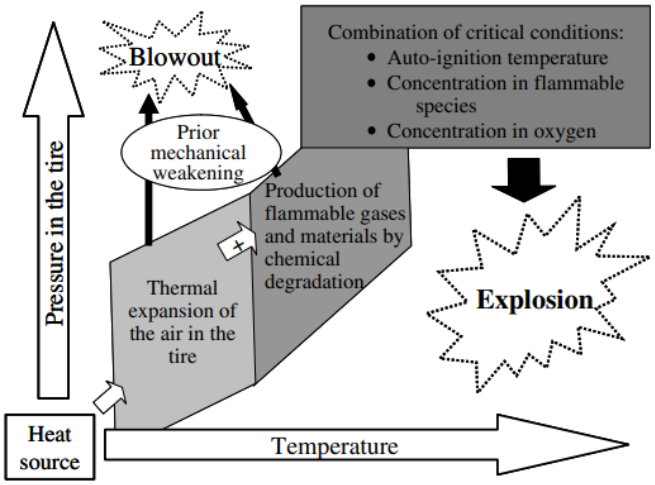
Safety Bulletin - Large Vehicle Tire Fires

Overview: A tire blowout occurs after the mechanical failure of the tire or rim assembly at pressures typically around 145 psi. Tires exposed to heat may undergo the process described below and violently explode.

Explosive Process: There are three phases leading to a tire explosion:

1. Air pressure inside the tire will rise from 90 to 235 psi as temperatures rise.
2. At approximately 365º Fahrenheit, the rubber undergoes a runaway exothermic reaction and releases flammable gases that increase pressure within the tire. This reaction can continue even if exterior fire is extinguished.
3. An explosion will occur when the tire contains at least 5.5 percent oxygen, and the flammable gases reach their lower explosive limit and auto-ignition temperature. Explosion may generate shock waves and pressures over 1000 psi. **Note, this explosive force is generated from tires inflated with ambient air and regardless of the rim assembly present on the vehicle.**



Processes leading to tire blowout or explosion (Dolez et al., 2007)

Explosive Effects: The explosion generates a shock wave and projectiles. The shock wave pressures of tractor-trailer and heavy equipment tire explosions were utilized to establish the "Exclusion Zone" and "Immediate Rescue Only Zone," illustrated in the figures on page two of this document, based on:

- Shock wave pressures of 1.5 psi or less are safe.
- Shock wave pressures between 1.5 and 14.5 psi will cause injury.
- Shock wave pressures between 14.5 and 43.4 psi may cause fatal injury.
- Shock wave pressures at and above 43.5 psi are fatal.

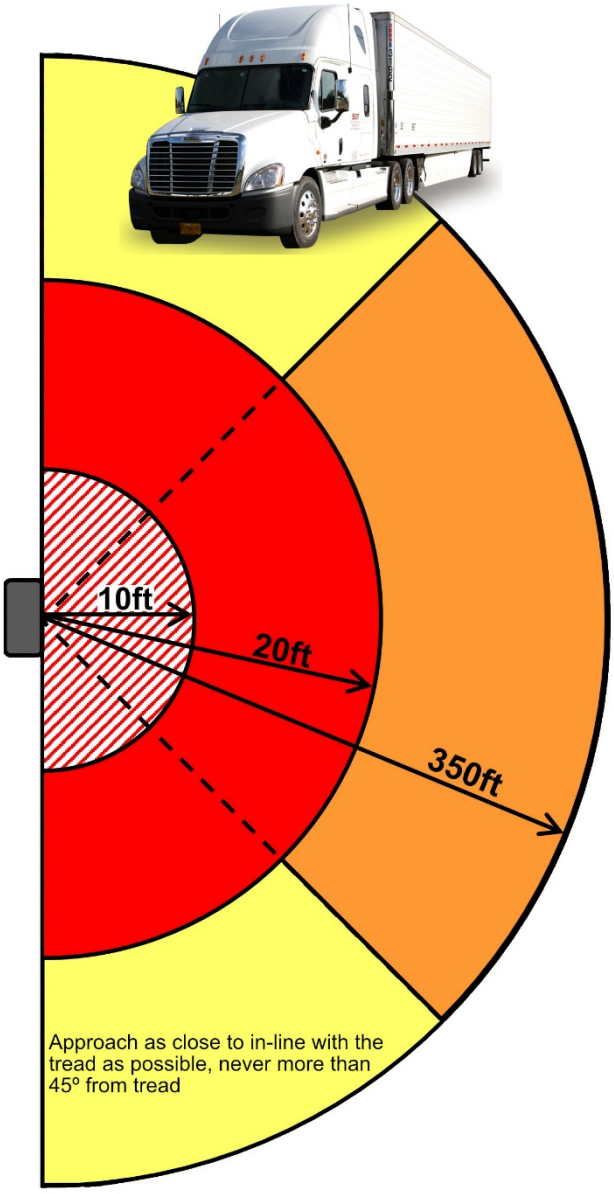
Projectiles from both tractor-trailer and heavy equipment tire explosions may travel up to 350 feet. This value was utilized to establish the "Rescue Only Zone" and "Limited Operation Zone," as identified in the following diagram.

