



## General-Purpose Spark Arresters

### SPARK ARRESTERS AND THE PREVENTION OF WILDLAND FIRES

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#### HISTORY

All equipment has the potential of starting a wildland fire due to hot exhaust particles, hot exhaust systems, or operator error. The combination of dry fuels and hot exhaust can be disastrous. One out of every five human-caused fires is equipment related.

Equipment requiring the use of a general-purpose spark arrester can be found in all types of wildland settings. This equipment ranges from huge tractors involved in road construction to rototillers and lawn mowers used by homeowners.

#### CARBON PARTICLES—AN EXHAUST BY PRODUCT

Despite the large size differences of equipment with internal combustion engines, there is a common thread—the production of carbon particles as an exhaust byproduct. Carbon particles may be laced with hot, volatile gases reaching temperatures as high as 3,000 °F. When temperature, relative humidity, and wind conditions are combined in the right condition, a burning carbon particle escaping from a hot exhaust system can ignite a potentially disastrous wildland fire. A properly installed and maintained spark arrester can greatly reduce the threat of fire by trapping or pulverizing the carbon particles.

#### GENERAL-PURPOSE SPARK ARRESTERS

There are three types of general-purpose spark arresters: fallout, pulverizer, and trap, which includes the screen type.

A fallout arrester uses a long chamber that allows the heavier carbon particles to lose velocity and drop to the bottom of the chamber. The lighter particles with a diameter less than 0.023 in are carried through the chamber by the exhaust gases. This design is seldom used because it is too large for most applications.

The pulverizer arrester circulates the gases within the arrester and literally pulverizes the carbon particles. Only one manufacturer has a qualified pulverizer arrester. This manufacturer is noted in the remarks section of the *Spark Arrester Guide* greensheet listing.

The trap arrester is the most common general-purpose spark arrester. The arrester works in two different ways: either by trapping carbon particles through centrifugal force, or by screening the particles out of the exhaust using a screen with openings smaller than 0.023 in. Through centrifugal force, the heavier carbon particles are thrown against the inside walls of the arrester and are directed into a trap. This is achieved by a series of stationary fins or fan-like louvers that set the exhaust gas into circular motion as it enters the arrester. Gases are allowed to escape into the atmosphere through the outlet, but the heavier carbon particles are trapped within the arrester. Trap spark arresters require periodic removal of the trapped carbon particles.



## **SPARK ARRESTER EVALUATION**

The United States Department of Agriculture (USDA) Forest Service San Dimas Technology and Development Center (SDTDC), evaluates all spark arresters that are submitted for approval. Guided by the USDA Forest Service Specification 5100-1 and Society of Automotive Engineer's standards, the test procedures ensure that spark arresters approved for field use meet certain qualifications.

Through the use of measuring devices and instruments, the arresters are tested for their ability to remove pieces of carbon greater than 0.023 in. The arrester must also collect at least 80 percent of the particles. Additionally, the arrester must pass a series of other tests to become qualified for use. When the arrester is qualified, SDTDC publishes the information in the next edition of the *Spark Arrester Guide*.

## **SPARK ARRESTERS MUST BE INSTALLED PROPERLY**

A qualified spark arrester must be properly installed and maintained in effective working condition. Motor trucks, truck tractors, buses, and passenger vehicles, except motorcycles, are exempt from the spark arrester requirement provided that the exhaust system is equipped with a muffler, as defined in the Vehicle Code.

The exception for passenger and transportation vehicles is granted because they generally are not driven in close proximity to flammable vegetation. Although mufflers and catalytic converters can help reduce the problem of spark emissions, they are not spark arresters. Catalytic converters also pose a special fire threat as they generate temperatures in excess of 2,000 °F that can ignite wildland vegetation.

## **SPARK ARRESTER GUIDE PROVIDES INFORMATION**

The *Spark Arrester Guide* provides all the information needed to determine whether a spark arrester is qualified for use. Spark arresters must be permanently marked with the model number and manufacturer's name or trademark. The words "Qualified," "Approved," or "Forest Service Approved," are not required to appear on the arrester and do not indicate that the arrester is qualified for use.

