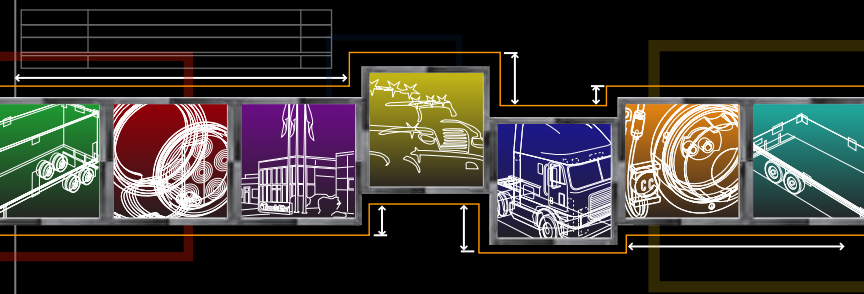
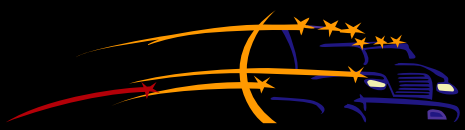
Truck-Lite®

Lighting

USER'S GUIDE





PRODUCT ID	L180 - LIGHTING USER'S GUIDE	2007

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User's Guides

Truck-Lite's series of User's Guides now offers solutions for each major facet of the Truck-Lite product line, providing training and education in great detail. Designed to help readers better understand topics on the basic of electrical concepts to specific installation and preventive maintenance techniques, Truck-Lite's series of User's Guides makes for an excellent training source in a conveniently sized manual.

To request a printed copy of Truck-Lite literature, or to download an electronic copy, check out Truck-Lite's website at www.truck-lite.com.

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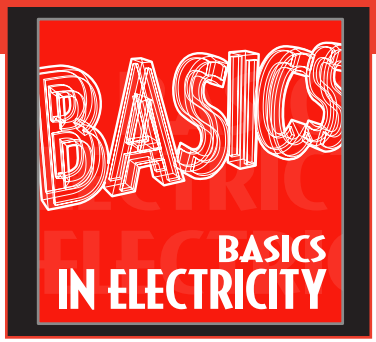
Definitions



A comparison between electrical energy and water flow will be useful in explaining and understanding electrical concepts, but remember - water and electricity generally should not be mixed.

SECTION OBJECTIVES
1. Definitions & Major Concepts
2. Wire Calculations
3. Useful Formulas

1. VOLT (Potential) V

The unit of measurement applied to the difference in electrical potential between two points; that is, the potential for electricity to flow.

- Usually referenced from "ground."
- In water, voltage is roughly equivalent to the difference in elevation from ground to a tank of water elevated above the ground; the electrical potential is similar to water pressure.
- The higher the potential (or elevation), the more force the water is able to exert and the more likely it is to flow.

2. AMP (Current) I

The unit of measurement applied to the flow of electrical current through a conductor.

- The amount of current (electrons) passing through a conductor or passing a point in a wire or other electrical device such as a light bulb.

3. OHM (Resistance) Ω

As electrons flow through conductors, they meet opposition, due to the collisions between the electrons flowing and the electrons and atoms of the conductor.

- The unit of measure applied to the opposition of current flow, called Resistance.

4. WATT (Power) P, W or Pw

The unit of power applied to the rate at which energy is used.

- Power is the amount of work that can be accomplished in a specified amount of time.
- Work is simply defined as converting energy from one form to another (changing electrical energy into light energy).

5. WIRE SIZE (AWG)

Because everything electrical depends on current flow, the conductors that carry the electricity are a critical part of any electrical system. The size of wires is important to allow the proper flow of electrons.

- Resistance is opposition to current flow.
- Wires that are too small in diameter will oppose current flow (the opposition to current flow is because of the collisions of electrons which do not have enough room through which to pass).
- These collisions convert electrical energy into heat (if enough of these collisions occur, the wire could overheat to the point of causing insulation melt-down and/or fire).
- Wire sizes are measured according to the American Wire Gage (AWG).

6. VOLTAGE DROP Vd

Voltage drop occurs when power is dissipated across a component of the electrical system.

- In the case of a bulb or other lighting device, voltage is dropped in the production of light and heat.
- Typically, the more current that flows through a system, the higher the voltage drop will be.
- Voltage drop across a wire is undesirable, as it is an indication that power is being wasted and heat is being generated.

7. HORSEPOWER

To determine horsepower required to operate lighting equipment, calculate the total power requirements of all lamps (in watts). Then divide that total by a value of 746 (HP = P / 746).

Example:

QTY	LAMP TYPE	INCANDESCENT TOTAL AMPS	LED TOTAL AMPS
11	Clearance/Sidemarker/Identification	3.63	0.66
1	Licence	0.33	0.06
2	Tail (minor function)	0.96	0.05
2	Rear Clearance (minor function)	0.96	0.05
2	Stop (major function)	4.20	0.61
2	Turn (major function)	4.20	0.61
		14.28	**2.04**

INCANDESCENT

P = V x I
P = 12.8v x 14.28a
P = 182.784 watts

HP = P ÷ 746
HP = 182.784 ÷ 746
HP = 0.2450

LED

P = V x I
P = 12.8v x 2.04a
P = 26.112 watts

HP = P ÷ 746
HP = 26.112 ÷ 746
HP = 0.0350

It would take about 1/4 of a horsepower to run the lamps on a standard trailer outfit with the minimum requirements of incandescent lighting.

A comparable LED lighting package would require only 0.035, or 1/32 of a horsepower. This tells us that the ratio of the incandescent value of 0.245 to the LED value of 0.035 is 7 to 1. A 700% increase in power is required to use incandescent lamps over LEDs.

Wire Size Calculations

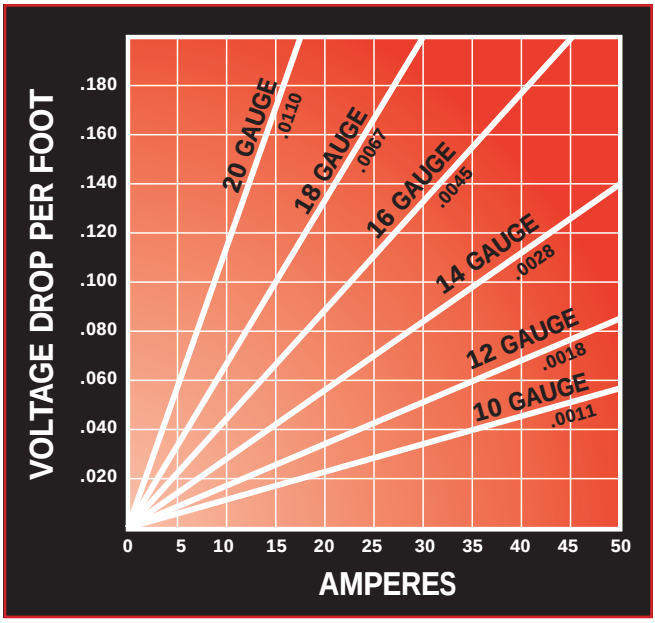
The length of wire in a circuit is a major contributing factor to voltage drop. The table on the next page may be used in determining adequate wire gauge sizes for specific lengths of cable when the amperage (current) requirements are known.

- Everything electrical relies upon current flow
- The conductor that carries the electricity is a critical part of the system
- Wire size is vital to allow the proper flow of electrons (smaller diameter wire will oppose current flow)
- Constricting the room for electrons to pass within the wire causes collision of electrons, which generates heat inside the wire

TOTAL FOOTAGE OF WIRE FROM POWER SOURCE TO THE MOST DISTANT ELECTRIC LAMP

AMPERAGE REQUIRED											
24v System	12v System	10'	20'	30'	40'	50'	60'	70'	80'	90'	100'
2.0	1.0	18	18	18	18	18	18	18	18	18	18
3.0	1.5	18	18	18	18	18	18	18	18	18	18
4.0	2.0	18	18	18	18	18	18	18	16	16	16
6.0	3.0	18	18	18	18	18	16	16	16	14	14
8.0	4.0	18	18	18	16	16	16	14	14	14	12
10.0	5.0	18	18	18	16	14	14	14	12	12	12
12.0	6.0	18	18	16	16	14	14	12	12	12	12
14.0	7.0	18	18	16	14	14	12	12	12	10	10
16.0	8.0	18	18	16	14	12	12	12	10	10	10
20.0	10.0	18	16	14	12	12	12	10	10	10	10
22.0	11.0	18	16	14	12	12	10	10	10	10	8
24.0	12.0	18	16	14	12	12	10	10	10	8	8
30.0	15.0	18	16	12	12	10	10	10	8	8	8
36.0	18.0	16	14	12	10	10	8	8	8	8	8
40.0	20.0	16	14	12	10	10	8	8	8	8	6

*** Values depict wire gauge**

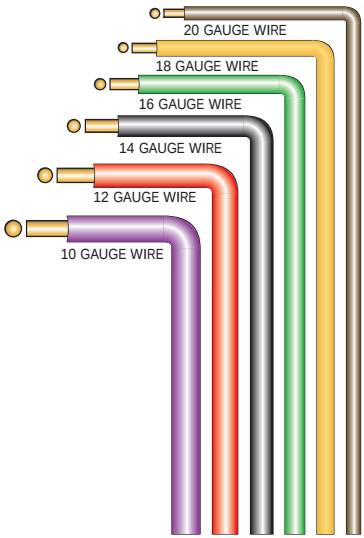


Example: A lamp is 38' from the power source and required 10 amperes. This figure, rounded upwards to the nearest column heading given in the table is 40'. The wire gauge in the 40' column corresponding to 10 amperes is No. 12

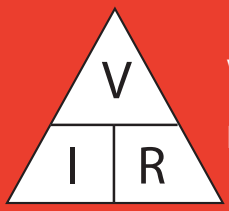
*Recommended minimum wire gauge size for stop light and ground circuits

	Stop (red)	Ground (white)
Single trailer up to 50' length	12 ga.	10 ga.
Doubles trailer 2-28' lengths	12 ga.	10 ga.
Doubles trailer 2-40' lengths	10 ga.	8 ga.
Triples trailer 3-28' lengths	10 ga.	8 ga.

