# Truck Fires – Top 10 Causes

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Tractor trailers, RV's, heavy equipment, farm tractors, combines and smaller trucks are all expensive assets and a great loss to a company if one is disabled by a fire. The only thing you know: Nobody knows what caused the fire. Was it a manufacturer's defect? Operator error? Improper aftermarket work? Component malfunction? Human involvement? Lack of maintenance? A proper and thorough fire investigation can protect your interests and possibly help you to recoup some of your loss. This paper is focused on truck tractors, although many points also pertain to other commercial vehicles.

Most tractor fires occur while the truck is cruising down the road. The engine is running, all electrical systems are energized, brakes may be hot, the exhaust system is hot, fluids are flowing and tires are turning. In other words, all potential ignition sources are working. When the truck is parked and off, most of the ignition sources are also off. The exhaust remains hot and can be an ignition source for several minutes, until the heat dissipates. This hot surface for ignition remains hot enough for only minutes, not hours. An electrical short can occur at any time, but is less likely when the truck is off. A short circuit usually occurs due to wear and vibration, which is more common when the truck is running. A short can often start small, slow and unnoticeable, until it grows and causes a fire hours later, infrequently days later.

An accurate cause determination depends on the amount of damage. If the cab and hood are burned, all the electrical wires are melted and in pieces, and engine parts are partially melted, the cause cannot be proven. Sometimes, false determinations are made in an attempt to "extort" money from an innocent. A good investigator can prevent this, often before it happens. To protect your interests, do not send a failed part back to the manufacturer.

1. **Electrical Short - Engine compartment**
   In the over 500 vehicle fires I have investigated, the most common cause of a tractor fire is an electrical short in the engine compartment. Most tractors have multiple batteries, usually under the driver's step. From here, large gage "hot" wires travel through the metal box, along the frame rail, around, over and under metal and combustible components to multiple locations in the engine compartment. These include the starter solenoid, alternator, fuse panels, other solenoids, and possibly other locations. All these wires are large, carrying 12 volts, over 3,000 amps, and are typically unfused. This means that if a short circuit starts, it won't stop until the batteries are disconnected or lose power. Through and around metal components, the wire's thin insulation is often the only barrier. During years of use and vibrations, the insulation rubbing on the metal can wear through, allowing the "hot" copper wire to contact the grounded metal components and start a short circuit. (The arcing can cause the insulation to char, causing long term arcing through char.) An electrical short occurs at over 5000 ° F, (hot enough to melt iron). This overheating can ignite the insulation and any nearby combustibles. The shorted wire can overheat completely back to the batteries, cause additional arcing, and ignite any combustibles along its path, including diesel hoses. However, a fire from another source can damage these wires and cause them to arc. Other factors should be explored to determine if the arcing caused the fire, or was merely a result.

## 2. Arson

About 20% of all fires are intentionally set. There are a variety of motives why somebody might want to burn their tractor or another. Arsons often go undetected due to lack of resources, training and knowledge, or lack of effort. Although not proof, arsons often occur in the middle of the night, when the engine is off, and often in an unpopulated area. (The discovery of the fire takes longer, the Fire Department will have a longer response time, the truck will more likely burn completely, and little or no evidence will remain.) Usually, an arsonist will accelerate the fire by pouring gasoline in the passenger compartment, sometimes in the trailer, but rarely in the engine compartment. If the cab burns completely, the evidence is gone. However, the more that remains the more likely evidence of arson remains also. Gasoline will burn down through cushions, burn tracks in carpet, collect and burn in low areas. The gasoline will usually not burn completely away. The scene must be cleaned, patterns analyzed and samples taken from properly identified and likely locations. A chemical analysis of the debris can distinguish between gasoline, diesel fuel and other accelerants. There is no reason for traces of gasoline to be in the cab of a diesel truck. (Gasoline is more commonly used than diesel, because it ignites more easily.) Diesel fuel typically can't get into the cab, even during a fire. If arson is suspected, an investigation should be conducted ASAP, before the gasoline evaporates.

## 3. Electrical

### a) An Un-fused Electrical Add-On

Radios, CD players, data loggers, CB's, coolers, specialty boxes, stereos, radar detectors, satellite communications, heaters, stoves and chargers are all examples of aftermarket items which are often added to the completed truck. Usually, these components are properly installed by experienced servicemen who have all the tools and correct components they need; such as fuses, wires and grommets. Sometimes the work is not 100% correct. It is not uncommon for the truck driver to do much of the electrical work himself. Unfused circuits, connecting to the wrong side of the fuse panel, wrong wire size, lack of grommets through metal, poor wire routing and protection, improper installation, mechanical damage and improper use are just some examples I've seen.

### b) Water Entry - Electrical Short

Electrical short fires can be caused by water entry, by rain, inside spills and power washing. Electrical components in the engine compartment and below the cab are often not sealed water tight or the seal can become worn and broken. Water, especially from high powered pressure washing, can cause the electrical components inside to short circuit, overheat back to the energy source, and ignite any combustibles nearby. They say that water is an insulator, but only pure water. Any contaminant changes water into a conductor. Almost all water has contaminants; chlorine, road dirt, cleaners, salt, oil, etc.

