23

INTERNATIONAL STANDARD

ISO 9518

First edition
1992-06-15

Forestry machinery — Portable chain-saws — Kickback test

Matériel forestier — Scies à chaîne portatives — Essai de rebond

Reference number
ISO 9518 : 1992 (E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Tables

Figures

Annexes

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.

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 9518 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 forms an integral part of this International Standard. Annex B is for information only.

Introduction

The movement of a chain-saw during kickback can be simulated by a mathematical model. Through application of sound engineering principles, vertical, horizontal and rotational components of the chain-saw's movement are predicted. The model is presented in this International Standard in the form of a computer program which predicts the peak position of the chain-saw, upward and backward towards the user. This is called the "computed kickback angle" and is illustrated in figure 1.

The computer program uses standard engineering force-motion equations to predict the path of the saw based on kickback energy, physical characteristics of the chain-saw and simulated operator reaction forces. User reaction forces were determined through analysis of high-speed motion pictures of actual hand-held kickbacks.[1)]

Input data for the computer program is obtained from physical measurements and from kickback energy tests performed on a completely assembled chain-saw including powerhead, guide bar and saw chain.

Kickback energy of a chain-saw is measured on an apparatus (called the kickback machine) developed specifically for this purpose. Kickbacks are generated by delivering the flat surface of a fibreboard test specimen into contact with the bar tip under controlled conditions. This apparatus and standardized specimen have been found to yield a realistic measurement of kickback energy of any specific saw/bar/chain combination.

The test procedure requires testing over a range of conditions to ensure that peak kickback energy for the particular saw/bar/chain combination on test is determined.

When the rotating parts of a chain-saw are stopped by a chain brake, a moment is generated that tends to reduce the kickback angle. The procedure accounts for this effect.

Annex A is a flow diagram of the computer program used to determine the computed kickback angle. Annex B contains a BASIC language program (complete with examples) to make these computations.

1) For additional details see *Overview of the KICKBACK Computer Program — Contents and Development,* available from the Portable Power Equipment Manufacturer's Association, 4720 Montgomery Lane, Suite 514, Bethesda, MD 20814, USA.

Forestry machinery — Portable chain-saws — Kickback test

1 Scope

This International Standard specifies the methodology for determining the kickback potential of a gasoline-powered chain-saw, complete with guide bar and saw chain.

Although this International Standard is an accurate method of measurement for evaluating computed kickback angles and energy associated with chain-saw kickback, it is not intended to evaluate automatic chain brake performance on a chain-saw with a chain brake which can be activated independently of the operator, or to chain-saws with an engine capacity of 62 cm^3 and above.

NOTE — Research is being conducted to extend the scope of the Standard to chain-saws of capacity larger than 62 cm^3.

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 6535 : 1983, *Forestry machinery — Portable chain saws — Chain brake — Performance.*

BOM-0100, *Kickback machine — Bill of materials.* 1)

3 Definitions

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

3.1 bar tip guard: Shield that prevents contact with the chain at the tip of the guide bar and which may be removable and replaceable.

3.2 chain brake lever: Device, usually the front hand guard, used to activate the chain brake.

3.3 computed kickback angle: Angle used as a measure of the reaction of a hand-held chain-saw, backward and upward toward the user, when subjected to a rotational kickback under simulated conditions. (See figure 1.)

3.4 contact angle: Angle between the surface of the test specimen and a perpendicular to the guide bar centreline.

3.5 data set: Group of data points, all taken at the same test conditions.

3.6 horizontal system: Portion of the kickback machine used to measure the horizontal energy of the kickback reaction.

3.7 impact: Test sequence involving releasing the specimen into contact with the moving saw chain at the guide bar tip to create a simulated kickback reaction.

3.8 kickback; rotational kickback: Rapid upward and backward motion of the saw which can occur when the moving saw chain near the upper portion of the tip of the guide bar contacts an object such as a log or branch.

3.9 kickback machine: Apparatus used to measure the energy generated by a chain-saw kickback under controlled conditions.

3.10 powerhead: Chain-saw without the guide bar and chain.

