White Paper

L.J.STAR INCORPORATED

How to Spec Lighting for Sight Glass Applications

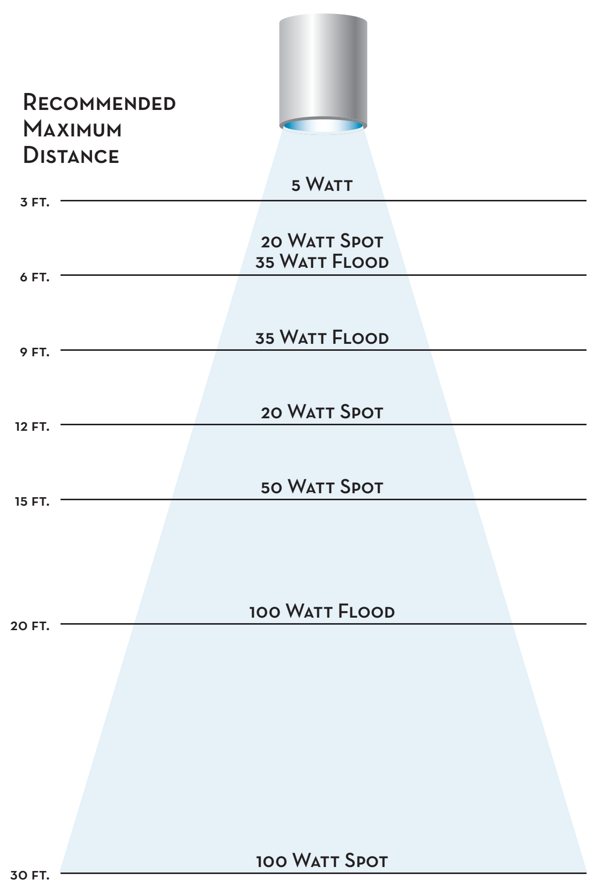
Chances are pipelines and vessels are too dark for level detection and to view important stages of a process through a sight glass. Flashlights cannot supply sufficient lighting, and may cause a glare on the sight glass, making visual inspection virtually impossible. If the view port is small, there may not even be enough room to combine viewing and lighting. Illumination may be supplied by adding lights (also called "luminaires") on sight glasses.

When deciding upon a proper light for an application, be sure to consider all of the properties of the light. The size, weight, voltage, wattage, materials of construction, mounting configuration, and light pattern are all very important factors.

How to know what wattage light the application requires

The wattage of the bulb you select should be based on the distance of the bulb from the target. The following figure shows the maximum recommended distance for bulbs of different wattages.

The brightness of a light can be measured in lumens. However, because process lighting is focused with a reflector, a better unit of measure is the foot-candle, which measures reflected light rather than direct light. The shape of the reflector and its position in relationship to the bulb affects how wide or narrow the beam will be.



Lighting options

Lights are available in many different sizes and options. If the light needs to be installed in a hazardous area, explosion proof lights are also available. If a port is too small to utilize a standard light, try a fiber optic light – it can fit even the smallest of ports. Cameras, remote electronic timers, pneumatic timers, and pushbutton switches are also available as accessories.

Mounting lights

Lights use different mounting configurations, from a "half-moon" type designed to fit a weld-on sight port to the latest sleek sanitary design where the light fits directly into a sanitary fitting for one-piece mounting right onto the ferrule. For existing sight ports, some lights are made to mount easily onto the cover flange. Often, the construction of the light interferes with the design of an existing port. Special ports require special mounting – ask your vendor to design a mounting configuration to suit your needs.

Factors of Reflected Light

Measurement of Light

Lumens is a measurement of light in all directions. This unit of measurement is best used for incandescent bulbs.

When a reflector is used, the light is reflected in one direction. As a result, lumens is not an effective measurement of reflective light. Therefore, the unit of measurement that measures light at a distance from the bulb is called candela, or more commonly referred to as foot-candles. Another effective unit of measurement of reflective light is called lux. Foot-candles can be converted to lux by the following formula:

$$\text{Foot-Candles} \div 0.0929 = \text{Lux}$$

Generally speaking, foot-candles and lux are inversely proportional to the distance squared. For example, a lux of 200 at a distance of 5 ft. from a bulb is 50 lux at a distance of 10 ft. In other words, if the distance is doubled the lux is reduced to ¼ of the original lux.

