

# Lighting Requirements when Converting a Truck Tractor to an RV Hauler

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# Overview

- General lighting and electrical principles
- Who regulates automotive lighting
- What lights/markings are needed and what purpose do they serve
- How to find “good” lights, and put the right light in the right place

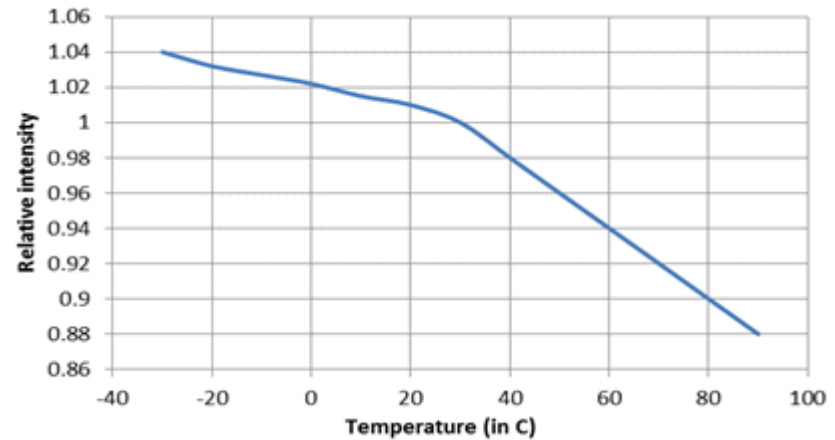
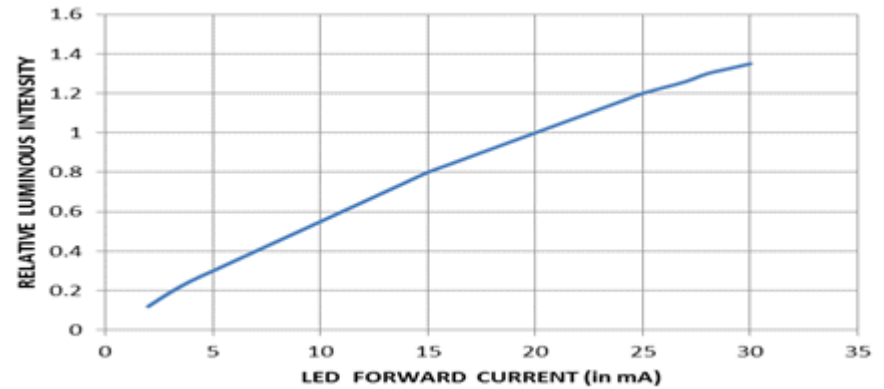
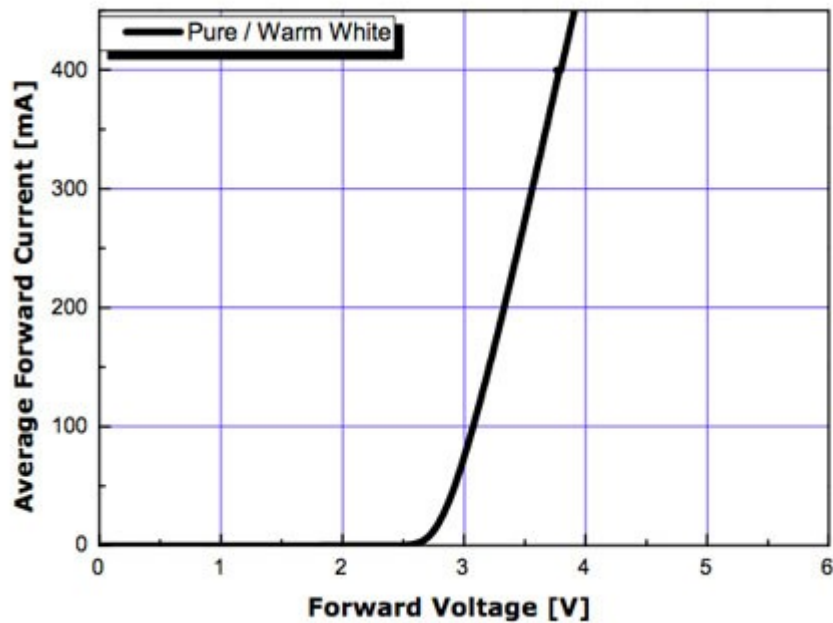
# Basic Lighting Principles