3.11 rotary system: Portion of the kickback machine used to measure the rotary energy of the kickback reaction.

3.12 specimen; test specimen: Block of medium density fibreboard 38 mm × 38 mm × 250 mm used as an object for the saw chain to engage in a simulated kickback.

1) The bill of materials and engineering drawings describing the kickback machine are available from the Portable Power Equipment Manufacturer's Association, 4720 Montgomery Lane, Suite 514, Bethesda, MD 20814, USA.

4 Test method

4.1 Principle

The flat surface of a wood-like specimen is thrust into contact with the moving saw chain at the tip of a chain-saw guide bar, in order to produce a simulated kickback reaction. This takes place under controlled conditions in apparatus designed to measure the magnitude of rotary and horizontal energies generated during the resulting kickback reaction. A step-by-step search, covering a range of critical test conditions, determines the peak energy values to be used in computing kickback angle. This peak value is intended to simulate the most severe conditions reasonably expected to be encountered by typical users. Since there may be some variability, several impacts are made under each set of conditions and the results averaged.

4.2 Materials

Calibrated test samples, 38 mm × 38 mm × 250 mm, consisting of medium-density fibreboard. Samples shall be oriented with the rough side (end grain) facing the bar tip.

NOTE — Because kickback energy measurements are sensitive to the consistency of the fibreboard, careful control of these specimens is essential. In order for test results to be reproducible over time and for comparisons with results from other laboratories, the test specimens need to be calibrated against "known" specimens. Calibration requires kickback testing with samples from batch lots using a "standard" saw/chain/bar combination for which the kickback energies have been established. A calibration factor can then be applied to the energy values before they are used in the computer model.

4.3 Apparatus

4.3.1 Chain-saw kickback machine BOM-0100 for energy level measurements. (See clause 2.)

4.3.2 Engine speed indicator with a rotational frequency reading accuracy of ± 1,5 % of the measured value.

4.3.3 Carriage velocity timing device, including probes with an accuracy of ± 1 ms and a holding circuit to prevent unwanted re-triggering.

4.3.4 Chain brake timing device, including probes having an accuracy of ± 3 ms.

4.3.5 Chain brake testing apparatus in accordance with ISO 6535.

4.3.6 Computer and kickback program to compute the kickback angle.

4.4 Preparation

NOTE — Record all measurements on the kickback test record (see figures 9 and 10).

4.4.1 Physical measurements

The following physical measurements are to be made with the guide bar and saw chain attached in proper working position and with oil and fuel tanks full. The saw chain shall be prepared in accordance with 4.4.2 prior to taking measurements.

4.4.1.1 Chain saw mass, in kilograms. An accuracy of ± 50 g is acceptable for this measurement.

4.4.1.2 Location of axis of rotation, through the centre of gravity, perpendicular to the plane of the guide bar. It is to be marked on the saw body. An accuracy of ± 6 mm is acceptable for this measurement.

4.4.1.3 Chain-saw moment of inertia about an axis through the centre of gravity and perpendicular to the plane of the guide bar, in kilograms metre squared.

4.4.1.4 Chain-saw bar tip, front handle and rear handle locations relative to the centre of gravity expressed as x, y co-ordinates, in millimetres. An accuracy of ± 3 mm is acceptable for these measurements (see figure 2).

4.4.2 Saw chain preparation

4.4.2.1 The saw chain shall be new and shall be prepared for the test by cutting clean or debarked wood for approximately 5 min.

4.4.2.2 Saw chain tension shall be set in accordance with figure 3. The chain should move freely on the bar.

4.4.3 Chain-saw preparation

4.4.3.1 The chain-saw shall be in functionally new condition.

4.4.3.2 The saw shall be run-in according to the manufacturer's recommendations.

4.4.3.3 If the saw is equipped with a removable bar tip guard, remove the bar tip guard for testing.

4.4.3.4 If the saw is equipped with a chain brake, disable the mechanism if necessary to prevent activation.

4.4.3.5 Remove the front handle grip cover in the area where the saw handle clamp will be attached and construct a clamp insert to fit the saw handle. Attach the saw handle clamp to the front handle so that it is as nearly parallel to the guide bar centreline as possible (see figure 4). Tighten securely.

