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TECHNICAL NOTE

Title: DETERMINATION OF LED FIXTURE AS REPLACEMENT FOR METAL HALIDE. (AN OVERVIEW)

A guide for the Electrical Contractor

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The question is often asked regarding the LED equivalent to Metal Halide fittings and why a given LED fitting has substantially less lumen output but is still considered the correct match.

Without becoming overly technical, it should be noted that the efficiency of LED fittings is not measured solely in terms of luminous efficacy; it can also be measured in terms of efficient light distribution. Historically all fittings were rated on the lamp lumen output independent of the fitting/reflector and while this sufficed when comparing like for like in fittings such as Metal Halide where lamp design played a major role and reflectors were similar, the process was inadequate to describe LED lumen outputs in comparative fittings.

For example, the initial lumens for a 400W Metal Halide lamp is approximately 36,000. This is the amount of light that is produced the first time the lamp is turned on. All lamps have some form of lumen depreciation and it is therefore usual to gauge the lumen output based on its mean lumen output which is the lumen output left after a predetermined time of around 40-50% of its rated life. In the case of Metal halide this is typically 24,000 lumen

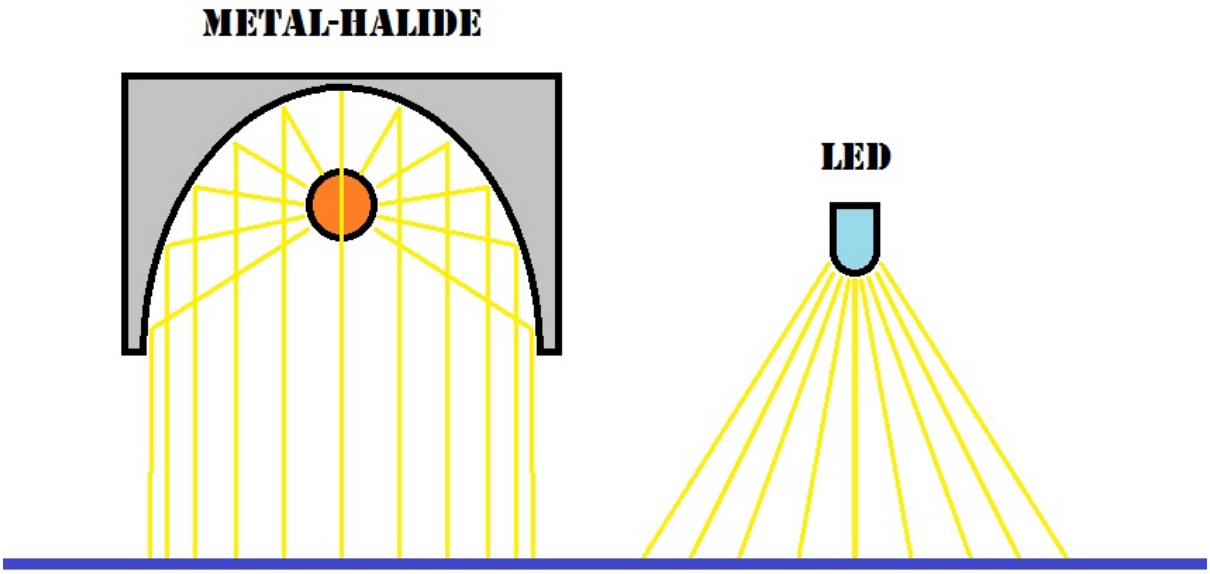
If we then look at a 400W Metal Halide LED Replacement fitting, we suggest a 150 unit with a lumen output of around 12,000 at the same rated life point. Straight away we can see a significant difference between the two. But we know from practical experience that using these LED fittings give us overwhelmingly positive results.

The answer to this revolves around fixture efficiency and delivered lumens. The efficiency of a luminaire is a comparison of the light output emitted by a fixture verses the light output of the fixtures lamp only. LED fitting lumen output is expressed in terms of “whole of fitting” while fittings with Metal Halide light sources are expressed in terms of “lamp lumen”

Traditional light fittings, especially those with directional illumination have an inherent issue, light is needed in one direction while the lamp produces omni-directional illumination. The light extends in all directions inside the fitting. To adjust the light distribution and allow more light to emit from the fitting in the desired direction, reflectors and lens are incorporated to push light forward out of the fitting rather than have a high percentage of the light trapped within.

