

Fix — Fixed Pitch Drive
ODP — Open Drip Proof
TEFC — Totally Enclosed Fan Cooled
Var — Variable Pitch Drive

*Based on 3-phase, 1800 rpm, 60 Hz motors.
†Not available with high-efficiency motors.

Physical data (cont)

COILS

39L UNIT SIZE	03	06	08	10	12	15	18	21	25
CHILLED WATER/DIRECT EXPANSION									
Large Face Area									
Nominal Capacity (cfm) at 550 Fpm	1996	3245	4345	5247	6149	8200	9740	11,880	13,750
Face Area (sq ft)	3.63	5.90	7.90	9.54	11.2	14.9	17.7	21.6	25.0*
Number of Tubes/Face	16	20	24	24	24	32	38	38	22/22
Finned Tube Length (in.)	26.1	34.0	37.9	45.8	53.7	53.7	53.7	65.5	65.5
Small Face Area									
Nominal Capacity (cfm) at 550 Fpm	1496	2596	3619	4372	5126	6666	7689	9405	11,275
Face Area (sq ft)	2.72	4.72	6.58	7.95	9.32	12.1	14.0	17.1	20.5
Number of Tubes/Face	12	16	20	20	20	26	30	30	36
Finned Tube Length (in.)	26.1	34.0	37.9	45.8	53.7	53.7	53.7	65.5	65.5
HOT WATER									
Nominal Capacity (cfm) at 700 Fpm	1904	3304	4606	5565	6524	8470	9800	11,970	14,350
Face Area (sq ft)	2.72	4.72	6.58	7.95	9.32	12.1	14.0	17.1	20.5
Number of Tubes/Face	12	16	20	20	20	26	30	30	36
Finned Tube Length (in.)	26.1	34.0	37.9	45.8	53.7	53.7	53.7	65.5	65.5
STEAM									
Face Area (sq ft)	2.13	4.18	6.22	7.53	8.85	11.06	13.28	16.21	18.92
Number of Tubes/Face	4	6	8	8	8	10	12	12	14
Finned Tube Length (in.)	25.5	33.4	37.3	45.2	53.1	53.1	53.1	53.1	64.9

*39LA and 39LD large face area units have 2 coils.

UNIT WEIGHTS* (lb)

UNIT TYPE	UNIT SIZE								
	03	06	08	10	12	15	18	21	25
39LA	200	280	411	470	540	620	695	740	820
39LB	150	210	308	352	405	465	521	555	615
39LC	170	238	349	400	459	527	590	629	697
39LD	230	322	472	540	621	713	799	851	943
39LF	230	322	472	540	621	713	799	851	943
39LG	120	168	246	282	324	372	417	444	492
39LH	220	308	452	517	594	682	764	814	902

*Less coil and motor.

ACCESSORY WEIGHTS (lb)

39L UNIT SIZE	03	06	08	10	12	15	18	21	25
Angle Filter	75	82	97	107	114	134	140	159	185
Flat Filter	37	43	48	50	55	74	75	86	90
Access	48	55	60	64	68	74	77	87	92
Preheat (Water)	36	42	43	46	49	52	54	53	57
Preheat (Electric)	49	56	61	66	72	74	76	87	89
Mixing Box	139	164	193	219	226	244	283	272	311
Filter-Mixing Box	150	173	208	227	245	279	327	340	395

MOTOR WEIGHTS (lb dry)

HP	1/2	3/4	1	1 1/2	2	3	5	7 1/2	10	15	20	25
lb	21	24	30	32	36	56	70	127	141	187	211	269

COIL WEIGHTS (lb dry)

COILS FOR 39L UNIT SIZE	03	06	08	10	12	15	18	21	25
CHILLED WATER*/DIRECT EXPANSION*									
Large Face Area									
4-Row	59	90	105	118	147	192	214	271	303
6-Row	68	104	134	152	190	255	294	357	398
Small Face Area									
4-Row	48	76	97	112	142	172	195	227	257
6-Row	57	91	122	139	176	213	245	293	336
8-Row	68	102	144	161	210	256	295	356	415
HOT WATER*									
1-Row	20	35	40	50	60	65	80	90	100
2-Row	30	45	55	65	80	95	110	125	140
STEAM†									
6 FPI	50	70	85	95	110	135	150	180	215
9 FPI	55	80	100	115	125	155	175	214	256
12 FPI	60	85	115	130	145	180	205	248	297

LEGEND

FPI — Fins per inch

*Coils are $^1/_2$-in. OD with 14 aluminum fins per inch on copper tubes.
†Steam coils are one-row, 1-in. OD.