4.4.3.6 Attach the cradle to the saw-clamp assembly. Do not tighten.

4.4.4 Kickback machine preparation

4.4.4.1 If the chain-saw mass (see 4.4.1.1) is less than the standard carriage (4 kg), the standard carriage may be replaced with the lightweight carriage.

4.4.4.2 Insert a fibreboard test specimen in the carriage clamp. The specimen shall be oriented with the rough side (end grain) facing the guide bar tip.

4.4.4.3 If necessary, add weight to the carriage until the carriage mass (including fibreboard specimen) equals the mass of the saw ± 100 g.

4.4.5 Chain-saw installation and alignment

4.4.5.1 Install the saw/clamp/cradle assembly in the kickback machine in accordance with figure 4, and align the guide bar with the centreline of the fibreboard specimen.

4.4.5.2 Adjust the chain-saw, clamp and cradle in the kickback machine so that the centre of gravity of the saw is aligned to within ± 3 mm of the rotary axis. Make this adjustment by rotating the saw/clamp/assembly where it attaches to the cradle and by sliding the cradle in the support blocks.

NOTE — Do not rotate the clamp where it attaches to the saw handle: this was adjusted in 4.4.3.5.

4.4.5.3 Attach a brace assembly between the chain-saw handle and either leg of the cradle as near as possible to the rotary axis. The brace attachment may be located on either side of the rotary axis. A second brace may be installed if needed to maintain saw position during testing.

4.4.6 Saw/clamp/cradle assembly balance

4.4.6.1 Fuel and oil tanks shall be filled.

NOTE — External fuel and oil supplies to maintain full tanks are acceptable.

4.4.6.2 The system shall be balanced using the minimum amount of mass located as close to the rotary axis as possible (see figure 4).

4.4.6.3 Acceptable initial balance is achieved when the saw/clamp/cradle assembly will not rotate at the "horizontal" or "vertical" positions or when a 60 g mass hung from the rotary pulley will counter any observed rotation. If the centre of gravity of the saw shifts due to soft isolators, a compromise between the horizontal and vertical positions is permissible.

4.4.7 Friction measurement

4.4.7.1 Horizontal friction shall be measured prior to and after kickback energy tests. Measurements shall be made with the ratchet pawl in its activated position: they shall be made over a distance of at least 300 mm. If the horizontal friction in the direction of travel away from the powerhead exceeds 2,2 N the source(s) of friction shall be located and corrected.

4.4.7.2 Rotary friction shall be measured prior to and after kickback energy tests. Measurements shall be made with the ratchet pawl in its activated position: they shall be made through an angle from 0° to 180°. If the rotary friction exceeds a force of 2,2 N applied to the rotary pulley, the source(s) of friction shall be located and reduced.

NOTE — In saws with soft isolator systems, the centre of gravity shifts as the saw and cradle rotate. If shifting of the centre of gravity of the saw prevents accurate friction measurements, a substitute saw of about the same mass may be used for friction measurements.

4.4.8 Restraining systems alignment

4.4.8.1 The specimen contact angle shall be set to 30°. Position the carriage so that the specimen contacts the saw chain. Adjust the position of the rack/horizontal restraining assembly so that the cable from the carriage to the pulley is vertical (see figure 5).

4.4.8.2 With the guide bar centreline horizontal, install the cable attachment pin on the rotary pulley and adjust the turnbuckle to bring the 0,9 kg weight on the rotary restraining system to the zero position (see figure 6).

4.4.9 Impact velocity adjustment

Adjust the carriage release point to achieve a velocity (just prior to contact of the specimen with the bar tip) of 0,76 m/s.

4.5 Test requirements and procedures

NOTE — Record data on the kickback test record, figure 9.

4.5.1 Test requirements

4.5.1.1 Adjust the specimen contact angle to the value shown for data set 1A in table 1. For subsequent data sets, readjust the angle as specified.

4.5.1.2 After each impact the chain-saw should be inspected for unusual conditions and reset for the next impact. Do not operate a damaged saw.