*Compiled from SAE, TMC & Other sources.



Useful Formulas



V - Potential in Volts (E)*
I - Current in Amps
R - Resistance in Ohms

* E is the symbol for Electromotive Force in Volts, as defined in Ohms Law.

$V = I \times R$
Voltage (volts) = Current (amps) x Resistance (ohms)

$I = V/R$
Current (amps) = Voltage (volts) ÷ Resistance (ohms)

$R = V/I$
Resistance (ohms) = Voltage (volts) ÷ Current (amps)

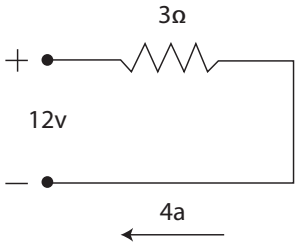
Frequency is stated as E = I x R

Power can be represented as P, W or Pw.

a) $Pw = V \times R$
Power (watts) = Voltage (volts) x Current (amps)

b) $Pw = I^2 \times R$
Power (watts) = Current (amps) x Current (amps) x Resistance (ohms)

c) $Pw = V^2/R$
Power (watts) = Voltage (volts) x Voltage (volts) ÷ Resistance (ohms)



a) $Pw = V \times I$
$Pw = 12 \times 4$
$Pw = 48w$

b) $Pw = I^2 \times R$
$Pw = 4 \times 4 \times 3$
$Pw = 48w$

c) $Pw = {}^{V^2}/_{R}$
$Pw = 12 \times 12 \div 3$
$Pw = 48w$

Notes:

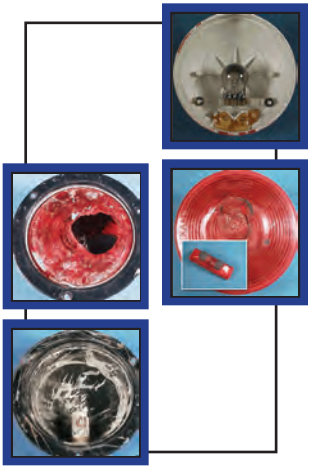
Major Causes Of Safety Lighting Failure

SECTION OBJECTIVES

1. Major Causes Of Safety Lighting Failure
2. Tips For Longer Lasting Lighting Systems
3. Chemical Impact On Lighting
4. Product Pitfalls

CORROSION

Causes of Corrosion:
Water, Dirt, Salt and any other road contaminants can enter a lamp or connector, providing an electrical path which can vastly accelerate corrosion.



Minimizing Corrosion:
Corrosion cannot occur when the bulb is sealed within lamp housing. For example, Truck-Lite's sealed lighting products.

Further Protection:
Connectors should be sealed with non-conductive grease in areas like electrical contacts, circuit switches and junction boxes.

Purpose of sealant:
To totally encapsulate the area to protect it from the elements.

SHOCK, VIBRATION & BURNOUT

Major cause of shock & vibration:

Constant road pounding experiences when a tractor/trailer is traveling down a highway can cause filaments in a bulb to distort and prematurely break.

In addition, shock and impact damage are sometimes caused by something other than road vibration. Some examples are:

- Loading container chassis on to a truck chassis
- Dump truck loading or tailgate banging
- Loose mounting of cargo hardware
- Unloading operations
- Impact with stationary objects such as poles or loading docks

Solution to shock & vibration:

Install a lamp designed with shock-mounted mechanisms that cradle the bulb and absorb the effects of shock and vibration that otherwise would be transferred directly to fragile bulb filaments or LED lamps.

Baseless bulbs:

Suspended to endure heavy-duty applications more than traditional S-8 non-shock-mounted bulb units or standard J-slot bulb sockets.

Advanced Technology - LED's:

- LED's rated at 100,000 hours of operation
- Solid state, and much less susceptible to shock and vibration
- Electronics are completely sealed in epoxy

INADEQUATE WIRING & CABLE

Suitable wiring:

Wire size or gauge is very important, as the use of a wire gauged too small can lead to dim or intermittent operation, excessive voltage drop and present a potential fire hazard.

Avoiding excessive voltage fluctuation:

Suitable Wiring has a positive effect on product life and safety. A sealed waterproof wiring harness system based on electrical load of the vehicle should be selected.

Stranded copper wire should be used. Copper wire has a higher current carrying capability than an aluminum wire of the same size, is more flexible and less likely to break.

Truck-Lite offers harness systems that:

- Exceed industry standards
- Eliminate troublesome splices
- Seal out the elements
- Provide a common ground
- Last the life of the trailer

EXCESS VOLTAGE

Always a difficult problem for bulb life, as many as 60 percent of bulb failures are not as they appear. Many failures caused by voltage spikes as a result of load dumps (such as starting the engine with the lights on). Other sources of over-voltage conditions are heavy draw electrical devices such as lift gates or welders. When the units are turned off, they can create a back lash in the form of a voltage spike.

Voltage regulators that are set too high can shorten life as well, in addition to battery disconnection while the truck is in operation.

A good way to specifically protect the lights of voltage damage, is to avoid starting the vehicle or using heavy draw accessories while the vehicle lights are on.

Voltage should be checked regularly to insure the vehicle is operating within a safe range. One volt beyond designed voltage will reduce expected life of a bulb filament by more than 50 percent.

POOR GROUNDING

Installing a lighting product and harness system that uses an internal ground will help assure an absolute ground-forever because it does not depend only on the chassis ground. Internal ground also helps to eliminate rust and corrosion associated with chassis grounding.

LOSS OF BULB CONTACT

In the traditional non-shock-mounted bulb units and the standard J-slot bulb socket, corrosion and/or loss of spring tension cause loss of contact. With the inception of the sealed baseless bulb lamp and soldered connections, product life is further enhanced and bulb contact is certain.

PHYSICAL DAMAGE

Answer to the problem is a super-tough high-impact plastic that's… Impervious to heat generated by the bulb and damage resulting from typical use. Both lenses and lamp housing should

be manufactured of a space-age plastic such as polycarbonate. Using recessed mounts and branch deflector designs further protect lamps from impact damage. Often, lamp lenses are broken or damaged by tree limbs or other obtrusive objects.

THE 21st CENTURY LIGHTING SYSTEM

Studies have shown that when sealed shock-mounted bulbs and lighting devices are used along with sealed wiring harness systems, product life can be extended as much as 20 times beyond traditional unsealed bulb units in heavy-duty truck and tractor/trailer applications.

Using an original equipment part that lasts the life of the vehicle, or alternatively requires little attention and minor cost after initial purchase, should be everyone's goal. Technology is available today to design and produce lighting products that can offer 500,000 to 1,000,000 miles of maintenance free service for most applications.

Product life performance can be extended and overall costs of vehicle operation reduced by doing a careful evaluation of the total vehicle lighting system… its problems… and the methods to control and eliminate those problems.

Tips for Longer Lasting Lighting Systems

1 Mechanic should never use test probes to puncture insulation while troubleshooting lighting complaints.

If it ever becomes necessary, then the hole from the probe must be resealed. If not, wicking action can cause moisture to travel considerable distances inside the wire resulting in corrosion at critical locations destroying the circuit. When correcting illumination problems… Don't just turn up the voltage output. Find the source that caused the failure. Over-voltage is a killer of lamps and batteries. Always replace trailer light cords with the same, or better, quality and gauge of wiring than that used in the original specifications. Otherwise you lose current carrying capability.

2 To correct voltage problems, discover the real cause. Under-voltage often is caused by poor electrical connections. To correct under-voltage, don't just turn up the voltage - find out the root of the problem for a more efficient operation.

3 Don't just throw away lamps if they are not burning. Play detective when solving lamp problems, to learn if another source is the cause of your lamp failure. Testing the lamp with a meter, power supply or battery can yield a truthful determination of the lamp's cause of failure.

- a bulb with stretched or broken filaments most likely failed as a result of vibration

- a yellowish, whitish or bluish glaze on the bulb indicates a rupture in the bulb's glass envelope
- a dark metallic finish indicates old age
- a black, sooty bulb indicates a poor seal in the bulb

The Truck-Lite Laboratory estimates that up to 20 % of discarded lamps are still in workable condition. Save the removed lamps and bench-test them. The ones that aren't working can be turned over to your lamp supplier. They can analyze them to find out why the lamps have failed.

4 Treat the electrical system like you would the chassis. Lubricate sockets, pigtails, battery terminals and connections with NYK-77 "nonconductive" anti-corrosion compound. The purpose of the sealant is to completely encapsulate and protect against corrosion and water. Mechanics should carry their own supply of lubricant as a sealant. Grease or any type of corrosion preventive compounds may be used as long as they are not carbon based greases.

5 Inspect for improper ground connections. This is a major cause of lamp failure, especially when the trailer is used for a ground. When lamps are grounded through the lamp housing, make sure there is a clean connection (i.e., metal-to-metal). Also, a fifth wheel ground strap may be used for added protection on the chassis ground system.

6 Look for loose, bare or unsupported wire and fixtures. Harness and wiring should be on the underside of top frame members rather than on the bottom where dirt and road splash connect.

7 Heat is an enemy of lamps. Lamps must "breathe" or the heat buildup will shorten life. All lamps will live longer if they run cool and can dissipate heat. The use of LED lamps, and their lower power draw can alleviate some concerns with heat. However, dirt on the lens can increase the heat with a lamp, so keeping your lamps clean can keep the lamps operating in a cooler environment.

