TECHNICAL REPORT

ISO TR 9412

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Portable chain-saws — Automatic chain brake and cutting equipment — Operator's safety test

Scies à chaîne portatives — Frein de chaîne automatique et équipement de coupe — Essai de sécurité de l'opérateur

Reference number
ISO/TR 9412:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 9412, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

A Draft International Standard (ISO/DIS 9412) with the same title was circulated on 1988-03-17. Although it received the required majority for approval as an International Standard, the sub-committee found, after presentation of further data on measurements of reproducibility and repeatability, that more experience of the method was needed and resolved that the draft should be issued as a Technical Report.

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This document is therefore being issued in the Technical Report (type 2) series of publications (according to subclause G.6.2.2 of part 1 of the IEC/ISO Directives) as a "prospective standard for provisional application" in the field of Forestry machinery — Portable chain saws, because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than two years after its publication with the options of: extension for another two years; conversion into an International Standard; or withdrawal.

Annex A forms an integral part of this Technical Report.

Portable chain-saws — Automatic chain brake and cutting equipment — Operator's safety test

1 Scope

This Technical Report specifies a test method for assessing the efficiency of the overall safety features inherent in a complete chain-saw comprising chain brake, guide bar, chain and power head when the chain-saw undergoes a simulated kickback. The method applies to portable hand-held, combustion engine chain-saws for use primarily in forestry.

The method is especially suitable for evaluating an operator-independent chain brake system.

2 Definition

For the convenience of the user of this Technical Report, the following definition is repeated from ISO 6531:1982, *Machinery for forestry — Portable chain saws — Vocabulary* (definition 1.6).

kickback: Uncontrolled (sudden and accidental) upward and/or backward motion of the guide bar which may occur when the saw chain at the nose (tip) of the guide bar contacts an object such as a log or branch or when the wood closes in and pinches the saw chain in the cut.

NOTES

1 The magnitude and speed of these reactions are often such that they may not be controlled by the operator.

2 The first part of this definition forms the basis of this Technical Report since there is currently no test available for pinching. It is expected that after such a test is developed, this Technical Report may be extended to include the measurement of pinching reactions.

3 Principle

Determination of the risk of a chain-saw operator being injured by a kickback situation.

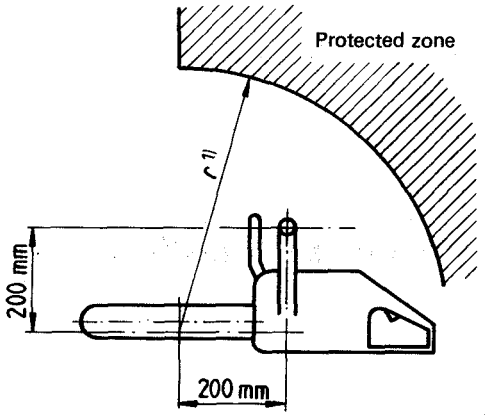
The principle of the measurement is a determination of whether or not the rotating chain enters a defined "protected zone", which corresponds to the operator's normal working position.

The test procedure and data acquisition in this Technical Report are intended to be as realistic as possible. The test procedure has also been developed with the objectives of making measurements as precise as possible and of ensuring sufficient repeatability and reproducibility of the test data. Therefore, no hand-held test method can be recommended.

The test method is based on the fact that the greatest risk for the operator is if he loses control of the saw during kickback and is then injured by the rotating chain (worst case). These conditions can be regarded as simulated if the saw hangs in cords in such a way that the effect of these cords can be ignored during the kickback.

The test parameters have been selected in order to achieve the maximum amount of kickback.

The defined protected zone, the radius of a quarter of a cylinder, (see figure 1) should be based on an extensive analysis of the operator's normal working position.



1) Recommended value of r is 600 mm.

Figure 1 — Protected zone

4 Instrumentation

4.1 Test rig (see figure 2).

4.2 Timer starting device with an accuracy of ± 1 ms (chain stop time, protected zone entrance time).

The timer starting device can consist of a so-called electric tape on the wood surface where the tip of the guide bar touches the wood piece.

4.3 Chain stop timing device with an accuracy of ± 1 ms (pick up and electronic clock).

4.4 Zone timing device with an accuracy of ± 1 ms (pick up and electronic clock).

The zone timing device can consist of a microswitch connected to a cord from the tip of the guide bar.

NOTE 3 The electronic clocks in 4.3 and 4.4 can be replaced by an oscilloscope.

4.5 Tachometer, with an accuracy of ± 1,5 %.

5 Preparation

Adjust the chain-saw for best cutting performance in accordance with the manufacturer's recommendations. The oil and fuel tanks shall be three-quarters filled or full.

