

Cleanroom Energy Consumption Using Envirco MAC 10 Fan-Filter Units

Energy consumption for fan systems is basically flow times the fan pressure. For Imperial units, the brake horsepower fan equation is

$$Hp = (CFM * Static Pressure)/(6356 * Fan Efficiency)$$

This yields the Horsepower required at the fan shaft to deliver the air volume at the static pressure at sea level. So, in order to have an efficient system, care must be taken to keep the system static pressure low as possible and the fan efficiency as high as possible. This is accomplished by limiting the return air static pressure loss to less than 0.1" w.g. Additionally, Envirco has designed their fan-filter unit to recover some of the fan kinetic energy as well as using deeper pleated HEPA media to lower the pressure loss through the filter.

Motor horsepower may be converted to Kilowatts by multiplying Hp times 0.746. This is now the energy rate at the fan shaft in Kilowatts. In order to convert this to incoming power that is paid for, the motor efficiency must be known. Motors for fan-filter systems are fractional, less than one Hp. Typical motors are 1/5 to 1/3 Hp for a two foot by four foot unit delivering 650 CFM. These motors are not considered high efficiency motors that are available in integral Hp units.

The typical motor used for the MAC 10 Original is a 1/5 Hp Permanent Split Capacitor AC motor. Motor efficiency runs in the range of 60% for these motors. Envirco also offers a unit, called the MAC 10 IQ, that uses the 1/3 Hp ECM motor from General Electric that is a DC motor with integral rectification. These motors operate very efficiently, even at partial loads.

As part of Gerbig Engineering's cleanroom certification procedures, kilowatt and airflow data are collected for our fan-filter projects. The electrical energy is measured at the electrical panel using a watt meter with power factor correction. This data is then converted to watts per 1000 CFM.

The instruments used for testing are the Shortridge with the Velgrid for filter flow and the electrical data is collected from our Powersight PS3000 Energy Analyzer.

Some results of our testing are shown in the table below. We will update this table from time to time.

Project	Fan Filter	Watts/1000 CFM	Project Comments
Injection Molding Class 10,000	Original	360	16 foot ceiling
Film line mfg	IQ	188	277 volt units in ceiling