8 There are many household cleaning products that are not compatible with polycarbonate lenses and housings.

The following solvents/cleaners **MUST NOT BE USED** with polycarbonate:

Trichlor	Carbon Tetrachloride	Diversol®
Acetone	Chlorinated Hydrocarbons	Lemon Joy® (phosphate free)
Triclene®	Texize-8006, 8129, 8758	Kleenol Plastics
Methyl Ethyl Keytone (MEK)	Liquid Cleaner - 8211	Lestoil®
MIBK	Agitene®	Lysol®
Toluol	Ajax®	Stanisol Naphtha®
Benzol	All Liquid Detergents	Oils
Gasoline	Pink Lux® (phosphate free)	

The following solvents/cleaners **are compatible** with polycarbonate:

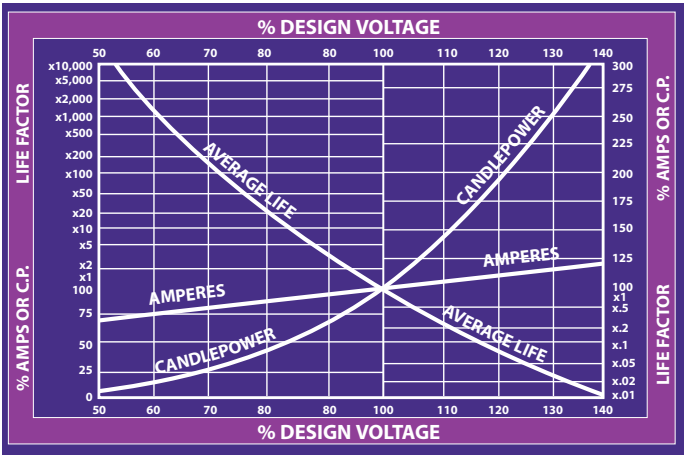
Mild soap and water	10% Sol Bon Ami®
Mineral Spirits	Dirtex®
Hexane	2% Sol. Reg. Joy
VM & P Naphtha	Heptane
Varsol No. 2	White Kerosene
#1 & #3 denatured alcohol	Methyl, isopropyl & isobutyl alcohols
Freone TF & TE-35	Lacryl® PCL-2035 polycarbonate cleaner
Ethanol	Petroleum Ether/65 degrees C boiling point

Questions as to compatibility of other specific materials should be directed to the manufacturer and/or the Truck-Lite Corporate Laboratory.

9 Always replace wiring, trailer light cables and harnesses with an equal or heavier gauge of wire than was used in the original specifications. Using lighter gauge wire can lead to problems. See pages 8 and 9 for wire gauge details.

10 You should never crank the truck with any lights on: Voltage surge is hard on lamps. You should also avoid using the hazard markers and clearance lights needlessly. When parked at a truck stop or terminal yard, save the lights by turning them off. Avoid parking against the dock with the hazard markers, turn signals or tail lamps operating.

Over-driving your headlamps can severely shorten the life of the bulb. The life of a bulb is very vulnerable to being powered at a consistent rate.



Chemical Impact on Lighting

What is it?

Almost all cracked parts are caused by incompatible chemicals or cleaners. Although very tough and durable, lenses can crack due to the combination of stress induced by the molding process and chemical acceleration of the stress.

Typical Examples:

- Lights on buses or vehicles that are frequently washed with incompatible cleaners
- Lights near engines or exhausts
- Lights exposed to some soaps, body cleaners, lubricants, paint, paint cleaners, antifreeze, washer fluids, brake fluid and hundreds of other chemicals

What makes the plastic crack?

The chemical "penetrates" the plastic and "unhooks" the long chains of molecules that makes the plastic strong. Wherever the plastic is under stress (like a lens weld on a mounting hole), it may crack.

Can cleaning solutions be damaging?

The use of solvents which are not compatible with polycarbonate will result in the softening, crazing and/or cracking of the plastic part. Adding to this, polycarbonate lamps & mounting bases may be used under stress in their normal applications (see chart on page 19).

Product Pitfalls

Truck-Lite has discovered some things that cause problems in the field. Here are a few of the "repeat offenders."

P Over tightened Mounting Screws:
S Polycarbonate cracks after a while when under stress. The rule of thumb is use the minimum torque possible. Never use more than 20 inch lbs.

P Loose Brackets or Undersized Grommet Holes:
S Both of these conditions increase shock and knock out filaments prematurely.

P Not Adding NYK-77® to Plugs or Lights When Installing:
S The amount of NYK-77 Truck-Lite adds during manufacturing is enough for the lamp only, and additional should be used on the connection end.
Note: Not recommended for use with LED lamps using Fit 'N Forget® connectors.

P Continued Stretching or Pulling (especially sideways) of a Cable on a Junction Box or Distribution Module:
S This may eventually cause a disconnect or a short

P Using a Backup Light for a Dome Light or Vice Versa:
S One will cause heat damage; the other will not be legal

P Not Replacing Plugs Which Show Signs of Corrosion:

S Even though they may "work", they will promote rapid pin corrosion on the "new" replacement light pin (plug) connection.

P Using Incompatible Cleaners or Chemicals and Allowing Them to Get on the Lights:

S Lights will crack and fail.

P Painting a Vehicle and Allowing Paint or Solvent to Contact Lights or Wiring:

S Most paints (except water based) are incompatible with polycarbonate lights. They may also cause wires or cable insulation to crack.

P Allowing Lights to Contact Insulating Materials (like loading dock air seals) While Energized:

S Another Variation of this is the placement of insulation too close to contacts of the light housings. This can result in heat distortion/damage and shorter life.

P Failure to Orient Lights With the Word "TOP" Properly:

S This is important for a couple of reasons including the fact that the bulb life may be shortened by heat or increased shock. The other reason is that it is an obligation for legal compliance.

P One volt beyond designed voltage will reduce expected life of a bulb filament by more than 50 percent*:

S It is not always controllable, but the "rule of thumb" is that vehicle voltages should be adjusted to the minimum acceptable voltage for proper operation.

*See chart on page 20 for reference.

Federal Requirements

Who's who when it comes to lighting regulations?

SECTION OBJECTIVES
1. Federal Requirements
2. ID Codes
3. Most Common Legal Questions

"NHTSA" is the National Highway Traffic Safety Administration. They regulate lighting requirements for all over-the road vehicles except pole trailers and converter dollies. Their regulations take precedence over state regulations and they have the power to implement fines, recalls and new regulations. State Enforcement agencies use the NHTSA regulations for their light requirements.

"FMVSS-108" is Federal Motor Vehicle Safety Standard No. 108. This is the federal code (law) that regulates lighting performance requirements and also the numbers and locations of lights on vehicles. NHTSA publishes the "108" regulations.

"SAE" is the Society of Automotive Engineers. They write many of the standards that are referenced in 108. However, they do not have any legal authority.

"FHA" is the Federal Highway Administration. They issue Federal Motor Carrier Safety Regulations (FMCSR). These rules regulate

commercial vehicles and buses. Some of these deal with lighting and wiring. Most states "enforce" these standards.

"DOT" is the Department of Transportation. This functions like a large governmental umbrella for anything dealing with transportation, including "NHTSA", "FHA", etc. The "DOT" lettering is often put on lights to show that they conform to all government regulations.

Explanation of ID Codes

The SAE J759 Lighting Identification Code can be difficult to interpret regarding clearance and marker applications. This additional information may be helpful.

P2: Clearance Sidemarker and Identification Lamps

This marking is currently used for both "over" 80 inch and "under" 80 inch vehicles. It has become the standard for vehicles under 80 inches, but government specifications (FMVSS-108) have never called out increased requirements for the smaller width. P2 is the minimum standard for clearance, sidemarker or identification lights. All Truck-Lite devices meet this standard, even if they are marked PC, P3, etc.

PC: Combination Marker and Clearance or Identification for vehicles over 80 inches wide

To be used as a "combination" light, devices must be mounted on a 45° bevel at the corner

of a vehicle. This allows Clearance and Marker functions to be "combined" in one light, and eliminates the need for a second device. A PC light can always be used anywhere a P2 light would have been used, but the reverse is not true.

P3: Clearance, Sidemarker or Identification lights for use on vehicles over 80 inches wide

A P3 designated lamp has wider light outputs than a P2 rated lamp. It is legal wherever a P2 light would be used. Because the federal regulations (FMVSS-108) has yet to adopt P3, many manufacturers have not made lights to meet the standard. Some of Truck-Lite's lamps do not meet this standard, and are marked accordingly.

PC2: Combination Marker and Clearance or Identification lights used on a vehicle over 80 inches wide

PC2 Lamps meet an increased angle output, and are designed as combination lamps. When used as combination lamps, they must be mounted on a 45° beveled corner. Because the federal regulations (FMVSS-108) have yet to adopt P3, many manufacturers have not made lights to meet the standard. Some of Truck-Lite's lamps do not meet this standard, and are marked accordingly.

Additional Points of Concern:

- Currently, the FMVSS-108 standard has recognized only the standards that call for P2 or PC markings. The other markings are for "optional" SAE standards.

- The PC or PC2 lights offer the widest patterns of visibility.
- FMVSS-108 does not require any of these lens markings, with the exception that they accept "DOT" lettering as certifying legal compliance
- NHTSA and Transport Canada are in the process of rewriting FMVSS-108. It is not known if the "new" version will recognize PC2 or P3 markings. If they are recognized, it is certain that there will be a several-year phase-in of the requirements.