## 4. Trailer Fires: Brakes, Bearings, Flat Tire

Truck fires don't usually start at the trailer because there are few ignition sources. Often, the available fuel can be huge and the contents costly. A trailer fire can originate at the refrigeration unit, which should be obvious. A refrigerated trailer has another engine and compressor with electrical, fuel and exhaust systems, which can fail. A trailer fire at an axle should be obvious, but there are only a few potential causes.

When wheel bearings run out of lubrication, friction causes them to become hot. Hot enough for the cages to dislodge, the races to wear away and the roller bearings to disintegrate. The temperature can get hot enough to ignite residual grease, brake phenolic, and the tire. Once the tires start burning, the trailer and cargo often ignite shortly thereafter. The normal question is: "Why did the bearing run out of lubrication, (oil or grease)"? Compare the failed bearing to bearings for the adjacent wheels. Even after a fire, innocent bearings should look good and rotate easily.

Brakes can be improperly installed or adjusted, air leaks can occur, can be too worn, be improperly assembled or components can break. A dragging brake can be difficult for the driver to "feel" when pulling a heavy load. A dragging brake can overheat to the point that the brake pad phenolic and even the tire can ignite. A brake fire will usually leave indicators on the drum and pads themselves. Compare these to the brakes on the other axel.

If the bearings and brakes can be eliminated, consider the possibility of a flat tire. With two axles and dualies, sometimes a tire can go flat and be unnoticed for a long time, since the other tires carry the load. (Ever seen pieces of truck tire on the highway?)
A flat tire can overheat by:

-Spinning on the rim.
-Rubbing against the other tire or frame rail.
-Being stuck and dragging on the road.
-Impacting the bottom of the trailer

All while scraping metal creates sparks. Heat patterns and rub marks in these areas can be obscure.

## 5. Vehicle Accident

Occasionally, a truck accident will result in a fire, especially in multi-vehicle collisions. Fires don't usually occur in smaller incidents, and vehicles don't burst into flames when they drive over a cliff, like in the movies. Oftentimes, there are misdirected investigations into a defect or malfunction 'cause' of the fire. Check the timing, but the cause is usually related to mechanical damage resulting from the accident. Even though diesel doesn't give off ignitable vapors until heated above 100 °F; in a high speed accident, if the tank is impacted or ripped, the fuel can be mechanically atomized; as ripped metal hitting the road creates sparks. The diesel fuel doesn't have to be pre-heated to ignite under these conditions. A cars ruptured gasoline tank can also be a factor. It's not too surprising that a fire occurs if the fuel container is compromised.

## 6. Exhaust systems

Exhaust gases can reach temperatures of up to 1000 ° F. At the catalytic converter and DPT, they can reach 2000 ° F. Normally enclosed in a path of metal pipe; the hot gases are exhausted to a safe place, above the cab roof. If there's a break, corrosion or a leak in the exhaust pipes, the hot gasses escaping can impinge combustible materials and cause a fire. In some cases, the exhaust pipe breaks near a plastic/rubber fuel line. An exhaust leak directed up can burn into a combustible floor, even through a bottom layer of sheet metal. Any combustibles too close to the hot exhaust pipe can ignite, sometimes after years of exposure: (Pyrolysis). I worked a case where a driver changed a tire and strapped the old torn up tire to the back of his cab. The torn rubber flapped against the vertical exhaust pipe, caught on fire and burned the entire tractor and trailer.

7. **Fluid Leaks**

Diesel fuel, hydraulic oil, antifreeze, power steering fluid, butane, brake fluid, windshield washer fluid, and engine oil are all ignitable liquids found in the engine compartment of a truck. Fuel fires are less common in trucks than automobiles; mainly because gasoline ignites at all common temperatures, while diesel fuel does not. Diesel fuel has to be heated above 100 ° F. to give off enough flammable vapors to burn. (That doesn't mean you should check your fuel level with a lit match, as vapors can be created mechanically too, not just by heating.) Most trucks have the fuels on the driver's side and the exhaust/turbo on the passenger's side. The fuels and ignition sources are somewhat separated. However, fuel leaks can spray, accumulate or atomize in the engine compartment. The turbo runs hot enough to ignite any fuel which comes in contact with its housing. It should be determined if a leak caused the fire or was a result of heat exposure during the fire.

8. **Recalls**

Recalls can include anything from a loose grounding strap to a faulty gasket. Recalled items are often unusual and obscure. Multiple fires originating from the same area will get the manufactures attention. Then they'll figure out why the fires occur. Of course, the main reason for a recall is: money. The manufacturer doesn't want to lose money on a product through lawsuits (ie: like the ignition switches). A recall and repairs are also costly. Whichever costs the least, wins. If only one in a million will fail, the potential lawsuits will be cheaper. Manufactures don't want a recall, or want it limited to specific months of manufacture; even though products outside the recall dates can often fail in the same way.

