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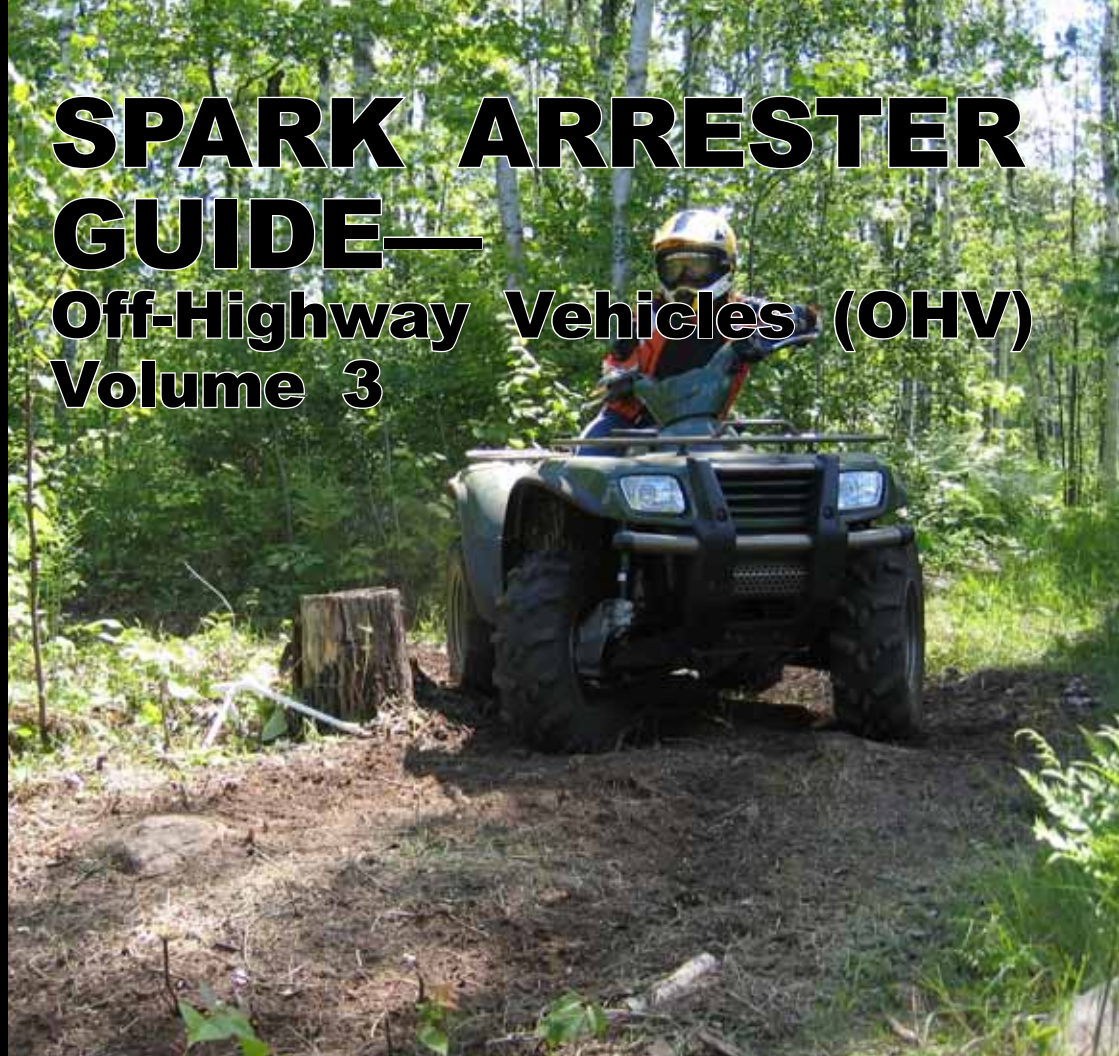
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SPARK ARRESTER GUIDE— Off-Highway Vehicles (OHV) Volume 3