Notes:

Lighting ID Codes:

A	Reflex reflector
A2	Reflex reflector for use on vehicles 2032mm or more in overall width
A3	Reflex reflector for conspicuity treatment (CT), for use on vehicles 2032mm or more in overall width
A4	Reflex reflector for CT (vehicles > 2032mm in width) - 50mm wide [truck/trailer]
A5	Reflex reflector for CT (vehicles > 2032mm in width) - 75mm wide [truck/trailer]
A6	Reflex reflector for CT (vehicles > 2032mm in width) - 100mm wide [truck/trailer]
A7	Reflex reflector for CT (vehicles > 2032mm in width) - 25mm wide [truck/trailer]
C	Motorcycle auxiliary front lamp
D	Motorcycle and motor-driven cycle turn signal lamp
DL	Distributed lighting system (headlamp)
E	Side turn signal lamp - vehicles 12m or more in length
E2	Side turn signal lamp - vehicles less than 12m in length
EVS1	Siren - interior location
EVS2	Siren - exterior location
EVS3	Siren - under hood location
F	Front fog lamp
F2	Fog tail lamps
G	Truck cargo lamp
H	Sealed beam headlamp
HC	Headlamp center
HG	Discharge forward lighting (headlamp)
HH	Sealed beam headlamp housing
HR	Replaceable bulb headlamp
I	Turn signal lamp spaced greater than 100mm from headlamp
I3	Turn signal lamp spaced from 75mm to less than 100mm from headlamp
I4	Turn signal lamp spaced from 60mm to less than 75mm from headlamp
I5	Turn signal lamp spaced less than 60mm from headlamp
I6	Rear mounted turn signal lamp and front mounted turn signal lamps mounted 100mm or more from the headlamp, for use on vehicles 2032mm or more in overall width
I7	Front mounted turn signal lamp mounted less than 100mm from the headlamp, for use on vehicles 2032mm or more in overall width
J1690	Flasher
K	Front cornering lamp
K2	Rear cornering lamp
L	License plate lamp
M	Motorcycle and motor-driven cycle headlamp - motorcycle type

N	Motorcycle and motor-driven cycle headlamp - moto driven cycle type
O	Spot lamp
P	Parking lamp
P2	Sidemarker lamp for use on vehicles 2032mm or less in overall width
P3	Clearance, sidemarker and identification lamp for use on vehicles 2032mm or more in overall width
PC2	Combination clearance and sidemarker lamp for use on vehicles 2032mm in width or more in overall width
Q	Turn signal operating unit - Class A
QB	Turn Signal operating unit - Class B
QC	Vehicular hazard warning signal operating unit
QD1	Turn signal operating unit for use on vehicles 2032mm in width or more in overall width - Type 1
QD2	Turn signal operating unit for use on vehicles 2032mm in width or more in overall width - Type 2
QE1	Hazard warning operating unit for use on vehicles 2032mm in width or more in overall width - Type 1
QE2	Hazard warning operating unit for use on vehicles 2032mm in width or more in overall width - Type 2
R	Reversing (back-up) lamp
S	Stop lamp
S2	Stop lamp for use on vehicles 2032mm or more in overall width
T	Tail lamp (rear position lamp)
T2	Tail lamp (rear position lamp) for use on vehicles 2032mm or more in overall width
U	Supplemental high-mounted stop and turn signal lamp
U2	High-mounted stop lamp for use on vehicles 2032mm or more in overall width
U3	Center high-mounted stop lamp for passenger cars, light trucks and MPV's
W	Warning lamp for emergency, maintenance and service vehicles
W2	Warning lamp for school buses
W3-1	Optical warning device - Class 1
W3-2	Optical warning device - Class 2
W3-3	Optical warning device - Class 3
W4	Emergency warning device [triangular shape]
W5-1	360° gaseous discharge lamp - Class 1
W5-2	360° gaseous discharge lamp - Class 2
W5-3	360° gaseous discharge lamp - Class 3
X	Adaptive [forward] lighting system
Y	Auxiliary high beam lamp
Y2	Daytime running lamp
Z	Auxiliary low beam lamp

BASIC EQUIPMENT REQUIRED ON ALL TRAILERS

	DESCRIPTION			MANDATORY REQUIREMENTS			
	Area Equipment	SAE Lens Coding	Functional Purpose	Quantity	Color	Location	Height mm(in.) from the ground
1	Tail Lamps	(T)	Indicate vehicle's presence and width	Minimum 2	Red	On the rear - symmetrical as far apart as practicable	380-1830 (15-72)
	Stop Lamps	(S)	Indicate braking	Minimum 2	Red	On the rear - symmetrical as far apart as practicable	380-1830 (15-72)
	Rear Turn Signal Lamps	(I)	Indicate direction of turn	Minimum 2	Red or Yellow	On the rear - symmetrical as far apart as practicable	380-2110 (15-83)
	Rear Reflex Reflectors	(A)	Indicate vehicle's presence and width	Minimum 2	Red	On the rear - symmetrical as far apart as practicable facing rearward	380-1530 (15-60)
2	License Plate Lamp(s)	(L)	Illuminates license plate	Minimum 1	White	On the rear - above or at the sides of license plate	No requirement
3	Rear Side Marker Lamps *photometrically certified at installation angle	(P2, PC* or P3, PC2*)	Front and rear side marker lamps / side reflex reflectors indicate vehicle's presence and length	Minimum 2	Red	Each side at rear as far back as practicable	380-1530 (15-60) no max. for veh. < 2032mm (80") wide
	Rear Side Reflex Reflectors	(A)		Minimum 2	Red	Each side at rear as far back as practicable facing sideward	380-1530 (15-60)
4a	Front Side Marker Lamps *photometrically certified at installation angle	(P2, PC* or P3, PC2*)		Minimum 2	Yellow	Each side at front as far forward as practicable	380 (15) minimum
4b	Front Side Reflex Reflectors	(A)		Minimum 2	Yellow	Each side at front as far forward as practicable facing sideward	380-1530 (15-60)

ADDITIONAL EQUIPMENT FOR TRAILERS EXCEEDING 9.1m (30 ft.) or longer engtn

	DESCRIPTION			MANDATORY REQUIREMENTS			
Area	Equipment	SAE Lens Coding	Functional Purpose	Quantity	Color	Location	Height mm(in.) from the ground
5a	Intermediate Side Marker Lamps	(P2 or P3)	Indicate presence of a long vehicle	Minimum 2	Yellow	Each side near center facing sideward	380 (15) minimum
5b	Intermediate Side Reflex Reflectors	(A)	Indicate presence of a long vehicle	Minimum 2	Yellow	Each side near center facing sideward	380-1530 (15-60)

Width 2032mm (80 in.) or wider

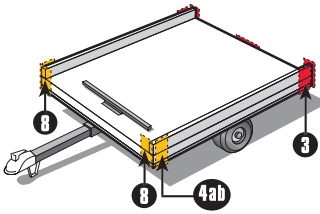
DESCRIPTION			MANDATORY REQUIREMENTS				
Area	Equipment	SAE Lens Coding	Functional Purpose	Quantity	Color	Location	Height
6	Rear Clearance Lamps *photometrically certified at installation angle	(P2, PC* or P3, PC2*)	Show vehicle's width MAY NOT be combined with tail lamps	Minimum 2	Red	At widest point - symmetrical on the rear or near the rear facing rearward	As high as practicable may be lower only if ID lamps are at the top
7	Rear Identification (ID) Lamps	(P2 or P3)	Indicate presence of a wide vehicle	Exactly 3	Red	On the rear - center horizontally spaced 150mm (6 in.) to 300mm (12 in.) apart facing rearward	At the top - may be lower if door header narrower than 25mm
8	Front Clearance Lamps *photometrically certified at installation angle	(P2, PC* or P3, PC2*)	Show vehicle's width	Minimum 2	Yellow	At widest point - symmetrical on the front or near the front facing forward	As high as practicable

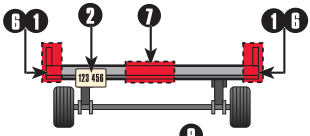
Width 2032mm (80 in.) or wider AND GVWR 4536 kg (10,000 lb.)

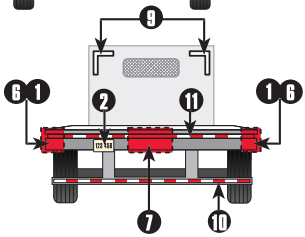
DESCRIPTION		MANDATORY REQUIREMENTS					
Area	Conspicuity Treatment	DOT Coding	Quantity	Color	Location	Height	Options
9	Rear Upper Body Markings	DOT-C DOT-C2 DOT-C3 DOT-C4	Exactly 2 pairs of 300mm long strips	White	On the rear upper corners facing rearward	At the top	Reflex reflectors may not be required if they are replaced in their required location with conspicuity treatment. Optional in Canada: Rear lower body and side conspicuity treatment may also be solid white, solid yellow, or white and yellow.
10	Bumper Bar Marking		Continuous	Red/White	On the rear bumper bar's horizontal element full width - facing rearward	No requirement	
11	Rear Lower Body Marking		Continuous	Red/White *(see options)*	On the rear full width of the vehicle facing rearward	As horizontal as practicable and as close as practicable to the range of 375 to 1525mm from the ground	
12	Side Marking		(see location)	Red/White *(see options)*	Each side - facing sideward continuous, or evenly spaced over minimum of 50% of length starts and ends as close to the front and rear of the vehicle as practicable	As horizontal as practicable and as close as practicable to the range of 375 to 1525mm from the ground	

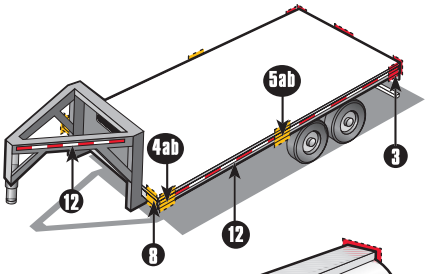
NOTE: The edge of red conspicuity tape shall not be closer than 75 mm to the edge of any amber lamp and the edge of white conspicuity tape shall not be closer than 75 mm to the edge of any lamp

