Incandescent Lighting

MASTERY STATEMENT:

In this module you will learn how incandescent lamps work and reasons for failure.

HOW INCANDESCENT LAMPS WORK

Incandescent lamps can come in several forms, but all incorporate some type of filament, whether a standard incandescent or halogen lamp. Incandescent lamps use tungsten wire structured in a variety of shapes to produce various light outputs in order to perform different functions. For example, a basic clearance/marker lamp is a single function lamp and requires only one filament.

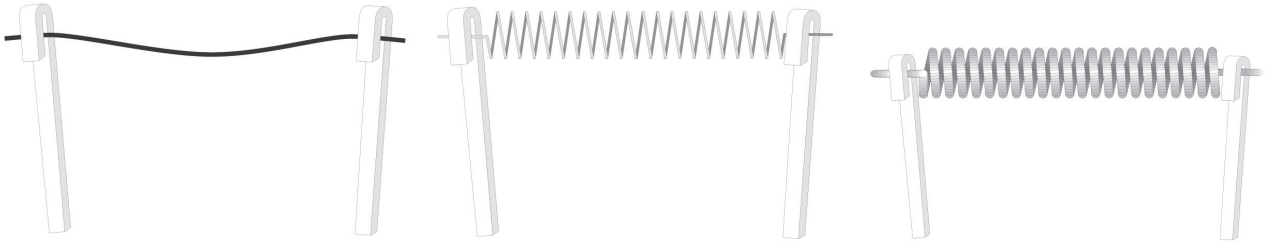
The filament is part of a light bulb's electrical circuit. As current passes through it, the filament wire heats up due to the resistance of the tungsten in the wire. When the current reaches a certain level, the filament begins to glow a dull color. Add enough current, and it will glow "white hot." Unfortunately, in order to operate, incandescent bulbs waste 95% of the energy flowing through them as heat.

If used in an atmosphere containing oxygen, the filament would quickly begin to combine with the oxygen and deteriorate, and the bulb would promptly fail. To prevent or slow the process, bulbs are filled with an inactive or inert gas that doesn't combine with the filament.

Filaments used as part of incandescent vehicle lighting are typically found in three styles. The simplest is a straight wire, a single strand that reaches directly from one support across to another.

Another style is the coiled filament, which has a conductor that is coiled and reaches across from one support to another. The coil provides a means of increasing the amount of filament surface area to produce more light, while concentrating the light. It also provides a spring-like action to help cushion the filament from vibration. The coiled filament is the most common type found in vehicle lamps.

A variation on the coiled filament is the coiled coil. With it, the filament wire is tightly coiled and then itself shaped into another coil then coiled again.



Straight Wire Filament *Coiled Wire Filament* *Coiled Coil Filament*

Key Points

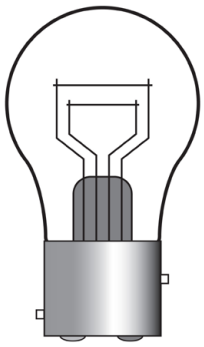
Incandescent bulbs waste 95% of the energy flowing through them as heat.

DUAL FILAMENT BULBS

A stop/tail/turn lamp is a dual function lamp and is designed to produce two levels of light output and therefore requires two different filaments within one bulb.

The light output of the filament is dictated mostly by the size of the filament, and the amount of voltage being provided to the circuit.

Each filament type is designed to function at a specific voltage to insure the longest life possible. If the voltage is too high or too low, the life of a filament bulb can be reduced by 50% or more.



Older standard incandescent bulbs were comprised of a filament encapsulated in a glass globe. The globe has multiple purposes, but its main purpose is to protect the filament and to provide for a means to produce a vacuum around the filament which increases its efficiency and life.