CHILLED WATER COIL CIRCUITNG DATA

LARGE FACE AREA (39LA, 39LD)

COIL TYPE	CIRCUITING	UNIT SIZE									
		03		06		08		10		12	
		Face Area (sq ft)									
		3.63		5.90		7.90		9.54		11.18	
		No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size
4-ROW	Q	4	$1^1/_2$	5	$1^1/_2$	—	—	—	—	—	—
	H	8	$1^1/_2$	10	$1^1/_2$	12	$1^1/_2$	12	$1^1/_2$	12	$1^1/_2$
	F	16	$1^1/_2$	20	$1^1/_2$	24	$2^1/_2$	24	$2^1/_2$	24	$2^1/_2$
	D	—	—	—	—	—	—	—	—	—	—
6-ROW	H	8	$1^1/_2$	10	$1^1/_2$	12	$1^1/_2$	12	$1^1/_2$	12	$1^1/_2$
	F	16	$1^1/_2$	20	$1^1/_2$	24	$2^1/_2$	24	$2^1/_2$	24	$2^1/_2$
	D	—	—	—	—	36	$2^1/_2$	36	$2^1/_2$	36	$2^1/_2$

LARGE FACE AREA (39LA, 39LD) (cont)

COIL TYPE	CIRCUITING	UNIT SIZE							
		15		18		21		25	
		Face Area (sq ft)							
		14.91		17.71		21.60		25.00	
		No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size
4-ROW	Q	—	—	—	—	—	—	—	—
	H	16	$1^1/_2$	19	$1^1/_2$	19	$1^1/_2$	22	$1^1/_2$
	F	32	$2^1/_2$	38	$2^1/_2$	38	$2^1/_2$	44	$2^1/_2$
	D	—	—	—	—	76	$2^1/_2$	88	$2^1/_2$
6-ROW	H	16	$1^1/_2$	19	$1^1/_2$	19	$1^1/_2$	—	—
	F	32	$2^1/_2$	38	$2^1/_2$	38	$2^1/_2$	44	$2^1/_2$
	D	48	$2^1/_2$	57	$2^1/_2$	57	$2^1/_2$	66	$2^1/_2$

LEGEND

D — Double Circuit
F — Full Circuit
H — Half Circuit
Q — Quarter Circuit

NOTES:
1. Connection sizes are MPT — inches.
2. Size 25 has 2 coils.

Physical data (cont)

CHILLED WATER COIL CIRCUITNG DATA (cont)

SMALL FACE AREA (39LB, 39LC, 39LF)											
COIL TYPE	CIRCUITING	UNIT SIZE									
		03		06		08		10		12	
		Face Area (sq ft)									
		2.72		4.72		6.58		7.95		9.23	
		No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size
4-ROW	Q	3	1 1/2	4	1 1/2	—	—	—	—	—	—
	H	6	1 1/2	8	1 1/2	10	1 1/2	10	1 1/2	10	1 1/2
	F	12	1 1/2	16	1 1/2	20	2 1/2	20	2 1/2	20	2 1/2
	D	—	—	—	—	—	—	—	—	—	—
6-ROW	H	6	1 1/2	8	1 1/2	10	1 1/2	10	1 1/2	10	1 1/2
	F	12	1 1/2	16	1 1/2	20	2 1/2	20	2 1/2	20	2 1/2
	D	—	—	—	—	30	2 1/2	30	2 1/2	30	2 1/2
8-ROW*	H	6	1 1/2	8	1 1/2	10	1 1/2	10	1 1/2	10	1 1/2
	F	12	1 1/2	16	1 1/2	20	2 1/2	20	2 1/2	20	2 1/2
	D	—	—	—	—	40	2 1/2	40	2 1/2	40	2 1/2

SMALL FACE AREA (39LB, 39LC, 39LF) (cont)									
COIL TYPE	CIRCUITING	UNIT SIZE							
		15		18		21		25	
		Face Area (sq ft)							
		12.12		13.98		17.10		20.50	
		No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size	No. Circuits	Connection Size
4-ROW	Q	—	—	—	—	—	—	—	—
	H	13	1 1/2	15	1 1/2	15	1 1/2	18	1 1/2
	F	26	2 1/2	30	2 1/2	30	2 1/2	36	2 1/2
	D	—	—	—	—	60	2 1/2	72	2 1/2
6-ROW	H	13	1 1/2	15	1 1/2	15	1 1/2	—	1 1/2
	F	26	2 1/2	30	2 1/2	30	2 1/2	36	2 1/2
	D	39	2 1/2	45	2 1/2	45	2 1/2	54	2 1/2
8-ROW*	H	13	1 1/2	13	1 1/2	—	1 1/2	—	1 1/2
	F	26	2 1/2	30	2 1/2	30	2 1/2	36	2 1/2
	D	52	2 1/2	60	2 1/2	60	2 1/2	72	2 1/2

LEGEND

D — Double Circuit
F — Full Circuit
H — Half Circuit
Q — Quarter Circuit

*Not available on 39LB units.

NOTE: Connection sizes are MPT — inches.