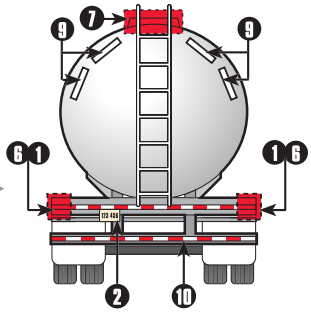
Trailer Equipment Location Requirements

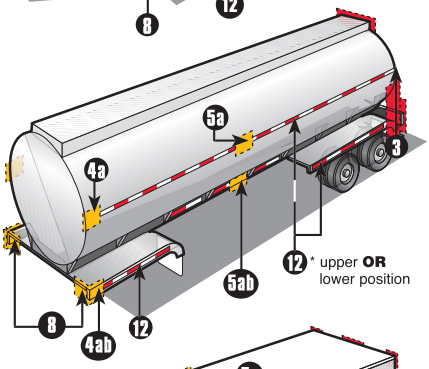


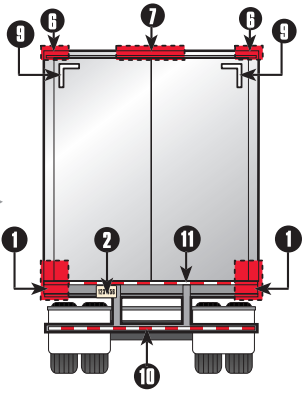


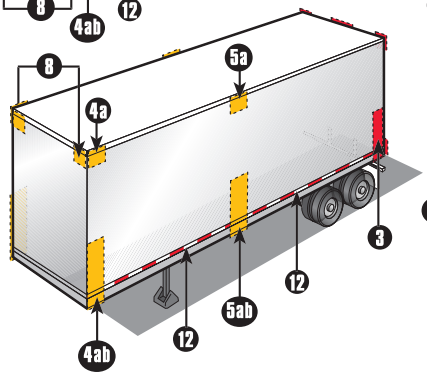




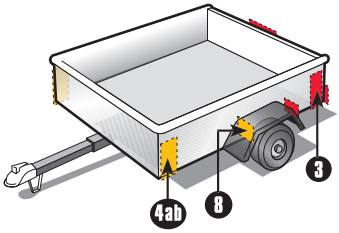


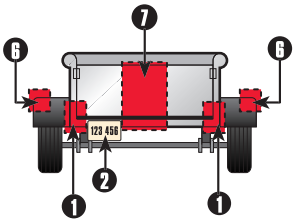


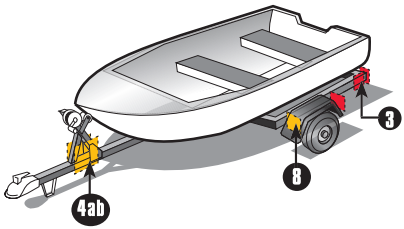


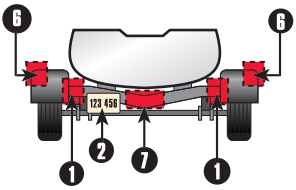


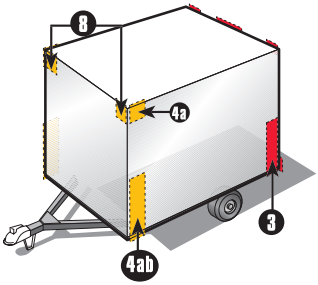
Trailer Equipment Location Requirements

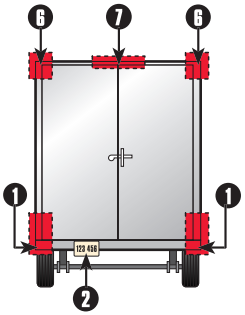


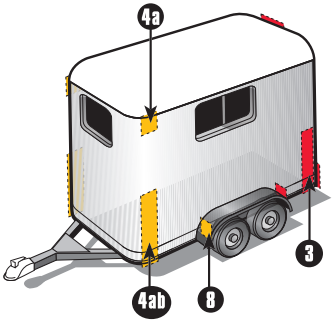


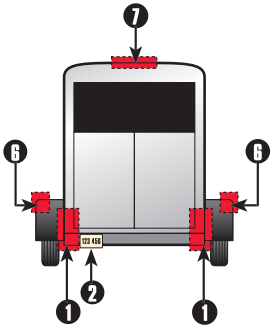












BASIC EQUIPMENT REQUIRED ON ALL TRUCKS, BUSES & MPVs

Area	Equipment	SAE Lens Coding	Functional Purpose	Quantity	Color	Location	Height mm(in.) from the ground
1	Headlamps - Lower Beam US requires "DOT" lettering on lens US&Canada - light source code required on lens	(H, HR)	Forward road illumination	Minimum 2	White	On the front - symmetrical as far apart as practicable If 4 lamp system - outboard or above upper beams	560-1370 (22-54)
	Headlamps - Upper Beam US requires "DOT" lettering on lens US&Canada - light source code required on lens	(H, HR)	Forward road illumination	Minimum 2	White	On the front - symmetrical If 4 lamp system - inboard or below lower beams	560-1370 (22-54)
	Parking Lamps Vehicles less than 2032mm wide	(P)	Indicate parked vehicle	Minimum 2	White or Yellow	On the front - symmetrical as far apart as practicable	380-1830 (15-72)
	Daytime Running Lamps (DRL) Canada - required / US - option US requires "DRL" lettering on lens if not headlamp	(Y2)	Indicate in use vehicle	Minimum 2	White or Yellow	On the front - symmetrical as far apart as practicable	380 (15) min. Max. depends on type of DRL
	Front Turn Signal/ Hazard Warning Lamps	(I)	Indicate direction of turn/ identify disabled vehicle	Minimum 2	Yellow	On the front- symmetrical as far apart as practicable	380-2110 (15-83)
2	Front Clearance Lamps Vehicles 2032mm wide or wider *photometrically certified at installation angle	(P2, PC* or P3, PC2*)	Show vehicle's width	Minimum 2	Yellow	At widest point - symmetrical on the front or near the front facing forward	As high as practicable
3	Front Identification Lamps (ID) Vehicles 2032mm wide or wider	(P2 or P3)	Indicate presence of a wide vehicle	Exactly 3	Yellow	On the front - center horizontally spaced 150 mm (6 in.) to 300 mm (12 in.) apart	As high as practicable or on top of the cab
4a	Front Side Marker Lamps *photometrically certified at installation angle	(P2, PC* P3, PC2*)	Front and rear side marker lamps / side reflex reflector indicate vehicle's presence and length	Minimum 2	Yellow	Each side at front as far forward as practicable	380 (15) minimum
4b	Front Side Reflex Reflectors	(A)		Minimum 2	Yellow	Each side at front as far forward as practicable facing sideward	380-1530 (15-60)
5a	Rear Side Marker Lamps ** *photometrically certified at installation angle	(P2, PC* or P3, PC2*)		Minimum 2	Red	Each side at rear as far back as practicable	380 (15) minimum
5b	Rear Side Reflex Reflectors ** **not required on Truck Tractors	(A)		Minimum 2	Red	Each side at rear as far back as practicable facing sideward	380-1530 (15-60)
6	Rear Clearance Lamps Vehicles 2032mm wide or wider Not required on Truck Tractors *photometrically certified at installation angle	(P2, PC* or P3, PC2*)	Show vehicle's width MAY NOT be combined with tail lamps	Minimum 2	Red	At widest point - symmetrical on the rear or near the rear facing rearward	As high as practicable may be lower only if rear ID lamps are at the top

7	Rear Identification (ID) Lamps Vehicles 2032mm wide or wider Not required on Truck Tractors	(P2 or P3)	Indicate presence of a wide vehicle	Exactly 3	Red	On the rear - center horizontally spaced 150mm (6 in.) to 300mm (12 in.) apart facing rearward	At the top may be lower if door header narrower than 25mm
8	Tail Lamps	(T)	Indicate vehicle's presence and width	Minimum 2	Red	On the rear - symmetrical as far apart as practicable	380-1830 (15-72)
	Stop Lamps	(S)	Indicate braking	Minimum 2	Red	On the rear - symmetrical as far apart as practicable	380-1830 (15-72)
	Rear Turn Signal/ Hazard Warning Lamps	(I)	Indicate direction of turn/ identify disabled vehicle	Minimum 2	Red or yellow	On the rear - symmetrical as far apart as practicable	380-2110 (15-83)
	Rear Reflex Reflectors	(A)	Show vehicle's presence and width	Minimum 2	Red	On the rear - symmetrical as far apart as practicable	380-1530 (15-60)
9	Backup Lamp	(R)	Illuminates ground behind the vehicle and alert road users	Minimum 1	White	Rear	No requirement
10	License Plate Lamp(s)	(L)	Illuminates license plate	Minimum 1	White	On the rear - above or at the sides of license plate	No requirement
11	Center High Mounted Stop Lamp Vehicles less than 2032mm wide and 4536kg	(U3)	Indicates braking	1	Red	On the rear - centerline of the vehicle	860 (34) minimum