- For incandescent bulbs, brightness is roughly proportional to power, so getting full voltage to the lights is critical, and requires good wiring and solid connections.

$$P = \frac{V^2}{R}$$

- Lights are tested at 12.8V—anything less and the light may not be as bright as required.
- At 11.5V at the bulb, brightness is reduced 25%
- LEDs draw less current, so wiring voltage drop is reduced, but LEDs are more sensitive to voltage.
- Lights should be mounted facing the direction required—either directly to the rear or side, not at angles. Some lights have a “TOP” marking also specifying the direction the lamp should be oriented on the mounting surface.

# LED Characteristics



# Basic Lighting Principles

- The lighting standards are intended to make sure a consistent message regarding the size, orientation, and operation of a vehicle is presented
- Even though most drivers don't know the details of the standard, we all use lights required by it to discern what other vehicles are doing and how big they are (especially at night)
- Red should only be on or at the back, white should only be on front (except reverse lights).

# Who regulates automotive lighting?

- Automotive safety standards are part of the Code of Federal Regulations, 49 CFR 571, the Federal Motor Vehicle Safety Standards (FMVSS)
  - Canada's standards (CMVSS) are virtually identical; the rest of the world uses Economic Commission of Europe (ECE) standards.
- Within the standard, there are a couple of relevant sections regarding applicability:
  - *A manufacturer, distributor, dealer, or motor vehicle repair business may not knowingly make inoperative any part of a device or element of design installed on or in a motor vehicle or motor vehicle equipment in compliance with an applicable motor vehicle safety standard prescribed under this chapter*
  - *When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter.*
  - *Compliance with a motor vehicle safety standard prescribed under this chapter does not exempt a person from liability at common law.*
- FMVSS 108 addresses lighting and conspicuity markings.
- Many “letters of interpretation” have been published addressing specific questions regarding the standard.

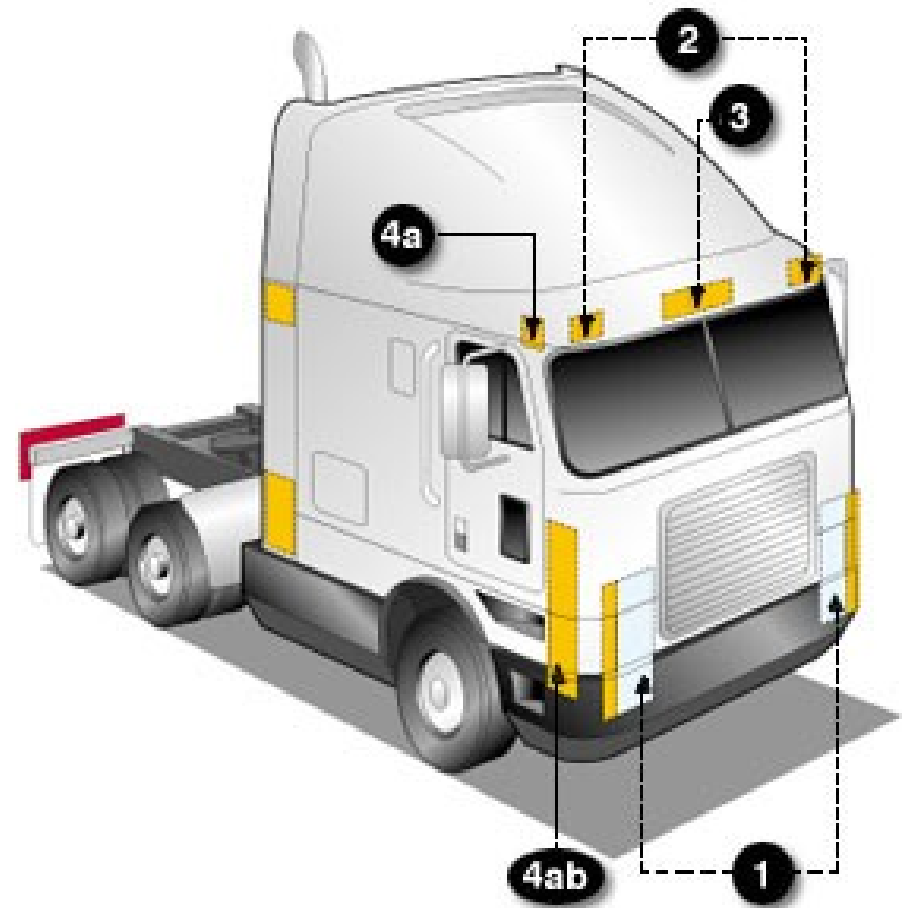
# Who regulates automotive lighting?

