



Railroad Locomotive Spark Arresters

SPARK ARRESTERS AND THE PREVENTION OF WILDLAND FIRES

Ralph H. Gonzales, Mechanical Engineer

HISTORY

The United States has an extensive railroad system crossing a multitude of agency boundaries and passing through every conceivable fuel type, with each having the potential to cause fires.

An ongoing program of locomotive inspections can reduce the number of wildland fires started by railroad operations. This report describes an inspection procedure for diesel-electric locomotives. It is intended for U.S. Department of Agriculture (USDA) Forest Service Prevention Technicians, Forest Protection Officers, and Law Enforcement Officers and their equivalents from other Federal agencies and States. Authority for performing these railroad locomotive inspections is from 36 CFR 261.52 citing USDA Forest Service-Standard 5100-1 or appropriate Society of Automotive Engineers (SAE) J335(b) and J350(a).

OPERATION OF A DIESEL LOCOMOTIVE

A diesel engine drives a generator that provides electricity for the traction motors. It also powers a compressor that provides compressed air for the braking system. The two most common brands of diesel-electric locomotives are those manufactured by the Electromotive Division of General Motors (EMD) and General Electric Co. (GE). Each has a different inspection procedure.

EMD engines can be either turbocharged or supercharged. All GE engines are turbocharged. An inspector needs to know the brand of locomotive to determine the inspection procedure and to complete the inspection sheet.

At first glance, EMD and GE locomotives appear quite similar. To differentiate between the two, look for the manufacturer's plate located below the cab or on either side of the locomotive. If these plates are missing, look at the locomotive identification card in the cab. If you cannot find the identification card, ask someone from the railroad for the brand name.

INDUSTRY MAINTENANCE STANDARDS FOR EXHAUST SYSTEM MAINTENANCE

The industry standard differs for exhaust system maintenance for the two locomotives. For the spark arrester equipped locomotives, the cleanout requirement is every 10 days. The turbocharged locomotives require eductor tube and exhaust stack maintenance every 30 days. These standards were designed for locomotives that are maintained in good order. A malfunctioning engine will quickly foul the exhaust system.

Indications of poor maintenance include carbon or oil around the lip of the exhaust stack or oil or unburned fuel on top of the locomotive. Poor maintenance may also be reflected by an overall appearance of being uncared for and rundown.

Safety Concerns When Inspecting Locomotives

Safety is a primary concern when inspecting locomotives. For example, personnel always face the locomotive when climbing or descending a ladder. Railroad safety rules include making sure anyone who could move the locomotive is aware an inspection is being conducted. If an inspection



is taking place in a railroad yard, make sure a safety-warning placard is posted on the locomotive. The railroad employee “blue flags” a locomotive to indicate that work is being done and removes the flag after the work is completed. The blue flag also keeps the locomotive from being moved.

Ventilator fans on engines are thermostatically operated and can start unexpectedly. It is safer to inspect a locomotive when the engine is not running. If circumstances permit, request that the engine be shut down during your inspection.

The top surface of a locomotive can be very uneven—presenting a trip hazard—and unburned fuel oil can make it very slippery. Not all railroad employees are permitted on top of locomotives. If you request someone to accompany you to the top of the locomotive and the person declines, do not insist. When walking on the edge of the locomotive top, use caution. It is preferable not to walk on the fan grating.

Exercise caution to avoid dropping anything down the fan or exhaust ports. Very expensive damage could result. If this should occur, notify the railroad immediately.

When inspecting locomotives, have appropriate equipment available. At a minimum you will need a hardhat, safety glasses or goggles, coveralls, gloves, mirror, flashlight, red tags, screw driver and pliers, 8-oz jars with lids to use as containers for carbon particles, a 1-lb can to collect carbon when removing the arrester cleanout cup, and chalk for marking the locomotive.

Although you may have a legal right to inspect, always ask permission before boarding the locomotive.

INSPECTION PROCEDURES FOR TURBOCHARGED ENGINES WITH EDUCTOR TUBES

All turbocharged locomotives have a single-exhaust stack. Turbocharged engines have a crankcase ventilation system called an eductor tube. This eductor tube system bypasses the turbocharger. This is permitted provided the eductor bypass is maintained and in effective

working condition. If not properly maintained, the eductor tube can start as many, if not more, fires than a normally aspirated engine with no spark arrester.

When inspecting the eductor, determine whether carbon buildup indicates that particles larger than 0.023-in can be emitted from the exhaust system. Evidence of this buildup of carbon on the eductor, and gaps in the buildup indicate missing carbon, particularly large pieces. The inspection of eductor tubes on the GE and EMD turbocharged locomotive differ slightly. The inspector must be aware of the procedure for proper inspection.

