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Forestry machinery — Portable chain-saws and brush-cutters — Exhaust system-caused fire risk

Matériel forestier — Scies à chaîne et débroussailleuses portatives — Risque d'incendie provoqué par le système d'échappement

INTERNATIONAL ISO

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9467 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Sub-Committee SC 17, *Manually portable forest machinery*.

Annex A of this International Standard is for information only.

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Introduction

During dry seasons, forest fires may be ignited by engine-powered equipment such as a portable chain-saw or brush-cutter. A chain-saw or brush-cutter exhaust system 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, chain-saw or brush-cutter usage patterns, the size of carbon particles that can be emitted, and temperatures of the exhaust gas and exhaust system surfaces.

Annex A lists sources of additional information regarding ignition characteristics of forest fuels and the fire ignition potential of chain-saws or brush-cutters.

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Forestry machinery — Portable chain-saws and brush-cutters — Exhaust system-caused fire risk

1 Scope

This International Standard establishes requirements and test methods for portable chain-saw and brush-cutter exhaust system characteristics related to fire ignition potential.

The requirements include:

— maximum temperatures for exhaust gases and exhaust system surfaces;

— maximum opening size for screen-type spark arresters;

— restriction on debris accumulation; and

— durability and serviceability requirements.

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 arresters.

NOTE 1 Means of limiting the size of carbon particle emissions, other than screen-type spark arresters, are not covered by this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7293:1983, *Forestry machinery — Portable chain saws — Engine performance and fuel consumption.*

ISO 8893:1989, *Forestry machinery — Portable brush-saws — Engine performance and fuel consumption.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 exhaust system: Part(s) used to contain and direct gas from the cylinder exhaust port to the atmosphere, including all shields for hot surface contact prevention.

3.2 powerhead: Chain-saw without guide bar and chain, or brush-cutter without shaft tube and cutting attachments or other removable extensions.

3.3 contact plane: Imaginary flat surface defined by at least three points of contact on the extremities of a chain-saw powerhead. (See 6.2.)

3.4 exposed surface temperature: Temperature at any point where the engine exhaust system touches a contact plane.

3.5 exhaust gas temperature: Temperature at any point where the exhaust gas crosses a contact plane.

3.6 maximum power speed: Engine speed at which maximum corrected brake power is obtained, in accordance with ISO 7293 and ISO 8893 as appropriate.

3.7 screen-type spark arrester: Exhaust system using a screen(s) or baffle(s) with small openings to limit the size of hot particles emitted into the atmosphere.

4 Requirements

4.1 Screen-type spark arresters shall not allow a 0,61 mm diameter wire plug gauge to penetrate any opening when measured in accordance with clause 5.

4.2 Exposed surface temperatures shall not exceed 288 °C when tested in accordance with clause 6.

4.3 Exhaust gas temperatures shall not exceed 246 °C when tested in accordance with clause 6.

4.4 The exhaust system shall be designed so that there are no external pockets where flammable material could collect.

4.5 The spark arrester shall permit field inspection without a major disassembly of the powerhead.

4.6 The spark arrester shall be easy to clean.

NOTE 2 Cleaning of parts should not be required more frequently than once for each 8 h of operation.

4.7 The exhaust system shall be identified by manufacturer name, trademark or model number.

NOTE 3 At present the service life of an exhaust system is expected to be sufficient if the screen is made of stainless steel or equivalent material.

5 Screen test

5.1 Apparatus

5.1.1 Wire plug gauge with a diameter of 0,61 mm. The gauge end shall be flat with an edge radius of a maximum of 0,03 mm.

5.2 Procedure

5.2.1 Use the wire plug gauge to probe the periphery of the installed screen for any gaps in the mounting structure. When gauging, do not exceed a force of 0,57 N.

5.2.2 Remove the exhaust system and randomly probe the screen in at least 20 places. Also probe at bends, mouldings and edges. When gauging, do not exceed a force of 0,57 N.

6 Temperature tests

6.1 Apparatus

6.1.1 Brake power test bench with a torque accuracy of 2 % of the measured value.

6.1.2 Tachometer with an accuracy of 0,5 % of the measured value.

6.1.3 Instrumentation (including a thermocouple) capable of measuring exhaust surface, exhaust gas and cylinder head temperatures to within 1 °C. The thermocouple measuring probe shall have a diameter of 2 mm ± 0,5 mm.

6.1.4 Spacer equal in thickness to the guide-bar.

6.1.5 Standard J or K type thermocouple wire with welded tip and grounded shield probe.

6.2 Contact plane determination

This procedure establishes standard points at which temperatures are to be measured.

6.2.1 Assemble in accordance with the manufacturer's specification.

For chain-saws, assemble without guide-bar, saw chain, fuel and oil.

For brush-cutters, assemble complete without fuel.