This is the third volume of the Spark Arrester Guide
Volume 1: General Purpose and Locomotive (GP&L) arresters
Volume 2: Multiposition Small engine (MSE) arresters
Volume 3: Off-Highway Vehicle (OHV) arresters

This volume supersedes the 2007 OHV Spark Arrester Guide

Additional information may be obtained from
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SPARK ARRESTER GUIDE— Off-Highway Vehicle (OHV) Volume 3

**San Dimas Technology & Development Center
San Dimas, CA 91773-3198**

April 2012

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FORWARD

In 1986 the National Wildfire Coordinating Group (NWCG) authorized the Fire Equipment Working Team (FEWT) to establish a subcommittee to improve and update the Spark Arrester Guide (SAG). The subcommittee reduced the size of the previous SAG and redesigned it to improve its effectiveness and expand its applicability to more wildland fire agencies and geographic regions. The SAG is published for the guidance of cooperating Federal, State, and local agencies and is now a publication of the Forest Service, an agency of the U.S. Department of Agriculture. Federal and State laws and administrative requirements prescribe when and where spark arresters are required.

Appropriate Standards referenced in this SAG establish the minimum performance and maintenance requirements of spark arresters for internal combustion engines to be operated on or near grass, timber, brush, or other wildland fuels. During periods of very high or extreme fire danger, spark arresters meeting these Standards will not give complete protection against exhaust spark fires. Additional measures, including shutdown of operations, may be required during such periods.

The U.S. Department of Agriculture (USDA) maintains a spark arrester test facility at the San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773. The camera-ready copy for the Spark Arrester Guide was produced by the following personnel:

Ralph Gonzales—Fire Program Leader

Trevor Maynard—Mechanical Engineer

Amandeep Tamber—Project Assistant

Manuel Damole—Mechanical Engineering Technician

Janie Ybarra—Visual Information Specialist

GENERAL INSTRUCTIONS FOR USE OF THE SPARK ARRESTER GUIDE (SAG)

The Off-Highway Vehicles (OHV) SAG is a compilation of information, lists, and illustrations of qualified OHV spark arrester systems and engines—including their identifying markings, design, and assembly.

The intent of the SAG is to provide field inspectors with adequate information to determine if an engine and exhaust system combination have been tested and qualified by the San Dimas Technology and Development Center (SDTDC) as meeting the Standard for spark arresting exhaust systems.

The SAG is produced in three volumes. This SAG covers Off-Highway Vehicle (OHV) arresters. The other two SAGs cover General Purpose and Locomotive (GP&L) and Multiposition Small Engine (MSE) spark arresters. This SAG is a duplicate of a portion of the GP&L volume. This volume supersedes all previous editions.

In each publication, there is a section for each type of arrester with illustrations of spark arresters listed in alphabetical order by the manufacturer’s name, and lists of qualified and rated spark arresters of that type. Inspectors can use these sections to verify qualification status. Specific instructions for use of each section precede the section.

Use of the SAG also is illustrated in the video “Spark Arresters and the Prevention of Wildland Fires” and may be used as a supplemental instruction tool. The video contains five separate modules titled, “Introduction, Multiposition Small Engine, General Purpose, Off Highway, and Railroad.”

The three SAG publications and the video may be requested through:

San Dimas Technology & Development Center (SDTDC)
444 E. Bonita Avenue
San Dimas, CA 91773

Phone: (909) 599-1267

Email: Mailroom_WO_SDTDC@fs.fed.us

For quick reference, updates should be inserted in the publication for the appropriate type arrester. These newly qualified arresters will be included with illustrations when the Guides are reprinted. (See following section.)

REPRINT INFORMATION

SDTDC will determine when adequate information has been compiled to require a reprinting of each publication. The Center will notify the Regional and State offices when a reprinting is available. It is anticipated that a reprinting of all three volumes will be required every other year.

SDTDC will include the following criteria in their reprint decision:

1. Determination of usable life of the SAG.
2. Volume and complexity of questions received from field users. Major users will be contacted periodically for feedback.
3. Number of SAG updates which have been issued.