The trick about determining if the recall was the fire cause is the same as in any fire**.** Can you prove that the recall item caused the fire, and can you rule out all other possible causes? Many investigators will determine the recall was the cause, before they've even seen the truck: Tunnel vision. A recall only gives you an important area that must be looked at. From there, a thorough investigation must:

-Eliminate other possible fire causes.

-Have proof remain that the recalled item did fail.

From my experience, over 50% of the time, the recalled item did not cause the fire. If you can't prove it, you'll lose it in court. Proof is different than speculation or witnesses observations.

9. **Human Involvement/Non-Arson**

Most fires are caused by one thing: Carelessness. Then, they are afraid to admit to it, thinking that they might be fired, might not be covered by insurance, or they may look foolish. Smoking, cooking, candles, incense, heaters, improper use, hot work, leaving items unattended, and drug use are all human involved potential fire causes.

Of course sometimes they will admit to doing something foolish. It's actually been admitted to me, 5 times out of 2500 fires, or .2% of the time!

If someone did do something foolish, they probably won't admit it. Sometimes, they blame other items or speculate. Like: "I didn't leave the stove on. It must have malfunctioned and come on by itself." Then, the stove needs to be secured, examined and tested. This is all a waste of time and money.

People need to understand: “Carelessness is insured.” For the most part, if an insured does something unintentionally foolish and it causes a fire, they are covered. Many fires which go to lawsuit were determined improperly; based on witnesses’ statements, jumping to conclusions, speculation, or intentional misleading. This wastes everybody’s time and money. A thorough cause determination will uncover these falsehoods. A speculative inspection will not.

## 10. Oil/Gas/Vacuum Trucks/Pressurized Tankers

This category deserves its own paper. Crude oil, oil well water, gasoline, flammable compressed gases in trailers, etc. all present their own problems. As long as the special codes, regulations and recommendations are followed, everything should operate without problems. But when they are not followed, or shortcuts are taken, disaster can follow. It usually happens at the worksite during loading or unloading.

When handling ignitable liquids, the basic rule of fire prevention must be followed:
Flammable vapors and ignition sources must remain separated.

If flammable vapors are being vented, all nearby ignition sources must be eliminated. This includes eliminating static electricity. Fluid flowing through a pipe or hose creates static electricity which can discharge and ignite a flammable atmosphere. Even waste water from the oil field contains some ‘gasoline’ and vapors which can ignite. Understanding the chemicals and their properties is critical to a proper investigation.

Here are some brief safety considerations, which I’ve seen ignored and cause fires:

-Diesel engines will and do ignite flammable gases, sometimes in a runaway condition. Adequate distances should be maintained between ignition sources and vented vapors.

-Flowing gases can be safe with the wind blowing, but consider the danger if the wind stops or changes direction. Watch wind socks, flags and tattletales.

-Heating stuck valves, using a Hotsy or welding on sludge encrusted tanks, will create flammable vapors which can explode. The hot work creates flammable vapors and can also be the ignition source.

-Flammable gases in the field don’t have odorant, so they don’t smell strongly. At the same time, well sites usually smell like oil, everywhere. Remain aware of the potential for flammable gases.

-Well site flammable gases can be explosive down to 2% in air. That’s not much. All of these gases, except methane, are heavier than air and can accumulate in low areas. If blown into the air, the vapors can fall back down and pool in areas. Utilizing a combustible gas detector, (LEL, or 4 gas monitor) is a good idea when working with flammable vapors.

-Crude oil usually contains gasoline and lighter components, (propane, natural gas, etc.), whose vapors are ignitable at all normal temperatures.

-Water (from a well), will often contain some ‘gasoline’, which floats on top of the water and gives off flammable vapors, which can ignite explosively.

-Workers should avoid complacency. The safety rules and regulations should be followed.

-Sometimes, an immediate situation occurs where flammable vapors and an ignition source are both present simultaneously. Reduce/remove the fuel flow, if it can be done safely. Otherwise, just get away. Do not enter an explosive atmosphere until it is safe to do so. Entering can introduce additional ignition sources and cause a flash fire.

-Don't assume that the previous worker left everything safe. Utilize your own lock-out/tag-out procedures and double check for dangerous conditions.

-Any fluid flowing through a pipe or hose creates static electricity, which can discharge. Plastic pipe makes it worse. Plastic should not be used in the oil field. Equipment should be properly grounded.

-Special circumstances often occur and conditions change. Workers should not be afraid to shut down an operation to wait, or change the configuration. Such stops should be welcomed by the company and parties involved, for safety's sake. Workers or companies should not be reprimanded for a safety delay, which possibly saved somebody's life.

Truck fires are very costly. An inaccurate origin and cause determination can cost even more. Frivolous lawsuits; an unidentified arson; blaming the wrong entity/product; not following through with a provable claim; speculative conclusions, are all a waste of time and money. A proper and thorough investigation gives you the best odds of determining the real root cause and liability.

Hiring a qualified and experienced fire investigator is the best way to protect your interests.

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