Stack Light Engineering Reference Guide

By Onyx Industries Inc.

There are many uses for Stack Lights (aka: Light Towers, Tower Lights, Signal Lights, AndOn Lights, Indicator Lights, etc). This documents some simple considerations to take into account when applying Stack Lights in order to keep machines & process equipment running optimally.

Purpose of a Stack Light

First let's look at what a Stack Light does its mission is simply to get the immediate attention of an operator, technician, supervisor or other plant personnel who need to respond to a specific machine condition or event. In this way, a stack light is the first line of defense against things like down-time and intercepting mid-process manufacturing issues.

So why put a stack light on a machine if there are devices like Operator Interfaces, Panel Meters and Pilot Lights at the operator console? These devices provide information to operators while they are at the console. Operators rarely spend all of their time at the control panel. If an operator must tend to the machine away from its console or the line is very long, then a high visibility Stack Light provides immediate machine status information across a greater area, especially when integral audible alarm buzzers are included in the Stack Light. It is also possible that other plant personnel, not regularly at the equipment, will need machine status information too. This could include maintenance technicians, fork lift drivers supplying raw materials, or a production supervisor as examples.

Stack Lights find numerous uses, including Lean Manufacturings 5S Initiatives (http://www.velaction.com/lean-andon/) and other production disciplines. These directives reinforce the fundamental reason to use Stack Lights, which is to keep equipment & processes running optimally. Plants don't make money when equipment doesn't run or, worse yet, produces substandard widgets.

Functions Indicated by Stack Lights

The colors of a indicator light are typically associated with a process or machine state. While there are no hard 'rules' about what colors apply to specific machine states, the following table helps provide 'typical' functions indicated by Stack Lights:

Color	Typical Functions	Solid On Examples	Flashing Examples
Red	Any Critical Event or Machine-State Condition that can cause a shut down	Machine Down, E-Stop Activated, Out of Material, Jam Detected, Motor Overload Trip, Failed Inspection	Machine Down, E-Stop Activated, Out of Material, Jam Detected, Servo Fault, Web Break Detected
Yellow	Any Warning Condition that may not necessarily shut a machine down	Low Material, Temp out of Range, Process Nearing Time Out, Manual Bypass Active, Cycle Interrupted	Recovery from E-Stop, Process Nearing Time Out, Manual Bypass Active, Safety Muting Active, Test-in-process
Green	Most often used to indicate machine is operating normally	Machine Running, Process in Cycle, Part Passed Inspection, Automatic Mode Active	Machine Ready to Start, Initializing, Manual Mode Active
Blue	Often used to Request Service from Maintenance, a Supervisor or other Plant Floor Personnel. "Down" for non machine failure reasons	Machine Down, waiting for Service Call or Raw Materials. Out of Work Orders to Process	Waiting for Service Call or Raw Materials for extended period of time (ie, no response to condition in x period of time)
Clear (White)	User Specified Functions, often specific to the machine	At Production Rate, Batch Complete, Machine Service Interval Due, Cycle Done	Below Production Rate, Approaching Batch Setpoint, Past Machine Service Interval

Table 1: Stack Light Functional Color Reference, Onyx Industries

Again, there are no hard-fast rules about what color represents what function- it is completely up to the system designer to address machine/operator interaction requirements. Typically, a Red or Yellow condition will require operator action. Blue or White conditions may require operator action. The IEC 60073 Specification addresses machine state color coding and is available for purchase at their webstore: http://webstore.iec.ch/

The addition of a buzzer adds priority by providing audible stimulus & is effective in capturing an operators immediate attention.

The use of a PLC can allow for a 'Slow' and 'Fast' Flash Rate to indicate more conditions as well. 2Hz is a typical flash rate for normal, slow flashing. 4Hz is typical for a fast flash rate.

Selection & Installation Considerations

Selecting the appropriate Indicator Stack Light for an installation is relatively simple. A site survey of the installation area will reveal quickly where to mount a unit so it is visible to all personnel who monitor equipment. Some engineering thought can identify what the colors will represent before the units are purchased.

In many plants, the place where a unit can be visible to all personnel who need to see it might also be the place where moving components are going by- this might include bridge cranes, fork lifts, or even the "rejection trajectory" an operator might use for discarding scrap. The mounting location, therefore, becomes a balancing act. Any manufacturer's Stack Light is a modest underdog when pitted up against a loaded bridge crane.