BASIC DEFINITIONS AND TEST STANDARDS

Exhaust Particles—All internal combustion engines produce exhaust particles which are predominately carbon with contaminates. These particles originate from deposits formed on the internal surfaces of the engine or exhaust system and, depending on their exact origin, may be expelled at temperatures in excess of 3,000 °F. Depending on the nature of the contaminates, these particles are capable of glowing or sometimes flaming combustion. When expelled through the exhaust system into the atmosphere, the combustion process may continue or even be accelerated during flight. Such particles, if larger than 0.023-inch in diameter and at temperatures of 1,200 °F, are capable of igniting cellulose materials upon contact.

A Spark Arrester is a device which traps or pulverizes exhaust carbon particles to a size below 0.023-inch in diameter, as they are expelled from an exhaust system. Trap-type spark arresters must have a method for removal of accumulated carbon particles. Most spark arresters generally perform in the high 90 percent spark arresting effectiveness range.

Off-Highway Vehicle Spark Arresters are tested against Forest Service Standard 5100-1c or the latest revision of Society of Automotive Engineers (SAE) Recommended Practice SAE J350. Either of these documents establish the minimum performance and maintenance requirements of single-position application OHV spark arresters. Spark arresting effectiveness shall be at least 80 percent for all flowrates on the cold test which correlates to 90 percent on a hot engine.

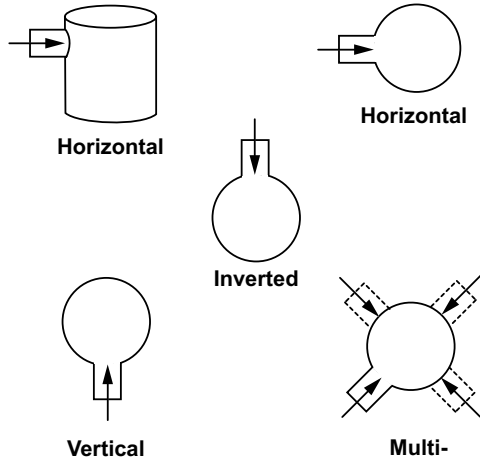
Screen-Type Spark Arresters as defined by Forest Service Standard 5100-1c fall into a special category. They are intended for use on small engine applications. All exhaust products must pass through the screen, which has openings of 0.023-inch or less. The effective exhaust area of the screen (total area of all screen openings) shall not be less than 200 percent of the engine exhaust port area at its smallest cross-section. Screen material shall be heat and corrosion resistant, and shall provide at least 100 hours of service life. These are originally qualified for all the positions described in the “Application Positions” section.

“Add-On” Spark Arresters are added onto an existing muffler exhaust system. They are typically used on off-highway- vehicles. Add-on spark arresters must have a method for removal of accumulated carbon particles. Such as a cleanout plug, snap ring, removable end cap, or a removable end cleanout. A removable end cleanout is usually secured to the muffler by a retaining band and/or several screws. In order to empty out the accumulated carbon particles with a removable end cleanout, the entire add-on must be removed by loosening the retaining band or screws, to shake out the carbon particles.

The retaining band or screw may not be replaced by welding the removable end cleanout to the existing muffler. This is considered a modification and also does not allow for removal of accumulated carbon particles. Any modification to the spark arrester as compared to the SAG line drawing in this SAG, voids qualification.

Application Positions—Four general positions are considered—vertical, horizontal, inverted, and multiposition. The application is determined by the attitude of the inlet pipe irrespective of the main body position or direction of outlet.

