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Understanding and Applying 15/75 cd eff. Strobes

A flashing light source of a given intensity (candela effective – cd eff.) produces a certain illumination (lumens per sq. ft, lumens per square meter, or footcandles) at some distance. The level of illumination follows the inverse square law. To make matters more complex, it is not the level of illumination on a surface that we see. What we see is some amount of reflected light, called the illuminance. Because the level of illuminance reaching the eye is a function of a large number of variables, the *National Fire Alarm Code* has chosen to include prescriptive requirements rather than performance requirements.

A large test series concluded that notification of occupants in certain size spaces can be achieved using *indirect* visible signaling. The tables in the *National Fire Alarm Code* define the required nominal on-axis intensity combined with the polar distribution requirements of UL 1971 to provide sufficient polar illumination to alert occupants.

15/75 cd eff. strobes are listed under UL 1971 to be rated as a 15 cd eff. strobe. UL 1971 includes requirements for the minimum effective intensity (cd eff.) on axis as well as several angles off axis. Specifically:

UL 1971 Horizontal Dispersion for Wall Mounted Products							
Degrees Off-Axis	**% of Nominal**	**Nominal Rating – cd eff.**					
		15	**30**	**60**	**75**	**90**	**110**
		Minimum Required Effective Intensity (cd eff.)					
0	100	15.0	30.0	60.0	75.0	90.0	110.0
5-25	90	13.5	27.0	54.0	67.5	81.0	99.0
35-45	75	11.3	22.5	45.0	56.3	67.5	82.5
50	55	8.3	16.5	33.0	41.3	49.5	60.5
55	45	6.8	13.5	27.0	33.8	40.5	49.5
60	40	6.0	12.0	24.0	30.0	36.0	44.0
65	35	5.3	10.5	21.0	26.3	31.5	38.5
70	35	5.3	10.5	21.0	26.3	31.5	38.5
75	30	4.5	9.0	18.0	22.5	27.0	33.0
80	30	4.5	9.0	18.0	22.5	27.0	33.0
85	25	3.8	7.5	15.0	18.8	22.5	27.5
90	25	3.8	7.5	15.0	18.8	22.5	27.5

In addition to a required horizontal dispersion of light, there is a similar table specifying the minimum vertical dispersion at various angles. The resulting polar pattern of light distribution is not uniform, but has been tested and found to provide alerting by providing sufficient illumination of surrounding surfaces (adjacent walls, floors and desk/work surfaces) to result in *indirect* signaling. While the method of occupant notification is *indirect*, the appliance itself is safe for *direct* viewing.

The ADAAG requires strobe lights spaced so that an occupant is within 50 feet of an appliance. This equates to a spacing of 100 ft. However, the ADAAG does not specify a polar distribution of the light. Prior to the existence of UL 1971 manufacturers found that the high source intensities, such as 75 cd eff., require a lot of electrical power. Because UL formerly only measured at one location – on axis, on the plane of the appliance – the manufacturers focused their appliance's lenses to achieve maximum efficiency (see UL 1638). Unfortunately, this resulted in very little light being

distributed off-axis. The net result is that the unit is effective as an alerting tool only for much smaller spaces. How much smaller? This was determined in the test series and is reflected in the UL 1971 polar distribution table.

Example: A device listed to UL 1638 produces 75 cd eff. on axis. That same device produces only 5 cd eff. at 90 degrees and 6 cd eff. at 60 degrees. Using the above table we see that because the appliance is limited to 6 cd eff. at 60 degrees it qualifies only as a 15 cd eff. strobe under UL 1971.

The result is that many manufacturer's strobes that qualify as 75 cd eff. under UL 1638, barely qualify as 15 cd eff. strobes under UL 1971.

Since the *National Fire Alarm Code* contains requirements that work *only* with strobes listed to UL 1971, why do manufacturer continue to get listed to two different UL standards and to publish dual ratings such as the infamous 15/75 cd eff. strobe? Because in corridor configurations, the *National Fire Alarm Code* permits 15 cd eff. strobes (UL 1971) to be spaced no more than 100 ft apart while the ADAAG permits 75 cd eff. strobes (UL 1638) to be spaced no more than 100 ft apart. Thus, in corridor applications, the 15/75 cd eff. strobe meets both the *National Fire Alarm Code* AND the ADAAG. This confusion should cease soon since the ADAAG has been rewritten to reference the *National Fire Alarm Code* and is in the final stage of approval (as of June 2005). In fact, one ADAAG web site already lists the new ADAAG guidelines.

Manufacturers produce a variety of various strobe intensities listed to UL 1971. To understand and apply these strobes you need only understand and apply the following:

> A strobe light listed to UL 1971 and mounted in the center of a wall will provide sufficient illumination in a polar pattern for a square space having sides defined by the distance at which the level of illumination on-axis is 0.0375 lumens/sq. ft or greater. At least, that is what the NFPA 72 tables imply.

Using the inverse square law, you can show that a 15 cd eff. strobe on-axis produces 0.0375 lumens per sq. ft at a distance of 20 feet. Similarly, for a room whose dimension opposite the strobe is 40 feet, a 60 cd eff. strobe is required to produce 0.0375 lumens per sq. ft on-axis. This same relationship holds for all entries in the *National Fire Alarm Code* tables.

However, the *National Fire Alarm Code* also contains a performance based methodology that requires 0.0375 lumens per sq. ft at all horizontal angles – something that the tables in the code do not comply with. The reason is that the original research does not have sufficient information to determine if subjects were alerted to off-axis illumination. When the committee wanted to expand and edit the tables (1999 and 2002 editions), sufficient data was not available to conclude that the tables were wrong, therefore there was no technical justification for their removal. Although they were originally put in without sufficient documentation, they could not now be removed or expanded using he same on-axis basis. Therefore, new additions to the tables as well as the section on performance based design are based on 0.0375 lumens per sq. ft at all horizontal angles, not just on-axis.