- State and local law enforcement agencies can issue citations for deficiencies based on local laws
  - This includes both requirements for equipment not included in federal standards, and prohibitions on equipment otherwise allowed.
  - e.g. 33 states require carrying flares and/or emergency reflective triangle signs
- Odds of being cited are generally small, and often include a “fix it” requirement alone or with a fine
  - The “fix it” requirement for a full-timer can be a hassle, in many cases requiring a trip back to the locale where the citation was issued to prove a repair was made.



# Starting with a truck

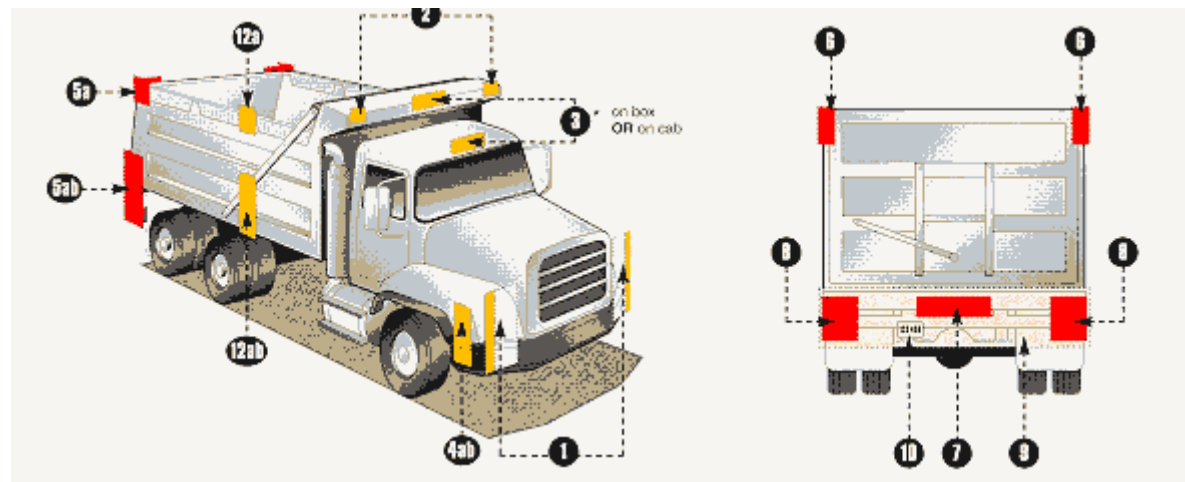
- If you've bought a run-of-the-mill over-the-road truck, it likely already meets the requirements of a truck tractor
- It's not a vehicle designed to carry any cargo—only for towing trailers, and only rarely operated without a trailer
- It is required to meet all lighting requirements except:
  - Rear clearance and ID lights
  - Rear side reflex reflectors
  - Rear side marker lamps
- It is also required to have conspicuity tape 2 places:
  - Rear upper body marking (L-shape on back of cab)
  - Rear marking (strip across top of mud flaps)





# What changes by adding a bed?

- It's no longer just a vehicle for pulling a trailer
- Practical places for mounting lights now exist
- It's much more likely to be driven without pulling a trailer (regardless of how you personally intend to use it)
- The truck may become longer, possibly exceeding 30' in length



# What lights does my bed need?

## On back:

- Tail lamps
- Brake lamps
- Stop lamps
- Turn signals
- Clearance lamps
- Identification lamps
- License plate lamp
- Reverse lamp(s)
- Rear reflex reflectors

## On side:

- Rear side marker lamp
- Rear side reflex reflector
- Intermediate side marker lamp
- Intermediate side reflex reflector
- **Intermediate turn signal**