After determining the name and model number on the body of the arrester, refer to the greensheet list in the guide for a listing of qualified spark arresters. The arresters are listed by the manufacturer name and model number. If the manufacturer's name and model number is not found, the unit is not qualified.

Each model listed indicates the mounting position for which the arrester is qualified. Positions include vertical, horizontal, or multiposition.

## **SPARK ARRESTER INSPECTION PROCEDURES**

Inspectors should only be concerned with the rated flow if there is a special notation in the footnotes or remarks column. If a limitation is placed on the maximum flow, an additional step is required. Find the engine maximum revolutions per minute and engine displacement tables in the *Spark Arrester Guide*. It must be determined whether the spark arrester is qualified for the particular engine application.

The next column in the guide lists the page number where a line drawing is provided for a complete identification. The engine should have a stamped plate indicating the number of horsepower and cycles. There is also a maximum horsepower limitation requirement for the engine application. This limitation is noted in the remarks section of the greensheet list.

The spark arrester must be checked to verify that it has been properly maintained and cleaned out. There should be no heavy carbon deposits or heavy corrosion on the screen or in the trap. The spark arrester must be free of modifications or any deterioration and must appear to have had regular maintenance.

No cracks or holes should be visible in the exhaust pipe leading to the spark arrester, and there must be a tight fit where the spark arrester connects to the exhaust pipe. Once the spark arrester is determined to be qualified, look for a cleanout plug or band. The pulverizing arrester does not require a cleanout mechanism. All other arresters require periodic cleaning of trapped carbon particles.

To clean the arrester, locate the cleanout device. It is usually a metal plug or a metal band around the arrester. Have the operator remove the plug or band. If the cleanout plug or band is rusted, it is doubtful that proper maintenance has been performed. Sometimes the carbon has hardened or crusted over. In this case, it is helpful to have the operator insert a small wire or stick to break up the carbon crust. Start the engine in a cleared area; the exhaust gases will force the built-up carbon from the arrester cleanout hole.

Sometimes the exhaust outlet needs to be covered to force out the collected carbon. Make sure that the cleanout plug or band is properly replaced and tightly closed. Check the arrester for dents that may cause the arrester to operate less efficiently, or not at all.

When inspecting centrifugal-type spark arresters, check the internal parts to ensure that they have not been removed or damaged. Internal parts have been removed or damaged if a 1/8-in probe can be passed the full length of the spark arrester.

### **SPARK ARRESTER INSTALLATION**

The arrester should be installed according to the manufacturer's directions and must meet the *Spark Arrester Guide* approved application. The arrester should not be forced too far down onto the exhaust pipe. This may cause excessive backpressure, or ruin the interior workings of the arrester. A spark arrester can only be mounted within 45 degrees of the position for which it was qualified. Ensure the arrester is installed in such a manner as to avoid accumulating debris around the arrester or exhaust pipe gaskets. All of the components must be in good working order for the equipment to be operated legally in the wildland environment.

Manifolds are part of the exhaust system and are located on the outlet side of the engine block. Manifolds are joined to the engine block by bolts and are sealed with gaskets. Manifold surface temperatures may exceed 1,000 °F.

The entire manifold surface should be checked for cracks, missing bolts, or missing gaskets. Any of these problems can lead to exhaust leaks. Indications of a problem may be exhaust carbon buildup on one of the surfaces or loose manifold bolts.

Flammable vegetation can accumulate around the exhaust system. This problem can often be alleviated by screening the engine compartment, reversing the radiator fan, or by making other design changes. However, it can seldom be completely eliminated. Always check for accumulations in and around the engine compartment.

Exhaust pipes lead away from the manifold. Inspection must include a check for cracks, loose connections, or exhaust leaks. Leaks are often minute and result from rusting or metal fatigue.

A poorly maintained engine can also increase the amount and size of the carbon particles being expelled from the exhaust system. When equipment is properly maintained and serviced, the fire risk is reduced.

### **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, 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 2 years. 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 general-purpose spark arresters. There are four other Tech Tips in this 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.sdtcd.wo.fs.fed.us>

### Approximate English to Metric System Conversion Factors

To Change	To	Multiply by
inches	millimeters	25.4

### Temperature Conversion of Units

$$^{\circ}\text{F} = (^{\circ}\text{C} \times 1.8) + 32$$

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