INTERNATIONAL STANDARD

ISO 11839

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Machinery for forestry — Glazing and panel materials used in operator enclosures for protection against thrown sawteeth — Test method and performance criteria

Matériel forestier — Matériaux pour vitrage et panneaux utilisés dans l'enceinte de l'opérateur contre la projection des dents de scie — Méthode d'essai et critères de performance

Reference number
ISO 11839:2010(E)

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11839 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 15, *Machinery for forestry*.

Introduction

Forestry machines that use circular saws with replaceable sawteeth can expose the operator to the hazard of thrown sawteeth. Operator enclosures on forestry machinery provide protection from a variety of hazards by interposing a system of structural members and panel materials between the operator and potential hazards (see, for example, ISO 8083 for falling objects or ISO 8084 for poking hazards).

When there is a hazard from circular-saw thrown sawteeth, panel and glazing materials used in operator enclosures can be appropriately selected to provide operator protection based upon this International Standard. Although surfaces meeting the criteria given in this International Standard might not give protection under all conceivable circumstances in which the machine could be impacted by thrown sawteeth, it is expected that protection against sawteeth thrown from circular saws will be provided under normal operating conditions.

Machinery for forestry — Glazing and panel materials used in operator enclosures for protection against thrown sawteeth — Test method and performance criteria

CAUTION — Some of the tests specified in this International Standard involve the use of processes which could lead to a hazardous situation.

1 Scope

This International Standard specifies test procedures and performance requirements for determining the protective ability of panel materials used in forestry-machinery operator enclosures intended to protect the operator against sawteeth thrown by circular-saw components. This particular type of hazard is specifically defined by the size and velocity of the sawteeth and is unique to these cutting devices.

This International Standard is applicable to panel materials for forestry machines defined in ISO 6814 that include an integrated or attached circular sawing device, controlled or powered by the primary machine (e.g. topping saws, felling saws or bucking saws).

It does not address protection from chain-shot hazards (see ISO 11837).

2 Normative references

The following referenced documents are indispensable for the application 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 6814, *Machinery for forestry — Mobile and self-propelled machinery — Terms, definitions and classification*

3 Tests

3.1 Test equipment

3.1.1 Projectile launcher, capable of propelling the specified test projectiles at the required velocities. The launcher shall have a controllable means of adjusting velocity. The launcher shall also have a means of orienting and directing the test projectile in relatively linear motion with the cutting surface towards the target. The test projectile may be supported in the launcher by a test projectile holder (i.e. a sabot). Such a test projectile holder should be less than 10 % of the mass of the tooth projectile being propelled, and any impact of the holder on the test panel shall be clearly inconsequential to the test result (see Figure 1).

3.1.2 Test projectile (F1), consisting of a representative four-pointed sawtooth, 300 g ± 5 g, with a cutting surface 50 mm ± 1 mm square (see Figure 2).

3.1.3 Test projectile (F2), consisting of a representative, four-pointed sawtooth, 800 g ± 5 g, with a cutting surface 60 mm ± 1 mm square (see Figure 2).

3.1.4 Target panel opening, consisting of a rigid steel frame surrounding a square opening of 450 mm ± 1 mm × 450 mm ± 1 mm.

3.1.5 Corrugated cardboard indicator panel, 500 mm × 500 mm, positioned 250 mm ± 5 mm directly behind the target panel opening.

3.1.6 Target support structure that rigidly positions the target assembly perpendicular to the line of motion of the test projectile, with the target surface 3 000 mm ± 50 mm from the muzzle of the launcher.

3.1.7 Means of measuring test projectile velocity to an accuracy of ± 2 m/s.

3.1.8 Means of measuring panel surface temperature to an accuracy of ± 1 °C.

3.1.9 Containment structure surrounding the test projectile line of motion, target assembly and indicator panel to provide suitable protection for test personnel.

3.2 Test samples and mounting

3.2.1 Test samples shall be representative of the commercial specification of the given product material. Appropriate material properties shall be determined and reported to verify test conditions.

3.2.2 Test samples shall be mounted onto the target panel opening using the manufacturer's specified attachment methods. The exception to this are test samples from materials that are typically attached using permanent methods such as welding; these may be attached to a separate frame that is then bolted to the target panel opening. Mounting details shall be recorded and reported.

