BS 8020:2011

BSI Standards Publication

Tools for live working – Specification for insulating hand tools for work on or near conductor rail systems operating at voltages up to 1 000 V a.c. or 1 500 V d.c.

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI to come into effect on 1 January 2012. It was prepared by Technical Committee PEL/78, *Tools for live working*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 8020:2002, which is to be withdrawn on 31 December 2011.

Relationship with other publications

While BS EN 60900 provides a specification for hand-held insulated and insulating tools for live working, these are tools primarily used by electricians and other electrical personnel. That standard does not provide an appropriate specification for the larger, purpose-designed, specialist tools employed in track work. However, full account has been taken of the requirements of BS EN 60900 in drafting this standard to ensure uniformity of approach and common requirements where practicable.

Information about this document

This is a full revision of the standard and introduces the following principal changes:

a) additional requirements concerning the design and construction of hybrid tools are included, i.e. tools that include both insulating and insulated parts;

b) an additional mechanical test for verifying the insulation bond of hybrid tools is included;

c) an additional mechanical test for verifying the insulation wear of hybrid tools and all other tools incorporating an insulating sleeve is included;

d) a type and sampling wet electrical test for verifying the electrical insulation of finished hybrid tools is included in addition to the routine dry electrical test;

e) the determination of sample sizes in Annex E has been simplified to reflect the fact that many tools are manufactured in small batch sizes.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body, with particular reference to material and chemical bonding used in the manufacture of insulating hand tools.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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0 Introduction

This British Standard specifies requirements for insulating hand tools and hybrid insulating hand tools, where the applied insulation for the latter is a combination of the measures used separately for insulated and insulating tools. This British Standard does not provide a specification according to the definition of an insulated tool because the size, design and construction of specialist track tools makes this method of insulation application alone impracticable.

The tools specified in this British Standard are for work on or in close proximity to ground-level, fully exposed live conductor rails providing traction supplies for electrified railways. Such traction supply systems are in wide use in certain areas of Great Britain, particularly in London and southern England. These traction systems date from the early days of railway electrification and their design and construction impose special requirements concerning tools used for track work, in order to meet modern safety requirements. These specialist tools are intended to protect the user from electric shock and minimize the risk of causing short-circuits by bridging between two conductive parts at different potentials.

NOTE BS EN 50163 specifies requirements for the supply voltages of traction systems.

1 Scope

This British Standard specifies requirements for insulating hand tools and hybrid insulating hand tools used for work on or in close proximity to conductor rails providing traction supplies, in accordance with BS EN 50163, to electrified railways and mass transit systems operating at voltages up to 1 000 V a.c. or 1 500 V d.c.

It is not applicable to hand-held insulated and insulating tools conventionally used by electricians and others for work on live electrical apparatus, which are specified in BS EN 60900.

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.

BS 876:1995, *Specification for hand hammers*

BS 1421:1995, *Specification for picks, beater picks and mattocks*

BS 2589:1955, *Specification for railway track spanners*

BS 2945:1995, *Specification for axes and hatchets*

BS 3388:2004, *Forks, shovels and spades – Requirements and test methods*

BS EN 60900:2004, *Live working – Hand tools for use up to 1 000 V a.c. and 1 500 V d.c.*

BS EN ISO 2039-2:2000 (BS 2782-3: Method 365C:1992), *Plastics – Determination of hardness – Part 2: Rockwell hardness*

IEC 60417-5216:2002 (DB:2002-10), *Graphical symbols for safety-related applications – Suitable for live working: double triangle and voltage indication*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

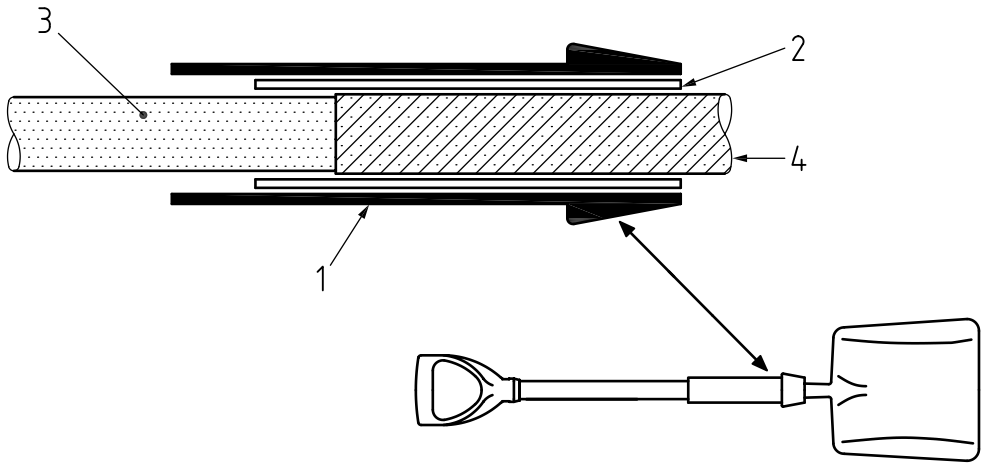
3.1 acceptance test
contractual test that provides the customer with evidence that the item(s) or product in question meet(s) the conditions of the customer's specification

3.2 hybrid insulating hand tool
hand tool employing a combination of insulated and insulating parts

NOTE 1 An example is shown in Figure 1.

NOTE 2 Annex A categorizes tools according to their design, construction and intended use. Category 5(a) is applicable to hybrid insulating tools. The construction and method of insulation might dictate that particular tools in other categories can also be classified as hybrid insulating tools, e.g. torque wrenches.

Figure 1 **Example of a hybrid insulating hand tool**



Key

1	Orange overguard	3	Insulating shaft
2	White underguard	4	Metal socket

NOTE 1 This figure is not to scale.

*NOTE 2 For clarity, all bonding between components, in accordance with **4.1**, have been omitted.*

3.3 insulated hand tool
hand tool made of conductive material(s), fully or partially covered by insulating material(s)

[IEC 60743, **2.3.1**]

3.4 insulating hand tool
hand tool made totally or predominantly from insulated material(s)

[IEC 60743, **2.3.2**]

NOTE 1 Insulating hand tools have metal working heads and might have some conductive parts used for reinforcement, which might or might not be exposed. Without any insulating material the remainder would no longer constitute a tool.

NOTE 2 Annex A categorizes tools according to their design, construction and intended use.

3.5 insulating insert
insulating material inserted between two conductive parts, e.g. in the case of a double-ended tool

3.6 material batch
purchase lot or production run of each finished length, profile and size of profile of insulating material to be used in the manufacture of insulating hand tools

3.7 routine test
test to which each individual insulating hand tool is subjected during or after manufacture to ascertain whether it conforms to certain criteria

3.8 sample test
test on a selected number of items taken at random from a batch

3.9 tool batch
production run of tools within a particular tool category

NOTE Definitions of tool categories are given in Annex A.