4.5.1.3 The centrifugal clutch shall be burned at the start of the test and after each 12 impacts.

To burn the clutch, clamp the saw chain to the guide bar and run the saw for 5 s with full throttle. Measure and record the slip speed in reciprocal seconds (s^{-1}).

If the slip speed varies by more than 8 s^{-1} during the test, replace the clutch.

4.5.1.4 Saw chain tension shall be set initially and adjusted during the test in accordance with 4.4.2.2.

4.5.1.5 On occasion, the balance of the saw/clamp/cradle may change. Check and reset balance if imbalance exceeds 60 g as specified in 4.4.6.3. If imbalance of more than 60 g occurs, data from the previous impact is invalid.

4.5.1.6 The specimen is to be clamped in the carriage with a rough face (end grain) presented to the saw chain.

4.5.1.7 Make only two impacts on each specimen (one on each rough face).

4.5.1.8 The specimen should be examined and changed after each impact.

The orientation of the specimen shall be adjusted so that the kerf from the chain will not intersect the upper edge of the specimen face. All saw chain cuts shall start within the middle 25 mm on the face of the specimen. If any kerf runs off the specimen or if the specimen splits, do not use the energy readings in the computations. Repeat the impact on another specimen.

Specimen splitting may be overcome by adding a C-clamp. If a C-clamp is so used, the carriage mass shall be compensated.

4.5.1.9 Upon completion of the test, horizontal and rotary friction levels are to be measured as described in 4.4.7. The greater measured level is to be used for energy computations. If friction at the end of the test program exceeds the specifications of 4.4.7, the test shall be repeated.

4.5.2 Kickback testing

Using the following procedure, perform impacts at the test conditions specified in the test sequence of table 1. If it is more convenient, the test sequence in table 2 may be used instead.

4.5.2.1 With the barrier bar in position, start the chain-saw. Adjust the engine speed to the value specified for data set 1A in the test sequence.

4.5.2.2 Raise the barrier bar and stand clear of the kickback machine.

4.5.2.3 Release the carriage, observing the engine speed just as the specimen contacts the moving chain at the bar tip.

4.5.2.4 Turn off the chain-saw.

4.5.2.5 Record the vertical displacement, in millimetres, of the horizontal restraining weight and the horizontal displacement, in millimetres, of the carriage (see figure 5).

4.5.2.6 Record the vertical displacement, in millimetres, of the upper and lower rotary restraining weights (see figure 6).

NOTE — The horizontal and rotary restraining systems may have separate calibrations to permit direct readings.

4.5.2.7 Complete data set 1A by repeating the steps in 4.5.2.1 to 4.5.2.6. Each repetition is considered one "impact". Each data set consists of either three or six impacts depending on the outcome of calculations specified in 4.5.3.

4.5.2.8 Repeat the steps in 4.5.2.1 to 4.5.2.7 for the remaining data sets as specified in the test sequence of table 1 or 2.

4.5.2.9 The test sequence may be discontinued if, at both engine speeds

a) there is a 50 % reduction in average rotary energy between measurements at two consecutive contact angles, or

b) there is a decrease in average rotary energy for two consecutive contact angles.

Table 1 — Test sequence

Data set	Contact angle degrees	Impact velocity m/s	Engine speed[1)] s^{-1} $\pm 3\ s^{-1}$
1A	0		183
1B	0		150
2A	5		183
2B	5		150
3A	10		183
3B	10		150
4A	15	0,76	183
4B	15		150
5A	20		183
5B	20		150
6A	25		183
6B	25		150
7A	30		183
7B	30		150

1) If a speed of 183 s^{-1} cannot be reached, the A-series tests shall be carried out at the highest possible speed and the B-series tests at the highest possible speed less 33 s^{-1}.

Table 2 — Optional test sequence

Data set	Contact angle degrees	Impact velocity m/s	Engine speed[1)] s^{-1} $\pm 3\ s^{-1}$
1A	0		183
2A	5		183
3A	10		183
4A	15		183
5A	20		183
6A	25		183
7A	30		183
		0,76	
1B	0		150
2B	5		150
3B	10		150
4B	15		150
5B	20		150
6B	25		150
7B	30		150

1) If a speed of 183 s^{-1} cannot be reached, the A-series tests shall be carried out at the highest possible speed and the B-series tests at the highest possible speed less 33 s^{-1}.