# Tail (T2), stop (S2), and turn (I6) lamps

## **Purpose:**

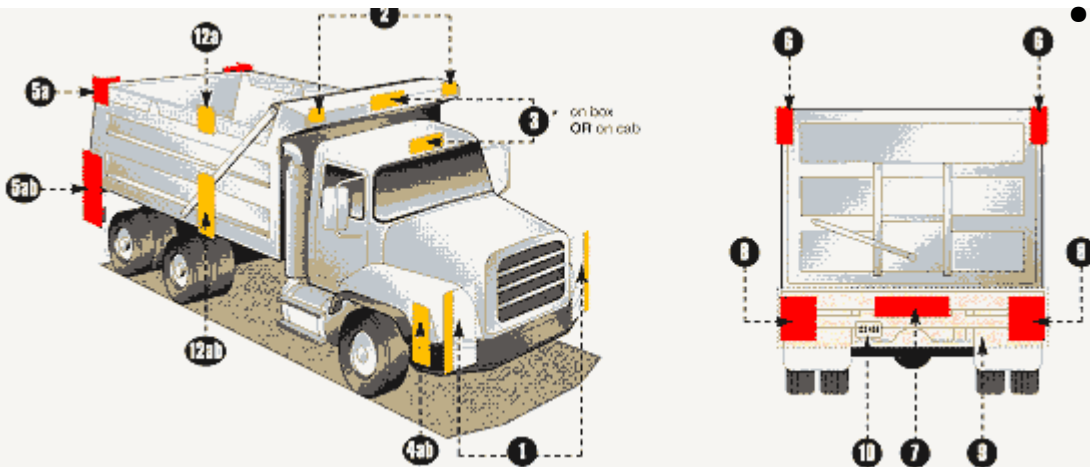
- To signal the presence and width of a vehicle, and to indicate when it is braking, turning, or disabled.
- **How many:** 2 minimum
- **Where:** On the rear - symmetrical - as far apart as practicable - facing rearward, 15-60" above the ground
- These lights should not be combined with any other functions.
- Turn signals should be mounted outboard of brake lights (if separate, which is recommended)

# Reflex Reflectors (A)

## Purpose:

- To signal the presence and size of a vehicle, particularly when parked or otherwise disabled

- **How many:** 2 rear, 2 rear side, **2 intermediate side**
- **Where:**
  - (2 red) On the rear - symmetrical - as far apart as practicable - facing rearward, 15-60" above the ground
  - (2 red) On the side at the rear, 15-60" above the ground
  - (2 amber) On the side near center – roughly front of bed side for most

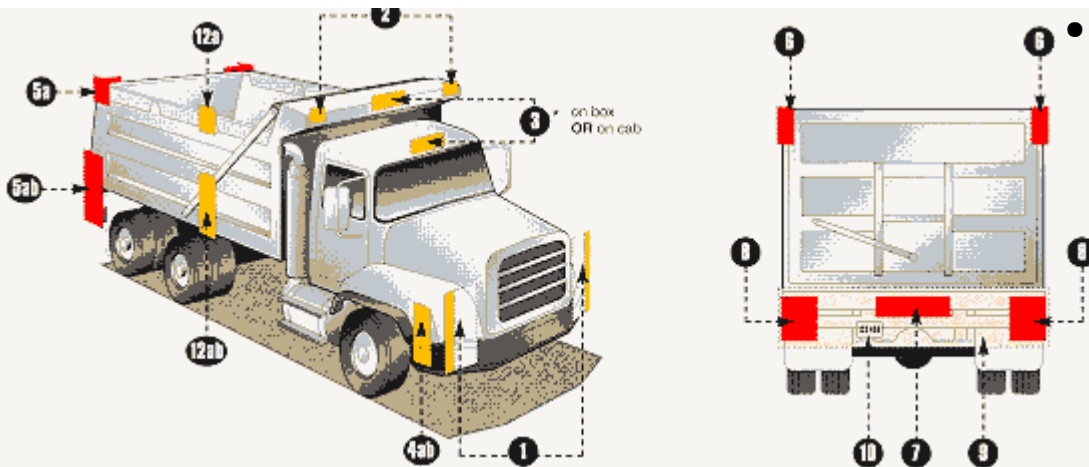


# Side Marker Lamps (P3)

## Purpose:

- To indicate presence and length

- **How many:** 2 rear, 2 intermediate
- **Where:** Each side at rear, and each side near center, as far back as practicable, at least 15" above ground
- Intermediate side markers can be repeated along vehicle's length. At least one for every 12-15 feet of length recommended.
- Side marker lights can be wired to flash with turn signals