- Inspection of the GE turbocharged locomotive is conducted from the top of the locomotive. Look down the exhaust outlet to see the eductor tube. There are two exhaust outlets. Railroad personnel may clean eductor tubes by using chipping and scraping tools.
- Inspection of the EMD turbocharged locomotive is also conducted from the top of the locomotive. Again, look down the exhaust outlet to see the eductor tube. The EMD eductor tube is located further down inside the exhaust stack and is shaped differently than the GE eductor tube.

Some turbocharged EMD locomotives are equipped with mufflers that prevent visual inspection of the eductor tube from the exhaust stack. If so, the eductor must be removed through the engine compartment for inspection.

The preferred method is to have a railroad employee do the removal.

“Red tag” the locomotive to alert the railroad to the locomotive’s condition, that is, it is operating in violation of spark arrester laws and regulations. The locomotive’s engine must be shut down to remove the eductor.

EMD eductor tubes can be either removable or welded in place, with or without a removable inner tube. The outershields must also be checked. They are welded in place and are often overlooked during the cleaning process. A clean inner eductor with a dirty outershield is indicative of such an oversight. The innershield slips inside the outershield and both must be cleaned.

“RED TAGGING” THE ENGINE

If an engine is found to be operating in violation of the spark arrester laws and regulations, and repairs are not going to be made onsite, the locomotive must be red tagged. Do not depend on verbal notification. Personally see that the locomotive is switched to isolation by placing a red tag on the isolation switch located in the locomotive cab. You may permit the railroad crew to move the locomotive to some other place for repairs at idle engine speed only. This is referred to as moving “dead in train” or D.I.T. Remember that the locomotive could start a fire and it cannot proceed unless the problem has been corrected or isolated.

Locomotives are used in consists, meaning two to five locomotives operating together. The first, or head engine, is the controlling engine. Individual engines in consist can be isolated or switched out so they are not running, merely in drag with the rest of the train.

While performing locomotive spark arrester inspection, if you cannot see down the exhaust stack, if the eductor tubes are packed with carbon, or if the spark arrester trap volute is overflowing with carbon particles or plugged, have the railroad maintenance person correct the problem during the inspection.

INSPECTION OF SUPERCHARGED LOCOMOTIVES WITH SPARK ARRESTER

Two or more exhaust stacks may identify supercharged locomotives. Supercharged EMD locomotives are inspected from inside the engine compartment. The volute trap collects the carbon particles. The cleanout cap is located at the base of the volute. A cap full of carbon does not mean that the spark arrester has been rendered ineffective. Most of the carbon will be held in the volute.

To remove the cleanout cap on the volute for inspection, raise the locking lever and unscrew the cap in a counterclockwise direction. Look inside the cap and insert a screwdriver or other sharp instrument inside the volute to dislodge any carbon clumps. You may need to strike the volute with a blunt object to further dislodge carbon particle clumps. Some spark arresters have a side cleanout in addition to the bottom cap.

Carbon that is present can be collected and retained to determine whether or not the spark arrester is full to capacity. A pint or more of carbon is indicative of an ineffective spark arrester.

Supercharged EMD locomotives can have an external screen spark arrester and can be visually inspected from the top of the locomotive. The maximum hole size in a screen is 0.023in. It is common to find it operating with burned out or otherwise ineffective screens.

SPARK ARRESTER GUIDE

The *Spark Arrester Guide* is the only authoritative industry source for information on qualified spark arresters for use on internal combustion engines. Use the guide when identifying qualified spark arresters. If the spark arrester number appears in the guide, then SDTDC has evaluated the arrester.

There are two volumes to the guide: *General Purpose and Locomotive*, Volume 1, and *Multiposition Small Engine*, Volume 2. A revision of the guide is published every year. Therefore, each volume is published every 2years. An online guide, updated every quarter, is available on the USDA Forest Service Intranet at <http://www.fsweb.sdtc.wo.fs.fed.us>. It is a searchable database that allows the user to make powerful searches.

ADDITIONAL INFORMATION

This Tech Tip offers a broad introduction to railroad locomotive spark arresters. There are four other Tech Tips in the series. For more information on spark arresters, or to receive copies of other related Tech Tips, contact:

USDA Forest Service
San Dimas Technology and Development Center
444 East Bonita Ave.
San Dimas, CA 91773

Attn: Spark Arrester Program Leader
or
<http://www.fsweb.sdt dc.wo.fs.fed.us>

Approximate English to Metric System Conversion Factors

To Change	To	Multiply by
inches	millimeters	25.4
pounds	kilograms	0.454
ounces	grams	28.349

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