DIRECT EXPANSION COIL CIRCUITING DATA

LARGE FACE AREA (39LA, 39LD)											
UNIT SIZE	**03**			**06**		**08**		**10**		**12**	
CIRCUITING TYPE	**Qtr**	**Half**	**Full**	**Half**	**Full**	**Half**	**Full**	**Half**	**Full**	**Half**	**Full**
CFM AT 550 FPM	1996			3245		4345		5247		6149	
FACE AREA (sq ft)	3.63			5.90		7.90		9.54		11.18	
TUBE FACE	16			20		24		24		24	
TUBE LENGTH (in.)	26.1			34.0		37.9		45.8		53.7	
NUMBER OF CIRCUITS	4	8	16	10	20	12	24	12	24	12	24
NUMBER OF TXVs	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF CIRCUITS/TXV*	2	4	8	5	10	6	12	6	12	6	12
SUCTION CONNECTIONS (in. OD)	7/8	1 1/8	1 3/8	1 1/8	1 3/8	1 1/8	1 5/8	1 1/8	1 5/8	1 1/8	1 5/8
DISTRIBUTOR CONNECTIONS (in. OD)	7/8	7/8	1 1/8	7/8	1 1/8	7/8	1 5/8	7/8	1 5/8	7/8	1 1/8
4-ROW COIL											
Circuit Equivalent Length (ft)	52	26	—	32	—	34	18	40	20	45	23
Distributor Tube Length (in.)											
Face Split	11	11	—	11	—	13	15	13	15	13	15
Row Split	13	15	—	16	—	18	18	18	18	18	18
Distributor Nozzle Size†	2	2	—	3	—	4	4	5	5	6	6
6-ROW COIL											
Circuit Equivalent Length (ft)	—	39	20	47	24	51	26	59	30	67	34
Distributor Tube Length (in.)											
Face Split	—	11	11	11	13	13	15	13	15	13	15
Row Split	—	15	16	16	18	18	21	18	21	18	21
Distributor Nozzle Size†	—	2	3	3	3	4	4	5	5	6	6

LARGE FACE AREA (39LA, 39LD) (cont)												
UNIT SIZE	**15**		**18**		**21**		**25**					
CIRCUITING TYPE	**Half**	**Full**	**Half**	**Full**	**Half**	**Full**	**Half**		**Full**		**Double**	
CFM AT 550 FPM	8200		9740		11,880		13,750					
FACE AREA (sq ft)	14.91		17.71		21.6		25.0					
TUBE FACE	32		38		38		22U-22L					
TUBE LENGTH (in.)	53.7		53.7		65.5		65.5					
NUMBER OF CIRCUITS	16	32	19	38	19	38	22		44		88	
							U	L	U	L	U	L
NUMBER OF TXVs	2	4**	2	4**	2	4**	2	2	2	2	4	4
NUMBER OF CIRCUITS/TXV*	8	8	9-10	9-10	9-10	9-10	5-6	5-6	11	11	11	11
→ **SUCTION CONNECTIONS (in. OD)**	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 1/8	1 1/8	1 1/8	1 5/8	1 5/8	1 5/8	1 5/8
DISTRIBUTOR CONNECTIONS (in. OD)	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	7/8	7/8	1 3/8	1 3/8	1 3/8	1 3/8
4-ROW COIL												
Circuit Equivalent Length (ft)	45	23	45	23	54	26	54	54	26	26	—	—
Distributor Tube Length (in.)												
Face Split	15	16	16	16	16	16 3/4	12	12	15	15	—	—
Row Split	26	16	28	16	28	16 3/4	21	21	23	23	—	—
Distributor Nozzle Size†	8	4	10	5	10	5	8	8	5	5	—	—
6-ROW COIL												
Circuit Equivalent Length (ft)	67	34	67	34	81	40	—	—	40	40	—	—
Distributor Tube Length (in.)												
Face Split	15	16	16	18	16	18 1/2	—	—	15	15	—	—
Row Split	23	16	28	18	28	18 1/2	—	—	22	22	—	—
Distributor Nozzle Size†	8	4	10	5	10	5	—	—	5	5	—	—

LEGEND

L — Lower
TXV — Thermostatic Expansion Valve
U — Upper

*Where each TXV has the same number of circuits, that number is shown once. When coil has an uneven number of circuits per TXV, both values are shown.

†Factory-supplied distributors have factory-selected nozzle sizes shown. If necessary, replace factory-supplied nozzles with field-supplied and installed nozzles. Consult ***AHU*Builder®** program for correct nozzle selection.

**May be field manifolded for either face split or row split.

Physical data (cont)

DIRECT EXPANSION COIL CIRCUITING DATA (cont)

SMALL FACE AREA (39LB, 39LC, 39LF)

