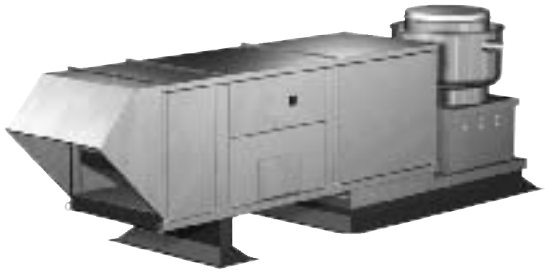
UNIT SELECTION: MAKE-UP AIR SELECTION

The purpose of make-up air, supply air, and several ways to introduce it were thoroughly discussed in an earlier section of this guide. There are several types of make-up air units (MUA) used to bring supply air into the building that will be discussed in this section.



Types of Make-Up Air

Untempered – The unit introduces outside air directly into the building without heating or cooling it. These units have a low up-front cost, use less energy to operate, and are often ideal for tempered climates that remain comfortable most of the year.

Heating

Direct Gas – The most common units, especially in the northern half of the United States, are the direct gas-fired units. These units provide outside air that is usually untempered in the summer months and heated in the fall, winter, and spring months. They have an operating efficiency of nearly 100% because the flame is directly in the airstream. Some efficiency is lost in the combustion process. A temperature sensor is set in the unit to regulate the heating cycle. Direct gas-fired units move the air directly over a burner to obtain the desired leaving air temperature. A unit that is running too slowly is likely to introduce unwanted by-products into the building airstream.

Fortunately, many manufacturers have the ability to operate their units at 70-50% of the total airflow. A modulating damper at the inlet maintains a minimum airflow velocity of 3000 fpm across the burner. It is important to verify the heat and airflow turndown with the manufacturer to prevent costly redesigns.

Indirect Gas – Similar to direct gas-fired, indirect gas-fired units also heat the air when needed or otherwise bring in untempered outdoor air during warm months. This process uses a heat exchanger which is 80% efficient. Gas is fired through a clamshell or S-tube heat exchanger. Heat is then transferred to the air as it passes over the clamshell or tubes while combustion by-products are vented to the outdoors.

Steam Coil – Air reaches its leaving temperature by flowing over steam heated radiator coils. Steam from a boiler system can be tied into a series of coils in a make-up air unit. This allows the use of steam in heating air during cold periods.

Hot Water – Hot water can be used similar to a steam coil but is uncommon in kitchen applications.

Electric Heating – Electric-heating coils can be placed in a heater control cabinet on a make-up air unit to provide heat during cooler periods of the year. However, electric heat can be costly.

Cooling

Direct Expansion – This method of cooling utilizes refrigerant gas in a cooling coil. Air is cooled as it travels across the coil. This method is commonly used with direct gas-fired and indirect gas-fired units when both heating and cooling is desired.

Evaporative Cooling – Evaporative cooling is inexpensive and works well in areas that are hot and dry. The hot, dry air is passed through a moistened media and cooled using the principle of evaporation. Heat is needed to cause evaporation, thus heat is pulled from the hot air passing over the media. This is an easy addition to any make-up air unit to provide inexpensive and efficient cooling.

Chilled Water Coil – Just the opposite of the hot water coil, chilled water runs through a set of coils cooling the air as it passes over them. An easy and relatively inexpensive option if already using chilled water cooling to condition a building.

In many cases, heating is required more often than both heating and cooling. Additionally, a building may have an air conditioning system already in place that can supply enough cool air to the kitchen during warm days eliminating the need for cooling. However, heating and cooling options can be combined into one make-up air unit. It is best to consult the manufacturer for a full list of heating and cooling options.

Selecting and Customizing

The 3 steps to selecting a base make-up air unit include:

1. Determine required tempering options. If required, decide which type of heating and/or cooling.
2. Determine required supply airflow.
3. Determine external static pressure.
4. Select the proper motor voltage for the application.