4.5.3 Kickback energy determination

4.5.3.1 Compute the horizontal energy, W_h, for each impact:

$$W_h = [(9{,}8\, G_h)\,(S_h) + (F_h)\,(S_c)] \times 10^{-3}$$

where

W_h is the horizontal energy, in joules;

G_h is the mass of the horizontal restraining weight, in kilograms;

F_h is the horizontal axis friction, in newtons;

S_h is the displacement of the horizontal restraining weight, in millimetres;

S_c is the displacement of the carriage, in millimetres.

4.5.3.2 Compute the rotary energy, W_r, for each impact:

$$W_r = [(9{,}8\, G_u + F_r)\,(S_u) + (9{,}8\, G_l)\,(S_l)] \times 10^{-3}$$

where

W_r is the rotary energy, in joules;

G_u is the mass of the upper rotary weight, in kilograms;

G_l is the mass of the lower rotary weight, in kilograms;

S_u is the displacement of the upper rotary weight, in millimetres;

S_l is the displacement of the lower rotary weight, in millimetres;

F_r is the rotary friction force, in newtons.

4.5.3.3 After performing three impacts at the conditions specified for a data set, compute the average of the three rotary energy values and the average of the three horizontal energy values.

4.5.3.4 If the rotary energy values are each within 10 % of the average rotary value, use the average of the three values.

4.5.3.5 If any of the rotary energy values is not within 10 % of the average, perform three additional impacts and use the average of all six rotary energy values. Similarly, use the average of the six horizontal energy values.

4.5.3.6 The peak rotary energy without a chain brake, W_r, is taken as the highest of the average rotary energies found in the test sequence.

4.5.4 Chain brake energy determination

NOTE — At the discretion of the manufacturer, 4.5.4.1 to 4.5.4.3 may be omitted.

4.5.4.1 At the conclusion of the test sequence specified in 4.5.2, remove the means used to prevent the chain brake from actuating and perform three additional impacts at peak rotary energy conditions. If the rotary energy values are not within 10 % of the average, perform three additional impacts and compute the average of all six impacts.

4.5.4.2 If the chain brake actuates each time, the energy value that is put into the computer model as rotary energy with the chain brake operating, W_c, is taken as the average of the rotary energy values. If the chain brake does not actuate each time, proceed to 4.5.4.3.

4.5.4.3 Mount the brake actuator on the left side of the main-frame column of the kickback machine.

4.5.4.4 Set the spring-loaded lever so that the lever and the hand guard contact each other at or immediately past the point where the saw exits from the test specimen (see figures 7 and 8).

4.5.4.5 Set the spring-loaded lever of the chain brake actuator in the set position so that its centreline intersects the chain-saw centre of gravity as shown in figure 7.

4.5.4.6 Adjust the position of the spring-loaded lever (in its set position) so that the contact point of the chain brake lever (hand guard) with the spring-loaded lever is 90 mm from the pivot point of the spring-loaded lever (see figure 7).

4.5.4.7 Recheck steps 4.5.4.4, 4.5.4.5 and 4.5.4.6. Readjust if necessary.

4.5.4.8 Measure the chain brake release force, in newtons, with the engine not running. The brake release force shall be measured with a spring scale accurate to ± 1 N. The force shall be applied at a uniform rate at the centre of the top part of the brake lever. The force shall be measured in a direction which is normal to the centreline of the spring-loaded lever when the saw is in the position shown in figure 7 and the spring-loaded lever is set as shown in figure 7.

4.5.4.9 Adjust the release force of the spring-loaded lever to a value equal to the chain brake release force plus 10 N. Measure the release force of the spring-loaded lever by placing a spring scale at a point 90 mm from the pivot point of the spring-loaded lever and pulling normal to the centreline of the lever.