Beyond that, the following criteria may important to your device selection:

1. **Quality**- Stack Lights come in a wide variation of quality and buyers have ample product to select from to match their specific quality/price requirements. The majority of units are made mostly of plastic, though some have Metal Shell Housings.. The components affecting quality include luminous intensity, durability, ease of use/installation and connectivity.
2. **Environment**- Consideration must be given to the installed environment, including key factors such as:
    a. Temperature/Condensation
    b. Exposure to Water and Direct Sunlight (for visibility & UV Compatibility of Polycarbonate Lenses)
    c. Excessive Vibration or Shock Loads
    d. Hazardous Environment
    e. Outdoor use, which incorporates any of the previous environmental items.
3. **Size**- In general, a larger unit is visible from longer distances. Good manufacturers make use of the additional real estate inside the illuminated segment to add more LEDs and increase the luminous intensity.
4. **Illumination Source**- There are [2] principal illumination sources-
    a. Incandescent Type Bulbs- These are typically bright, inexpensive and sometimes can work well in areas with exposure to natural sunlight. However, filaments will fail and require replacement at some point. They also are considerably less efficient typically requiring ~2-6 times more current than similar LED based units at 24Vdc. Incandescent Bulbs are not a good choice in high shock load environments, such as Stamping Presses.
    b. LEDs- LEDs provide rich color & exceptional brightness at low currents, with exceptionally long life. Major manufacturers of Stack Lights will use LEDs from high quality manufacturers like Osram or Cree. SMT (Surface Mount Technology) LEDs

perform very well in high shock load environments, and are therefore preferable to LEDs with leads.

5. **Audible Buzzer**- Most manufacturers offer integral buzzers with their products. Buzzers are usually offered in the 80-105db sound pressure rating and are most useful when they include a means of dampening the sound to fit the installation area. They should be “annoying” but not “deafening” to an operator.
6. **Appearance**- for OEMs, a little attention to the aesthetics of machine design can go a long way in showing your customers that you are attempting to produce a quality, well thought out piece of equipment. A Stack Light naturally draws attention by the nature of what it does and therefore directly affects the aesthetics of a machines appearance.
7. **Assembly**- Manufacturers provide these as either fully assembled units or as components where the user must separately specify & purchase a base, pole, buzzer & each illuminated module. Component “modular” units allow modification but the negative is they also allow disassembly or mis-assembly.
8. **Voltage & Current Demand**- Power Supplies should be able to supply enough current, with a reasonable safety margin, to power all Stack Light color segments at once, even if it is unlikely they will all be on concurrently. LED units will usually pull less current than Incandescent Units (~2-6x less), often allowing a smaller power supply to be used in a system. Typical voltages from major manufacturers of Stack Lights includes 24Vdc, 115Vac, 220Vac. 12Vdc is sometimes available too.
9. **PLC Integration**- Most of the time, Stack Light Color Segments can be driven directly by Transistor or Triac Output Points on a PLC without interface relays. Most 24Vdc Stack Lights are bi-polar (allowing sink or source control). It is advisable to check the specifications of the PLC output module before designing the system, including max output current per output module (the current per output bank common or the entire module itself). For hardwired installations, consideration should be given to circuits where the Stack Light will be installed along with inductive loads. In general, it is not best engineering practice to wire Stack Lights in parallel with Solenoids and other inductive loads since the voltage spike created by a collapsing coil must get absorbed somewhere.
10. **Wiring/Connectors**- Manufacturers offer many wiring options. Flying leads are common, but you will also find Jacketed Multi-conductor cables to Flying Leads, or Jacketed Cables with industrial Connectors (M12 being most common). Connectors are very useful with systems that require shipping, as they allow for easy dis-assembly in preparation for shipment. Wiring Installation in areas where the cabling for the Stack Light will move should use flex duty stranded cable. Some units have integrated networks, such as DeviceNet or Modbus, typically for a premium.
11. **Mounting**- Mounting can be simple. Major Manufacturers should allow mounting directly to a panel, to a wall, or to a machine frame. Manufacturers with threaded mounts can support inverted ceiling mounting since they have threaded connections (not slip fits with set screws). Common mounting arrangements include:
    a. Direct (Panel) Mount
    b. Wall Mount with a bracket
    c. Pole Mount

    Note that Inverted Ceiling Mounting should only be done using threaded connections at the base of the Stack Light and any accessory used in its installation.
12. **Accessories**- Poor Quality Accessories defeat the objective of a good installation. Mounting with Metal Poles and Bases are preferable to plastic ones for obvious reasons.

Conclusion

The dynamics of specifying Machine Indicator Lights do not approach the complexity of specifying a Motion Control System or a Robotic Work Cell. However, when misapplied, they are just as pointless as an undersized servo motor is to machine productivity. So a quick review of these concepts will help ensure successful installations.

About Onyx Industries: Onyx Industries is the manufacturer of the Command Tower Line of Industrial Indicator Products & Systems located in Hastings MN. For further information, visit our website at www.onyx-industries.com or contact Lee Clore at 651.204.0797 or lee@onyx-industries.com

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