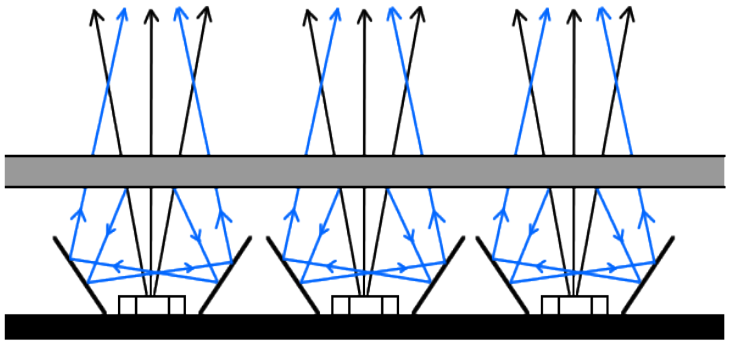
It is interesting to note that in the early days of LED design, this very aspect of light retention within a fitting was explored with LED in an effort to increase lumen output using reflector design only. The process was called light scavenging and basically allowed LED light to imping the front of a reflector and return into the depths of the fitting and then by using a multiplier or additive effect it was hoped that increased lumen output would occur as the light beam finally exited the fitting. It gave a modest improvement and was quickly discarded once LED design advanced.

Returning to traditional fittings, even with the best reflector design, these components are not 100% efficient. A significant proportion of the light becomes trapped within the fixture hampering the overall efficiency of the lighting system. In floodlights for example, it is common for efficiencies to range from 50-70%. This means that 30-50% of the lumens from a Metal halide lamp are trapped and wasted inside or adjacent to the fixture.



On the other hand, LED luminaires can offer vastly superior fixture efficiency. LEDs are a directional light source and the illumination extending from the LED is directed outside of the fixture. Additionally, the illumination can be more efficiently controlled allowing numerous distribution patterns and beam angles with minimal light loss. Fixture efficiency can be in the order of 92-95%.

This is readily apparent in the new LED UFO highbays where by using removable lens covers only, beam angles of 60/90/120 degrees are achieved and without any further fixture modifications or degradation of lumen output.



General schematic of LED chips with integral reflector demonstrating linearity of beam.

Finally, the lumen outputs tested and reported for LED fittings are the actual illumination extending from the fitting. True, the LED modules or packages are tested under LM-80, but for life expectancy where lumen output is the criteria. LM-80 is not a test of the whole fitting as this LM-80 test is done by the chip manufacturer long before fitting installation.

Fixture manufacturers/assemblers sent their fittings to certified test laboratories where the lumen output is then determined.

If we look at a chart comparing Metal Halide and LED luminaire efficacy of the two technologies, it is clear that the initial discrepancy between the two is much closer.

	400W Metal Halide	**150W LED UFO**
Mean Lumens	24,000	12,000
Luminaire Efficacy	60%	95%
Fixture Lumens	14,400	11,400

Other factors including distribution, beam angle and field efficiency should be taken into account as well. Emitting more lumens outside a fixture is not beneficial if a proportion is wasted and not placed in the intended space. Testing and data can show how efficiently lumens are being distributed and delivered within the intended area. LED fittings are able to tightly control light distribution without the same need for costly and inefficient reflectors and lens.

Laboratory testing on typical LED UFO Highbays show that over 92% of the delivered lumens were emitted within the classified NEMA spread. This concept is known as field efficiency. Field efficiency is that percentage of initial lumens from a light source that are utilized within the field angle or the degree of light to 10% of maximum intensity on either side. Field efficiency builds off the concept of luminaire efficiency. Depending on the model, Metal Halide flood fittings offer field efficiency of between 35% to 55%.

The table below shows the average delivered lumens from both Metal Halide and LED UFO fixtures.

Metal Halide Watts	Mean Lumens	Delivered Lumens	LED UFO Watts	Mean Lumens	Delivered Lumens
175W	13,000	5,850	100W	12,000	11,400
250W	17,000	7,650	150W	18,000	17,100
400W	24,000	10,800	200W	24,000	22,800
1000W	71,500	32,175	240W	28,800	27,360

This table clearly shows why end users express surprise at the increased amount of light in a space once 400W MH Highbays for example are replaced with UFO LED Highbays.

End Report