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Exhaust system for multi position small engine machines — Test procedures and performance requirements for spark arrestors

Système d'échappement pour machines à petit moteur multi-positions — Méthodes d'essai et exigences de performance pour les pare-étincelles

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable (hand-held) powered lawn and garden equipment and forest machinery.*

This second edition cancels and replaces the first edition (ISO 9467:1993), which has been technically revised.

The main changes are as follows:

— the normative references have been updated;

— multi-position small engine equipment pole pruners, edgers, hedge trimmers and blowers have been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

During dry seasons, forest fires can be ignited by small internal combustion engine-powered equipment such as portable chain-saws, brush-cutters, grass-trimmers, pole-mounted pruners, edgers, hedge trimmers and blowers. The exhaust system of such equipment presents three potential sources of ignition to dry vegetation: hot exhaust gas, hot exhaust system surfaces and the emission of glowing carbon particles. The potential for ignition depends on the specific vegetation involved, environmental factors, equipment usage patterns, the size of carbon particles that can be emitted, and temperatures of the exhaust gas and exhaust system surfaces.

This document highlights the minimum performance and maintenance requirements of spark arrestors for single and multi-position small internal combustion engines used in proximity to grass, brush, timber, and similar cellulose materials. This document provides methods for arrestor performance evaluation, size selection, and determination of application position.

The requirements include:

— maximum temperatures for exhaust gases and exhaust system surfaces;

— maximum opening size for screen-type spark arrestors;

— restriction on debris accumulation.

The test methods include:

— uniform procedures for measuring exhaust gas and exhaust system surface temperatures; and

— a procedure to evaluate opening size for screen-type spark arrestors.

Local laws can govern when and where the use of spark arrestors is required. During periods of very high or extreme fire danger, arrestors meeting the requirements of this document cannot give complete protection against exhaust spark fires. Additional measures, including complete shutdown of operations, can be required during such periods.

Exhaust system for multi position small engine machines — Test procedures and performance requirements for spark arrestors

1 Scope

This document establishes requirements and test procedures for determining the performance of spark arrestor exhaust systems of multi position small engines used in portable applications, such as chain-saws, brush-cutters, grass-trimmers, pole-mounted pruners, edgers and similar shaft-drive machines, hedge trimmers and hand-held and back-pack blowers.

It is not applicable to spark arrestors used in vehicles or stationary equipment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6531, *Machinery for forestry — Portable chain-saws — Vocabulary*

ISO 7112, *Machinery for forestry — Portable brush-cutters and grass-trimmers — Vocabulary*

ISO 7914, *Forestry machinery — Portable chain-saws — Minimum handle clearance and sizes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6531, ISO 7112 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
contact plane
imaginary flat surface defined by at least three points of contact on the surface of MSE power unit extremities

3.2
exhaust gas temperature test
test to determine exhaust gas temperature at the points where the hottest gases impinge a *contact plane* (3.1)

3.3
exhaust gas temperature
temperature of the exhaust gas at any point where it crosses a *contact plane* (3.1)

3.4
exhaust system
device(s) used to contain and direct gas from the cylinder exhaust port to the atmosphere, including spark arrestor and all directly attached shields for hot surface contact prevention

3.5
exposed surface temperature
temperature of the engine *exhaust system* (3.4) at the points where it contacts or intersects the *contact plane* (3.1) surface established by the extremities of the MSE

3.6
maximum power
maximum corrected brake power, as applicable

3.7
maximum power speed
engine speed at which maximum corrected brake power is obtained, in accordance with ISO 7293 or ISO 8893, as applicable

3.8
multi position small engine machine
MSE
hand-held, hand-guided, or back-pack mounted machine having an internal combustion engine operable in more than one position

3.9
power unit
MSE (3.8) exclusive of extensions which are not integral to the operation of the engine, or which can be removed without tools

3.10
spark arrestor
device through which the exhaust gases pass, intended to stop smouldering/burning particles

4 Test equipment

4.1 Calibrated loading device

An apparatus designed to test multi position small engine machines (MSEs) at given loads and speeds, which displays torque or power and is compatible with a multipoint recorder or data logger. A calibrated loading device is required in a chain-saw temperature testing and is optional in temperature testing of MSEs other than chain-saws.

4.2 Tachometer

A device for determining the rotational speed (with a measurement accuracy ±5 % of tachometer reading) of an MSE. It may be separate or integrated with the calibrated loading device or multipoint recorder or data logging device.

