Air Circulator Applications

AIR CIRCULATOR APPLICATIONS

There are four main uses for fans which circulate air through an enclosed space at appreciable velocity.
(1) To create a curtain of high velocity air in order to prevent the movement of insects or the convective movement of air between adjoining spaces.
(2) To eliminate dead air spots within an enclosure.
(3) To cool hot materials, machinery or parts by moving cooler air across their surfaces.
(4) TO COOL PEOPLE. This is by far the most common use for air circulating fans.

In the effective cooling of people, air movement utilizes favorable phenomena in human physiology. Human bodies have a built-in temperature regulation system. Their metabolism produces body heat. In order to maintain thermal equilibrium, the body must lose heat at exactly the same rate as its metabolism produces it.

The body rejects excess heat by evaporation, convection and radiation, all of which are affected by environment. Only the first two can be assisted by circulating fans. FANS WILL NOT MATERIALLY AFFECT BODY HEAT LOSS OR GAIN RESULTING FROM RADIATION. A man working near a red hot furnace can better be protected by installation of a shiny aluminum shield between his position and the infra-red source.

Fans will help the body lose heat by convection provided the temperature of the air is lower than the surface temperature of the skin. The convective loss is limited by the temperature differential as well as by human perception, about which more will be said later.

Of substantial benefit is the assistance fans give to body heat losses by evaporation. It is, in effect, air conditioning. When perspiration changes from the solid to the gaseous state for any reason, heat is absorbed by the vapor. If perspiration can be induced to evaporate at a faster rate, more heat is removed. This phenomena is called Evaporative Cooling.

Any movement of air across a sweating surface increases cooling. The higher the velocity of air movement, the higher the rate of comfort cooling up to the limits of human tolerance.

As a broad rule of thumb, general ventilation fans are primarily an aid to convective heat losses. Air circulators help where it means the most – when the temperature is high - by accelerating evaporative cooling.

Air circulators are subject to the human perceptions previously mentioned. Actual tests with many individuals show that most people are subject to these:
(1) They are slightly cool at 72° F, up to almost 90% relative humidity.
(2) They are comfortable at 77° F., up to about 70% relative humidity, and slightly warm at a higher humidity.
(3) They are slightly warm at 82° F. at relative humidity 50% or lower, and warmer at a higher humidity.
(4) They are definitely warm, often uncomfortably so, at 87° F. at 30% to 40% relative humidity, increasingly warm and uncomfortable as humidity rises above 40%.

Here, then, are the environmental conditions where air circulators will be beneficial. When humidity rises over 50% or temperature over 80° F., fans will usually be welcome, but this doesn't end people's perceptions.

(5) They usually cannot feel air movement of 30 FPM velocity or less.
(6) They usually do not like a CONTINUOUS breeze in excess of about 100 FPM, but do not mind an intermittent breeze of 200 FPM or more.
(7) They usually do not like a breeze of less than 80° F. temperature. They refer to lower temperature breezes as a "draft".
(8) Finally, at very hot or humid conditions, all perceptions are off, and almost any air velocity above 200 FPM at almost any temperature up to ambient will make them feel better - or at least think they do.

Note that nowhere in this discussion have we mentioned cubic feet per minute (CFM). Instead the word has been VELOCITY or FPM. It is a fact that 10,000 CFM at 25 FPM will accomplish less cooling of a person in a hot environment than 1,000 CFM at 100 FPM. It is the velocity distribution pattern of an air circulator that is important, not its CFM rating (with or without the "induced air" effect).