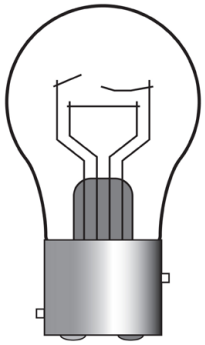
In recent years incandescent lamps have been greatly improved by advancements in the types of gases and coatings used inside the glass globe; these improvements have led to longer filament life and increases in efficiency by as much as 50%.

One other important thing to note in the dual filament bulbs: common sense tells us that the most frequent failures will be to the minor or tail lamp filament, because it is illuminated much longer than the random stop or intermittent turn function, and is more likely to be on when the equipment experiences the strongest amounts of vibration.

This same logic applies to single filament clearance/marker lamps. Many of these marker lamps are available in a two bulb lamp design so if one bulb fails a functioning bulb will still be working which reduces immediate down time. (Operators are encouraged to have replacement lamps on hand in their vehicle at all times).

While most forward lighting applications such as head lamps, have already made a complete transition to halogen-type lamps, the safety and signal lighting industry still uses many different varieties of incandescent lighting.

Remember: no matter if you are dealing with standard incandescent or halogen lamps, it is important to insure they are working at the specified voltages and conditions.



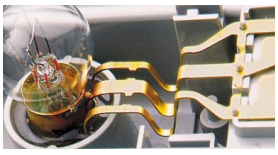
Broken or stretched filament are usually caused from shock and/ or vibration

DIAGNOSING INCANDESCENT LAMP FAILURE

There can be many reasons for an incandescent lamp to fail, but the most common are:

- VIBRATION
- CORROSION
- CONTAMINANTS
- TOO HIGH OR TOO LOW VOLTAGE

Vibration:
The most common cause of incandescent lamp failure is vibration. Every application is exposed to some vibration. Some applications encounter extreme vibration, such as the lamps on a dump truck body. When the lamps are on and the filaments are hot, the vibration caused by the slamming of the dump truck body door can be devastating to the bulbs.



In many cases, there is not a lot that can be done to eliminate vibration. The next best thing is to minimize it as much as possible. Over the years, Grote has developed three patented bulb socket designs that are second to none in reducing vibration failures in incandescent lightning. They are:

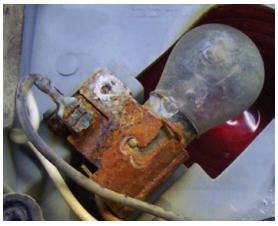
Torsion Mount I
Torsion Mount II
Torsion Mount III

While each socket has its own special cradling design characteristics, Torsion Mount® III with the Grote Gel-Mount® system provides sealed contacts and a secure mounting method to hold the lamp in place even in cases of heavy vibration. In this fixture, the lamp

socket is filled with a soft gel material that dampens vibration and helps protect the contact points from moisture and corrosion.

Also, there are no wires inside the shell of the device. Instead, a brass assembly conducts the electrical current to the bulb and acts as a cradle for it.

All three Torsion Mount options are invaluable in lengthening the life of your incandescent lamps and adding value to the original lamp cost.


Results of corrosion

Corrosion:
Corrosion has become almost an accepted part of our industry because there just doesn't seem to be any way that it can be completely prevented. Using the dielectric coating helps prevent the development of corrosion, a major cause of failure in splices and connections. The answer is to physically isolate electrical components from corrosion. When possible, try to use lamps with secure types of connections that lock onto the lamp such as Grote's male-pin or hard-shell lamp connections. To provide extra protection, it is necessary to periodically check all connections and be sure they have been treated with Grote-Ultra Seal corrosion-preventinve sealant, which is a type of dielectric coating.

Grote Ultra-Seal Dielectric corrosion-preventinve sealant is also highly recommended when installing new lamps. Wire and connections, by their very nature, are vulnerable to damage. They are subject to abrasion, cuts, breaks and disconnects. That's even truer for vehicle applications. A very important component of safe and secure connections is the use of a dielectric (non-conductive) coating. It functions primarily as a barrier to moisture and other contaminants, preventing them from reaching the connection.