UNIT SIZE	03		06			08		10		12	
CIRCUITING TYPE	Qtr	Half	Qtr	Half	Full	Half	Full	Half	Full	Half	Full
CFM AT 550 FPM	1496		2596			3619		4372		5126	
FACE AREA (sq ft)	2.72		4.72			6.58		7.95		9.32	
TUBE FACE	12		16			20		20		20	
TUBE LENGTH (in.)	26.1		34.0			37.9		45.8		53.7	
NUMBER OF CIRCUITS	4	6	4	8	16	10	20	10	20	10	20
NUMBER OF TXVs	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF CIRCUITS/TXV*	2	3	2	4	8	5	10	5	10	5	10
SUCTION CONNECTIONS (in. OD)	7/8	1 1/8	7/8	1 1/8	1 3/8	1 1/8	1 3/8	1 1/8	1 3/8	1 1/8	1 3/8
DISTRIBUTOR CONNECTIONS (in. OD)	7/8	7/8	7/8	7/8	1 1/8	7/8	7/8	7/8	7/8	7/8	7/8
4-ROW COIL											
Circuit Equivalent Length (ft)	52	26	62	32	—	34	18	40	20	45	23
Distributor Tube Length (in.)											
Face Split	11	11	11	11	—	11	18	11	18	11	18
Row Split	11	11	11	15	—	16	18	16	18	16	18
Distributor Nozzle Size†	1 1/2	1 1/2	2 1/2	2 1/2	—	4	4	5	5	5	5
6-ROW COIL											
Circuit Equivalent Length (ft)	58	39	—	47	24	51	26	59	30	67	34
Distributor Tube Length (in.)											
Face Split	11 1/2	11 1/2	—	11 1/2	11 1/2	11 1/2	13	11 1/2	13	11 1/2	13
Row Split	11 1/2	13	—	15	16	16	18 1/2	16	18 1/2	16	18 1/2
Distributor Nozzle Size†	1 1/2	1 1/2	—	2 1/2	3	4	4	5	5	5	5
8-ROW COIL††											
Circuit Equivalent Length (ft)	—	52	—	63	32	68	34	78	39	89	45
Distributor Tube Length (in.)											
Face Split	—	11 1/2	—	11 1/2	11 1/2	11 1/2	13	11 1/2	13	11 1/2	13
Row Split	—	13	—	15	16	16	18 1/2	16	18 1/2	16	18 1/2
Distributor Nozzle Size†	—	1 1/2	—	2 1/2	3	4	4	5	5	5	5

SMALL FACE AREA (39LB, 39LC, 39LF) (cont)

UNIT SIZE	15		18		21		25		
CIRCUITING TYPE	Half	Full	Half	Full	Half	Full	Half	Full	Double
CFM AT 550 FPM	6666		7689		9405		11,275		
FACE AREA (sq ft)	12.12		13.98		17.1		20.5		
TUBE FACE	26		30		30		36		
TUBE LENGTH (in.)	53.7		53.7		65.5		65.5		
NUMBER OF CIRCUITS	16	26	15	30	15	30	18	36	72
NUMBER OF TXVs	2	4**	2	4**	2	4**	2	4**	4**
NUMBER OF CIRCUITS/TXVX*	6-7	6-7	7-8	7-8	7-8	7-8	9	9	18
SUCTION CONNECTIONS (in. OD)	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8
DISTRIBUTOR CONNECTIONS (in. OD)	7/8	7/8	7/8-1 1/8	7/8-1 1/8	7/8-1 1/8	7/8-1 1/8	1 1/8	1 1/8	1 3/8
4-ROW COIL									
Circuit Equivalent Length (ft)	45	23	45	23	54	26	54	26	—
Distributor Tube Length (in.)									
Face Split	13	16	13	16	13/15	16	16	15	—
Row Split	21	16	23	16	23 1/2	16	26	15	—
Distributor Nozzle Size†	6	3	8	4	8	4	8	4	—
6-ROW COIL									
Circuit Equivalent Length (ft)	67	34	67	34	81	40	—	40	—
Distributor Tube Length (in.)									
Face Split	13	16	13	16	13/15	16	—	16 3/4	—
Row Split	21	16	23 1/2	16	23 1/2	16	—	16 3/4	—
Distributor Nozzle Size†	6	3	8	4	8	4	—	4	—
8-ROW COIL††									
Circuit Equivalent Length (ft)	89	45	89	45	—	54	—	54	26
Distributor Tube Length (in.)									
Face Split	13	16	15	16	—	16	—	16 3/4	16
Row Split	21	16	23 1/2	16	—	16	—	16 3/4	16
Distributor Nozzle Size†	6	3	8	4	—	4	—	4	8

LEGEND

TXV — Thermostatic Expansion Valve

*Where each TXV has the same number of circuits, that number is shown once. When coil has an uneven number of circuits per TXV, both values are shown.

†Factory-supplied distributors have factory-selected nozzle sizes shown. If necessary, replace factory-supplied nozzles with field-supplied and installed nozzles. Consult ***AHU*Builder®** program for correct nozzle selection.

**May be field manifolded for either face split or row split.

††Not available on 39LB units.

HOT WATER COIL CIRCUITING

39L UNIT SIZE		03	06	08	10	12	15	18	21	25
		No. of Circuits								
1-ROW	H	6	8	10	10	10	13	15	15	18
2-ROW	H	6	8	10	10	10	13	15	15	18
	F	12	16	20	20	20	26	30	30	36

LEGEND

F — Full Circuit
H — Half Circuit

NOTE: All hot water coils have $1^1/_2$-in. MPT.

