



Johnson Air Rotation[®] Systems

Heating With Air Rotation[®]

The Air Rotation[®] System uses a high volume, low-velocity, air-circulation system to distribute conditioned air to a large open space. We say “conditioned” air because the air in the space may be heated, cooled, humidified, dehumidified, or supplemented with outside, fresh air as required by the dictates of the space and the activities in the space.

While we initially describe the heating system (which was how the Air Rotation[®] concept began), it has been further refined to include all the functions of a total conditioning system, including general ventilation. The cooling function is described in another section.

The general concept of Air Rotation[®] is to return all the air in the space to an Air Rotation[®] unit a sufficient number of times per hour to ensure an even distribution of the conditioned air. This concept will provide for an even temperature distribution of the conditioned air product. Throughout the building, the temperature typically will not vary by more than $\pm 2^{\circ}\text{F}$ from set point and more frequently will only vary by $\pm 1^{\circ}\text{F}$. The measured temperature variation throughout the building height will typically indicate a maximum 2-degree temperature rise for every 10 feet of elevation increase.

The Air Rotation[®] unit is designed to pull the return air to be conditioned into an Air Mover Module at floor level by means of a continuously running circulating fan system. The Air Mover Module has a building thermostat that measures return air temperature. When the thermostat detects the requirement to add building heat, for example, the heat module directly above the Air Mover Module will function to heat the air. The air-heating device is an indirect-fired stainless steel heat exchanger with a gas burner; but may also be a steam coil, hot water coil, etc. Dual heat sources within the same unit are also very practical and allow the end user to enter into favorable interruptible gas service contract with the utility. The discharge air is passed on to an air outlet where it is directed into the space, typically near the ceiling. The heated air is a low temperature-rise product, generally only 20°F above the thermostat set point. This low temperature air, when delivered to the space, will mix better with the existing ambient air and will not stratify as easily as if it were delivered at a high temperature-rise.

Many other heat delivery systems use a high temperature rise to deliver air with a temperature 70 or 80 degrees or higher than the space temperature and with a volume (CFM) of less than one fourth of the capacity of the Air Rotation[®] system. Further, as soon as the thermostat is satisfied, the air delivery ceases. All of these factors encourage air stratification as the warmer (lighter) more buoyant air takes off for the ceiling. Some of these heating systems can do a credible job in a low ceiling, or in an irregular shape building such as a “C” shape, whereby using positive pressure

they can push the air toward leakage areas and obtain a pseudo distribution. However, as buildings become tighter, and as building construction techniques have improved, and there is less building leakage, the effectiveness of these other systems is diminished; or conversely, as many doors are opened (as in the case of many warehouses, distribution and manufacturing buildings), the building positive pressure will drop, and all conditioned air will exit the door openings with no real conditioning occurring in the quiescent areas of the building.

With other competitive equipment, the majority of space thermostats are located five foot off the floor at the personnel working level. In response to the thermostat, the heating system responds to deliver a comfortable product to the personnel at floor level, all the while it is heating from the top down because of the stratification effect. This top down heating wastes heating fuel. Some of these systems also use poor control systems to compound the problem. For example, four thermostats that are positioned in a large open space may be wired to temperature average the space. If they are all set at 65 degrees and their readings are 60, 60, 70 and 70 giving a net average of 65; but the temperature difference will be 10 degrees between the highest and lowest readings.

The Air Rotation[®] System avoids the problems described for these other competitive systems by its continuous circulation of a high volume low ΔT heated air. The Air Rotation[®] System does not need a temperature averaging system described above, as it is bringing the building back to the Air Rotation[®] unit. It is a physical averaging system that circulates all the air in the building to the unit several cycles every hour. The Air Rotation[®] heat source runs when the return air thermostat senses the temperature drop below set point. In a manufacturing operation with heat gain, the Air Rotation[®] unit will capture the heat gain and disrupt stratification, thus using less heating fuel. Other methods of heating without continuous air circulation don't have the ability to capture any heat gain from the conditioned space. Examples of heat gain sources include people, machinery, and the lighting load. Warm air rises and the area under the roof is usually the greatest heat loss in any building. Warm air will only rise and stratify when there is no impetus to cause it to move to a lower level. When there is no fan to effect air movement, air will immediately begin to stratify according to temperature and the laws of physics. Think of the warm air discharged near the ceiling from the Air Rotation[®] unit as being slightly positive with respect to the floor level, while the air in the lower portion of the building is slightly negative with respect to the upper level as it is being pulled toward the Air Rotation[®] unit. If you pull the rug out from under the upper level air, it has to come down. This is the entire principle of Air Rotation[®]. We use many schemes of fan utilization including Variable Frequency Drives to modulate the Air Rotation[®] scheme. The trade-off between fan electrical consumption vs. fuel savings is always favorable to the end user; but the bottom line is, "No Fan – No Rotation" and no fuel (energy) savings.

Our Air Rotation[®] units are generally designed to throw, or project air up to 400 feet from the heat source. We provide our units with a custom-designed air outlet for each space that can directionally project the conditioned air out over the tops of storage racks, etc., where it gently drops down into rack aisles and these aisles then become our invisible return air ducts. For this reason it is necessary to have a certain minimum height for the

Air Rotation[®] principle to work properly. If the building is less than 12 feet in height or has a poor height to width and length ratio, the Air Rotation[®] unit cannot physically be built high enough to project the air away from the unit and it will “short cycle” and not condition the building properly. The Air Rotation[®] concept is the best choice for a high ceiling, large, cubic-content building.