4.3 Temperature thermocouple

Temperature thermocouple composed of Standard J or K type thermocouple wire with a grounded junction and a probe sheath diameter of 3,2 mm or smaller, used to measure exhaust gas and surface temperatures.

4.4 Graduated cylinders

Calibrated containers for measuring amounts of fuel and lubricant for the fuel mix, with an accuracy of ±2 % of the amount actually contained.

4.5 Wire plug gauge

A round wire gauge of 0,61 mm diameter with precision ground squared ends used to evaluate the geometry of the spark arrestor screen and associated housing openings. Replace if any rounding > 0,03 mm is noted.

5 Performance requirements for multi-position small engine machines

5.1 Marking and identification

The power unit shall be identified by the manufacturer name or trademark and model number.

The exhaust system shall be identified by the manufacturer name or trademark and model number. Due to space limitations in these exhaust systems, partial marking is acceptable provided the marking uniquely identifies the exhaust system.

Acceptable methods of identification are metal stamping, etching, dot peening, or durable labels.

5.2 Mounting and installation

The spark arrestor screen of exhaust systems shall be easily removable for inspection, cleaning or replacement, without major disassembly of the power unit or removal of the exhaust system from the power unit.

5.3 Screen material

The spark arrestor screen used with the engine exhaust system shall be resistant to the high temperatures and corrosive materials present in the engine exhaust gas.

5.4 Screen geometry

Spark arresting screens shall have no screen or housing openings allowing the 0,61 mm diameter wire plug gauge to penetrate any opening when tested in accordance to Clause 6.

5.5 Exposed surface temperature

The maximum exposed exhaust system surface temperature, obtained when tested according to Clause 9, shall not exceed 288 °C.

5.6 Exhaust gas temperature

The maximum exhaust gas temperature in any contact plane, obtained when tested according to Clause 9, shall not exceed 246 °C.

5.7 External pockets

The exhaust system shall be designed so that there are no external pockets in the area surrounding the exhaust system, where flammable material can accumulate.

5.8 Internal pockets

An area on the outer surface area of the exhaust system forming an internal pocket shall be either closed or the surface temperature inside the internal pocket shall not exceed 288 °C. This applies only to front mounted chain-saw exhaust systems.

6 Screen test

6.1 General

The screen test shall be performed using the wire plug gauge on all MSEs with removable (serviceable) screen-type spark arrestors.

6.2 Screen housing seal

With the screen installed in the exhaust system, probe the entire periphery of the screen for any gaps in the mounting structure. When gauging, do not exceed 0,56 N of force.

6.3 Screen openings

Remove the screen from the exhaust system and randomly probe the screen at least 20 times. Especially pay attention to any bends, moulding, or edges. When gauging, do not exceed 0,56 N of force.

6.4 Screen housing seal after reassembly

Install the screen in the exhaust system and repeat 6.2.

6.5 Screen material

Verify that the screen is constructed of a metal alloy, which is heat and corrosion resistant. Verification may be performed through review of supplier material certifications or appropriate metallurgical analysis.

7 Contact plane determination

7.1 General

Determine the configuration of the MSE to be tested in accordance with 7.2 through 7.5.

Place the MSE power unit on the horizontal plane in the position, which places the exhaust system nearest to that plane. In this position, identify three points where the power unit contacts the horizontal surface. This is the first contact plane. Using two existing contact points in the first plane, rotate the power unit until a third contact point has been identified. This is the second contact plane. Repeat this process until a total of three contact planes have been established. Additional planes may be tested using good engineering practice. (Refer to Figure 1 for chain-saws, Figure 2 for brush cutters, grass trimmers, pole pruners, edgers and similar shaft-drive machines, Figure 3 for hedge trimmers, and Figures 4 and 5 for hand-held and back-pack blowers). Use narrow drafting-style tape and/or stiff, straight metal rods (3,0 mm or less in diameter) to connect the contact points in each plane, as shown in Figures 1 to 3. These shall be used to provide more accurate thermocouple probe alignment during the test.

The contact plane closest to the exhaust flow direction shall be used for determination of the hot spot for the exhaust gas temperature.

If any test plane contacts the exhaust system surface, the exhaust surface temperature shall be measured at this contact point. Mark the contact point accordingly.