When using a dielectric coating, apply it to all of the components of the splice or connection. Then finish the job by crimping or otherwise securing the connection. Use only enough to protect the actual joint. Using too much does not provide additional protection.

Protecting the wiring is an important factor in the safe operation of any vehicle. It is ideal for heavy duty, automotive, agricultural, marine, industrial and RV applications. It has an operating temperature range of -40°C (-40°F) to 150°C (302°F), prevents rust and corrosion and has added tackifiers improve adhesion and resistance to washout.

Key Points

Grote uses an advanced bulb cradle system called Torsion Mount to increase bulb life.

Contaminants:
While contaminants are a similar enemy to corrosion, they are generally introduced by man-made sources. Contaminants can come from the de-icing chemicals sprayed on highways or by harsh chemical cleaners used to wash certain pieces of equipment on such vehicles as tankers and dairy haulers. Certain chemical cleaners can cause lamps to lose their seals. This allows moisture to enter into the bulb sockets and their components and can greatly reduce the life of lamps.

Improper Voltage:
Voltage that is too high or too low can damage incandescent lamps. Low voltage is probably the most common electrical problem that occurs. This can be the result of loose ground wires, or just an overworked alternator. Adding lamps will increase resistance in the circuit which in turn results in a decrease of voltage.

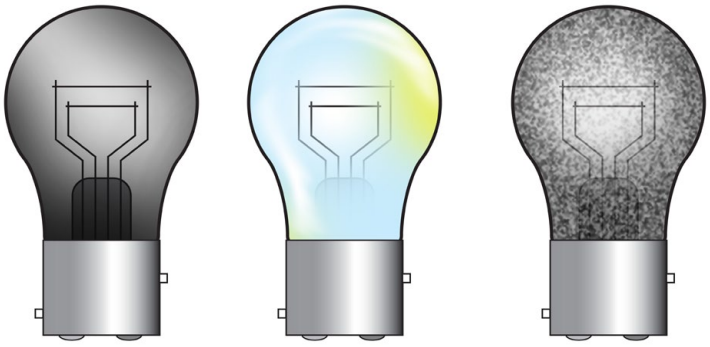
A good indicator of a low voltage problem occurs when you notice that the lamps that are farthest from the battery are failing quicker than other ones that are closer to the battery. It may become necessary to increase the wire gauge of the ground wire in your harness. High voltage can result from a bad ground wire or contact that is allowing

excessive voltage to bleed over into other lamps. This should be easily identified, because the lamp receiving the extra voltage should glow significantly brighter than the other lamps. In either case, low voltage or high voltage, the filaments deteriorate more rapidly and this results in premature failure of the lamps.

DIAGNOSIS:

Now, having discussed some of the reasons for failure, let's discuss what you can learn from an incandescent failure. In many cases, you can actually tell what made a filament type bulb fail.

1 2 3



Normal Long-Life Failure

White or Yellowish/ Bluish glaze caused by leak in the envelope

Black or sooty deposits on the envelope and melted contact towers due to over voltage or voltage spikes

1. A dark metallic appearance indicates old age. The bulb has functioned as expected. The appearance is the result of the deposits accumulating on the glass as a result of the filament deteriorating over time.

2. A lamp with a yellowish/bluish or white haze indicates the bulb has developed a leak in the glass globe that has resulted in the loss of the vacuum. When the filament is exposed to oxygen, it goes through a rapid heat up and burns through the filament. This is what is commonly called a "smoker."

3. Black sooty deposits indicate a voltage surge, typically the result of a short circuit or spike in power supply.

Key Points

The cause of failure can many times be determined by looking at the bulb itself.

FORWARD LIGHTING

Typically, when we think about incandescent lighting in our industry, we think about signal lighting. However, we need to be sure to include forward lighting as well. Signal lighting is quickly moving to LED technology. However, in the white light portion of our industry, such as work lamps and fog lamps, incandescent technology is still being used.