Maximizing Light Output

In order to maximize the light output using a reflector, the center of the bulb's filament must be placed at the focal point of the reflector. The intention is to have all the light directed in a parallel manner (see Figure A). There will always be some angle of light since some light will be direct (see Figure B). A typical angle of reflection for a spot configuration is 10°.

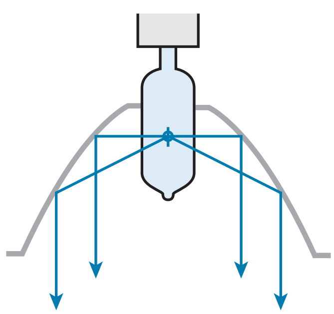


Figure A

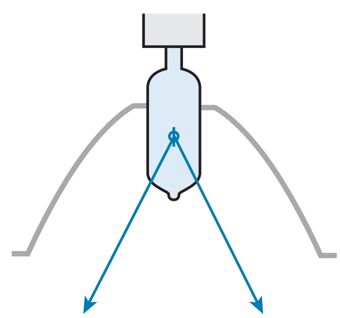


Figure B

Flood Light

It is not always desirable to have a narrow light beam or a spot light. There are three ways to accomplish this, but keep in mind that light efficiency will be compromised. The first way is to position the center of the filament further from the base of the reflector's focal point. In doing so, light is reflecting at angles other than parallel with the ends of the reflector (see Figure C). In addition, this allows for more direct light to be generated.

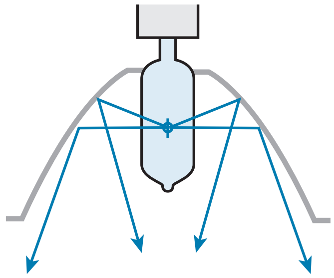


Figure C

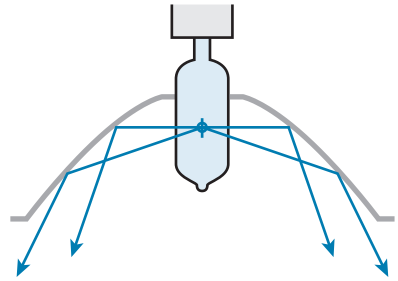


Figure D

A second method is to design the reflector at a slightly different parabolic shape so as to reflect the light at angles (see Figure D). A third way can be accomplished by a dimpled glass lens which is usually incorporated into the bulb and reflector, known as an encapsulated bulb. A common example of this is an outdoor floodlight. A typical angle of reflection for a floodlight is approximately 30–35°.

The surprising relationship of voltage to brightness

A bulb with lower voltage (say 24V) will give light more efficiently than a bulb with higher voltage, such as 120V. First we must illustrate the basic power formula:

$$\text{Voltage} \times \text{Amperage} = \text{Wattage}$$

As the voltage increases and the wattage remains the same, the amperage must be reduced. In other words, the amperage is inversely proportional to the voltage, assuming the wattage remains constant.

As a result, the higher the voltage the more resistance is needed. Therefore, a longer, thinner filament is required. A shorter, thicker filament has two benefits: First, a thicker filament can burn hotter and produces a brighter, whiter light. Second, a shorter filament produces more light at the reflector's focal point, resulting in more efficient reflections.

Light vs. Heat

A typical halogen bulb produces 15% light and 85% heat. Heat comes from the infrared light of a bulb, which cannot be seen by the naked eye.

There are three ways to reduce the IR light (or heat) from a light source. First is the use of a cool beam bulb. This type of bulb incorporates a reflector that allows IR light to pass through while reflecting the white or visible light. However, this is not 100% efficient in eliminating IR light from exiting the luminaire since some light is direct and does not pass through the reflector.

A second method of reducing IR light is to incorporate an IR mirror. This device, placed opposite the reflector, reflects the IR light back into the luminaire while allowing the visible light to pass through.

A third solution, similar to the IR mirror, is an IR filter. However, instead of reflecting the IR light, the filter absorbs it while allowing the visible light to pass through. This device is not as efficient as the above mentioned mirror. The combination of a cool beam bulb and an IR mirror is very efficient.

Lastly, LED lights are now available that do not add heat to the process. These lights have the additional advantage of extremely long life, which reduces maintenance costs.

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