7.2 Chain-saw

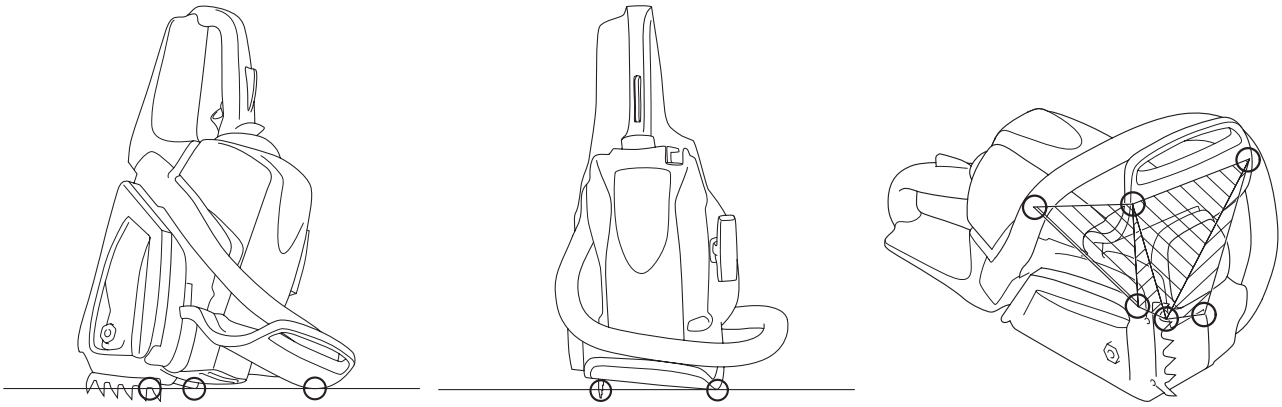
Assemble per manufacturer's specification, without guide bar and chain, fuel, and oil.

If spikes or bumper bars are supplied and required by the manufacturer, test the chain-saw with spikes in place. Locate the test planes from the root(s) of the uppermost bumper spike(s).

Fit a spacer, having the same thickness as the guide bar, between the sprocket cover and body and reinstall the sprocket cover. The spacer shall not protrude beyond the body of the chain-saw.

Secure the hand guard in the position specified by the minimum handle clearance of 35 mm in accordance with ISO 7914.

Determine the contact planes per 7.1.

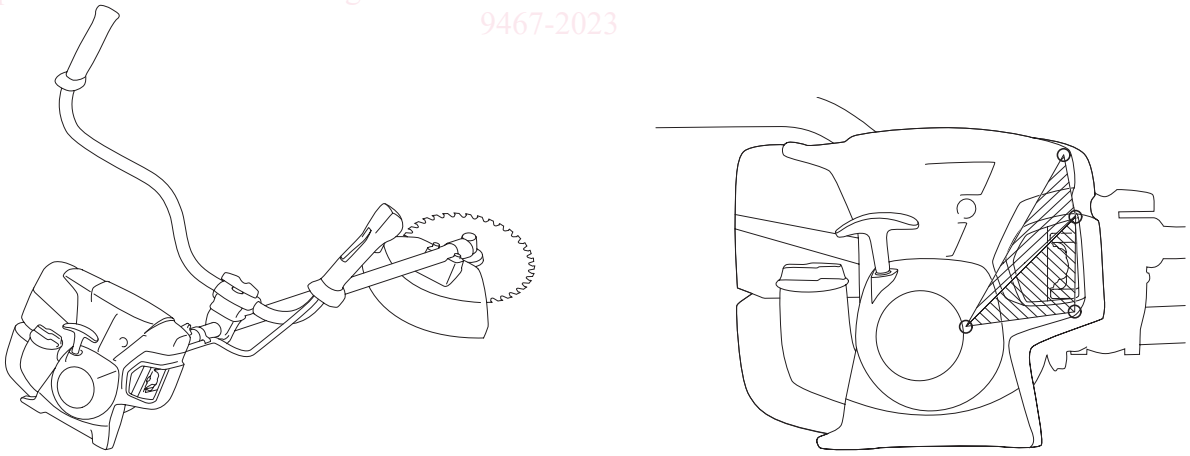


a) Contact point determination **b) Contact planes**

Figure 1 — Chain-saw — Contact plane determination

7.3 Brush cutter, grass trimmer, pole pruner, edger and similar shaft-drive machines

Determine the contact planes per 7.1 using the power unit and lower end shaft.



a) Brush cutter (example) **b) Contact plane**

Figure 2 — Brush cutter, grass trimmer, pole pruner, edger and similar shaft-drive machines — Contact plane determination

7.4 Hedge trimmer

Determine the contact planes per 7.1, with cutting attachment installed.