3.10 tool working head
part of an insulating hand tool intended to perform the function of the tool, which might be in contact with or in close proximity to conductor rails

3.11 type test
test of one or more insulating hand tools manufactured to a certain design to show that the design meets certain specifications

4 Materials

4.1 General

The insulating material(s) shall be compatible with one another and with any other materials used in the construction of the insulating hand tool.

NOTE Such compatibility ensures adequate bonding of the insulating material(s), as well as no adverse chemical inter-reaction(s).

When selecting and applying insulating materials, the materials shall be selected and applied to prevent the absorption or ingress of moisture beneath such material(s).

In the case of category 5 tools, the handle grip shall be formed from material that has a comparable di-electric performance to the tool shaft.

4.2 Fibreglass

When fibreglass insulating material is required as a structural component of the tool, fibreglass shall be used that contains a mass fraction of not less than 60% fibre, and fibres that are tensioned, continuous and parallel.

The fibreglass specification shall be obtained from the fibreglass manufacturer and shall be made available to the tester and/or the purchaser if requested.

4.3 Appearance

The colour of the insulating parts shall be predominantly orange.

In the case of hybrid tools, the outer layer (overguard) shall be orange and the under layer (underguard) shall be white.

5 Construction

5.1 General

An insulating or hybrid insulating hand tool shall be manufactured from an assembly including one or more insulating parts in conjunction with the conductive tool working head.

*NOTE 1 Insulating parts can be applied over other insulating parts (multi-layer construction to which **4.3** refers). The design and construction of the tool might necessitate some overlap of insulating and conductive parts where joined at the tool working head.*

All metallic parts shall be securely fixed to the insulating handle or insulating insert, as appropriate. Conformity shall be verified by means of the test specified in **8.3.3**.

The final assembly shall be constructed to prevent the ingress of moisture.

Where insulating or hybrid insulating hand tools are assembled by the user from component parts, the integrity of the assembly shall be verified to be in accordance with the specification for that tool or, in the absence of such information, in accordance with BS EN 60900.

NOTE 2 An example of such a tool is a ratchet handle with detachable socket head.

5.2 Handle grip

Where the handle end incorporates a sleeve type grip, the adhesion of the sleeve shall be tested in accordance with **8.3.2**.

5.3 Insulating components

Where hollow or foam-filled insulating components are used in the construction of a tool, design and/or construction measures shall be employed to prevent internal moisture accumulation or migration.

5.4 Additional requirements for particular insulating and hybrid insulating hand tools

If the intended use for a tool dictates the necessity for additional requirements particular to that use, e.g. a multifunction hand tool such as a permanent way spanner that can be used as both a hammer and a spanner, these shall be agreed between the manufacturer and the railway infrastructure controller. The additional requirements shall be fully documented and the tool shall conform to these requirements in addition to the requirements specified in this British Standard.

6 Properties

6.1 Mechanical properties

The mechanical properties of an insulating or hybrid insulating hand tool shall conform to the relevant requirements of the appropriate British Standard for an uninsulated tool having the same function:

- BS 876:1995 for hand hammers;
- BS 1421:1995 for picks, beater picks and mattocks;
- BS 2589:1955 for railway track spanners;
- BS 2945:1995 for axes and hatchets;
- BS 3388:2004 for forks, shovels and spades.

6.2 Flame retardancy

The insulating material(s) shall be flame retardant and the flame retardancy shall be tested in accordance with **8.5**.

6.3 Hardness

For hybrid insulating hand tools both the overguard and underguard insulating material hardness shall be above 40 on the Rockwell M scale, determined in accordance with BS EN ISO 2039-2:2000.

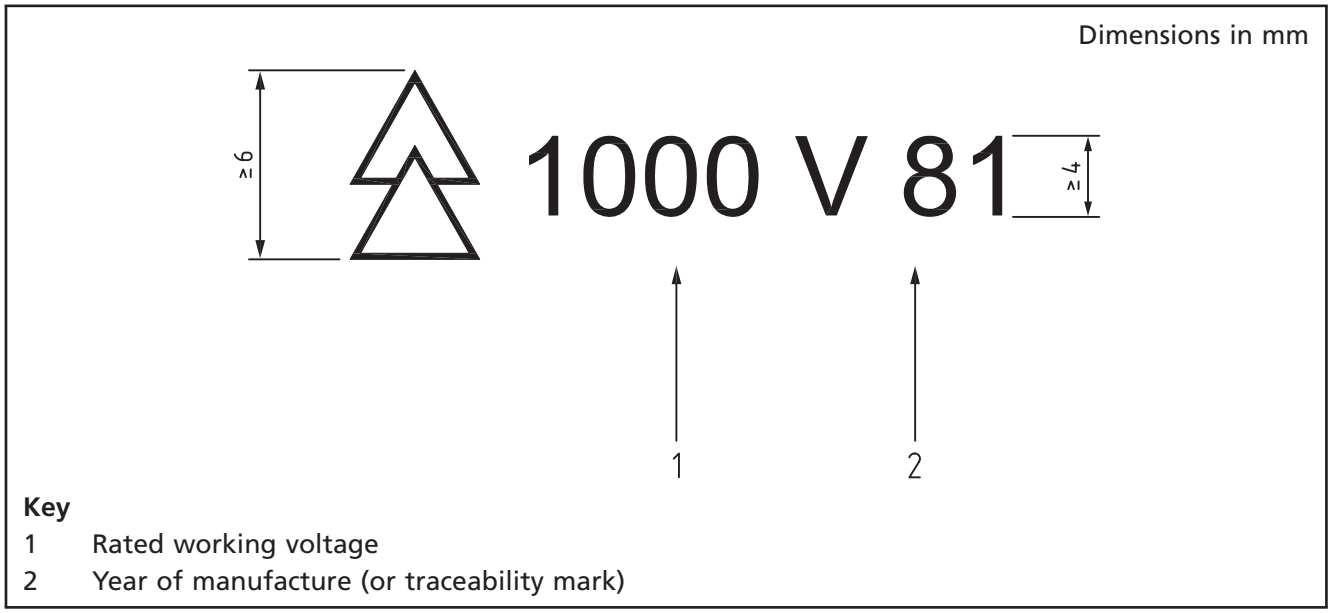
7 Marking and instructions for use

7.1 Marking

Every tool shall be legibly and permanently marked with the following information:

- manufacturer's name, trade mark or other identification;
- year of manufacture or traceability mark;
- double triangle symbol with rated working voltage (1 000 V) in accordance with IEC 60417-5216 (DB:2002-10), as shown in Figure 2;
- the number and date of this British Standard, i.e. BS 8020:2011 [1)].

Figure 2 **Marking symbol**



Key

1 Rated working voltage

2 Year of manufacture (or traceability mark)

The durability of the marking shall be tested in accordance with and shall conform to the requirement specified in **8.6**.

If the purchaser requires additional elements of marking, e.g. to indicate ownership, these additional requirements shall be agreed between the manufacturer and the purchaser. The additional requirements shall be fully documented and the marking shall conform to these requirements in addition to Clause **7**.