Therefore, there remains a need in our industry for high quality and highly efficient white lighting. Most applications today utilize halogen lamps, which are sub-types of incandescent lamps.

Key Points

When a halogen bulb begins to cool down, the vaporized tungsten is redeposited back onto the filament. This results in increased bulb life.

Even though more expensive, halogen has replaced ordinary incandescent lamps. Halogen produces a whiter light that makes objects appear closer to their true, natural color. Compared to the warm yellow cast of incandescents, most drivers prefer halogen. Halogen lights also last longer and deliver more consistent performance under variable conditions.

In some ways, halogen is similar to incandescents but out performs them by a wide margin. Basically, a halogen lamp has a small amount of halogen gas added to the iodine, bromine, chlorine, and fluorine mixture in the clear shell. Halogen lights operate at a higher temperature range. When the light is on, the filament begins to lose tungsten by evaporation, it combines with the halogen. When it cools down, the tungsten is redeposited on the filament. The life of the filament is dramatically extended because of this recycling.

That's why halogen, compared to various incandescent sealed beams, is known for its relatively long life and greater light output of whiter light – and there are no blackened bulbs to rob performance.

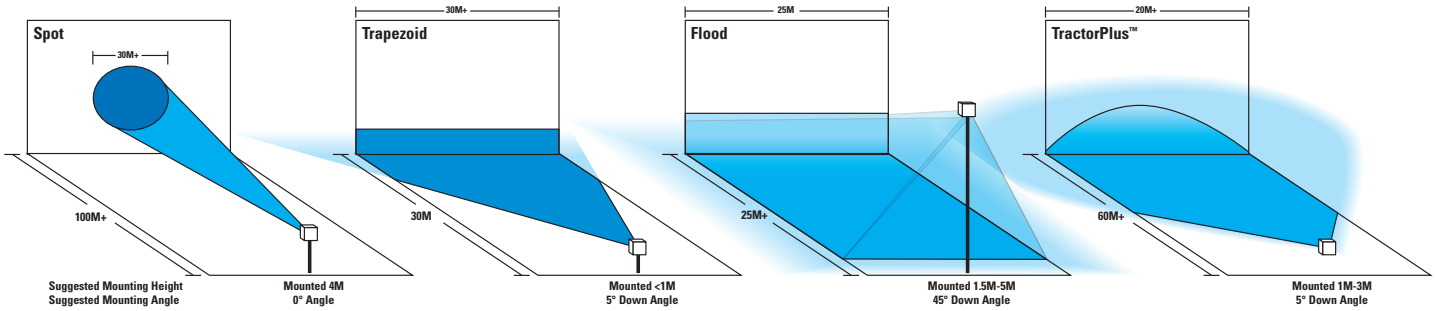
Key Points

The three most common beam patterns for work lamps are:

Spot
Trapezoid
Flood

BEAM PATTERNS

For all lighting applications, it is important to familiarize ourselves with the different Beam Patterns available. In the world of work lamps, there are three specific patterns that can be described as: spot, trapezoid and flood.



When addressing driving lamps, the most common patterns available are:

Fog (Similar to Trapezoid)

Fog: Beam pattern pierces through fog, rain, snow, and dust effectively, focused ahead and low to the road, and giving side-to-side as well as forward illumination.

Driving (Similar to Spot)

Driving: Powerful focused "pencil-shaped" pattern reaches ahead the vehicle, far beyond high-beams, to give you the reaction time you need to prevent accidents.

Off Road Wide Flood (Similar to Flood)

Off-Road Wide Flood: Widest illumination for RV's, motor homes, tractors, utility and off-road construction. Use them for back-up, loading, fueling and troubleshooting.

While incandescent lamps remain an inefficient form of lighting compared to other technologies, they still drive demand for a large portion of lighting in our industry.