3.3 Test method

3.3.1 Five samples shall be tested at low temperature and five samples at room temperature. Each sample shall be impacted once. The low-temperature samples shall be conditioned for 3 h prior to testing with the impact side exposed to −32 °C ± 3 °C, and the operator side shall be exposed to a room temperature of +22 °C ± 3 °C. The room temperature samples shall be conditioned for 3 h at +22 °C ± 3 °C.

3.3.2 Five samples of non-metallic materials shall also be high-temperature-tested at +49 °C ± 3 °C. Samples shall be conditioned at the elevated temperature for a minimum of 3 h prior to testing.

3.3.3 Each material shall be tested at the appropriate energy level, namely either

— 1 084 J to 1 311 J for F1, or

— 4 840 J to 5 856 J for F2.

The selection of the energy level shall be based on consideration of the type of thrown sawteeth hazard the material will face, in accordance with Annex B.

3.3.4 The F1 test projectile shall impact the target at a velocity of 85 m/s to 94 m/s. The F2 test projectile shall impact the target at a velocity of 110 m/s to 121 m/s.

3.3.5 If the velocity of the test projectile is less than the minimum specified velocity and the sample does not fail, the test shall be repeated. If the velocity of the test projectile is less than the minimum velocity and the sample fails, the test result (failure) is accepted. If the velocity of the test projectile is more than the maximum velocity, and the test sample passes, the test result (pass) is considered acceptable.

3.3.6 The test projectile shall impact the panel with the cutting surface forward in at least three of the sample impacts and within the target opening.

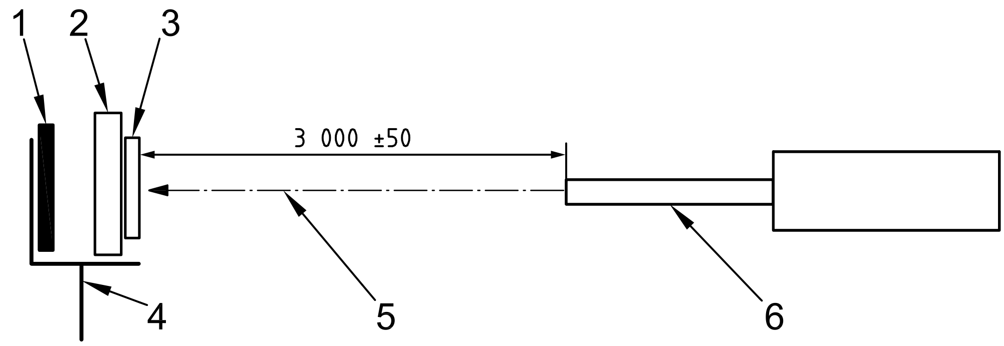
4 Performance requirements

The panel material is deemed to have failed if the test projectile and/or panel fragments impact the indicator panel. All samples shall pass the test in order for the material to be classified at the tested level.

5 Reporting results

The results of the tests shall be reported using a test report whose content is in accordance with Annex A.

Dimensions in millimetres

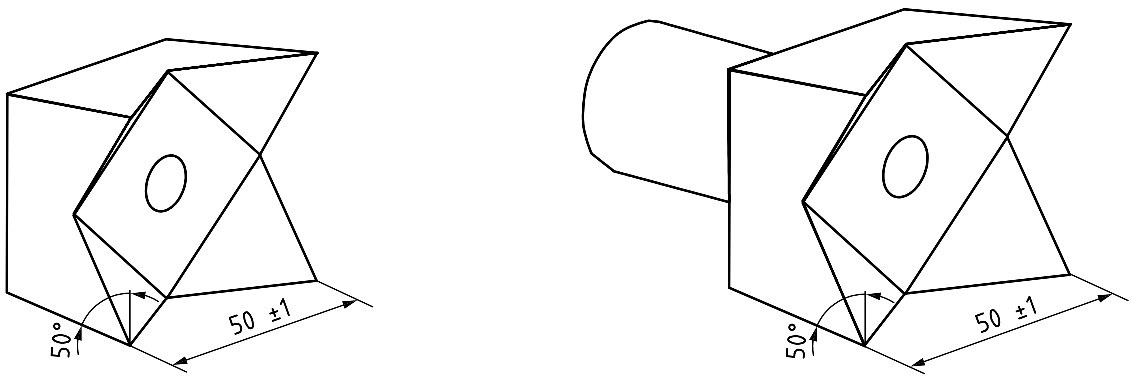


Key

1 indicator panel
2 target panel opening
3 target panel
4 target support structure
5 line of motion
6 projectile launcher

Figure 1 — Illustrative arrangement of test equipment

Dimensions in millimetres



F1: 300 g ± 5 g

F2: 800 g ± 5 g

Figure 2 — Illustrative test projectile specification

Annex A
(normative)

Test report

A.1 Material description

Manufacturer ....