[1)] Marking BS 8020:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

All marking on insulating materials shall be completed prior to electrical testing.

7.2 Instructions for use

For each different tool, written instructions shall be provided concerning its intended use and maintenance requirements. For tools that need to be assembled, additional information shall be provided concerning the correct method of assembly.

NOTE Annex B gives recommendations concerning use and in-service care of insulating hand tools.

8 Type tests for hand tools

8.1 General

The series of type tests specified in this clause shall be carried out in the sequence stated to determine whether hand tools conform to Clause **4**, Clause **5**, Clause **6** and Clause **7**.

The type tests shall be repeated when there is any change in the type, thickness or composition of the insulating materials employed in the manufacture of hand tools.

NOTE When developing new hand tools, an initial electrical type test might prove helpful for verifying the effectiveness of the electrical insulation before embarking on the full series of tests to verify other properties.

8.2 Visual and dimensional check

8.2.1 General

The design, dimensions and construction of a tool shall be checked visually and deemed to be safe with respect to:

- the general operation of the tool by a user (i.e. the tool shall be deemed not to constitute a danger to the user when used in accordance with the manufacturer's instructions and any potentially conductive parts that can be handled by the user during the course of normal use are insulated from the working head);
- accidental contact by a user with the working head (i.e. it shall be deemed that such contact has been minimized);
- the traction supply system (i.e. the tool shall be deemed not to constitute a danger to the traction supply system when used in accordance with the manufacturer's instructions).

  NOTE See BS EN 50163:2004+A1 for descriptions of traction supply systems.

8.2.2 Visual check

The tool shall be subjected to a thorough visual examination and shall be free from visible defects.

The marking shall be checked to determine that it conforms to **7.1** and **8.6**.

8.2.3 Dimensional check

The dimensions shall be checked to determine their conformity to the manufacturer's detailed specification and any relevant British Standard (see **6.1**).

8.3 Mechanical tests

8.3.1 General

The tests in **8.3** shall be carried out under the test conditions specified in Annex C, unless otherwise specified in the details of a particular test.

8.3.2 Handle grip sleeve adhesion test (for tools of all categories provided with a handle grip sleeve)

When tested in accordance with **C.2.3**, the grip sleeve shall remain secure.

8.3.3 Handle pull-apart test [for all tool categories except 4(c) and 5]

When tested in accordance with **C.2.4**, the working head shall remain firmly fixed to the handle.

8.3.4 Handle material bend test [for tool categories 1, 3, 4(a), 4(b), 5 and 6]

Category 1 tools shall be tested in accordance with BS 876. For all other tools, a sample of the tool handle material shall be tested in accordance with **C.2.5**.

There shall be no audible or visible stress. The deflection, d, measured in mm at the point of application of the force, shall not exceed the value given by the equation $d = 200L^2$, where L is the handle length measured in metres. On removal of the applied force the residual deflection (set) shall not exceed 1% of the handle length after an elapse of 5 min.

8.3.5 Handle torsion test [for category 4(c) tools]

When tested in accordance with **C.2.6**, the rotational deflection of the handle in relation to the working head shall not exceed 25° and there shall be no audible or visible signs of stress. The residual deflection (set), measured 5 min after removal of the torque, shall not exceed 4°.

8.3.6 Insulation bond test [for category 5(a) – hybrid insulating tools]

When tested in accordance with **C.2.7**, there shall be no visible signs of distress to the bond and the tool shall pass the electrical test specified in **8.4.3** (water immersion).

8.3.7 Insulation wear test [for category 5(a) – hybrid insulating tools, and all tools incorporating an insulating sleeve]

8.3.7.1 General

Separate tests shall be undertaken:

1) following the application of its base layer insulation (the underguard test in **8.3.7.2**);

2) in its finished form (the overguard test in **8.3.7.3**).

NOTE Different tool samples may be used for each of these tests.

8.3.7.2 Underguard test

When tested in accordance with **C.2.8.1**, no metal parts of the tool shall be exposed, there shall be no cuts or splits in the underguard insulation and the tool shall pass the electrical test specified in **8.4.3**.

8.3.7.3 Overguard test

When tested in accordance with **C.2.8.2**, the underguard insulation shall not be exposed, there shall be no cuts or splits in the overguard insulation and the tool shall pass the electrical test specified in **8.4.3**.

8.4 Electrical tests

8.4.1 Insulating materials

The insulating material shall be tested in accordance with **C.3.1**. No electrical breakdown shall occur and the leakage current shall not exceed 1 mA.

8.4.2 Finished tools [for all categories except 5(a) and other hybrid insulating tools]

The finished tool shall be tested in accordance with **C.3.2**. No electrical breakdown shall occur and the leakage current shall not exceed 1 mA.

In the case of double-handled tools, this test shall be used to verify the insulation of both handles.

8.4.3 Finished hybrid insulating tools [category 5(a) and other hybrid insulating tools]

The finished tool shall be tested in accordance with **C.3.3**. No electrical breakdown shall occur and the leakage current shall not exceed 1 mA per 200 mm length of the immersed tool, rounded up to the next whole mA.

8.5 Flammability

When tested in accordance with Annex D, the flame propagated during the test shall be self-extinguishing within 20 s.

8.6 Durability of marking

When tested in accordance with **C.4**, the marking shall remain legible to a person with normal or corrected vision.

9 Production conformity evaluation

9.1 General

Routine and sampling tests shall be performed to verify that finished tools and materials conform to the requirements of this British Standard.

NOTE BS EN 61318:2008 provides details of conformity assessment applicable to tools.

9.2 Routine tests

9.2.1 General

Routine tests shall be performed on all finished tools.

9.2.2 Visual check

A visual check shall be carried out in accordance with **8.2.2**. Tools failing the visual check shall be either repaired or rejected.

9.2.3 Electrical test

Tools shall be tested in accordance with **8.4.2** except that no conditioning shall be carried out and the duration of the applied voltage shall be 1 min. No electrical breakdown shall occur and the leakage current shall not exceed the permitted value.

*NOTE The routine test for hybrid tools is restricted to a dry test given in **8.4.2**, but the type and sample tests for such tools are wet tests given in **8.4.3**.*

9.3 Sample tests

9.3.1 Insulating material

One sample from each material batch or delivery shall be tested in accordance with **8.4.1**, **8.5** and **8.6** and, where appropriate, **8.3.2**.

9.3.2 Finished tools

The procedure to be followed for the sample tests on a tool batch of finished tools shall be as specified in the relevant type tests in accordance with **8.3.2** (unless previously sample tested in accordance with **9.3.1**), **8.3.3**, **8.3.4**, **8.3.5**, **8.3.6**, **8.3.7**, **8.4.2** and **8.4.3**. Sample sizes shall be as specified in Annex E. If a failure occurs the complete current tool batch shall be rejected.

NOTE 1 The purchaser may specify additional tests, including sample sizes.