FEATURES AND BENEFITS OF INCANDESCENT LAMPS

Key Points

In northern climates, the heat generated from incandescent lamps can actually melt the snow on your lamp, keeping it visible.

Low Cost:

Incandescent lamps have been around for many years and have experienced many changes and improvements, but at the same time, they have remained a "low cost" alternative for the automotive and trucking industry.

With the introduction of HID and HIR and now LED lighting, the industry has an ever widening selection of technologies to choose from. For the next few years to come, however, incandescents will still be the most affordable choice among users, from an "up front cost" standpoint.

Heat:

Usually when one mentions "heat" in our industry, it is a bad thing. As mentioned earlier, excessive heat will shorten the life of an incandescent.

However, in some applications in cold climates, heat can sometimes be a benefit. When dealing with snow and ice, the heat from the incandescent can actually keep your marker lamps and stop/turn lamps more visible as it reduces the amount of build up on the lamps. This also plays a positive roll in applications such as snow plow lamps, which are exposed to direct forward contact with the weather conditions.

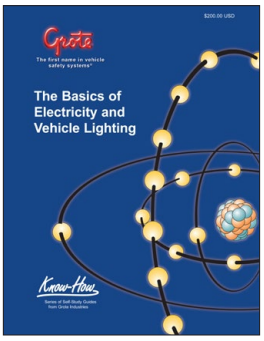
Selection:

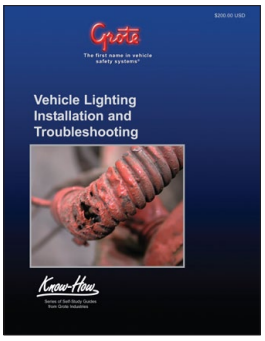
From individual operators to nationwide fleets, there still remains a sizeable need for replacement lamps of incandescent style lamps. Long term, all lamp styles will remain in production in the face of continuous advancements in lighting technology. For those lamp styles that will remain incandescent, Grote has committed to continue to provide a wide selection of high quality, cost efficient lamps for the industry.

NOTES

ADDITIONAL RESOURCES

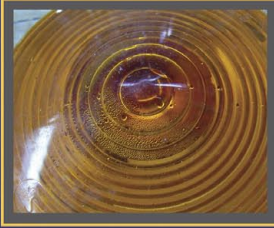
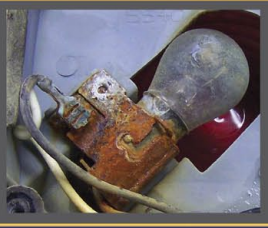
These resources can be acquired online or through the marketing department.





Also, see the "9 common causes of Failure" on the cack of this module. The "9 Common Causes of Failure" can be ordered in power form as a quick shop reference.

TRUCK WIRING AND LIGHTING
9 Common Causes of Failure

MOISTURE & CORROSION

Condensed water droplets inside a lens or corrosion around a lamp socket are sure signs that moisture has penetrated the system.

Water can enter the system through ineffective wire seals, unprotected splices, unsealed crimps and connectors and non-mating seals.

When making repairs, don't replace a sealed system with unsealed components. Make certain that connector seals are in place and undamaged. Inspect them carefully for cuts, tears and punctures.

CHEMICAL DAMAGE

Continuous exposure to many of the common chemicals found in and around trucks can cause plastics to swell, crack, soften or otherwise become degraded. Diesel fuel and hot engine oil are the main culprits.

To minimize the effects of chemicals, inspect the wiring for signs of degradation. If it is occurring in an area that is generally free of contamination check for leaky hoses, gaskets or fittings and repair if damaged or leaking.

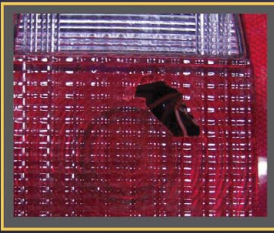
To avoid damage from chemicals, don't run wiring in areas where the chance for continuous exposure is likely, such as under fuel lines and filters.