COIL VOLUME (gal. water)

39L UNIT SIZE	03	06	08	10	12	15	18	21	25
CHILLED WATER									
Large Face Area									
4-Row	2.5	3.5	4.5	5.2	5.6	7.3	8.5	10.4	12.0
6-Row	3.2	4.7	6.0	6.8	7.7	10.1	11.7	14.2	16.3
Small Face Area									
4-Row	2.1	3.3	3.9	4.1	5.1	6.3	7.3	8.7	9.8
6-Row	2.4	3.7	5.1	5.9	6.6	8.3	9.5	11.8	13.5
8-Row*	2.7	4.1	6.4	7.4	8.4	10.7	12.1	14.7	17.2
HOT WATER									
1-Row	0.5	0.8	1.0	1.3	1.5	1.8	2.1	2.5	2.9
2-Row	0.7	1.3	1.6	2.0	2.4	2.9	3.4	4.0	4.8

*Not available for 39LA,LB, or LD units.

OPERATING CHARGE

39L UNIT SIZE		03	06	08	10	12	15	18	21	25
→ **REFRIGERANT**		R-22 or R-410A (lb)								
ROW	**4**	1-2	2-3	3-4	4-5	4-5	5- 6	6- 7	6- 8	6- 9
	6	1-2	2-4	5-6	5-6	6-8	8-10	9-11	11-13	11-16
	8*	2-3	3-5	5-6	5-7	7-9	10-12	12-14	13-19	16-24

*Not available for 39LA,LB, or LD units.

FILTER DATA

39L UNIT SIZE	03	06	08	10	12	15	18	21	25
Angle Filter Qty…Size (in.)	2…16x25	4…16x20	2…16x20 2…16x25	4…16x25	6…16x20	9…16x20	12…16x20	4…16x20 8…16x25	4…16x20 8…16x25
Nominal Face Area (sq ft)	5.56	8.89	10.00	11.11	13.33	20.00	26.67	31.11	31.11
Filter Mixing Box Qty…Size (in.)	2…16x25	4…16x20	2…16x20 2…16x25	4…16x25	6…16x20	9…16x20	9…16x20	3…16x20 6…16x25	4…16x20 8…16x25
Nominal Face Area (sq ft)	5.56	8.89	10.00	11.11	13.33	20.00	20.00	23.33	31.11
Flat Filter Qty…Size (in.)	2…16x16	2…20x20	2…20x25	2…16x25 1…20x25	3…20x25	6…16x20	3…16x20 3…20x20	3…20x25 3…16x25	2…16x20 2…20x20 2…20x25 2…16x25
Nominal Face Area (sq ft)	3.56	5.56	6.94	9.03	10.42	13.33	15.00	18.75	22.50

Guide specifications

Central Station Air-Handling Unit

HVAC Guide Specifications — Section 15860

Size Range: **1,800 to 15,000 Nominal Cfm**
Carrier Model Number: **39LA,LB,LC,LD,LF,LG,LH**

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. Indoor mounted central station air-handling unit designed to provide air to a conditioned space as required to meet specified performance requirements for ventilation, heating, cooling, filtration and distribution. Unit shall be assembled for draw-thru application and shall be arranged to discharge conditioned air horizontally or vertically as shown on the contract drawings.

B. Unit with a direct-expansion cooling coil shall have the capability to be used in a refrigerant circuit in conjunction with air-cooled condensing units.

1.02 QUALITY ASSURANCE

A. Unit performance shall be rated in accordance with AHRI (Air-Conditioning, Heating and Refrigeration Institute) Standard 430 for Central Station Air-Handling Units and subject to verification of rating accuracy by AHRI-sponsored, third party testing.

B. Coils shall be certified in accordance with AHRI Standard 410, latest edition.

C. Direct expansion coils shall be designed and tested in accordance with ANSI/ASHRAE (American National Standard Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers) 15 Safety Code for Mechanical Refrigeration.

D. Insulation and insulation adhesive shall comply with NFPA (National Fire Protection Association) 90A requirements for flame spread and smoke generation.

E. The management system governing the manufacture of this product is ISO 9001:2008 certified.

F. Unit shall be constructed in accordance with ETL and CSA (Canadian Standards Association) standards and shall carry the ETL and CSA labels.

1.03 DELIVERY, STORAGE AND HANDLING

Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

Part 2 — Products

2.01 EQUIPMENT

A. General:

Unit shall be a factory-assembled, single-piece central station air handler. Unit may consist of a fan and coil section with factory-installed chilled water or direct expansion coil, preheat or reheat coil, heating coil section, filter section, mixing box or combination filter/mixing box, or access section as indicated on the equipment schedules. Unit base rail shall be 14 gage galvanized steel.

B. Unit Cabinet:

1. Unit panels shall be constructed of 20 gage galvanized steel. Casing panels shall be removable for easy access to the unit. All panels shall be gasketed to ensure a tight seal.
2. Optional double wall construction shall be available with inner panels constructed of 20 gage steel.
3. Hinged access doors shall be double wall with 1.5 lb dual-density fiberglass between galvanized steel panels.
4. Insulation for casing panels on unit shall be 1-in. minimum thickness dual-density fiberglass insulation with a nominal density of not less than 1.5 lb per cubic foot.
5. Insulation shall be secured to casing with waterproof adhesive.
6. Condensate drain pans shall be sloped to prevent standing water and constructed of stainless steel; they shall have double wall construction with threaded drain connection.