*NOTE 2 Pre-conditioning in accordance with **C.2.2** is required only for hybrid tools.*

9.4 Records

The manufacturer shall keep records of all tests in accordance with the manufacturer's quality control procedures, subject to them being kept for not less than seven years. All records shall be available for inspection by the customer.

9.5 Acceptance tests

The acceptance tests (see **3.1**) shall be agreed between the manufacturer and the customer.

Records shall also be kept and made available to the customer when requested.

Annex A (normative) Tool categories

COMMENTARY ON Annex A

This annex is provided because the tool category determines the appropriate tests. In the case of tools not specifically listed, or where the nature of the tool imposes particular construction or test requirements, the railway infrastructure controller should agree the relevant tool category and construction and test requirements with the manufacturer.

A.1 Category 1: striking tools

The following tools shall be designated as category 1:

- hammers;
- keying hammers;
- picks.

A.2 Category 2: tools struck by a hammer

The following tools shall be designated as category 2:

- key extractors;
- rail setts;
- taper wedges;
- dolly punches.

A.3 Category 3: rail manipulating tools

The following tools shall be designated as category 3:

- slewing bars;
- elastic rail spike extractors;
- conductor rail lift levers;
- ratchet rail turning bars;
- Japanese cant hooks;
- panpullers;
- pansetters;
- panlock pullers;
- jack handles;
- stock rail bolt retaining tools;
- rail turning bars;
- rail tongs, sleeper nips and lifters;
- fastclip tools;
- double ended tools, e.g. spannapullers.

A.4 Category 4: spanners

A.4.1 Category 4(a): lever, open ended

The following tools shall be designated as category 4(a):

- open jaw spanners.

A.4.2 Category 4(b): lever, closed end

The following tools shall be designated as category 4(b):

- ratchet spanners.

A.4.3 Category 4(c): tee-shaped

The following tools shall be designated as category 4(c):

- tee box spanners.

A.4.4 Category 4(d): miscellaneous

The following tools shall be designated as category 4(d):

- torque wrenches.

A.5 Category 5: ballast and other ground work tools

A.5.1 Category 5(a): overall length up to 1.25 m

The following hybrid tools of overall length up to 1.25 m shall be designated as category 5(a):

- forks;
- shovels;
- spades.

NOTE Due to their design and construction, all tools in this category are deemed to be hybrid tools.

A.5.2 Category 5(b): overall length over 1.25 m

The following tools of overall length over 1.25 m shall be designated as category 5(b):

- forks;
- shovels;
- spades;
- digging bars.

A.6 Category 6: miscellaneous

The following tools shall be designated as category 6:

- point cleaners;
- line scrapers/de-icers;
- paper pickers;
- beater packers;
- hook switch poles.

Annex B (informative) Recommendations concerning use and in-service care

B.1 General

To be safe, tools need to be used and cared for correctly, depending on the type of work and work environment. The following recommendations are given concerning the storage, pre-use inspection, use, periodic examination and electrical retesting of insulating hand tools. The examination of all tools should be entrusted to appropriately qualified and experienced people.

B.2 Storage

Care should be taken to minimize risk of damage during storage and transportation.

B.3 Pre-use inspection

Before use, a visual inspection of the tool should be undertaken to check for signs of damage likely to affect its safety in use. Where there is any doubt about the safety of the user from the tool, it should be withdrawn from service and examined, retesting if necessary. For example, in the case of hybrid tools, if any part of the white underguard is visible the tool should be withdrawn from use and discarded.

B.4 Use

All tools should be used in accordance with the manufacturer's instructions. Tools should not be subjected to mechanical overstress, e.g. by overloading or incorrect use. Where it is considered that a tool might have been overstressed, it should be withdrawn from service and examined, retesting if necessary.

B.5 Periodic examination and electrical retesting

Tools should be subjected to a periodic thorough examination, the frequency of the examination being determined by relevant factors such as the frequency of use, the type of work activity for which the tool is used and the nature of the work environment. If an electrical retest is deemed to be necessary, the routine test (see **9.2.3**) should be used.

Annex C (normative) Type tests

C.1 General

Unless otherwise specified, the type tests in this annex shall be carried out on at least three tools that are representative of a particular tool category (see Annex A).

If a tool fails any part of any type test, the series of tests shall be repeated on at least six further tools. If any of these six tools fails any part of any type test, the tool shall be deemed to have failed.

Unless otherwise specified, tests shall be carried out on tools that have been stored for not less than 16 h at a temperature of (23 ±5) °C and a relative humidity of 45% to 75%. Unless otherwise specified, the result of each type test shall be within ±5% of the specified value.

C.2 Mechanical tests

C.2.1 General

Mechanical tests on insulating hand tools shall be for the appropriate tool category as specified in Annex A and, where relevant, also satisfy the British Standards listed in **6.1** for the equivalent uninsulated tools.

C.2.2 Preconditioning

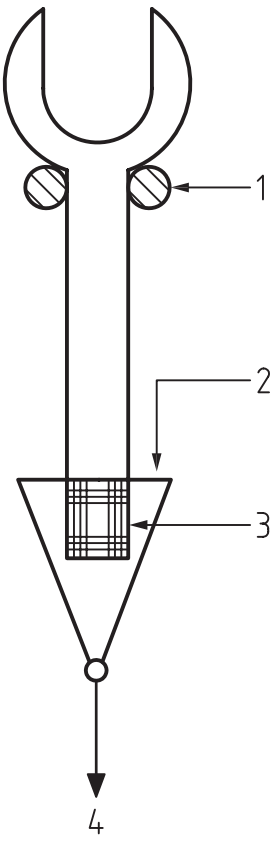
Before undertaking the mechanical tests, all hybrid insulating hand tools shall be conditioned by placement first in a cooling chamber for 2 h at (–20 ±3) °C and then in a heating chamber with normal ventilation for 2 h at (70 ±3) °C. The tools shall be allowed to rest at room temperature for 30 min following each period of conditioning.

*NOTE For tools exceeding 1.7 m in length, shortened versions can be used to enable them to fit into the available conditioning facilities, see also **C.2.5**.*

C.2.3 Method of test for handle grip sleeve adhesion

Hold the tool handle securely. Place a device having an adjustable collet around the handle; see Figure C.1 for an example of the test arrangement. Apply a force of 100 N in the same plane as the handle.