There are many different options to accessorize the unit, but the three steps above will aid in selecting the proper base model. Two of the most common accessories are filter choices and combination curbs. Different manufacturers offer a choice of filter type to be used on the inlet of the make-up air unit. Consider efficiency, cost, durability, and the ability to clean when choosing the proper filter for an application. It is usually wise to consider a combination curb if possible when selecting make-up air unit ducts. Combination curbs offer the benefit of requiring only one roof penetration for the supply and exhaust ducts. In this case, it is important to ensure enough roof space such that the inlet of the make-up air unit is able to be mounted 10 ft. from the exhaust fan outlet per NFPA 96 standards. ***Figure 47*** shows an example of a typical commercial kitchen make-up air unit given the following information.

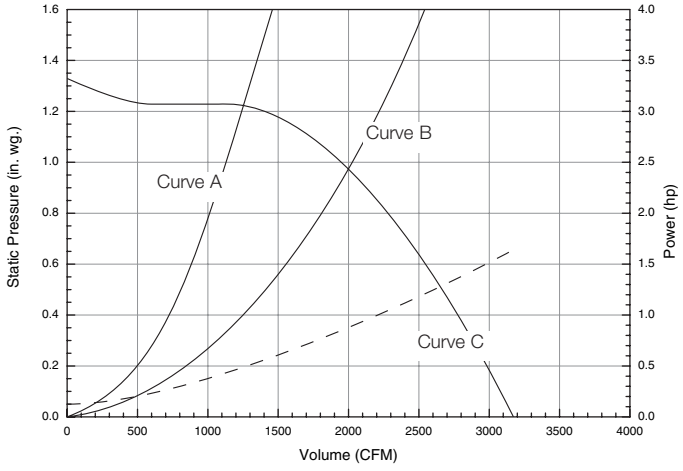
Required Specifications:

1. Direct gas-fired make-up air unit
2. 2000 cfm of airflow
3. 0.25 in. wg static pressure (external)

Make-Up Air Manufacture Data											
Model	Volume (cfm)	Ext. SP (in. wg)	Total SP (in. wg)	Fan RPM	Operating Power (hp)	Motor Size (hp)	Heat LAT (ºF)	Htg. Input (MBH)	Htg. Output (MBH)	dBA	Sones
1	2000	.25	.989	1214	.89	1	70	208.3	191.7	67	14.7
2	2000	.25	.912	786	.55	.75	70	208.3	191.7	63	11.8

Figure 47

Make-Up Air units must be selected based on the power of the motor, the fan speed, static pressure, sound level, and fan performance curves (***Figure 48***). Volume and static pressure are determined from the system and drive fan selection. Make sure the motor operating power does not exceed the motor size. Choose a fan that will be quiet (lower sones or decibels), but above all, be sure to look at the fan curves. Curve B must fall to the right of Curve A, otherwise instability will occur. Curve A represents the boundary for the fan, Curve B shows where the fan is operating given the operating conditions, and Curve C represents fan performance at a particular fan speed. Choose a fan where Curve B falls far to the right of Curve A (Model 1). Curve B for Model 2 falls too close to the fan boundary (Curve A), thus a system variation may cause the fan to become unstable. The dashed line represents fan brake horsepower. These curves differ from the exhaust fans (***Figures 48***) because a forward inclined fan wheel is used for make-up air units.



Model 1

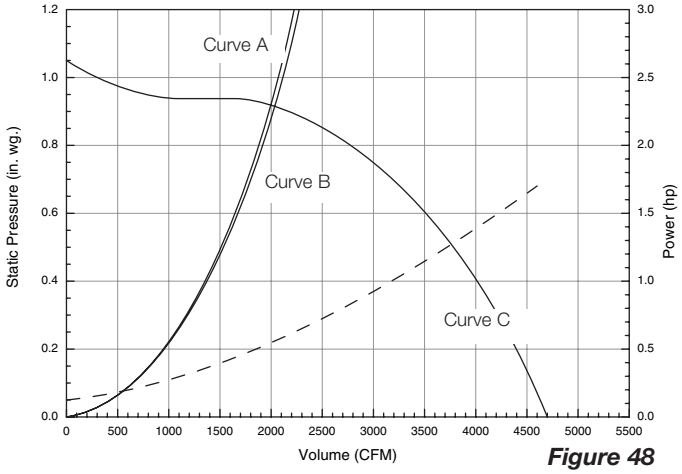


Figure 48

Model 2

Forward Curved