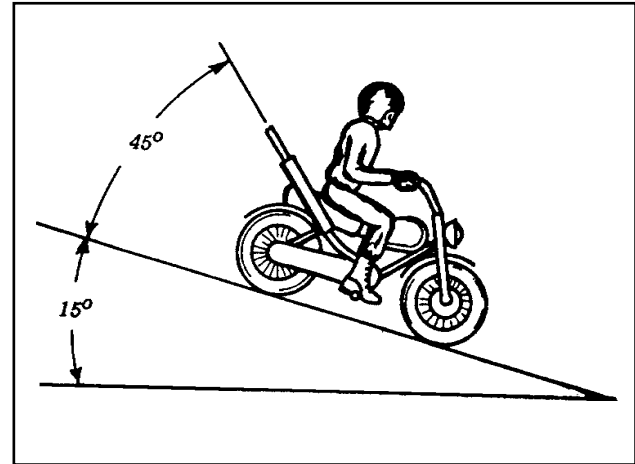
For example:



The qualified positions listed include only those tested. In some cases, the manufacturer may claim other positions, but test information at this time neither support or refute such claims. An arrester tilted more than 60 degrees from its qualified operating position may not adequately arrest sparks.

Therefore, arresters on mobile equipment—other than screen type arresters— shall not be mounted more than 45 degrees from the qualified position. See column marked “Appl Pos.”

Note that Forest Service Standard 5100-1d allows 60 degrees deviation, but at least 15 degrees should be reserved for deviations because of road grade or slope. (See illustration.)



Rated Flow of Arrester is the rate of test gas flow in cubic feet per minute at which the corresponding back pressure is 1 pound per square inch. This is the maximum desirable back pressure for most four-stroke cycle applications. See column marked “Flow.” Note: OHV Screen Type Spark Arresters are limited to the listed rated flow, 2 or 4 cycle, and horsepower.

Some two-cylinder engines may require a higher back pressure. An arrester may be used above its rated flow—provided it maintains a qualifying arresting effectiveness at all levels of use. Arresters that do not have an adequate effectiveness above their rated flow will be designated in the “Remarks” column, and are not qualified to operate in applications where they may be ineffective. With this exception, a qualified arrester properly installed and maintained is acceptable legally regardless of size or rated flow. It is the owner’s business if he/she chooses an arrester too large or too small, even though the cost may be excessive or the back pressure too high.

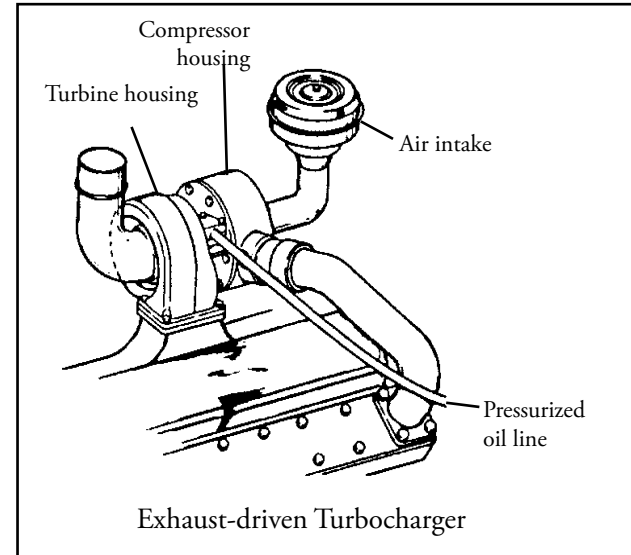
Cleaning—The arrester shall have provision for the easy disposal of the accumulated particles without removal of the clamping or mounting devices from the stack, pipe, or manifold assembly. Screen-type devices shall provide for the easy removal and cleaning or replacement of the screen.

Marking and Labeling—Each arrester shall be permanently marked with the manufacturer’s model number designation and a trademark or other identification of manufacturer. Where an inverted installation is possible, the inlet or outlet shall also be marked. In addition to the above markings, screen-type devices must have the words “Screen Type” clearly imprinted in 1/8-inch or larger letters. The model number must match exactly. The words “Qualified” or “Approved” are not required, and do not indicate that the unit is in fact a qualified arrester.