Figure C.1 **Example test arrangement for handle grip sleeve adhesion test**



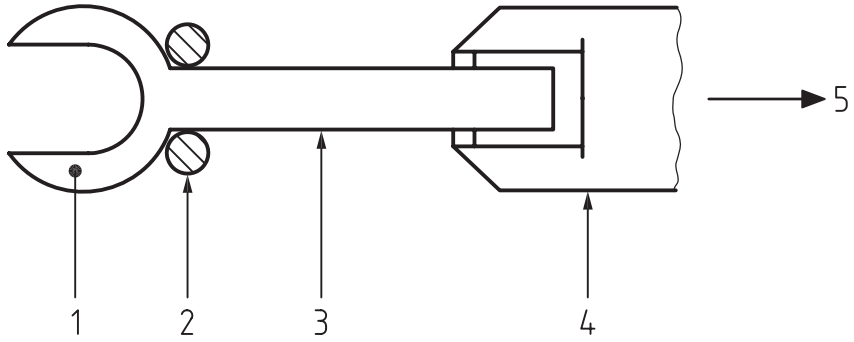
Key

1	Tool head support	3	Handle grip sleeve
2	Adjustable collet	4	Force

C.2.4 Method of test for handle pull-apart

Hold the tool working head with a restraining device and apply a loading jaw to the handle; see Figure C.2 for an example of the test arrangement. Apply a force, progressively increasing to the value specified in Table C.1 for category 1 tools or 9 800 N for all other tools. In the case of double-ended tools repeat this test to verify the attachment of each working head.

Figure C.2 **Example test arrangement for handle pull-apart test**



Key

1	Tool head	4	Loading jaw
2	Tool head restraining device	5	Force
3	Tool handle		

Table C.1 **Applied force for handle pull-apart test for category 1 insulating hand tools**

Tool working head, mass	**Applied force**
kg	N
Up to 1.25	9 800
Over 1.25 and up to 6.0	12 000
Over 6.0	15 000

C.2.5 Method of test for bending the handle material

For all tools (except category 1), hold a sample of the tool handle material of the correct length securely at one end; see Figure C.3 for an example of the test arrangement.

All tools over 1.7 m in length shall be tested without being shortened but can be tested without preconditioning in accordance with **C.2.2**.

Apply a force at an angle of 90° to the handle material, 100 mm from the end that is not being held, progressively increasing to 750 N (1 500 N in the case of panpullers, pansetters and panlock pullers). Maintain that value for at least 10 s.

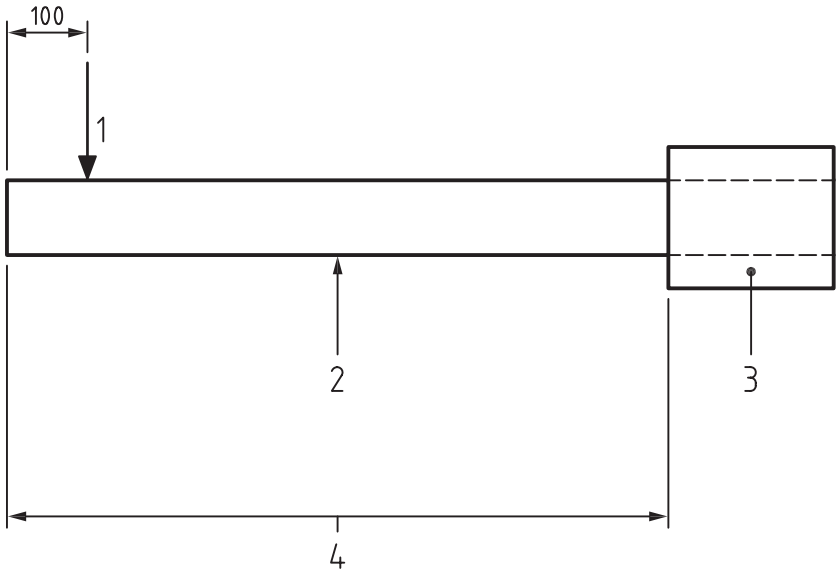
C.2.6 Method of test for handle torsion

Position the tool vertically with the working head attached to a firmly secured torque measuring device; see Figure C.4 for an example of the test arrangement. Apply a torque anti-clockwise and equally distributed between and within 100 mm of each handle end, progressively increasing to 120 N·m for tools intended for single-handed operation and 240 N·m for any tool intended for use by two people simultaneously. Maintain the torque at that value for 10 s.

C.2.7 Method of test for the insulation bond

Clamp the tool blade and apply a force of 750 N at the top of the handle grip at right angles to the tool shaft; see Figure C.5 for an example of the test arrangement. Subject the tool to 1 000 cycles.

Figure C.3 **Example test arrangement for handle material bend test**



Key

1	Force	3	Clamping device
2	Sample of tool handle material	4	Handle length

NOTE Each cycle constitutes force being applied and then relaxed to allow the handle to return to the rest position.

C.2.8 Method of test for insulation wear

C.2.8.1 Underguard

Clamp the tool horizontally with the insulated part of the tool socket resting on an abrasive block. The abrasive block shall be formed from a proprietary curved shaper surface forming tool blade having a regular pattern of 'D' shaped holes with raised cutting edges created on the straight sides; see Figure C.6 for an example of the test arrangement. Secure a weight of 5 kg on top of the tool's blade. Apply an oscillating force to the tool handle on the horizontal plane so as to achieve a stroke distance of not less than 75 mm. Subject the tool to 150 cycles at a rate of 40-60 cycles/min. A new abrasive block blade shall be used for each tool test.

NOTE 1 Each cycle constitutes force being applied first in the forward and then in the reverse direction.

NOTE 2 A proprietary wood forming and shaping tool blade can be used to form a suitable abrasive block.

C.2.8.2 Overguard

Use the same test arrangement and method of test specified in **C.2.8.1**. Subject the tool to 1 500 cycles.

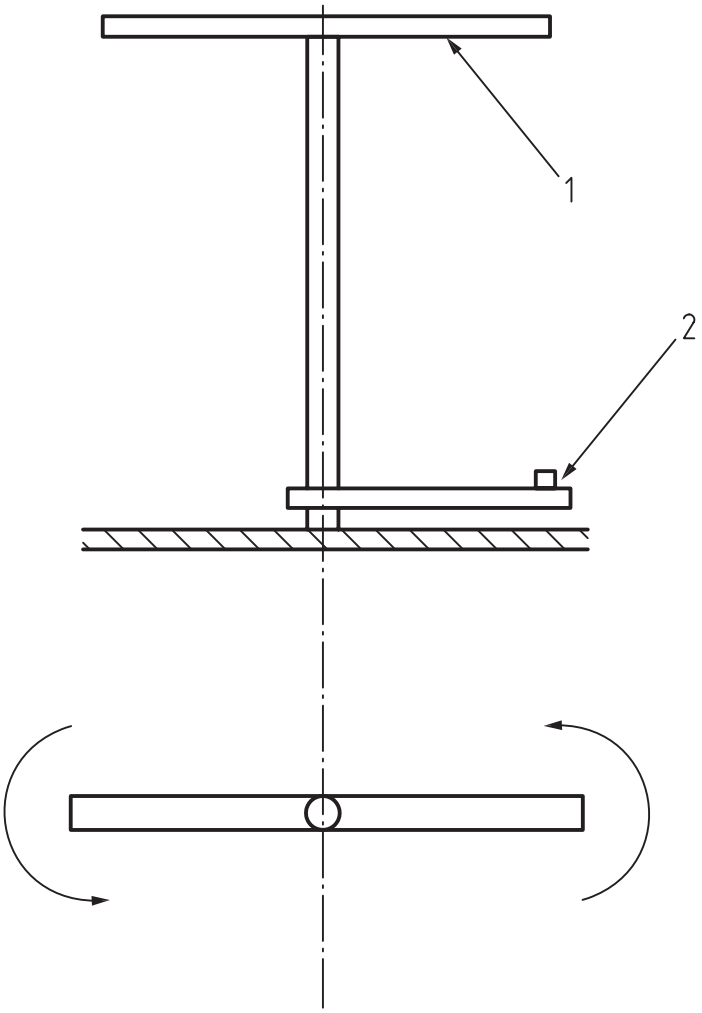
C.3 Electrical tests

C.3.1 Method of test for the insulating materials

C.3.1.1 Preconditioning

Take three samples from each batch of different insulating material used in the tool construction and immerse them totally in tap water at (23 ±5) °C for (24 ±0.5) h. Following this conditioning, wipe dry the material samples and commence test within 5 min.

