

DIMMER CABINET COOLING METHODS

Issues related to the use of fan cooled dimmer cabinets versus natural convection cooled cabinets have been a topic of interest to the specification community for several years. Lithonia Controls manufactures both forced air and natural convection cooled cabinets for architectural applications, and has employed both cooling methods successfully for several years. Having both methods of cooling in our product lines offers us the ability to use each method of cooling when appropriate.

FAILURE MECHANISMS AND RESULTS

Convection Cooled Cabinets

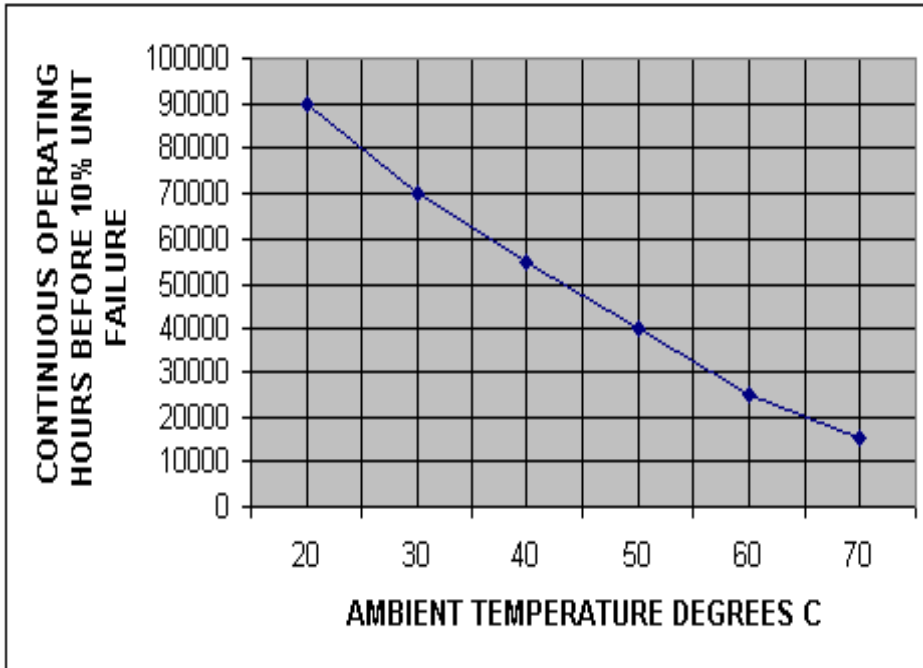
The failure mechanism most often found in properly designed natural convection cooled cabinets involves blockage of the air grills or ducts which allow the air to flow in to, or out of the dimmer cabinet. This blockage is most often a result of the owner storing material in front of the cabinets. To safeguard this type of installation Lithonia supplies convection cooled cabinets with either front mounted heat sinks (no air flow channel blockages are possible) or with individual module thermal cut-out devices which will cycle off and on pairs of dimmers until the obstruction is removed. It is important to note that the cycling of the dimmers is not done on a cabinet basis, but on pairs of circuits. This practically insures that any area with more than two circuits will not be left in total darkness. (Emergency lighting will not turn on unless there is a loss of normal power.)

Not all manufacturers of convection cooled dimmer cabinets provide these important safeguards. Some manufacturers of convection cooled cabinets provide thermal shutoff of the entire cabinet, leaving the area in total darkness if a cooling problem exists. Other manufacturers of convection cooled cabinets provide no safeguards for over-temperature conditions. For those reasons, Lithonia feels that specifications for convection cooled cabinets should include requirements for either front mounted heat sinks, or requirements for individual module thermal cut out devices.

A second failure mechanism, though less catastrophic than the above issue, involves the accumulation of dust and debris in the cooling channel, caused by the continual flow of air through the dimmer cabinet chassis. This accumulation will cause component temperatures to rise above those in a clean cabinet, and will degrade their life over the standards derived for clean, unobstructed cabinets. While this effect may not be large, it is a general rule in the electronics industry that each 10 degrees Celsius increase in component temperature will cause a 50% reduction in the component life. For this reason in dusty environments it might be prudent to blow the dust and dirt out of the dimmer cabinets every five to six years.