Mufflers—Experience and tests have shown that mufflers, in general, are inadequate as spark arresters. Few muffler devices submitted for formal tests meet the requirements of Forest Service Standard 5100-1c or SAE J350. However, properly maintained baffled mufflers constructed to automotive industry standards, and installed on motor vehicles other than motorcycles are accepted for “on- highway” and “off-road” use in some jurisdictions. Exceptions are for designated areas where a spark arrester is required on cross-country vehicles. Straight-through mufflers, such as glass-pack designs without baffles, are not acceptable. Consult your agency’s policy for more specific guidelines.

Turbochargers qualify as effective spark arresters when 100 percent of the exhaust gases pass through the turbine wheel. The turbine wheel must be turning at all times and there must be no exhaust bypass to the atmosphere. Depending on design, small enclosed system bypasses that reroute some of the exhaust back through the engine may be allowed. The illustration of the exhaust-driven turbocharger shows the air intake and the exhaust path through the turbine wheel. The action of the rotating turbine wheel causes carbon particles to remain within the confines of the turbo-drive section until they are reduced to a harmless size by attrition.

Superchargers, which are strictly mechanically driven, do not qualify.



Exhaust System—The exhaust system consists of the manifold (on multicylinder engines), muffler or spark arrester or both, an exhaust pipe between the engine cylinder exhaust outlet port, and the end of the exhaust pipe which is open to the atmosphere.

Exhaust Manifold—A chamber into which the exhaust from each of the engine cylinders is collected. The exhaust is then directed out of the manifold to a muffler or spark arrester or both.

Most large locomotive engines have the spark arrester designed into the exhaust manifold. Small, single-cylinder engines do not have manifolds.

Modification—Any modification or damage to any part of the system as it was presented to SDTDC for testing voids the qualifications of the spark arrester on the equipment. Modifications usually consist of removal of or damage to parts, change in exhaust outlets, replacing the fiberglass packing with steel wool, improper mounting, and bypasses.

Follow your agency policies when a modified/ unqualified spark arrester system is encountered.

OFF-HIGHWAY VEHICLE SPARK ARRESTER INSPECTION PROCEDURES

Forest Service Standard 5100-1c requires that each arrester shall be permanently marked with the model number and the manufacturer's name or trademark. The model number must match exactly. The identification must be stamped in the metal body or on an attached metal plate. The words "Qualified" or "Approved" are not required, and do not indicate that the unit is in fact a qualified arrester.



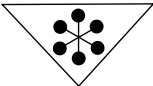
1. If identification of the manufacturer's name and model number is found, then refer to the "Qualified and Rated" list.
2. Check the "Qualified and Rated" list to establish if the arrester is qualified.
3. If not on the "Qualified and Rated" list, be sure to check any SAG update information you have received since the time of the printing of your present SAG. The absence of an arrester from these lists indicates that the arrester has not been qualified.
4. After the arrester has been identified, turn to the Drawing Section and check the spark arrester illustration for an exact match on the configuration, dimensions, and cleanout devices. The drawing must match the spark arrester you are inspecting.

5. Suggested tools for inspections:

- a. Hand tools to open cleanout, screwdriver, and pliers.
- b. Flashlight.
- c. 1/8-inch wire rod or stick to probe inside the arrester to determine if stationary fan or vanes are in place.
- d. Tape measure.
- e. 0.024-inch wire gauge to determine screen size.

6. Inspect to ensure that:

- a. The spark arrester is correct for the position of application.
 - b. The exhaust system between the engine and the spark arrester is in good order.
 - c. The arrester is properly maintained and cleaned out when necessary.
7. More detailed instructions are available in the NWCG video, “Spark Arresters and the Prevention of Wildland Fires.”
8. Follow your agency’s policies when an unqualified spark arrester system is encountered.

MANUFACTURER	TRADEMARK
AKRAPOVIC	
DMC	
FLEETGUARD	FGD
HER CHEE	HC
NELSON	NM
SOUNDMASTER/WALKER	
TECUMSEH (formerly TAYLOR)	