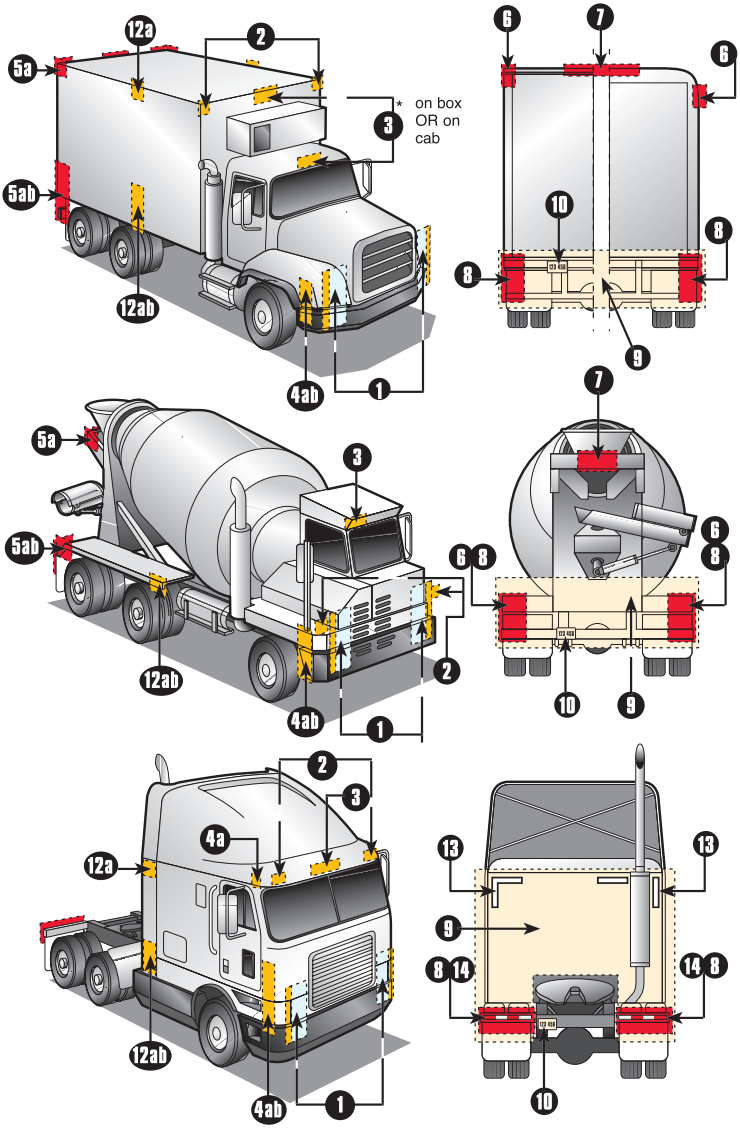
VEHICLES 9.1m (30 Ft.) LONG OR LONGER
ADDITIONAL EQUIPMENT FOR SPECIFIC VEHICLES
Truck Tractors

DESCRIPTION				MANDATORY REQUIREMENTS			
Area	Equipment	SAE Lens Coding	Functional Purpose	Quantity	Color	Location	Height mm(in.) from the ground
12 a	Intermediate Side Marker Lamps	(P2 or P3)	Indicate presence of a long vehicle	Minimum 2	Yellow	Each side near center	380 (15) minimum
12 b	Intermediate Side Reflex Reflectors	(A)	Indicate presence of a long vehicle	Minimum 2	Yellow	Each side near center facing sideward	380-1530 (15-60)

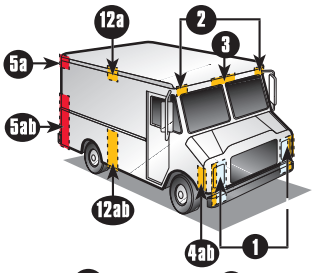
DESCRIPTION			MANDATORY REQUIREMENTS				
Area	Conspicuity Treatment	DOT Coding	Quantity	Color	Location	Height	Options
13	Rear Upper Body Markings	DOT-C DOT-C2 DOT-C3 DOT-C4	Exactly 2 pairs of 300mm long strips	White	Rear upper corners of cab facing rearward	As high as practicable excluding fairings	
14	Rear Marking		Exactly 2 sections of min. 600mm each	Red/ White	Rear - facing rearward - on fenders, on mud flap brackets, or within 300mm below the top of mud flaps	As horizontal as practicable and not higher than 1525mm from the ground	If mud flaps not used - on the cab or frame mounted brackets

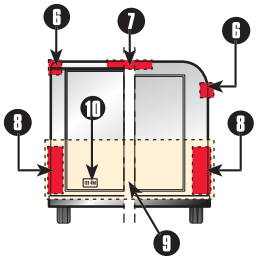
NOTE: The edge of red conspicuity tape shall not be closer than 75 mm to the edge of any amber lamp and the edge of white conspicuity tape shall not be closer than 75 mm to the edge of any lamp

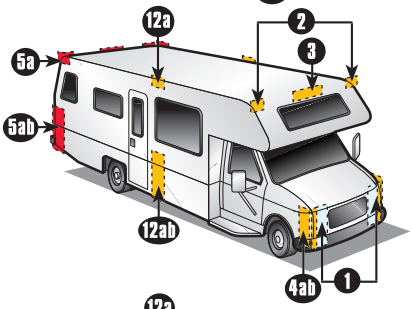
Truck, Bus, MPV Equipment Location Requirements

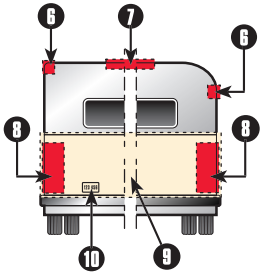


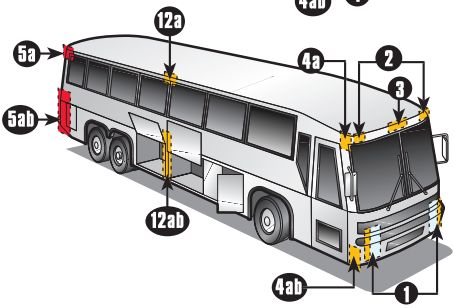
Truck, Bus, MPV Equipment Location Requirements

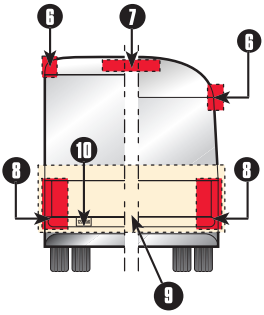


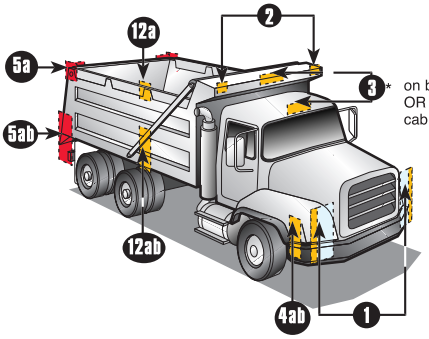


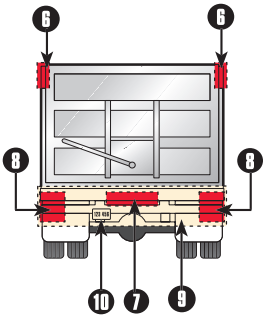












Most Common Legal Questions

Q What lights do I need?

A Browse the NHTSA charts (shown on pages 30-37). Truck-Lite Tech Support (888/562-5012) can be reached for additional questions. Note that states cannot require anything different than what is in "108". However, states can add regulations. Contact the Truck-Lite lab for special situations.

Q The vehicle has everything needed for 108, but the State Police gave me a ticket anyway.

A States can regulate anything not covered by "108". For example, any accessory lights or lights in addition to those in "108". Generally the problem is in these areas. Sometimes they make a mistake. In that case, the lab can often write a letter to clarify the issue.

Q Would it be all right to mount a light at some angle; that is, not "square" on the vehicle?

A "Maybe." You need to contact the Lab for a test in that position; otherwise, it can be questioned by NHTSA or enforcement people.

Q Can I ever use the Model 40 with the reflex reflector ring legally?

A Yes, as follows:
On any vehicle under 80" wide:
As an "extra" light on vehicles over 80", (reflex is legal). On vehicles made in 1991 or

earlier. When installed by the vehicles owner, although most states enforce the Federal requirement

Q Is it OK to use a light for "side turn" that isn't listed for that function.

A It is all right because side turns are NOT legally required anyway. Be careful that it doesn't violate some state laws regarding color or location. If it is also used as a side marker, that function must be listed on the lens code.

Q Is "SAE" or "DOT" lettering required on lights?

A No lettering is required by NHTSA (108) except for headlights and conspicuity tape. The Federal Motor Carrier Safety manual mentions that some lights should be marked "SAE" but this is not enforced. Truck-Lite marks all their lights with "SAE" and/or "DOT" markings.

Q What is a combination marker/clearance light and how do I mount it?

A It is one light doing the work of two. It must be at a 45 degree angle (on corners) to be legal. It needs to be marked "PC" in the lens code. If there is a question, contact the Truck-Lite laboratory.

Q Are there special lighting requirements for vehicles hauling flammable or explosive materials?

A There are no "special" Federal requirements as "108" covers all over-the-road vehicles.

Some states or municipalities have regulations, but these cannot "supersede" 108, they can only add to it. FMCSR and the NFPA (National Fire Protection Association) publish requirements for wire protection as well.

Truck-Lite's sealed lights and wiring systems have been tested to all known standards and certification. Reports are available from the Truck-lite lab.

Q "108" says that some lights must be mounted as high as "practicable" or as far apart as "practicable." What is "practicable?"

A NHTSA has stated that the vehicle manufacturer has the responsibility to choose the best mounting location "in light of the particular design/configuration of the vehicle involved" and they will not contest it unless it is "clearly erroneous. Recently, Canada has started to strictly enforce the word practical as meaning capable of being done." In the case of sidemarkers, not more than six inches from the edge of the vehicle is practical.

Q I want to add some auxiliary lights like illuminated signs, deceleration lights, or "decorative" lights. Are these legal?

A Yes, provided they do not:
Render inoperative any device in compliance with "108". Negatively affect the performance of required equipment. Create confusion or misunderstanding of lighting signals. Always contact the lab if you have any questions.

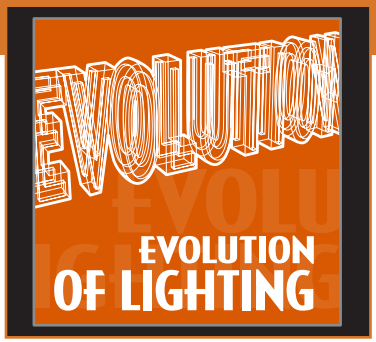
Q What is the "12 Square Inch Rule"?

A On December 1, 1991, the National Highway Traffic Safety Administration (NHTSA) made effective the final ruling regarding the "12 Square Inch Rule." This ruling requires that the total luminous lens area for a stop and turn lamp must not be less than 75 centimeters squared (11.625 square inches) when used on vehicles over 80" wide.