Dimensions (thickness) ....

Construction (layers, coatings, etc.) ....

Material compound ....

Source information, lot number, manufacturing date ....

Glazing attachment method ....

A.2 Test conditions

Sample/test number ....

Temperature of material ....

Test projectile mass ....

Actual test projectile velocity at impact ....

Orientation of test projectile at impact ....

A.3 Test summary

Number of samples tested at each temperature condition:

.... /–32 °C, .../+22 °C, .../+49 °C (for non-metallic only)

Number of samples passing the test at each temperature condition:

.... /–32 °C, .../+22 °C, .../+49 °C (for non-metallic only)

A.4 Test results

The velocity of the test projectile met/did not meet the specified criteria (see 3.3.4).

The material failed/did not fail under impact (see Clause 4).

Therefore, the test result is acceptable/not acceptable according to the requirements of this International Standard (see Clause 4), and the material tested passed/did not pass.

Date of test ....

Name and address of test facility ....

Name of test engineer ....

Date and number of test report ....

Annex B
(normative)

Thrown sawteeth hazard from circular saws

One means of cutting trees is the circular saw, a rotating disk with peripherally-mounted teeth. There are two basic types of circular saw: intermittent saws, where the saw only rotates when it is powered through a tree; and continuous saws, where the saw rotates all the time. Intermittent saws tend to have lower-speed, higher-torque designs, while continuous saws have high speeds and lower torque. The inertia stored in the high-speed saw disk is a key factor in maintaining rotation during a cut. Continuous saw disks also tend to have larger diameter than intermittent disks. It is generally assumed that the thrown sawteeth hazard is associated with the continuous saw design where the tip speed is highest and the possibility for unguarded blade contact is greater.

A survey of high-speed sawhead specifications identified over 40 models in current production. Older designs are still in use, but specifications were unavailable. Most of the designs (68 %) rotated at a speed of 1 300 min^{-1} or greater, although the rotational speeds ranged from 600 min^{-1} to 1 650 min^{-1}. Combining rotation with disk diameter to calculate tip speed reveals a narrower distribution, with almost all designs (88 %) working at a tip speed that exceeded 85 m/s. The highest tip speed in the sampled designs was 102 m/s.

There is very little published information about the actual failure modes of the circular sawteeth. Anecdotal reports suggest that loosening mounting bolts can lead to detachment. Operators have reported missing teeth in trade safety reports. For the purposes of this International Standard, it is assumed that, if a mounting bolt fails, the tooth would separate from the holder and be carried in the debris stream around the inside of the saw shroud. At the discharge point, the tooth could be moving at the tip speed velocity. The performance test is structured around the assumption of straight-line motion at tip speed. However, there may be other failure modes that could produce higher sawteeth velocities in field conditions.

Just as there is a wide range of sawhead designs, there is a wide range of sawteeth and mounting configurations. Teeth generally have multiple cutting faces that allow for repositioning to compensate for wear. There are shankless one-piece and two-piece styles. Shankless teeth are basically a cutting face mounted directly onto the saw disk. One- and two-piece designs have a round shank behind the tooth that fits into a bore in the mount. The shank takes some of the loading that would otherwise be carried by the mounting bolt. One-piece teeth are an integral component with tooth and shank, while two-piece teeth have replaceable cutting faces. A one-piece 57 mm kerf long-shank tooth has a mass of nearly 800 g. The more common 51 mm kerf tooth with shank has a mass of about 500 g, while a shankless tooth has a mass of 300 g or less.

The kinetic energy, E_k, of a sawtooth moving at tip speed is calculated in joules as the product of mass and velocity:

$$E_k = 0,5 \times m \times v^2$$

The selection of an appropriate test level for a panel material shall be based on calculation of the anticipated energy level of the potential thrown sawtooth on a particular design. Select a test energy that equals or exceeds the calculated value.