Suspend the saw by cords so that it behaves like a physical pendulum (see figure 2 and figure 3). The cords A, one for each side of the saw, start from the bar and then slide over a steel pipe down to a beam fastened to the rear handle. With two extra cords B, a defined position of the saw before the impact is easily obtained. The length of the cords shall be adjusted so that the saw is in a defined position (see below) before the start of the kickback. With these preparations, the friction of the cords on the test pipe is sufficient to maintain the right position when the saw is pulled backwards and when it swings forward to impact the wood. When the kickback motion starts, the cords A become slack causing the friction forces suddenly to be almost eliminated. The mass of the cords shall not exceed 50 g maximum.

The total mass of all extra equipment mounted on the saw (cord fastening, safety devices, etc.) shall not exceed 5 % of the mass of the complete saw (with empty tanks).

It is up to each test institute to take the necessary safety precautions, e.g. mounting a guard above the chain.

When the saw is hanging still, the tip of the guide bar shall touch a wood piece — the end of a sound, green, well-grown, freshly-felled softwood plank such as spruce (see figure 4). The dimension and location of the wood piece shall be such that the kerf from the chain does not intersect any edge of the piece. The centreline of the guide bar shall be horizontal. The guide bar plane shall be both vertical and at right angles to the wood surface. The guide bar plane shall also be parallel to the pendulum plane.

6 Test method

6.1 General

The measurement shall be carried out according to the test programme in 6.2.

The throttle shall be kept in a fixed position during the kickback. This position shall correspond

a) to the manufacturer's rated rotational frequency for maximum power;

b) to this rated rotational frequency plus 33 % or full throttle.

The engine rotational frequency shall be held within ± 5 % of the nominal engine rotational frequency.

The kickback starts when the guide bar tip touches the wood piece. The impact speed is given as the pendulum deflection, as shown in figure 2.

The pendulum deflection, d, in metres, is given by the formula

$$d = v\sqrt{\frac{R}{g} - \frac{v^2}{4g^2}}$$

where

v is the impact speed, in metres per second;

R is the pendulum length (2 m);

g is the gravitational acceleration, in metres per second squared.

For each kickback test, the following times shall be recorded in the test report:

— the stopping time of the chain;

— the time for the chain to enter into the protected zone.

If the chain does not stop or if the chain does not enter the protected zone, this fact shall also be noted in the test report.

Before each test, the plank shall be cut off perpendicularly so that the end surface is free from knots, etc.

6.2 Test procedure

6.2.1 Adjust the test equipment for the defined protected zone. Run the engine for 30 s at maximum power rotational frequency. Apply the brakes twice at 15 s intervals. Run the engine for 1 min at maximum power rotational frequency. Apply the brakes five times at 15 s intervals. Run the engine at maximum power rotational frequency.

Make five kickbacks at the impact speed of 0,5 m/s and at each impact angle, −5°, 0°, 5°, 10°, 15°, 20°, 25°, each at intervals of 1 min to 5 min and measure the zone time and stopping time at each kickback.

6.2.2 Run the engine at racing rotational frequency.

Make five kickbacks at the impact speed of 0,5 m/s and at each impact angle −5°, 0°, 5°, 10°, 15°, 20°, 25°, each at intervals of 1 min to 5 min and measure the zone time and stopping time at each kickback.

Make five kickbacks at the impact speed of 1 m/s and at each impact angle −5°, 0°, 5°, 10°, 15°, 20°, 25°, each at intervals of 1 min to 5 min and measure the zone time and stopping time at each kickback.

6.2.3 Calculate the average zone time, $\bar{t}$, for each impact angle, impact speed and engine rotational frequency combination by the following formula:

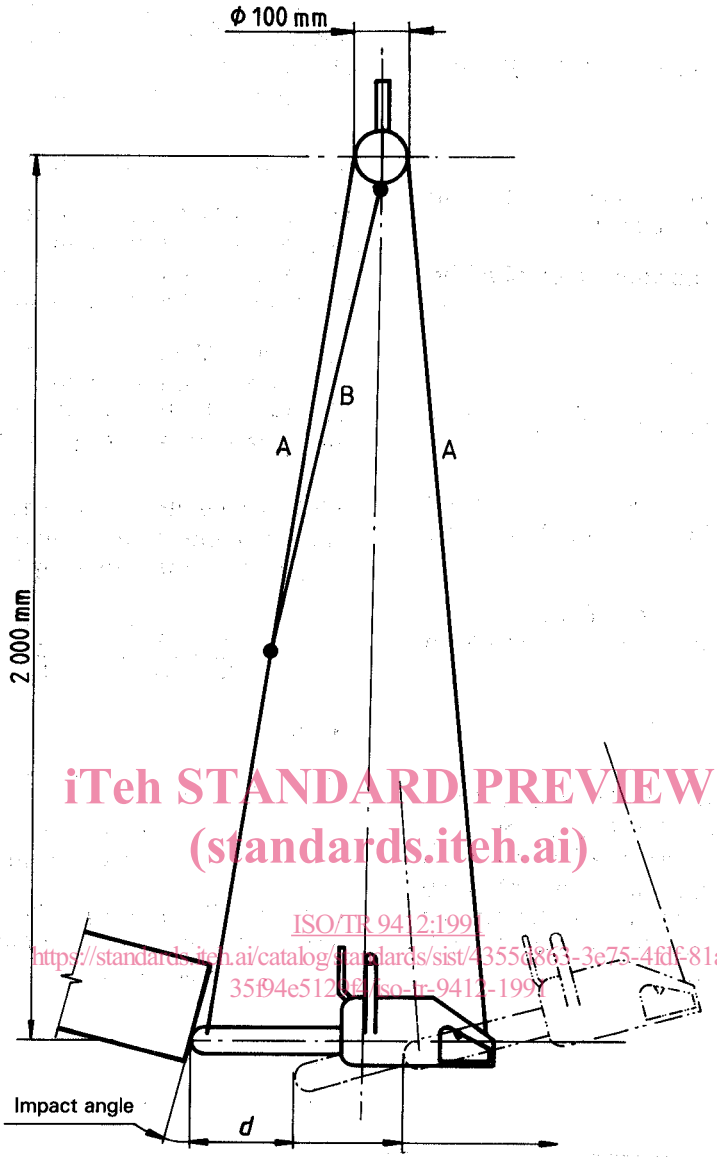
$$\bar{t} = \frac{n}{\frac{1}{t_1} + \frac{1}{t_2} + \ldots + \frac{1}{t_n}}$$

where

$t_1, t_2, \ldots t_n$ are the measured time values;

n is the number of measurements taken, normally five.

Calculate the average chain stopping time for each impact angle, impact speed and engine rotational frequency combination by the same formula.



NOTE — d = 225 mm for an impact speed of v = 0,5 m/s and d = 450 mm for an impact speed of 1 m/s.

Figure 2 — Test rig, front view

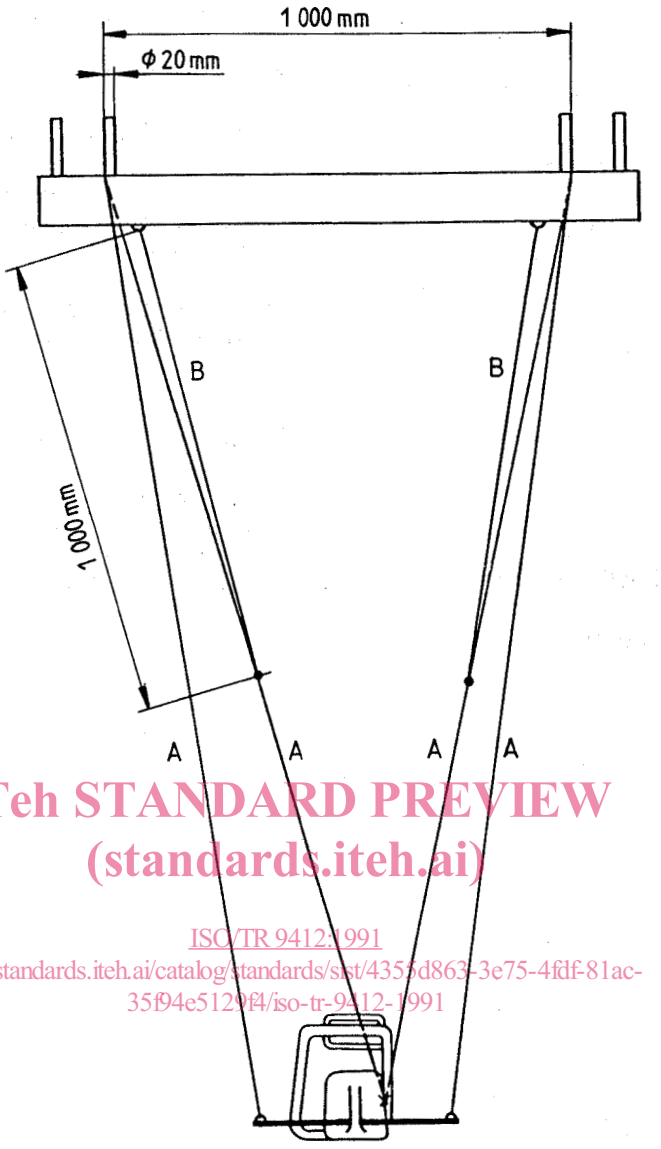
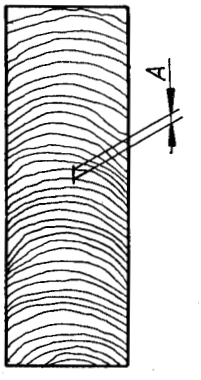


Figure 3 — Test rig, side view



A : Average ring distance within 2 mm to 4 mm.

Figure 4 — Plank end of softwood