Figure C.4 **Example test arrangement for handle torsion test**



Key
1 Tool handle
2 Torque measuring device (clamped)

NOTE Forced or artificial drying is not permitted.

C.3.1.2 Procedure

Place two electrodes, formed of conductive material, around the insulating material, ensuring contact around the circumference at a separation distance of (24 ±2) mm.

Apply a voltage of 10 kV a.c. (r.m.s.) 50 Hz continuously for 3 min across the electrodes.

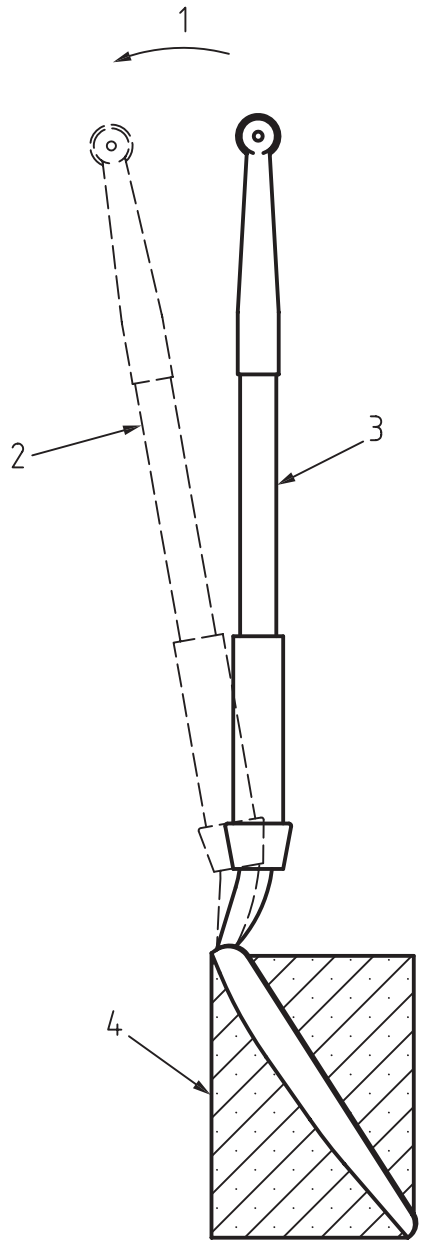
C.3.2 Finished tools

C.3.2.1 Preconditioning

Before testing, condition tools by total immersion as described in **C.3.1.1**. Following this conditioning, wipe dry the tool samples and commence testing within 5 min.

NOTE Forced or artificial drying is not permitted.

Figure C.5 **Example test arrangement for the insulation bond test**



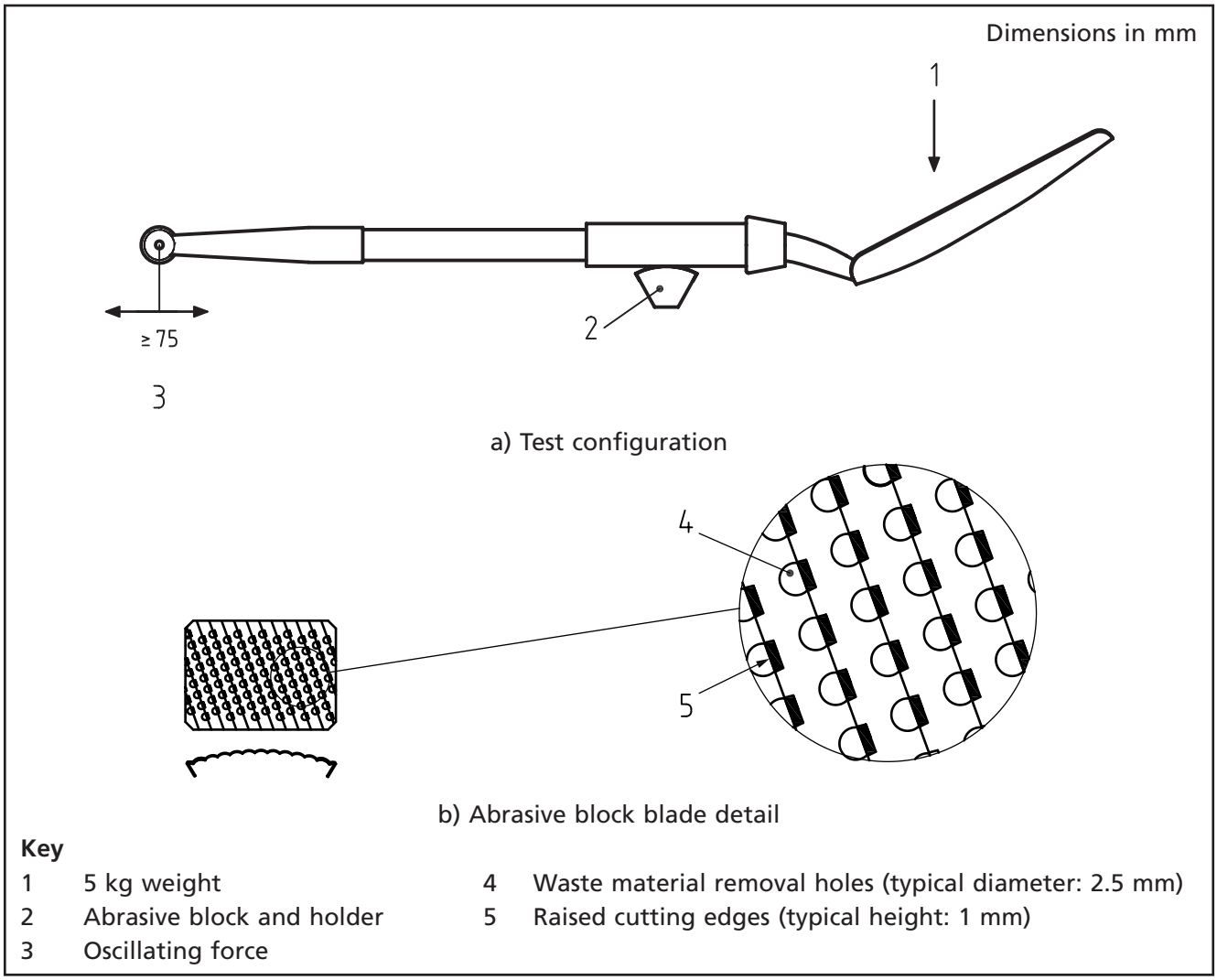
Key

1	Direction of force	3	Start position
2	Final position	4	Blade clamp

C.3.2.2 Procedure

Place two electrodes, formed of conductive material, on the tool with one attached to the metallic working head and the other around the handle, ensuring contact around the circumference at a point between 100 mm and 150 mm from the handle end; see Figure C.7 for an example of the test arrangement. Connect the phase conductor of the test supply to the electrode attached to the metallic working head. In the case of double-ended tools, place the electrodes around each conductive working head. Apply a voltage of 10 kV a.c. (r.m.s.) 50 Hz continuously for 3 min across the electrodes.