It must be noted that the Model 40 reflex reflector ring cannot be counted as square inch lens area. When the reflex ring is subtracted from the total 12 inch lens, it leaves less than the 12 square inches required.

Notes:

Lighting Evolution



INCANDESCENT LIGHTING

A bulb is generally inexpensive and produces brilliant white light, making it a natural source of light. However, a bulb has many disadvantages.

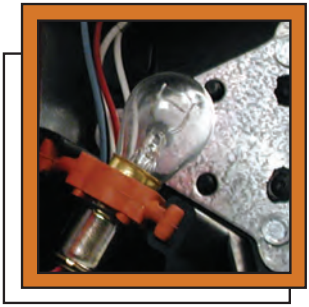
SECTION OBJECTIVES

1. Lighting Evolution
2. Introduction to LED Lighting
3. Future of LEDs
4. LED Lifetime Systems
5. Systems Approach

The most significant ones are:

- Limited life (less than 10,000 hrs.)
- Fragile filament (susceptible to breakage during shock & vibration). Some lighting manufacturers put bulbs in "shock mounts" to protect them from vibration, but even the best bulb will burn out or suffer a broken filament within 3 years.

Incandescent lamps operate though the excitement of tungsten filaments, that seeded in a sealed glass housing, will provide light output. Truck-Lite found that in the original 2" Round and 4" Round lighting applications, lamp damage was found to occur more often from damage to the bulb.



SEALED LIGHTING

While Truck-Lite manufactures lamps with shock-mounted systems (a method of attaching the bulb to the lamp in a suspended vibration-resistant device), not all lamps fail due to vibration alone. It was Truck-Lite's first development of the sealed lamp that tackled the problem of bulb failure.

Years ago, bulb replaceable lamps generally had poor lens gasketing, and often had drain holes. The drain holes allowed water into the lamp, which caused corrosion of the bulb socket and electrical contacts. Cold water could come in contact with the hot glass of the bulb, which would cause the bulb to crack. This led to a slow leak of air into the bulb, which caused a slow failure. The filament would become oxidized, produce a cloudy coating on the inside of the bulb, greatly reducing the light output, and reducing the life to a few hours at most. If the crack was severe, failure could happen instantaneously.

Truck-Lite's work to prevent damage to the bulb resulted in the advent of the sealed lamp. By creating a lamp that allowed no way for chemicals or liquids to enter the lamp housing, the possibility for damage was decreased.

BULB GASSES

The lamp filament, a tungsten material that burns to create the actual light output, evaporates over time. In a cycle in which the tungsten material is burned off and settles back on again, the conditions inside the bulb help to keep the filament in tact. Various gasses are inserted into the inside of the bulb to keep the eroded tungsten material circulating back for re-use.

Truck-Lite has evaluated the various gasses available to prolong the duration of the filament life. Some gasses keep the tungsten material from burning off, and allow the filament to burn longer and stronger. From Krypton to Argon, various gasses have different properties and success rates.

Introduction to LED Lighting

Since they were first studied in 1988 for possible use in heavy duty lighting applications, LEDs have become the new standard for long life, low current-draw lighting.

LEDs are electrically charged semi-conductor chips capable of emitting an intense output of light. In 1994, Truck-Lite introduced the first Stop, Turn & Tail lamp to effectively meet lighting

requirements while operating solely on LEDs. Since then, Truck-Lite has manufactured high quality LED products for every safety lighting application on trailers, trucks, buses and numerous other vehicles.

Advantages of LED Lighting

SAFETY

- Increases vehicle conspicuity with intense displays of light output
- Instantaneous response time, 200 milliseconds faster than that of incandescent lamps, creating 18 feet of additional stopping distance for trailing vehicles at highway speeds
- Low power consumption increases the length of time disabled vehicles can operate their 4-way flashers

ENERGY EFFICIENCY

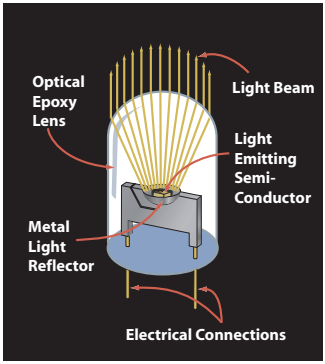
- 85% reduction of load on electrical systems allows more power for other vehicle applications
- Minimizes voltage drop and reduces load on alternators, flashers and switches

RELIABILITY

- Rated at 100,000 hours of operation, covering 4 million miles, and Warranted for Life when equipped with Fit 'N Forget® connectors and Series 88 harnesses
- Extended period of operation translates to less vehicle downtime and zero maintenance

DURABILITY

- Solid-state construction, with extra measures taken to assure longevity of circuitry and components
- Virtually impervious to shock & vibration



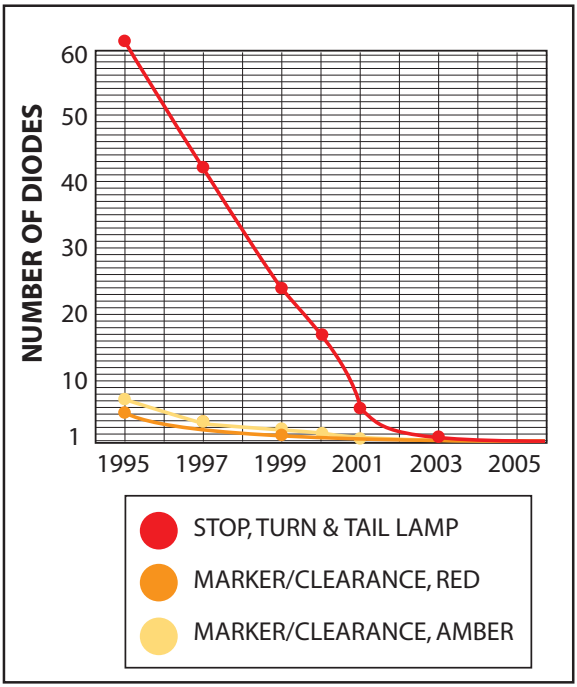
LED lamps produce light without relying upon a heated filament like their incandescent counterparts. This "Solid State" method of producing current eliminates filament failure, and ultimately translates into a much longer life! LED lamps continue to gain popularity as more and more industry professionals recognize the benefits LED lamps provide.

Truck-Lites LED lamps are extremely reliable and efficient, because they are internally sealed with epoxy to encapsulate the electronic elements. The solid state design makes for an extremely impact resistant light source, impervious to shock and vibration, even in the most damaging applications.

With a very high ratio of visible light produced as compared to heat, the filament damage incandescent lamps are susceptible to is not a concern with LED lighting. They have an extremely fast turn-on time, and can last up to 100,000 hours. Impervious to shock and vibration, they are ideal for the heavy duty industry.

LED's come in different types:

- "T1-3/4's"
- "HPA's"
- "SnapLED®"

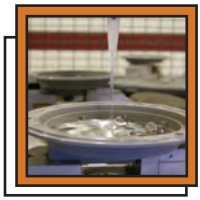


A single LED does not produce as much light as a single bulb. Therefore, many may be required to make a legal lamp, creating new options for light patterns, optics and lens design. Truck-Lite's advances in development of LED lighting has greatly reduced the number of required diodes to meet requirements for popular lamp applications.

Notes:

STANDARD LED FEATURES & BENEFITS

• Diodes Fully Sealed in Epoxy
- Electronics are secured in epoxy
- Ensures a lifetime hold
- Prevents corrosion



• Polycarbonate Lens & Housing
- Impact resistant polycarbonate used to manufacture stronger lamps
- Lamps are even further protected from damage or corrosives

• Sonic Vibration-Welded Lenses
- Creates a complete seal to the lamp, adding to the protection of the epoxy sealant

• Lamp Connection
- A non-sealed connector may be more convenient but it may not last for 10 years in severe applications
- Long life LED plugs utilize special connectors to prevent premature failure caused by pin corrosion

POTENTIAL LAMP FAILURE MODES

Incandescent lamp	LED lamp
Filament fracture	------
Pin corrosion	Pin corrosion
Internal corrosion	Internal corrosion
Physical damage	Physical damage
Chemical attack	Chemical attack

COLORS OF LIGHT

The colors of light produced by filament lamps in vehicle applications are the result of colored lens placement in front of an incandescent white filament. The red and amber color produced by LED lamps in vehicle applications are the result of colored light emitted from the diodes.

The Future of LEDs

Haitz Law states that the output of LEDs doubles every 18-24 months (see chart on page 47). As LEDs get brighter, the number of LEDs required per lamp has decreased resulting in possible price reductions.

The reduction in the required number of diodes allows for greater design capabilities, and brings the lamp manufacturing to more streamlined process. The continuing improvements in production of Light Emitting Diodes and their use in heavy duty lighting applications has already seen vast reductions in cost and lamp failure rates. New improvements are in development to create even more dependable, low cost products and the use of the state-of-the-art technology is opening doors to new lighting applications and safety systems.

LED Lifetime Systems

CUSTOMER EXPERIENCE

The best warranty is the one you never have to use! Lighting has the highest frequency of failure of any device on a truck and trailer & is third in total cost. All Vehicles Equipped With Truck-Lite LED Lamps, Fit 'N Forget® Connectors and 88 Series "Plug Together" Harness System Will Be **Warranted for Life of the Vehicle**! The manufacturing of the LED lighting and superior harnesses provides a system free of downtime concerns.

88 SERIES "PLUG-TOGETHER" HARNESS SYSTEM

- First introduced in 1996
- Sealed, plug together system
- Ensures solid weather-tight electrical contact
- Eliminates the need for junction boxes, distribution outlets & troublesome splices
- Internal ground guarantees reliability
- Color coded connections & wires
- Rear 7-way adapter offers versatility

LIFETIME SYSTEMS WARRANTY

Major step towards making vehicles safer and longer, Truck-Lite's Lifetime Systems warranty offers significant reduction in maintenance costs, and provides the piece of mind that the often temperamental lighting system can be free from worry. Keeping drivers on the road, Truck-Lite's Lifetime System is desirable for it's stability.