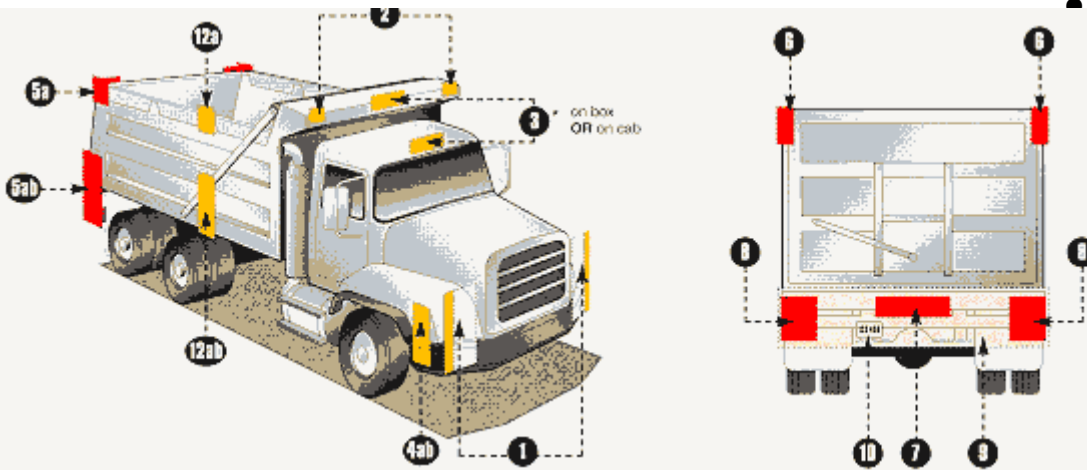


# Rear Clearance Lamps (P2)

## Purpose:

- To show the width of a vehicle

- **How many:** 2 minimum
- **Where:** At widest point, on the rear or near the rear, **symmetrical**, facing rearward, as high as practicable. May be lower only if ID lamps are at top.
- May not be combined with tail lamps.
- Top of rear side of bed, and/or top corners of sleeper/drom box



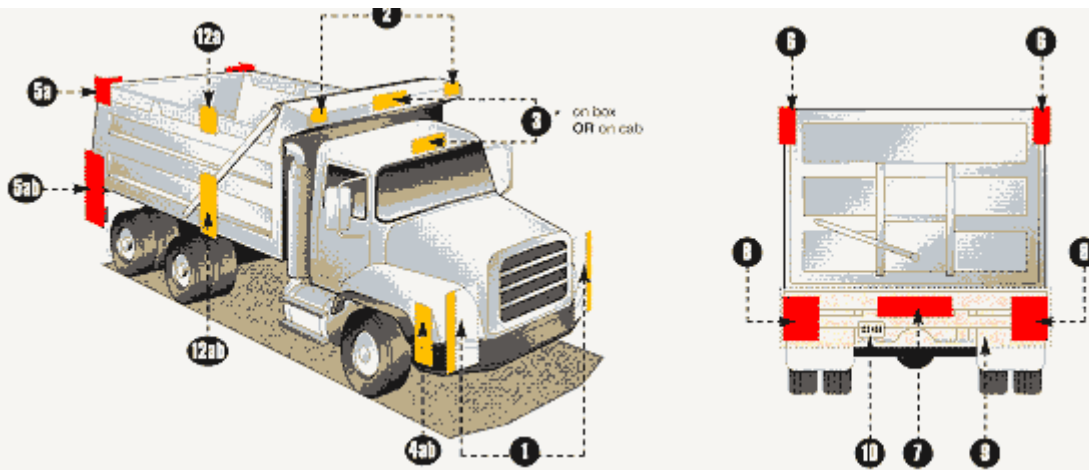
# Rear Identification Lamps (P2)

## Purpose:

- To indicate presence of a wide vehicle

- **How many: Exactly 3**
- **Where:** Rear - center - horizontally spaced 6-12 inches apart, facing rearward
  - US: As high as practicable
  - Canada: At the top
- May not be combined center brake light. No lights in between each of these lights.