4.5.4.10 Position the chain-saw so that the guide bar is horizontal, and set the contact angle and engine speed at the settings determined to give the highest average rotary energy in 4.5.3.

4.5.4.11 All tests performed in accordance with 4.5.4.12 and 4.5.4.13 shall be conducted at the contact angle and engine speed determined to give the highest average rotary energy.

4.5.4.12 Conduct the chain brake actuation test to determine the rotary energy with both the chain brake and the chain brake actuator operating, W_{ca}. Using the procedures detailed in

4.5.2, conduct the kickback test with both the actuator and chain brake operating. Repeat for a total of three impacts. If the rotary energy values are not within 10 % of the average, perform three additional impacts and use the average of the six values. If the chain brake activates on each impact, W_{ca} is taken as the average of the rotary values. If the brake does not activate on each impact, compute the kickback angle using values calculated in accordance with 4.5.3.

NOTE — If the brake activates but does not trip the spring-loaded lever, record that the lever did not trip and continue calculations and test as though the lever did trip.

4.5.4.13 Conduct the kickback test to determine the rotary energy with the chain brake actuator operating, W_a, but without the chain brake operating.

By a suitable means, such as taping or wiring the chain brake handle to the saw handle, disable the chain brake so that it will not activate. Using the procedures detailed in 4.5.2, conduct the kickback test with the chain brake actuator operating and the chain brake disabled.

Repeat for a total of three impacts. If the rotary energy values are not within 10 % of the average, perfom three additional impacts and use the average of the six values. W_a is taken as the average of the rotary energy values.

4.5.4.14 Calculate W_c, the rotary energy with the chain brake operating. This is the energy value which is input to the computer model:

$$W_c = W_r - W_a + W_{ca}$$

where

W_r is the peak rotary energy without a chain brake as determined in 4.5.3, in joules;

W_a is the rotary energy with the chain brake actuator operating, but without the chain brake operating, as determined in 4.5.4.13, in joules;

W_{ca} is the rotary energy with both the chain brake and the chain brake actuator operating, as determined in 4.5.4.12, in joules.

4.5.5 Chain brake actuation angle measurement

4.5.5.1 Measure the angles where the guide bar tip exits from the fibreboard specimens at peak rotary energy conditions as determined in 4.5.3 and compute the average. This is the specimen exit angle (see figure 8).

4.5.5.2 If the rotary energy, W_c, was determined in accordance with 4.5.4.2, then the actuation angle $A2$ is one-half of the specimen exit angle.

4.5.5.3 If the rotary energy, W_c, was determined in accordance with 4.5.4.14, the chain brake actuation angle $A2$ is taken as the specimen exit angle.

4.5.6 Chain brake stopping time measurement

The chain brake stopping time test shall be conducted at the engine speed setting of the peak rotary energy condition determined in 4.5.3. Use the pendulum test technique specified in ISO 6535.

4.5.6.1 The chain-saw shall be adjusted for best cutting performance in accordance with the chain-saw manufacturer's recommendations.

4.5.6.2 The chain-saw shall be solidly mounted during the test.

4.5.6.3 No adjustment of the brake is permitted during the test.

4.5.6.4 Initially, the brake shall be in a dry and unlubricated condition.

4.5.6.5 The chain brake shall be activated ten times without recording data. Then activate the brake three times and record the average stopping time. Refer to ISO 6535 for test apparatus details and test technique.

4.6 Kickback angle computation

The computed kickback angle, defined as shown in figure 1, is used as a measure of the reaction of a hand-held chain-saw when subjected to a rotational kickback under simulated conditions. Annex A is a flow diagram of the computer program used to determine the computed kickback angle.[1)]

4.6.1 Input data

4.6.1.1 Chain-saw mass, in kilograms, in accordance with 4.4.1.1.

4.6.1.2 Chain-saw moment of inertia, in kilograms metre squared, in accordance with 4.4.1.3.

4.6.1.3 Bar tip and handle locations, in millimetres, in accordance with 4.4.1.4.

1) A list of suppliers of computer programs to make these computations is available from the ISO Central Secretariat.

A FORTRAN version of this program may be found in ANSI B175.1, available from the American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036, USA.