6.2.2 For chain-saws, if a spiked bumper(s) is supplied and required by the manufacturer, test the saw with spiked bumper(s) in place. Locate test planes from the root of the spikes (see figure 1).

6.2.3 For chain-saws, fit a spacer, the same thickness as the guide bar, between the clutch cover and the engine and reinstall the cover. The spacer shall not protrude beyond the body of the powerhead or the root of the bumper spike.

6.2.4 For chain-saws, if equipped with a chain brake, place the actuator in the disengaged position.

6.2.5 For chain-saws, deflect the hand-guard, by the weight of the chain-saw, into its most rearward position and secure it in this position.

6.2.6 Place the exhaust side of the powerhead on a flat surface (or place a test plate on the powerhead), and identify at least three points on the powerhead to define this contact plane. Mark any points on the exhaust system that touch the plane and identify where hot exhaust gas may cross the plane. Reposition the powerhead (or plane) as many times as necessary to determine all possible exhaust system contact points and all planes intersecting the hot exhaust gas stream (see figure 2). Note that the exhaust gas direction may change from one plane towards another due to cooling air flow or other turbulences.

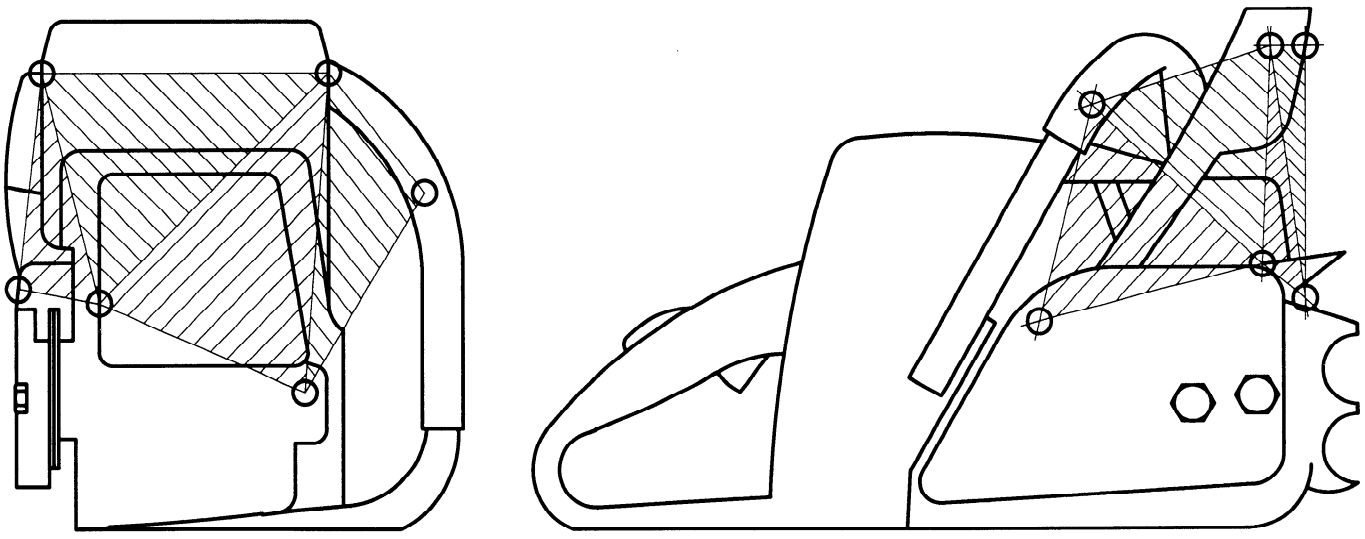

Figure 1 — Chain-saw with contact planes

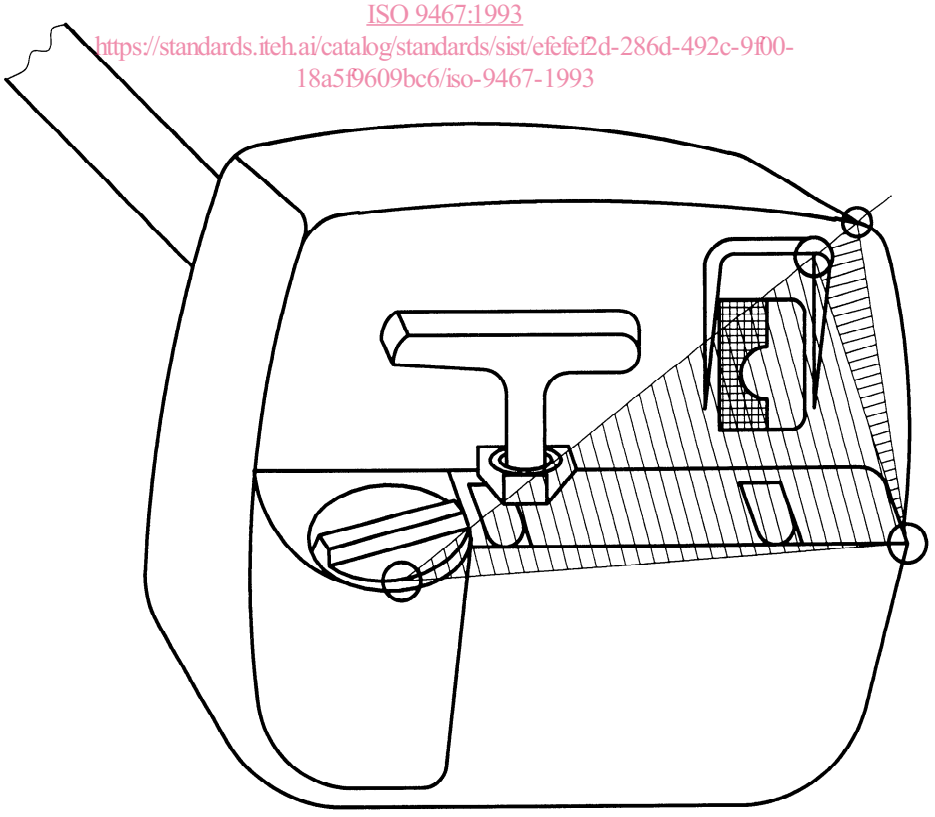

Figure 2 — Brush-cutter with contact planes

6.3 Preparation

6.3.1 Affix thermocouples to all exhaust system contact points identified in 6.2.6.

6.3.2 Install a thermocouple on the engine cylinder head or the spark-plug base.

6.3.3 Install the powerhead on the brake power test bench.

6.3.4 Fill the fuel tank with fresh fuel mixture, prepared in accordance with the manufacturer's recommendation.

6.3.5 Run the engine until it reaches operating temperature. Adjust for the maximum power speed stated by the manufacturer or in accordance with ISO 7293 or ISO 8893. Adjust the high speed mixture screw for maximum torque at this speed, then enrich the mixture just enough to reduce the torque by 3 % (to allow for proper lubrication). Additional enrichment may be used as necessary to prevent the cylinder head temperature from exceeding the manufacturer's recommendation (to prevent engine seizure).

6.3.6 Using a hand-held temperature probe, traverse the planes identified in 6.2.6 to find the points at which the exhaust gas is hottest. Mount temperature probes at these locations to monitor exhaust gas temperatures during the test.

6.4 Procedure