Either top of rear side of bed, or top of sleeper/drom box



# Backup and License Plate Lights

## *License Plate Light (L)*

- **How many:** Minimum 1, white
- **Where:** On the rear, above or beside license plate. No mounting height or left-right position requirement.

## *Backup Light (R)*

- **How many:** Minimum 1, white
- **Where:** On rear



# Finding the Right Lights

- There are no *DOT Approved* lights. Anyone claiming this is either misinformed or lying. A light should, however, be certified by its manufacturer as DOT compliant.
  - When you see this language from a vendor or manufacturer, it's probably safe to assume either that the product isn't compliant, or that the vendor isn't qualified to help you find what you need (or both)
- If it's labeled for off-road or show use only, it shouldn't be connected to any of your truck's lighting circuits. It's also illegal to sell a light for use on a motor vehicle that doesn't meet FMVSS 108 even if it's intended for off-road use.
- LEDs themselves are fairly reliable and made by only a handful of companies, but the reliability of the boards they're mounted on and the quality of the driver circuits varies quite a bit. Generally:
  - Stick to name brands
  - Look for the SAE type code, and make sure the light is designed for the function you need
  - Look for multiple resistors on the light's circuit board. Cheaper lights will use resistors to roughly control current through strings of (usually 3) diodes—this method doesn't sufficiently protect the diodes from higher voltages, and they're much more likely to dim if the voltage drops.

# Shopping List

- 7 Red marker/clearance lights with reflex reflectors (P2 or P3, A)
  - e.g. Signal-Stat 1052, 18050R, 21251R
- 2 Amber marker/clearance lights with reflex reflectors (P2 or P3, A)
  - e.g. Signal-Stat 1052A, 18050Y, 21251Y
- 2 Reverse lights (R)
  - e.g. 4060C, 44350C
- 1 License plate light (L)
  - e.g. 15061
- 2 (minimum) or 4 (recommended) Stop/tail/turn lights (T2, S2, I6)
  - e.g. Super44 44030R
- Wire, plug shells, pins, weather seals, mounting grommets and/or screws
  - Pre-made harness option

# Recommendations

- Keep the primary functions (stop, tail, turn, and reverse) in the same general area
- Use amber turn signals where possible (5% reduction in rear crash rates)
  - Not easy on truck
  - Strongly recommended on trailer
- Add a center high mounted stop lamp (red) on vehicle centerline that activates with brake signal, 34” minimum above ground on vehicle centerline
  - Brake light feed from stock trailer connector is easiest place to access this
- Leave (or install) conspicuity tape on back of sleeper and across top of mud flaps (truck tractor requirement)
- Be particularly attentive to mounting directions with LED lights
  - All lights directly facing to rear (or side), not at angles
- Walk along side of and around truck looking for places where lights may be obscured. Think about where other drivers are likely to be (e.g. adjacent lanes).
- Don't be scared of the Volvo LCM—it may seem to do strange things, but most of the time is there to help you.

# What about the front of my truck?

- Generally speaking, you shouldn't have to make any changes here, provided everything is working.
- Here's what's required:
  - High and low beam headlamps
  - Front turn signals
  - Front clearance and identification lamps
  - Front side marker lights and reflex reflectors
  - Parking lights and daytime running lights are not required in the US
    - Canada does require DRLs.
    - On 2<sup>nd</sup>-generation Volvo VNs, DRLs are also turn signals; on 1<sup>st</sup>-gen VNs they're also low beam headlights, so you still need the bulbs to be working.
    -

# What about my trailer?

- It's not uncommon to see RVs that have left out or improperly mounted required equipment
  - Some remedies are available via manufacturer; your notification to them starts a process that requires correction of the problem independent of any warranty.
- Requirements for the rear of the trailer are similar to the truck bed; a few extra lights are required for the front and side:
  - Stop, tail, and turn lamps
  - Rear reflex reflectors
  - Rear clearance and identification lights
  - Front clearance lights
  - License plate
  - Rear side marker lamps and rear side reflex reflectors
  - Front side marker lamps and front side reflex reflectors
  - Intermediate side marker lights and reflex reflectors (30' or longer)