

Fire Management Tech Tips

United States Department of Agriculture
Forest Service



**Technology &
Development Program**

May 2003

5100

0351 1305—SDTDC

Multiposition Small-Engine Spark Arresters

SPARK ARRESTERS AND THE PREVENTION OF WILDLAND FIRES

Ralph H. Gonzales, Mechanical Engineer

HISTORY

Multiposition small engines (MSEs) are hand-held internal combustion engines that can be operated in any position. The most common MSEs are chain saws, weed trimmers, and blowers.

Prior to 1978, MSEs only had a screen requirement. However, some fires were still being caused by equipment with screens installed. Research revealed that either hot exhaust gases or the surface of the exhaust system were coming into contact with flammable vegetation and causing the fires.

SPARK ARRESTER SURFACE AND GAS EXHAUST TEMPERATURES

The spark arrester surface temperature, gas exhaust temperatures, and carbon particle size are critical when using an MSE. The Society of Automotive Engineer's (SAE) Standard J335 describes the testing methods necessary to evaluate the fire ignition potential for these exhaust systems.

The temperature of exhaust gases, exhaust system surfaces, and carbon particles found in an internal combustion engine can reach temperatures in excess of 3,000 °F. Wildland fuels, however, can ignite at temperatures of only 400 to 500 °F. With these figures in mind, it is evident that fires can be started by wildland fuels coming into contact with hot exhaust gases and hot carbon particles, and from contact with the hot surfaces on exhaust systems.

There are several factors that affect an MSEs potential for starting fires. The condition of the engine affects the temperature of the exhaust and the size and amount of carbon particles it produces. The design and location of the spark arrester exhaust system can greatly affect whether or not a fire will start.

Currently, a significant number of States and all United States Department of Agriculture (USDA) Forest Service regions require MSEs to be tested and qualified to meet SAE Standard J335.

EVALUATION AND TESTING OF MSEs

Spark arrester testing is conducted or witnessed by independent laboratories, including Underwriter Laboratories, Canadian Standards Association, and Deutsche Landwirtschafts-Gesellschaft in Germany. These laboratories are qualified by the USDA Forest Service, San Dimas Technology and Development Center (SDTDC) in San Dimas, CA. A complete product unit, consisting of the MSE and the exhaust system, chain brake, handguard, bar wrap, spikes, and air filter, configured exactly as sold, is tested by these laboratories. The results of the test are sent to SDTDC for evaluation. SDTDC is the only facility authorized to evaluate the results and determine the qualification of the unit.

To pass the evaluation and become qualified for use, the MSE spark arresters must meet certain temperatures and screen requirements. The exposed surface of the exhaust system, where it



may come in contact with vegetation, must not exceed 550 °F. Where exhaust gas may come in contact with fuels, temperatures must not exceed 475 °F. The exhaust system must be designed so there are no pockets or corners where flammable material can accumulate.

Screens must be designed for easy replacement, inspection, and maintenance. They must also capture carbon particles with a diameter larger than 0.023 in, have a service life of at least 50 hours, and be cleaned once for every 8 hours of operation.

An MSE that has been tested and approved must be operated with all the original components that were present when it was qualified. After approval, any modification, addition, or removal of these components, however minor, renders the equipment untested and unapproved.

SPARK ARRESTER GUIDE PROVIDES INFORMATION

The *Spark Arrester Guide* provides all the information needed to determine whether a spark arrester is qualified for use.

MSEs are not required to have a model number stamped on them. Some individual MSEs may have more than one spark arrester exhaust system qualified for use. Each may be composed of several pieces. The spark arrester exhaust system must be approved for use with each separate MSE.

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

If you cannot distinguish the exhaust system from the photos or drawings in the guide, stop by a dealer and ask to see the exhaust systems for the equipment, using your guide as a reference. Even though not all States require that exhaust systems be qualified to meet SAE Standard J335, MSE manufacturers usually supply qualified spark arresters with each MSE unit sold.

If you cannot find the manufacturer name and model number stamped on the spark arrester, refer to the drawing section of the guide.

INSPECTION GUIDELINES FOR MSE SPARK ARRESTERS

All MSEs must be equipped with spark arresters when tested. Occasionally the equipment will have the grill or heat shield removed. This makes it easier to access the screen, but these grills and shields are part of the qualified spark arrester and are required. They keep fuels away from the exhaust system and must be in place to be operated legally.

When a spark arrester is inspected, have the operator disassemble the arrester to check the screen. Many illegal systems are found when operators claim they do not have the tools necessary to disassemble the exhaust system, so be prepared to provide tools.

To be legally operated, there should be no gaps or spaces larger than 0.023 in between the screen and the spark arrester component to which it is attached. These gaps allow exhaust gases to pass without going through the screen. The screen must be in good condition. If not, these parts are designed to be replaced.

If the screen is clogged with carbon, it does not allow the exhaust gases to escape properly. This can cause the entire system to overheat. Many exhaust systems have specially formed screens, or a screen that is welded to a plate of metal for a tight fit. Make sure the proper screen system is being used.

Part of the screen is visible without disassembling the arrester; you may want to take it apart to check for gaps. Some operators will cut or drill holes in a screen not visible without disassembly. To check the screen you will need a 0.024-in-diameter "no-go" wire gauge. If the gauge passes through the openings under light pressure, the screen does not qualify. MSEs may come from the factory equipped with an unqualified spark arrester to be operated in States that require spark arresters.

SUMMARY

An MSE must be operated with the same equipment with which it was tested. If a modification is made to the spark arrester, this new design must also pass the qualification test, as did the original equipment.

The inspection of a spark arrester on an MSE requires adequate study and preparation. The more pieces of equipment examined, the more proficient an inspector will become at identifying qualified or unqualified spark arresters.

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 2 years. An online guide, updated every quarter, is available on the USDA Forest Service Intranet at <http://www.fsweb.sdtdc.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 the operation, identification, and inspection of multiposition, small engine 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.sdtdc.wo.fs.fed.us>

Approximate English to Metric System Conversion Factors

To Change	To	Multiply by
inches	millimeters	25.4

Temperature Conversion of Units

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

Information contained in this document has been developed for the guidance of employees of the Forest Service, United States Department of Agriculture (USDA), its contractors, and cooperating Federal and State agencies. The USDA Forest Service assumes no responsibility for the interpretation or use of this information by other than its own employees. The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion, recommendation, endorsement, or approval of any product or service to the exclusion of others that may be suitable.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities



on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.