6.4.1 The measuring data shall be recorded at least every 30 s.

6.4.2 Run the engine as in 6.3 for at least 3 min, simultaneously recording time, speed, torque, and exhaust system, exhaust gas and cylinder head temperatures.

NOTE 4 If the cylinder head temperature continues to rise after 3 min, adjust the high speed mixture and repeat.

6.4.3 Increase the speed to 1 000 r/min above the maximum power speed and run for at least 3 min, simultaneously recording time, exhaust system, exhaust gas and cylinder head temperatures, engine speed and torque.

6.4.4 Decrease the speed to 1 000 r/min below maximum power speed in steps of 500 r/min. Record the torque for each step. When the 2 000 r/min speed reduction has been reached, run for 3 min, simultaneously recording time, exhaust system, exhaust gas and cylinder head temperatures, engine speed and torque.

EXAMPLE

If the maximum power speed is 8 000 r/min, then 6.4.3 would be conducted at 9 000 r/min and 6.4.4 would end at 7 000 r/min.

6.5 Test report

The following information shall be recorded/documented:

— manufacturer, model, serial number and exhaust system specification for the powerhead tested;

— specifications for temperature measuring instrumentation;

— the position of all contact planes used to establish measurement points;

— the location of all points at which temperatures were measured. Include relationship to the powerhead and the relevant contact plane(s);

— fuel mixture;

— ambient temperature and atmospheric pressure;

— running time, torque and hottest temperatures for each speed.

Annex A
(informative)

Bibliography

NOTE 5 This bibliography provides additional information regarding ignition of forest fuels and testing of small engines for fire ignition potential.

[1] STOCKSTED, DS. *Spontaneous and piloted ignition of pine needles,* Research note INT 194, USDA Forest Service, Northern Forest Fire Laboratory (1975).

[2] STOCKSTED, DS. *Spontaneous and piloted ignition of cheat-grass,* Prepublication research note, USDA Forest Service, Northern Forest Fire Laboratory (1976).

[3] KAMINSKI, GC. *Ignition time vs temperature for selected forest fuels,* Project record, USDA Forest Service, San Dimas Equipment development center (1974).

[4] HARRISON, RT. *Danger of ignition of ground cover fuels by vehicle exhaust systems,* ED & T Report 5100-15, USDA Forest Service, San Dimas Equipment development center (1970).

[5] *Standard test procedure for general spark arresters,* USDA Forest Service, San Dimas Equipment development center (1982).

[6] SAE J335-SEP 88, *Multiposition small engine exhaust system fire ignition suppression.*