ABRASION

Abrasion occurs when wires or wire wraps are allowed to rub against frame members or other abrasive surfaces. Once the insulation is worn away, bare conductors may contact a ground surface and create a grounded circuit. Or, it could cause wear to the point of fracture resulting in an open circuit.

Using the proper routing and coverings will help to prevent wear areas and abrasive damage.

Worn coverings such as loom, convoluted tubing or spiral wrap should be replaced if they are no longer providing sufficient protection for the wires inside.




IMPACT

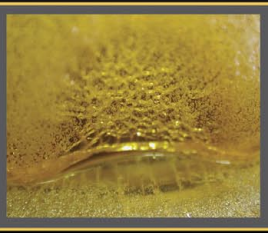
Lighting and wiring must be protected from the impact of rocks, gravel and other road debris. A major impact can cause enough damage to require extensive repairs. Smaller, more frequent impacts over time may deliver equally extensive damage. Damage from impacts can do damage although the wires are contained in a loom or other covering. During inspection, always check for damage from impacts and replace any wiring or lights that appear to be damaged. Make certain that the replacement parts are equivalent to or better than the original.


VIBRATION

Broken lamp filaments are one of the most common problems caused by vibration, but it can also lead to the abrasion of mating surfaces which causes connectors and splices to fail.
To minimize vibration problems, make certain that all wires and connectors are secured appropriately. Always secure the wiring as it exits the connector. Use cushioned mountings for lamps in applications where vibration failure is excessive.


GRIT & SAND

Accumulation of abrasive materials can lead to damage, especially when combined with vibration. If gritty materials enter connections, it can accelerate the wear on contact points causing interruption of the circuit and failure of the devices. Sand and grit can also attract and hold moisture, creating conditions conducive to corrosion. In some cases, sand and grit may work their way inside protective coverings and abrade the insulation of wires running through it if there is relative motion between the covering and the wire.
One of the ways of reducing sand and grit buildup is to eliminate abrasive materials in the areas where wiring is present. Another way is to seal openings on protective coverings to keep gritty materials from entering.

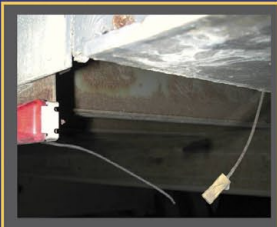



EXTREME TEMP

There are a variety of conditions that lead to extreme temperature build-up which can damage lighting and wiring. These include leaving a trailer's tail lights on when the trailer is backed up to a dock and air flow around the light is prohibited.

When lights have been damaged from heat build-up, the lenses are often bubbled and misshapen.

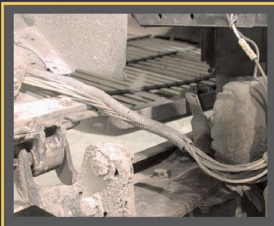
Where extreme temperatures can't be avoided, special heat-resistant wires and materials should be used.



TENSILE LOADS

Wiring should not be considered an appropriate load-bearing component. It's easy to exceed the designed load limit by inadvertently installing wires under tension or snagging a section of wire on one of the moving parts. Using a wire bundle as a handhold or step can destroy the integrity of the conductor and connections. So can the weight of accumulated ice, snow, mud and other materials.

Each of these points must be carefully considered when routing wires in a wiring harness.



FLEXING

There are many circumstances on a truck where the wiring must not only make sharp turns around corners, but is also subjected to constant flexing where doors or hoods are opened and closed repeatedly.

To prevent damage where wires must be subject to repeated flexing, avoid tight radius turns. Make sure that the wire is not snagged or stressed at its maximum extension. Also, make certain that the wire moves smoothly through its flexing cycle and doesn't rub or scrape adjacent components.

Grote®

The first name in vehicle safety systems®

For more information, visit www.grote.com.

GLB2004-20