Response: The Risk Management Process (RMP) shall be utilized on all incidents and include both the hazard(s) present and the incident priorities. The figures on page two increase the hazard awareness for incidents involving large vehicle tires. Hazard controls of time, distance, and shielding can be implemented based on the RMP and incident priorities. Note that incidents involving large vehicles may present additional hazards, such as alternative fuels and hazardous cargo, and the RMP must address each hazard present.

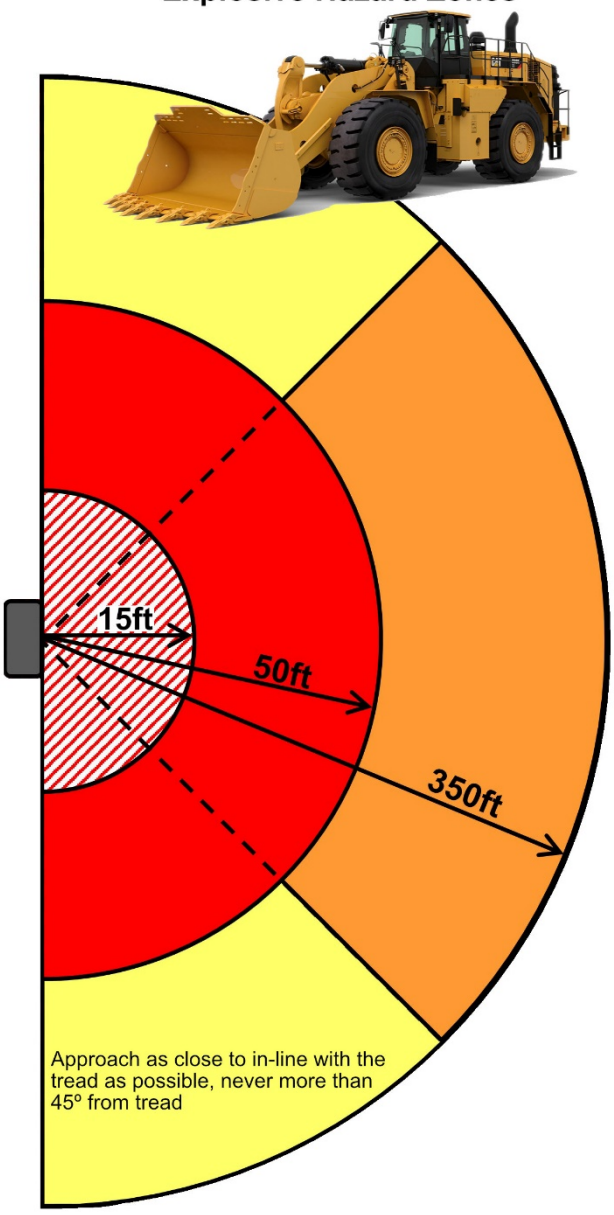
Safety Bulletin - Large Vehicle Tire Fires

Explosive Hazard Zones: The following figures identify the explosive hazard zones and acceptable operations for two general classifications of large vehicles, tractor-trailers and heavy equipment.

Tractor-Trailer Tire Explosive Hazard Zones



Heavy Equipment Tire Explosive Hazard Zones



Exclusion Zone: Lethal pressure waves will be generated in a tire explosion. Do not enter unless robust shielding (building, large vehicle, etc.) is present as PPE does not protect from pressure waves. Consider the use of tools to reach victims within the exclusion zone.

Immediate Rescue Only Zone: Pressure waves are likely to cause injury. Only operate in this zone for immediate victim rescue to limit exposure time unless robust shielding is present as PPE does not provide protection from pressure waves.

Rescue Only Zone: Only operate in this zone to perform a rescue as projectiles may be expelled into this area. On vehicles with dual tires, the explosion of the inner dual can expel the outer dual out from the vehicle in line with the axle. Full PPE may provide some protection from projectiles and shielding may mitigate the hazard in this zone.

Limited Operation Zone: The hazard of projectiles is reduced, but not eliminated if operations are aligned with the tire treads at the greatest distance from the tire possible. Only operate in this zone if the incident priorities dictate (rescue, prevent extension to other tires or vehicles, etc.). Consider unstaffed hose streams to reduce the time personnel are in this zone. Shielding may mitigate the hazard.

Even after exterior fire is extinguished, tires exposed to heat may continue to undergo a runaway exothermic reaction and explode. Do not immediately approach a tire which has been exposed to significant heat.