Fan Cooled Cabinets

The failure of a cooling fan is the worst case scenario for a fan cooled dimmer cabinet. For this reason, Lithonia uses highly reliable muffin style fans. The data below represents the continuous duty life of the Muffin fans at a given temperature after which 90% of the units will still be operating. It should be noted that Synergy systems are not recommended for applications with ambient temperatures above 40 degrees C without derating, and other special considerations. Additional product information on the Synergy fan is included with this Application note.



Worst Case Condition: When run in 40 Degree C ambient (104 degrees F), 90% of the fans will still be running after 55,000 hours continuous duty (21 Years operational life at 50 hours per week).

Typical Condition: When run in 25 degree C ambient (77 degrees F), 90% of the fans will still be running after 80,000 hours continuous duty (30 Years operational life at 50 hours per week).

The Synergy dimmer cabinet contains redundant cabinet thermal sensors, which operate in parallel, so that if either sensor closes both fans will operate. Each module also contains an over-temperature sensor so that in the extremely unlikely event that fan fails, the circuits will cycle on and off per module until the fans are repaired or replaced. As an assurance of safety, the Synergy dimmer cabinet passed the UL test for fan cooled dimmer cabinets. This test requires the cabinets to be connected to their maximum rated loads, and the fans be jammed in the locked rotor position. The submitted Synergy cabinet has passed this test even under overload conditions. Finally, Lithonia uses thermal-magnetic breakers which will trip should the cabinet go into an extreme over-temperature condition caused in the highly unlikely event that both fans, both thermal sensors, and most or all module over-temperature sensors fail.

Not all manufacturers of fan cooled dimmer cabinets provide these important safeguards. Some manufacturers provide thermal shutoff for the entire cabinet, leaving the area in total darkness if a cooling problem exists. Others only provide magnetic only breakers, or only a single fan, or only a single cabinet thermal sensor to control the fan. For those reasons, Lithonia feels that specifications for fan cooled cabinets should include redundancy requirements for fans and cabinet temperature sensors, should specify the use of thermal-magnetic breakers, and should require that each module be provided with an individual over-temperature sensor.

OTHER FEATURES AND BENEFITS

Convection cooled cabinets operate more quietly than fan cooled cabinets, and may be suitable for mounting in areas other than electrical closets. It should be cautioned, however, that any dimmer cabinet makes noise during operation. This noise is caused by the operation of the air gap relays if so equipped, and by the humming of the inductors. These inductors are present to limit lamp filament noise, and reduce radio

frequency interference (RFI). In our experience any fan noise, relay noise, or inductor noise will be considered objectionable when the dimmer cabinet is mounted in a user occupied space.

Noise that is created in the occupied space must be kept to a minimum, and it is for that reason, that all Lithonia architectural dimming systems are equipped with superior filtering to reduce lamp filament audible noise. The Synergy system provides 350 microsecond filtering, from 10-90% at 90 degree conduction angle at all points from 20% to full rated dimmer wattage. Achieving this superior level of filtering means that additional heat is dissipated into the dimmer cabinet enclosure. We chose in the design of the Synergy cabinet to maintain this high level of filtering even though it meant additional expense to the system due to the cost of higher quality toroidal inductors and the introduction of fans to remove the heat.

In our experience, when mounted in an electrical closet, the noise associated with the fan in a Synergy dimmer cabinet has not been viewed as being objectionable. The noise level of a Synergy fan cooled dimmer cabinet is much less than that of theatrical fan cooled cabinets. This is because we chose to design the Synergy cabinet with lower air flow fans. Lower air flow creates a quieter dimmer cabinet, and a corresponding reduction in the amount of noise present in the electrical closet. Choosing a lower volume fan meant that a fewer number of dimmers are housed within a cabinet. Fewer dimmers per cabinet meant our costs would increase, but overall we felt that the customer was better served with a quieter fan cooled cabinet.

We feel that the fan cooled Synergy dimmer cabinet strikes an excellent balance between high power density, retaining modularity for service and customization, and providing exceptional filtering to the loads. For applications where convection cooling is required, because of fan noise requirements, we offer the Maxstar line of convection cooled cabinets combining modularity, and exceptional filtering with convection cooling.