NEW TECHNOLOGY DIESEL EXHAUST & THE FIREFIGHTER

CLEANER, BUT HEALTH HAZARDS REMAIN

3 THREATS OF NTDE

Based on research studies we reviewed, there appears to be three major threats that NTDE poses for firefighters:

THREAT #1:
THE 10% OR MORE OF POLLUTANTS STILL BEING EMITTED

In 2015, The Advanced Collaborative Emissions Study (ACES), managed by the Health Effects Institute (HEI), a joint US government and auto-and-oil-industry association, published research stating that New Technology Diesel Exhaust (NTDE) was nearly as clean as ambient air. Specifically, the ACES study showed that the concentrations of PM and toxic air pollutants emitted from NTDE were more than 90% lower than emissions from TDE.[1] While the ACES research was received with great optimism, it also garnered some skepticism, including one researcher who challenged the ACES assertion that diesel exhaust is safe - but that "leaving 10% of something with no safe dose can cause substantial harm."[2]

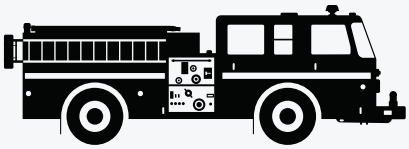
Further, the researched questioned why ACES focused its research on NO2 rather than PM, which has been linked to most diesel exhaust deaths. Finally, ACES' claim of "90% or more reduction" has not been not universally accepted. A 2016 Health Canada report has stated that NTDE removes "more than 70%" of compounds from diesel exhaust. The challenge is that there is no acceptable limit of diesel exhaust, as it is complex and contains both carbon particulates and 40 chemicals that are classified as "hazardous air pollutants" under the Clean Air Act.

THREAT #2:
THE INCREASE IN ULTRAFINE PARTICLES

Diesel exhaust contains "ultrafine particles" (UP), which are easily absorbed into lung tissue and the bloodstream, through the bloodbrain barrier, triggering adverse effects such as cardiovascular inflammation or causing blood clots. UPs have been shown to have negative effects on the cardiovascular system, including autonomic control of heart rhythm, endothelial cell function, and clotting/fibrinolysis pathways.[3]

Most studies define UP of 100 nanometers (nm) or less in aerodynamic diameter (PM0.1). UP is considered the most dangerous of all types of PM because they are small enough to be able to contribute to translocation across the cell barrier. Once particles translocate into the bloodstream they can reach any organ in the body including the brain.

A study from the Joint Research Centre of the European Commission testing diesel trucks with NTDE showed that the emissions of particles with size less than 23 nm can be "up to 200%" more than EU's current requirements for particles larger than 23 nm. The researchers suggested these particles are probably urea decomposition particles. Also, during engine cold start, trucks with NTDE exceeded the Euro VI particle number limit. These particles are probably soot or heavy hydrocarbons.[4]



At an EPA-sponsored workshop in 2015, a researcher from University of Minnesota suggested that “low sooting engine or fuel technologies that meet both mass and number standards without exhaust filters may emit significant numbers of solid particles below 23 nm.” [5]

A research team at the Health Science Centre in Canada studied the exhaust of a heavy-duty diesel truck with a DPF and identified “bleeding” of ultrafine particles (8-10 nm) from the DPF. This led them to conclude “the potential benefits of particulate matter reduction using a catalyzed DPF may be confounded by increase in NO2 emission and release of reactive ultrafine particles.” [6]

Many researchers studying diesel engine exhaust have indicated the need to further study the potential health effects related to UP exposures, and how much of the UP is captured by the aftertreatment technologies.

In an extensive 2016 Health Canada report, noted earlier, researchers stressed that even though NTDE reduces the hazards, “emissions may also change both physically and chemically, and it remains unclear as to how this will affect the toxicological properties of diesel exhaust as a mixture and the health risks of diesel exhaust exposure.” [7]

THREAT #3:
EMISSIONS WHILE IDLING

Another factor for firefighters to consider is how NTDE functions when the truck is idling during an apparatus check. Many NTDE devices require consistent high engine temperatures to operate as intended.

In one study, a 2012 diesel truck with a DCO installed showed an increase in N2O emissions when aftertreatment temperatures were below 570°F. (300°C). [8]

Research has shown that the DOC typically requires consistent high engine temperatures to operate efficiently. An idling truck may release emissions that contain unburned fuel and products of incomplete combustion. One study monitoring a diesel truck equipped with a DOC concluded that “emission reductions under load do not necessarily portray trends while idling if the DOC does not attain its operating temperature.” [9]

SCR output has also raised concerns when the engine is first started, because SCR injects ammonia into the exhaust gas stream and reacts with NO and NO2 to form nitrogen and water. Unfortunately, if too much ammonia is injected, then “ammonia slip” occurs, in which ammonia (NH3) is emitted. Inhaling NH3 can cause fluid to accumulate in the lungs (pulmonary edema). Ammonia slip is more likely to happen when the engine temperature is low. In response, engine manufacturers are adding Ammonia Slip Catalysts (ASC), which oxidizes the NO3 to harmless N2 and water, but as of this writing, the ASC is not standard technology on all diesel engines. [10]

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CONCLUSION:
MAKE LOCALIZED EXHAUST REMOVAL PART OF YOUR PREVENTION STRATEGY

Perhaps due to these ongoing diesel exhaust threats, NIOSH officials visited and measured air quality in fire stations and recommended “local exhaust ventilation systems” for fire apparatus, such as those offered by Plymovent, even though several trucks had NTDE installed. [11]

Because these systems are attached to the apparatus, diesel exhaust is captured at the source, serving as an extension of a vehicle’s exhaust system tailpipe and sending harmful particulates and gases outdoors. A localized exhaust removal system also minimizes the amount of air that needs to be removed, helping to reduce total energy costs.

A system like those offered by Plymovent include fans with timers to continue to capturing exhaust after the vehicle’s engine is turned off, further reducing the risk that any exhaust enters the station. Further, systems can include “high-temperature” hoses to accommodate the higher exhaust temperatures associated with NTDE.

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PLYMOVENT CORP.
5 Corporate Drive
Cranbury, NJ 08512
800-644-0911
cleanair@plymovent.com
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