C. Fan Section:

1. Fan sections shall be constructed of galvanized steel and shall have a formed channel base for integral mounting of fan, motor, and casing panels. Fan scroll, wheel, shaft, and bearings are to be rigidly secured to the base unit.
2. Each unit shall have a single fan wheel and scroll. Fans shall be double width, double inlet type, with forward-curved blades. Wheels shall be bonderized steel with baked enamel, or galvanized steel.
3. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed, and shall be statically and dynamically balanced as an assembly.
4. Fan shafts shall be solid steel, turned, ground and polished.
5. Fan bearings shall be self-aligning, pillow-block regreasable ball type selected for an average life of 200,000 hours at design operation conditions, per ANSI Code B3.15.
6. Fan motor shall be mounted within the fan section casing on slide rails having 2 adjusting screws. Motor shall be NEMA (National Electrical Manufacturing Association) Design B with sizes and electrical characteristics as shown on the equipment schedule.
7. Fan drive shall be designed for a 1.5 service factor and shall be factory mounted and aligned. Belt drive shall be variable or fixed-pitch type.

D. Coil Sections:

1. All coils shall have mill galvanized casings. Coils shall be factory leak tested at 450 psig air pressure.
2. Chilled water coils shall have aluminum plate fins with belled collars bonded to $^1/_2$-in. minimum OD copper tubes by mechanical expansion. Coils shall have galvanized steel casings and copper headers with threaded steel pipe connections. Working pressure shall be 300 psig at 200 F. Coils shall be drainable and have non-trapping circuits. No turbulence-promoting devices will be permitted inside the tubes. Headers shall have drain and vent connections.
3. Direct-expansion coils shall have aluminum plate fins with belled collars bonded to $^1/_2$-in. OD copper tubes by mechanical expansion. Coils shall be provided with pressure-type brass distributors with solder-type connections and shall have a minimum of 2 distributors. Coils for full face active or face-split operation shall have intertwined circuits for equal loading on each circuit. Suction and discharge connections shall be on the same end. Coils shall be designed and tested in accordance with ANSI/ASHRAE 15.
4. Hot water coils shall have aluminum plate fins with belled collars bonded to copper tubes by mechanical expansion. Coils shall have galvanized steel casings and copper headers with threaded steel pipe connections. Working pressure shall be 175 psig at 400 F. Headers shall have drain and vent connections.
5. Steam distributing coils (non-freeze type) shall have aluminum plate fins with an outer copper tube diameter of 1-in. with a $^5/_8$-in. diameter inner distributing tube, galvanized steel casings, and steel headers. Working pressure shall be 175 psig at 400 F.
6. Electric heat coils for use in large air-handling units shall be open wire type, 80% nickel, 20% chromium resistance coils, insulated by floating steatite bushings and supported in a galvanized steel frame. Bushings shall be recessed into embossed openings and stacked into supporting brackets spaced on not more than 4-in. centers. Thermal cutouts for primary and secondary overtemperature protection shall be provided to meet UL (Underwriters Laboratories) and NEC (National Electrical Code) requirements. Maximum element heating density shall be 55 watts/sq inch.

   An integral control box shall be furnished by the manufacturer. It shall contain thermal cutouts, primary and secondary control, sub-circuit fusing, airflow switch, and fused control transformer.

E. Filter Sections:

1. Each filter section shall be designed and constructed to house the specific type of filter specified on the equipment schedule.
2. Flat filter sections shall accept filters of standard sizes. Sections shall include side access slide rails and hinged door access. Flat filter section shall be arranged with minimum depth in direction of airflow.
3. Angle filter section shall accept 2-in. filters arranged in horizontal V formation. Double-walled hinged doors shall be provided.

F. Damper Sections:

1. Mixing boxes and filter mixing boxes shall have parallel blade, interconnecting outside-air and return-air dampers. Damper blades shall have parallel bends for stiffness and shall be welded to $^1/_2$-in. diameter steel rods rotating in nylon bushings and mounted in rigid galvanized steel frames. Dampers shall be sectionalized to limit blade width to no more than 50-in. to minimize blade warpage and to ensure tight closure. All mixing boxes and filter mixing boxes shall have double-walled hinged access doors.
2. All dampers for mixing boxes and filter mixing boxes shall be rated as low-leakage dampers, having a leakage rate not to exceed 2% of air quantity calculated at 2000 fpm velocity through damper and 4.0-in. wg pressure difference. Damper blades shall be gasketed and perimeter sealing strips shall be provided.

G. Access Sections:

1. Access sections shall be installed where indicated on the drawings and shall be as specified on the equipment schedule.
2. Access sections shall have double-walled hinged doors.

H. Special Features:

The following unit options shall be available.

1. Coil Section:
   a. Chilled water coil with copper plate fins or e-coated fins and stainless steel casing.
   b. Direct-expansion coil with copper plate fins or e-coated fins and stainless steel casing.
   c. Hot water (U-bend) coil with copper plate fins or e-coated fins and stainless steel casing.
   d. Steam distributing coil with copper fins or e-coated fins.