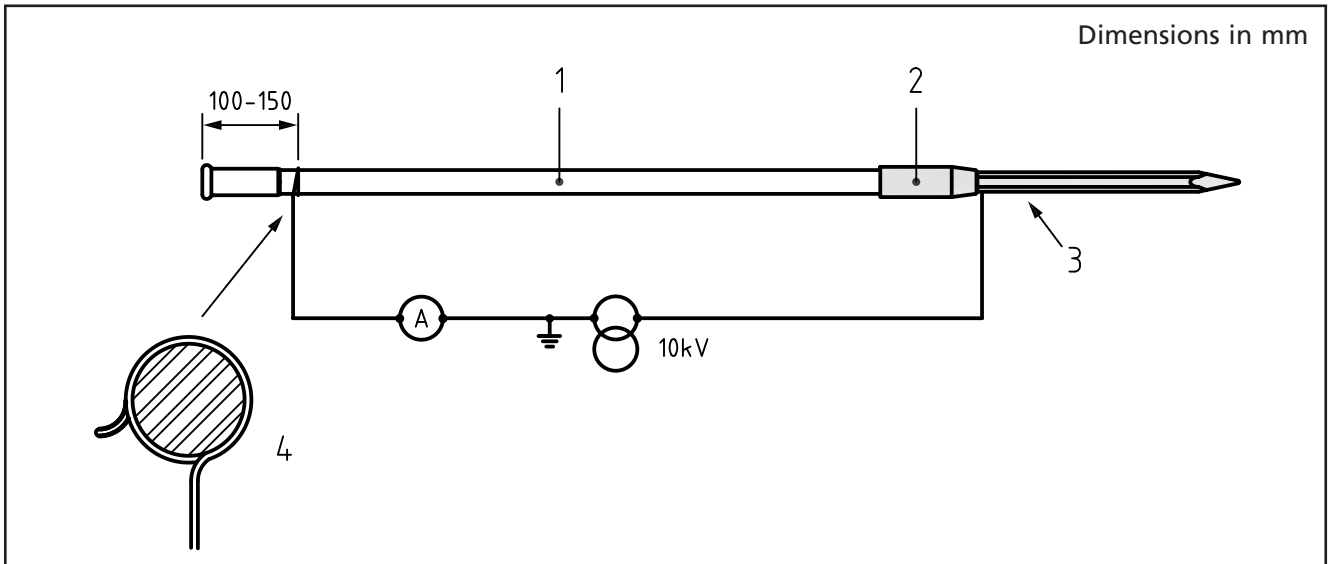
Figure C.6 **Example test arrangement for insulation wear test**



Key

1	5 kg weight	4	Waste material removal holes (typical diameter: 2.5 mm)
2	Abrasive block and holder	5	Raised cutting edges (typical height: 1 mm)
3	Oscillating force		

Figure C.7 **Example test arrangement for dry electrical test**



Key

1	Insulating handle	3	Metal working head
2	Metal socket	4	Contact around the circumference

C.3.3 Method of test for finished hybrid tools (for type and sample tests)

C.3.3.1 Preconditioning

Before testing, condition tools by total immersion as described in **C.3.1.1**. Following this conditioning, wipe dry the tool samples and commence testing within 5 min.

NOTE Forced or artificial drying is not permitted.

C.3.3.2 Procedure

Immerse the tool with its insulated part in a bath of tap water up to a level of 24^{+4}_{-2} mm from the nearest non-insulated part so that the conductive part is above the water level. Connect the phase conductor of the test supply to the metallic working head and connect the neutral (earthed) conductor of the test supply to an electrode placed in the water bath; see Figure C.8 for an example of the test arrangement. Apply a voltage of 10 kV a.c. (r.m.s.) 50 Hz continuously for 3 min across the electrodes.

C.4 Durability of marking

Rub the marking for 15 s with a clean cloth soaked in water and then for 15 s with a another clean cloth soaked in rubbing alcohol, e.g. isopropanol (CH_3-CH(OH)-CH_3).

Annex D (normative) Method of test for flammability

D.1 Apparatus and samples

D.1.1 *Flammability test apparatus,* see Figure D.1 for an example of the test arrangement, with a small burner arranged in such a way that the axis of the burner nozzle and the axis of the test piece are at right angles and form a vertical plane.

D.1.2 *Burner nozzle*, with a diameter of (9.5 ±0.5) mm and the capability of producing a 20 mm high blue flame.

D.1.3 *Natural gas*, with a heat content of approximately 37 MJ/m^3 or technical grade methane or liquefied petroleum gas.

D.1.4 *One sample of each different insulating material*, used in the assembly of the tool.

D.2 Test conditions

Conduct the test in a draught-free room.