Complete Systems Approach

The common downtime and repair of incandescent lighting extends past the price alone of replacement lamps.

Part Cost + Labor + Downtime

Truck-Lite's Value Analysis Software (provided on CD) helps to tell the complete story of downtime costs failed lamps can lead to. While the initial cost of LED lighting products may be higher, the advantages of not having to replace or repair the lamps will result in significant savings over the life of your vehicle. The LED purchase will provide a QUICK return on investment!

Downtime is costly. When you add in the additional costs of repair and replacement parts, to extend the lifetime cost of your lamp to a much greater value. The cost savings in the absence of downtime and repair can easily make up for the higher up-front cost of Lifetime LED lighting.

Notes:

Sales & Marketing Support

TOOLS
SUPPORT TOOLS

SECTION OBJECTIVES
1. Sales & Marketing Support
2. Laboratory Support
3. Technical Support
4. Truck-Lite.com
5. Industry Links

What Can the Truck-Lite Sales & Marketing Department provide for additional Support?

- New catalog with over 300 new products
  - Trilingual, user-friendly design
- Web enhancements
  - On-line catalog & training programs
  - New product updates
  - Press releases
  - Technical support via e-mail and FAQ's
  - Sales Territory Maps
- Lighting User's Guide CD
  - Truck-Lite Catalogs, Brochures and Product Flyers (Acrobat Reader)
  - Vehicle Life Cycle Cost Estimator - Allows the user to calculate cost of different types of lamps over the life of the vehicle(s)
- Field sales assistance

LABORATORY SUPPORT

What Can Truck-Lite's Laboratory provide for Sales & Product Support?

- Analysis of any product failure
- In-field assistance on product performance problems
- Letters for specific product certification (routine requests go to Customer Service)
- Certification for variation in mounting positions
- Letters or calls to clarify legal questions for lighting
- Warranty analysis and/or reports
- Product test data on almost every product in our catalog
- 'Vapor Proof' or non-incedive certification letters and reports
- Photographs of product features, defects, mountings etc.
- Shock mount performance information
- License plate light mounting positions
- Testing of solvents or cleaners for compatibility with plastic
- Physical properties of plastics, paints and materials

- Questions on bulb life, amperage, light output, wattage, corrosion, resistance, low temperature resistance etc.
- Laboratory tours, seminars, demonstrations
- Field test programs in cooperation with Sales & Engineering

Technical Support

What Can Truck-Lite's Technical Support Department provide for Sales & Product Support?

- Keeps current with internal design changes and new product development
- Informs engineering of new customer requests
- Serves as central technical resource
- Maintain database/log of customer inquiries and resolutions
- Coordinating technical liaison services with any application and/or installation practices using Truck-Lite's products between:

- Management	- Research & Engineering
- Production	- Customer Service
- Sales & Marketing	- Customers

Truck-Lite.com

What Can Truck-Lite's Corporate Website provide for Sales & Product Support?

- Provides preventive maintenance documents and resources
- Includes a Technical Help form to send questions directly to Truck-Lite's dedicated Technical Support staff
- Lists NHTSA regulations charts and legal Q&A
- Online catalog offers product information on over 5,000 products, including dimensional drawings, photos and product features

- Utilizes a fully searchable catalog to list every newly released product as soon as it becomes available
- Provides downloadable catalogs and product flyers of all of Truck-Lite's major literature

Industry Links

DAVCO - (www.davcomfg.com)
Makers of Fuel Pro®, Diesel Pro®, and Sea Pro® lines of fuel filtration systems

SAE International - (www.sae.org)
One stop resource for technical expertise used in designing, building, maintaining & operating self-propelled vehicles for land, sea, air and space

NHTSA - (www.nhtsa.com)
United States Department of Transportation resources regarding vehicle safety information

TSEI - (www.tsei.org)
The Transportation Safety Equipment Institute (TSEI) provides government representation and market research services, monitors proposed and enacted legislation and regulations, and serves as a technical forum to resolve industry problems

TMC - (www.trucking.org/cc/councils/tmc)
TMC is dedicated to a single purpose — providing maintenance and technology solutions to the trucking industry through education, networking, and standards development. If you're a motor carrier, manufacturer or industry service provider, you'll find that TMC is a valuable organization you'll want to join.

Index

Glossary

Acrylic - A glassy thermoplastic polymerized from acrylonitrile which can be cast and molded, which is resistant to damage from many cleaning solvents.

Aftermarket - A term that refers to the market place for our replacement or retro-fit business. The customer in this market is replacing an existing lamp or accessory on his vehicle.

Bracket - A rigid mounting device that allows a lamp to be mounted on the surface of the vehicle body. Some brackets are designed to be used alone or with a grommet.

Bulb Replaceable - Opposite of sealed. The lens is removable on a lamp of this type. When the bulb fails, the lamp may be repaired by replacing the bulb.

Cab Marker - A lamp similar in function to the marker clearance lamp, but these are always mounted on the roof of the truck or tractor cab. Technically, these are called a front identification or ID lamp.

Custom Cut - A term that refers to the harnesses that must be cut and terminated to the customer's specifications.

DOT - United States Department of Transportation, was created to serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

Grommet - A rubber like device used to mount a lamp into a hole in a vehicle body or a mounting bracket. The grommet may allow a lamp to be mounted "flush" into the body and thereby protects the lamp from physical damage. A grommet also gives the lamp additional protection against shock and vibration.

Harness - Also a wiring device. A harness can include MULTIPLE plug connectors and be used to control different types of lamps. Harnesses tend to be heavy duty, jacketed cable as opposed to lighting duty, unprotected wire as in "plugs".

HID - High Intensity Discharge, produces light by an electric arc between two closely spaced electrodes in a quartz glass bulb.

HIR - Halogen Infra Red, is a halogen lamp with an elliptical bulb envelope. The exterior of the bulb is coated with several layers of material, which are transparent to visible light but reflect infrared back to the filament. The effect is a brighter light for a given current.

ID Codes - ID Codes are the classifications given to various lighting applications in order to establish minimum requirements set forth by the SAE J759 regulations.

Junction Box - An accessory used with harness systems. All harnesses in a system are connected to this box. Signals from the control devices (switches on brake pedals, turn signal switches, etc.) are received in the accessory and are re-routed to the appropriate lamps via the harnesses.

Kit - A Truck-Lite term used to describe the combining of related products. For example, a lamp, a grommet, and a plug can be put together and sold as a unit or "Kit". A "Kit" can also be an entire "vehicle set", including all lamps, harnesses, and accessories needed to equip a vehicle.

LED - Light Emitting Diode. A "solid state" electronic device that converts electrical energy directly to light energy. When an electrical current is applied to the LED "chip", a colored light is emitted. The color depends on the chemical composition of the chip. Very little heat is produced with this process. Because the "diode" is cast into a solid block of epoxy, the LED is immune to vibrations and shock and can last up to 100,000 hours of operation.

Marker Clearance - Also called marker lamp. A small lamp used to mark the edges or corners of the trailer or truck body. These are normally amber in the front and middle of the vehicle, and red at the rear. Other colors are available for "auxiliary" use, but only red or amber (yellow) are legal for the use as marker clearance lamps in the U.S.

Module - A term used to describe a complete rear lighting assembly. The module usually consists of a housing (metal or plastic) with one or more tail lamps, and includes a harness or wiring assembly. The module may also include a marker lamp , reflector, or back-up lamps.

Multi-Function Lamp - A specialized Stop/Turn/Tail lamp. This type of lamp usually has a larger housing and can include side marker, license plate illumination, or reflectors, in addition to the basic rear lighting function.

NHTSA - The National Highway Traffic Safety Administration creates values and regulations which underpin the assurance of safe, secure, efficient automotive travel.

Ohms Law - Ohm's Law describes mathematically how voltage, current and resistance in a circuit are related through the formula: V = I x R, where V is equal to Potential in Volts, I is equal to current in amps and R is equal to Resistance in Ohms.

Plug Together Harness - The "brand name" for Truck-Lite's 88 series harness system and accessories. It features a system that eliminates the need for any type of distribution module. All components simply plug together insuring a solid electrical contact throughout.

Plug/Pigtail - The basic wiring accessory. Usually a 1, 2, 3, or 4 wire design with termination designed to mate with a socket or pin connection area on the lamp.

Polycarbonate - Any of a family of thermoplastics characterized by high-impact strength, light weight, and flexibility, and used as a shatter-resistant substitute for glass.

Reflector - A non-powered (non-electrical) device designed to reflect light. A reflector does not emit light by itself, but will return light that is aimed at it. Reflective tape or reflectors are required by law to supplement lighting systems.

Sealed Lamp - Any lighting device that has its bulb permanently sealed inside the lens and housing assembly. When this lamp fails, the entire unit must be replaced, unlike a bulb replaceable lamp.

Shock Mounted - A system used to suspend and insulate the bulb from vibration and shock (impact).

Stop/Turn Lamp - A rear lamp that is brighter than a tail lamp used to indicate that the vehicle is turning or stopping. The “major” filament of the bulb is used to perform this function. Sometimes referred to as a “SC” or since contact lamp.

Stop/Turn/Tail Lamp - A rear lamp that contains one or more bulbs with both major and minor filament functions, This one lamp performs the duties of both the Stop/Turn lamp and Tail lamp. Sometimes referred to as a “DC” or double contact lamp.

Super System - The “brand name” for Truck-Lite’s 50 Series Harnesses and accessories. This system features both the “custom cut” and customer buildable harnesses. “Compression fittings” are used to seal outlets where harnesses enter the junction box.

Tail Lamp - This term is used in general to describe the rear lighting of the vehicle. Specifically, the tail lamp function is performed by the “minor filament” of the bulb. This red light remains “on” as long as the headlamps/parking lamps are in use. This light is not as bright as a turn or stop lamp.

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