4.6.1.4 Energy levels established at the peak rotary conditions in accordance with 4.5.3:

a) horizontal energy, W_h, in joules;

b) rotary energy, W_r, in joules.

NOTE — If the average rotary energies measured at other sets of conditions are within 10 % of the peak rotary value, calculate the computed kickback angle for each of these sets of conditions and use the highest computed kickback angle.

4.6.1.5 Chain brake rotary energy, W_c, in joules, in accordance with 4.5.4.

4.6.1.6 Chain brake actuation angle, $A2$, in degrees, in accordance with 4.5.5.

4.6.1.7 Saw chain stopping time, in milliseconds, in accordance with 4.5.6.5.

NOTE — Before input to the computer program, energy values should be adjusted to account for any fibreboard specimen lot variations.

4.6.2 BASIC computer program

NOTE — The BASIC computer program was developed to run on a Tektronix 4052 microcomputer. If a different computer is used, some of the commands may have to be modified.

For the purposes of this International Standard, a simulation time increment, $T9$, of 0,001 s (1 ms) shall be used.

CAUTION: If the time increment at line 210 is changed, incorrect values of chain stop angle may result.

4.6.3 Results

Record the results on the test record, figure 9:

a) computed kickback angle (with or without brake);

b) chain stop angle (if appropriate).

NOTE — The analytical model is unproven above about 70° and computed kickback angles above this should be treated as speculative.

4.7 Test report

The test report shall include the test record (figure 9), the chain-saw installation and balancing record (figure 10) and the computer printout (see annex B).

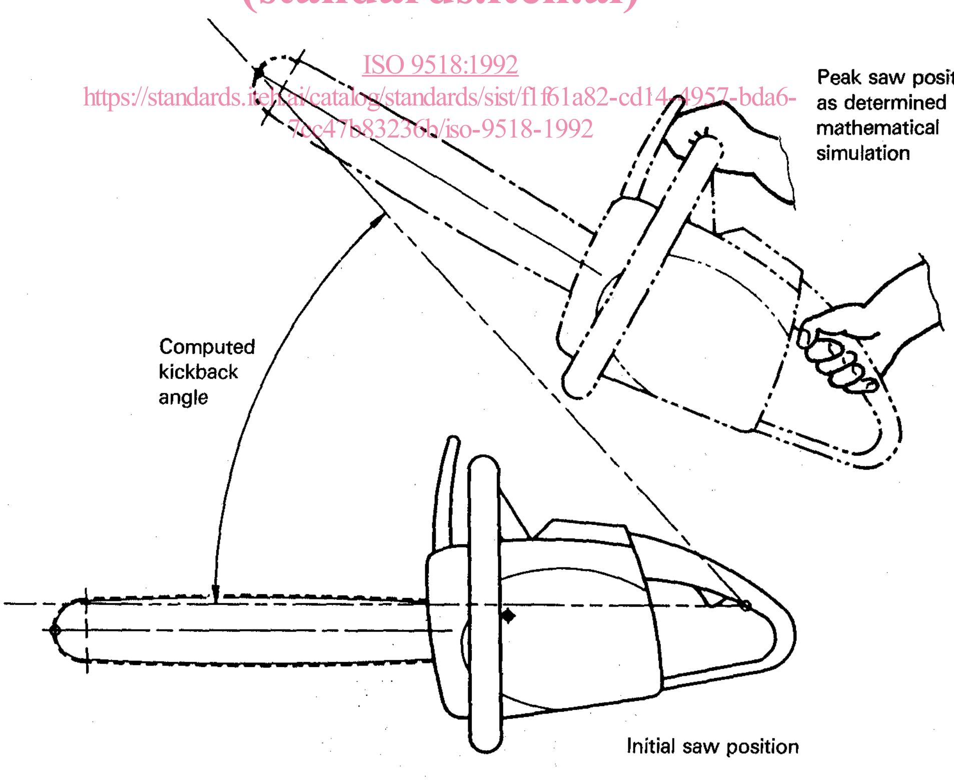

Figure 1 — Computed kickback angle