D.3 Procedure

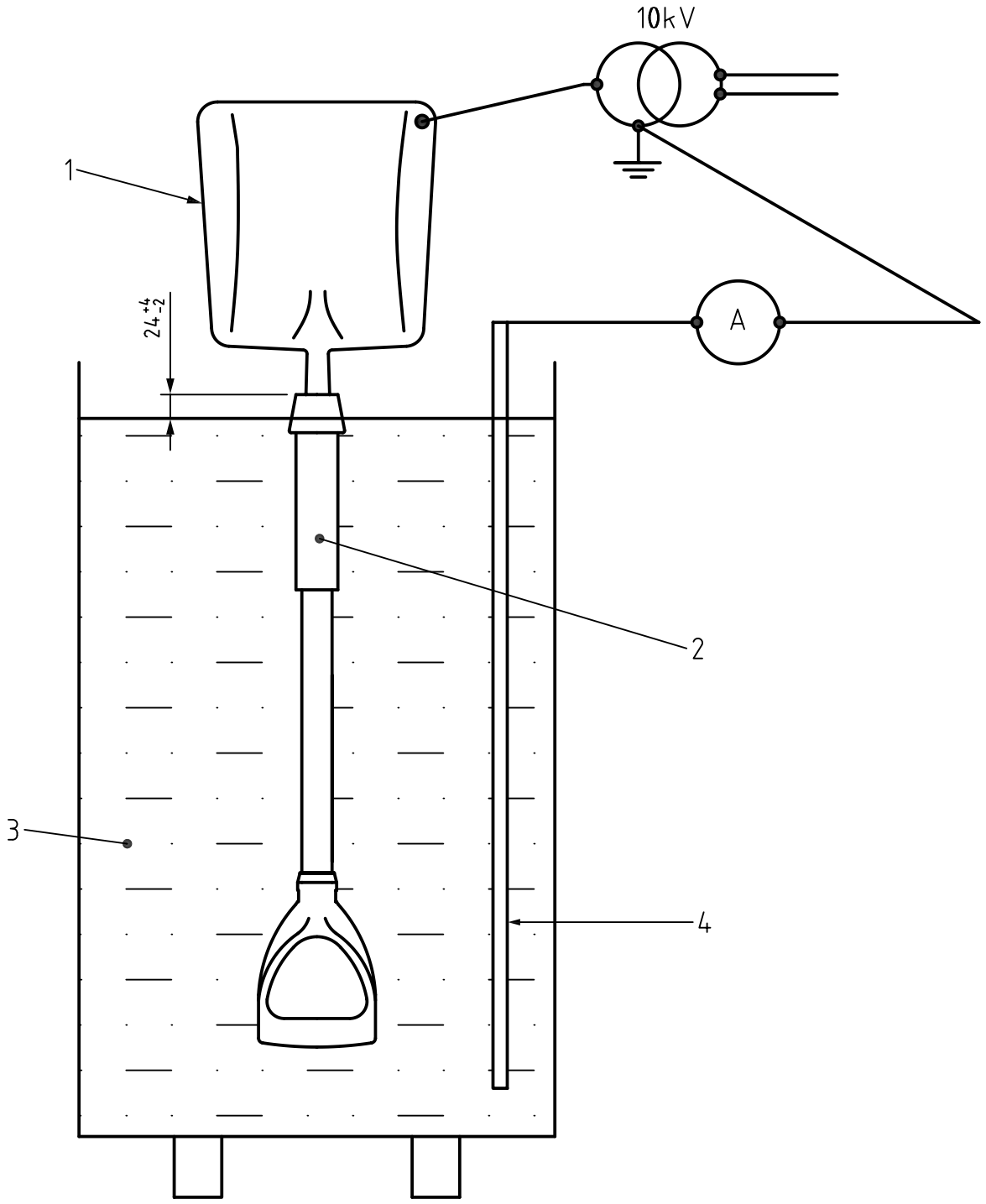
Clamp the test piece in a horizontal position. Ignite the burner at a distance from the test piece. Once the flame has been correctly adjusted, place the burner in the required position so that the tip of the flame just touches and acts on the test piece for 10 s. Then withdraw the flame and observe any flame propagation on the test piece for 20 s.

Annex E (normative) Sampling

E.1 Classification of defects

Defects shall be classified as major or minor, as specified in Table E.1.

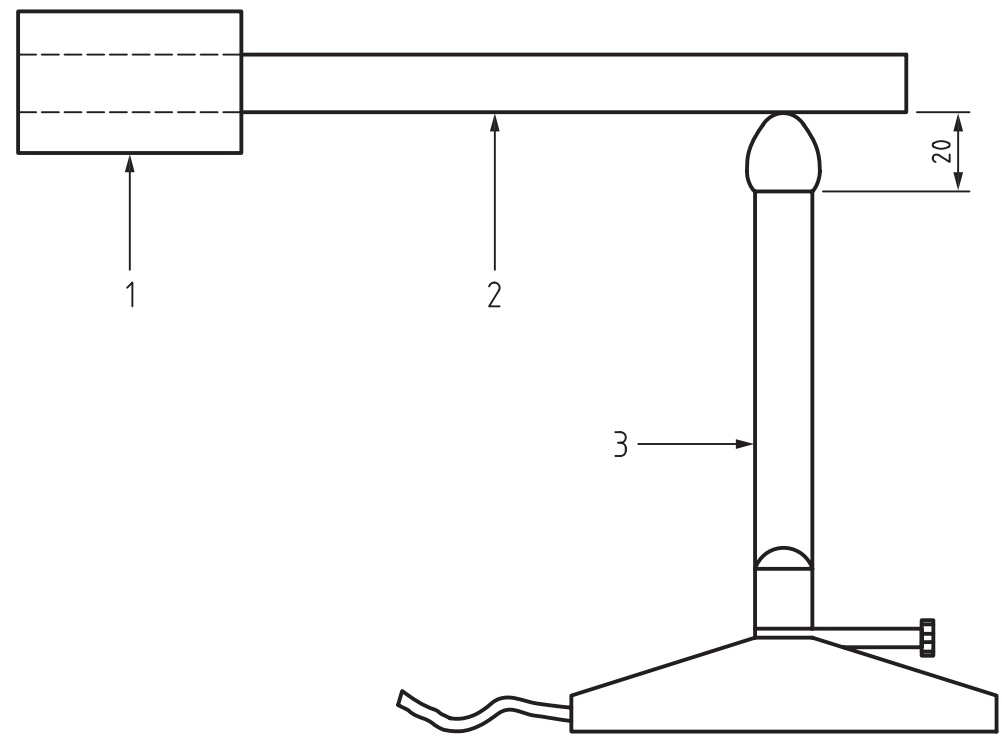
Figure C.8 **Example test arrangement for wet electrical test**



Key

1 Conductive head
2 Insulated section of tool
3 Bath filled with tap water
4 Electrode

Figure D.1 **Example test arrangement for flammability test**



Key
1 Clamping device
2 Test piece
3 Burner

Table E.1 **Classification of defects**

Test	Subclause reference for type test	Class of defect indicated by failure in test	
		Major	Minor
Visual and dimensional	**8.2.1**, **8.2.2** and **8.2.3**	–	X
Handle grip sleeve adhesion	**8.3.2**	–	X
Handle pull-apart	**8.3.3**	X	–
Handle material bend	**8.3.4**	X	–
Handle torsion	**8.3.5**	X	–
Insulation bond	**8.3.6**	X	–
Insulation wear	**8.3.7**	X	–
Electrical	**8.4.1**, **8.4.2** and **8.4.3**	X	–
Flammability	**8.5**	–	X
Durability of marking	**8.6**	–	X

E.2 Sample sizes

Sample sizes shall be determined according to the following criteria:

a) for the identification of major defects: 1%;

b) for the identification of minor defects: 0.5%.

In each case based on the cumulative production over a rolling three-year cycle and subject to the following:

1) a minimum of one sample test in each case;

2) where more than one tool is to be tested during the three-year cycle, a sample test shall be conducted following the cumulative production of every 100 tools in the case of major defects or 200 in the case of minor defects.

Bibliography

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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BS EN 61318:2008, *Live working – Conformity assessment applicable to tools, devices and equipment*

IEC 60743:2008, *Live working – Terminology for tools, equipment and devices*

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