I. Electrical Accessories:

1. Starters:

   Factory-supplied disconnects shall be covered under a 1 year limited warranty from the manufacturer from the date of shipment.

a. Starter without disconnect:
   1) Adjustable motor overload with trip indication.
   2) Manual overload reset button (accessible without opening enclosure).
   3) 115-v fused secondary control transformer (fuse included — fused primary and secondary over 50 amps).
   4) Hand/Off/Auto selector switch (accessible without opening enclosure).
   5) Separate 4-position terminal strip for remote H-O-A wiring.
   6) C series contactors.
   7) Horsepower rated for motor applications.
   8) NEMA 4X type non-metallic enclosures.
   9) Lug connections for field wiring.
   10) Factory mounted, wired, and run tested with factory-supplied motor.
   11) UL listed.

b. Combination Starter/Disconnect:
   1) Non-fused UL 508 disconnect switch with lockable handle (locks not provided).
   2) Cover interlock.
   3) Adjustable motor overload with trip indication.
   4) Manual overload reset button (accessible without opening enclosure).
   5) 115-v fused secondary control transformer (fuse included — fused primary and secondary over 50 amps).
   6) Hand/Off/Auto selector switch (accessible without opening enclosure).
   7) Separate 4-position terminal strip for remote H-O-A wiring.
   8) C series contactors.
   9) Horsepower rated for motor applications.
   10) NEMA 4X type non-metallic enclosures.
   11) Lug connections for field power wiring.
   12) Factory mounted, wired, and run tested with factory-supplied motor.
   13) UL listed.

J. Variable Frequency Drives:
   1. Factory-mounted variable frequency drives (VFDs) shall be wired to factory-supplied motors.
   2. Factory-supplied VFDs are programmed and started up from the factory and qualify the VFD, through ABB, for a 24-month warranty from date of commissioning or 30 months from date of sale, whichever occurs first.
   3. The VFD parameters are programmed into the controller and removable keypad. In the event that the VFD fails and needs replacement, the program can then be uploaded to the replacement VFD via the original keypad.
   4. The VFD package as specified herein shall be enclosed in a UL Listed type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO 9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and –35% nominal voltage as a minimum.
      a. Environmental operating conditions: VFDs shall be capable of continuous operation at –15 to 40 C (5 to 104 F) ambient temperature with no frost allowed as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFDs that can only operate at 40 C intermittently (average during a 24-hour period) and therefore must be oversized. VFDs shall be capable of operating at altitude 0 to 3300 ft above sea level and less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
      b. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFDs without these ratings are not acceptable. Type 1 enclosures with only NEMA ratings are not acceptable (must be UL Type 1).
   5. All VFDs shall have the following standard features:
      a. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
      b. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
      c. There shall be a built-in timeclock in the VFD keypad. The clock shall have a battery back-up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID (proportinal integral derivative loop) parameter sets and output Form-C relays. The VFD shall have a digital input that allows an

override to the timeclock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

d. The VFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

e. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.

f. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

g. The VFD shall have the ability to automatically restart after an overcurrent, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

h. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

i. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

j. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFDs with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.

k. The VFD shall include a coordinated AC transient surge protection system consisting of 4 to 120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

l. The VFD shall provide a programmable loss-of-load (broken belt/broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and/or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

m. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure/jam condition causing motor overload

n. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4 to 20 mA, 0 to 10V, and/or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.

o. If the input reference (4 to 20 mA or 2 to 10 V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.

p. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

6. All VFDs to have the following adjustments:

a. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.

b. Two (2) PID set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.

There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

c. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

d. Two (2) programmable analog inputs shall accept current or voltage signals.

e. Two (2) programmable analog outputs (0 to 20 mA or 4 to 20 mA). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

f. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24 VDC or 24 VAC.

g. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

h. Run permissive circuit: There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing." The safety input status shall also be transmitted over the serial communications bus.

i. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 to 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications).

j. Seven (7) programmable preset speeds.

k. Two independently adjustable accelerate and decelerate ramps with 1 to 1800 seconds adjustable time ramps.

l. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

m. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

n. The VFD shall include password protection against parameter changes.

7. The keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alphanumeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
   a. Start-up assistant
   b. Parameter assistants
   c. PID assistant
   d. Reference assistant
   e. I/O assistant
   f. Serial communications assistant
   g. Option module assistant
   h. Panel display assistant
   i. Low noise set-up assistant
   j. Maintenance assistant
   k. Troubleshooting assistant
   l. Drive optimizer assistants
8. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English

words (alpha-numeric codes are not acceptable):

a. Output Frequency
b. Motor Speed (RPM, %, or Engineering units)
c. Motor Current
d. Motor Torque
e. Motor Power (kW)
f. DC Bus Voltage
g. Output Voltage

9. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500 Hz (reverse) to 500 Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.
10. Serial Communications:
    a. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet*. [Optional protocols for LonWorks†, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.] Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e., BTL Listing for BACnet). Use of non-certified protocols is not allowed.
    b. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
        1) Data Sharing – Read Property – B.
        2) Data Sharing – Write Property – B.
        3) Device Management – Dynamic Device Binding (Who-Is; I-Am).
        4) Device Management – Dynamic Object Binding (Who-Has; I-Have).
        5) Device Management – Communication Control – B.
    c. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.
    d. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accelerate/decelerate time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC (direct digital controls) to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
    e. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass valve control, chilled water valve / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO (digital output) and AO (analog output) commands in memory in the event the serial communications connection is lost and continue controlling the process.
11. EMI/RFI filters. All VFDs shall include EMI/RFI (electromagnetic interface/radio frequency interface) filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.
12. All VFDs through 75 hp at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.
13. Operational Functions:
    a. The drive shall contain two separate acceleration/deceleration times with auto tuning for

*Sponsored by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers).
† Registered trademark of Echelon.

optimum setting (0.1 to 6000 seconds) with choice of linear, S, or C curves that shall be factory programmed to match the fan load and prevent nuisance overcurrent fault trips.

b. The drive shall be equipped with both local/remote and manual/auto keys on touchpad.

c. The drive shall be equipped with a quick setup key.

d. The drive shall contain 15 preset speeds, which can be activated from the keypad, terminal inputs, and host computer.

e. The drive shall have the capability of storable special custom user setting.

f. The drive shall restart into a rotating motor operating in either the forward or reverse direction and match that frequency.

g. The drive shall have adjustable soft stall (10% to 150%) which reduces frequency and voltage of the inverter to sustain a run in an overload situation factory programmed for each motor's characteristics.

h. The drive shall be capable of performing a time base pattern run using 4 groups of 8 patterns each using the 15 preset speed values for a maximum of 32 different patterns.

i. The drive shall have adjustable UL listed electronic overload protection (10% to 100%) factory programmed to match each motor's FLA/RLA (full load amps/rated load amps) ratings.

j. The drive shall have a custom programmable volt/hertz pattern.

14. Protective Features:

a. The drive shall be rated for 200,000 AIC (ampere interrupting capacity). The use of input fuses to achieve this rating shall not be acceptable.

b. The drive shall have external fault input.

c. The drive shall be capable of resetting faults remotely and locally.

d. The drive shall be programmable to alert the following alarms:

1) Over torque alarm.
2) Inverter overload pre-alarm.
3) Motor overload pre-alarm.
4) Braking resistor overload pre-alarm.
5) Inverter overheat pre-alarm.
6) Undercurrent alarm.
7) Overcurrent pre-alarm.
8) Communication error alarm.
9) Cumulative timer alarm.
10) Executing retry.

e. The drive shall identify and display the following faults:

1) Overcurrent during acceleration trip.
2) Overcurrent during deceleration trip.
3) Overcurrent during normal run trip.
4) Overcurrent on the DC Bus during acceleration trip.
5) Overcurrent on the DC Bus during deceleration trip.
6) Overcurrent on the DC Bus during normal run trip.
7) Load end overcurrent trip detected at start-up (output terminals, motor wiring, etc.).
8) U-phase short circuit trip detected at start-up.
9) V-phase short circuit trip detected at start-up.
10) W-phase short circuit trip detected at start-up.
11) Overvoltage during acceleration trip.
12) Overvoltage during deceleration trip.
13) Overvoltage during normal (constant speed) run trip.
14) Inverter overloaded trip.
15) Motor overloaded trip.
16) Inverter overheat trip.
17) Emergency off trip message.
18) EEPROM failure during write cycle.
19) EEPROM abnormality during initial reading.
20) RAM error.
21) ROM error.
22) CPU error.
23) Communication interruption error.
24) Gate array error.
25) Output current detection circuit error.
26) Option PCB error trip.
27) Low operating current trip.
28) Main circuit under voltage trip.
29) Over torque trip.
30) Software detected earth fault trip.
31) Hardware detected earth fault trip.
32) Inverter type form mismatch error.
33) EEPROM type form mismatch error.

15. Monitor Functions:

a. The drive digital display shall be capable of displaying the following: Frequency, percent current, current amps, percent voltage I/O, voltage in volts I/O, RPM, GPM, I/O watts, torque, and input reference signal, kWh.

b. The drive shall have 320 programmable parameters which can be changed while the drive is operating.

c. The drive's 353 parameters shall be adjustable from the 8-key touchpad or computer link.

d. The drive's 8-key touchpad shall be NEMA 12 rated.

e. The drive's keypad shall be capable of being extended 15 ft from the drive.

f. The drive shall contain a reset of all parameters to factory default settings or user defaults (whichever one is chosen).

g. The drive shall have 2 programmable analog outputs programmable to 17 choices.

h. The drive shall have one programmable relay output programmable to 67 choices.

i. The drive shall have 8 programmable digital inputs programmable to 54 choices.

j. The drive shall have a pulse train output proportional to frequency (48, 96, 360 times frequency).

k. The drive shall have an elapsed time meter.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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