

# Safety of hand-held electric motor operated tools

## Part 1. General requirements

The European Standard EN 50144-1 : 1995 has the status of a  
British Standard

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# Committees responsible for this British Standard

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- Agricultural Engineers' Association
- Association of Control Manufacturers (TACMA (BEAMA Ltd.))
- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- Association of Manufacturers of Domestic Electrical Appliances
- Consumer Policy Committee of BSI
- Consumers' Association
- Department of Trade and Industry (Consumer Safety Unit, CA Division)
- Electricity Association
- Health and Safety Executive
- Hire Association Europe
- Institution of Incorporated Executive Engineers
- Portable Electric Tool Manufacturers' Association
- Rotating Electrical Machines Association (BEAMA Ltd.)
- Co-opted members

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# National foreword

This British Standard has been prepared by Subcommittee CPL/61/6 and is the English language version of EN 50144-1 : 1995 *Safety of hand-held electric motor operated tools Part 1: General requirements*, incorporating corrigendum March 1996, published by the European Committee for Electrotechnical Standardization (CENELEC).

This standard should be read in conjunction with the relevant Part 2. The Parts 2 are in preparation and when published will supersede the BS 2769 series. No date of withdrawal has yet been set for BS 2769 : Part 1 : 1984 and BS 2769 : Part 2 : Section 2.0 : 1984 which this standard will supersede. These dates will be set by CENELEC when all the replacement Parts 2 have been published.

For tools intended to be used in locations where special conditions prevail, as in ships and vehicles, and in hazardous locations, for example, where explosions are liable to occur, requirements additional to those specified in this standard may be necessary.

**WARNING.** This standard calls for test procedures that may be injurious to safety or health if adequate precautions are not taken when conducting tests.

## Cross-references

| Publication referred to                  | Corresponding British Standard                                                                                                                                                                                        |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENV 25349 : 1992<br>(ISO 5349 : 1986)    | DD ENV 25349 : 1993 <i>Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration</i>                                                                   |
| ENV 28041 : 1993<br>(ISO 8041 : 1990)    | DD ENV 28041 : 1993 <i>Human response to vibration — Measuring instrumentation</i>                                                                                                                                    |
| EN 60065 : 1993                          | BS EN 60065 : 1994 <i>Safety requirements for mains operated electronic and related apparatus for household and similar general use</i>                                                                               |
| EN 60127-3 : 1991<br>(IEC 127-3 : 1988)  | BS EN 60127 <i>Miniature fuses</i><br>Part 3 : 1991 <i>Specification for sub-miniature fuse-links</i>                                                                                                                 |
| EN 60335-1 : 1994                        | BS EN 60335 <i>Specification for safety of household and similar electrical appliances</i><br>Part 1 : 1995 <i>General requirements</i>                                                                               |
| EN 61058-1 : 1992<br>(IEC 1058-1 : 1990) | BS EN 61058 <i>Switches for appliances</i><br>Part 1 : 1992 <i>General requirements</i>                                                                                                                               |
| HD 21                                    | BS 6231 : 1990 <i>Specification for PVC-insulated cables for switchgear and controlgear wiring</i>                                                                                                                    |
| IEC 85 : 1984                            | BS 2757 : 1986 <i>Method for determining the thermal classification of electrical insulation</i>                                                                                                                      |
| IEC 384-14 : 1993                        | BS 6201 <i>Fixed capacitors for use in electronic equipment</i><br>Part 3 : 1982 <i>Specification for fixed capacitors for radio interference suppression — Selection of methods of test and general requirements</i> |
| EN 60651 : 1994<br>(IEC 651 : 1979)      | BS EN 60651 : 1994 <i>Specification for sound level meters</i>                                                                                                                                                        |
| EN ISO 1463 : 1994<br>(ISO 1463 : 1982)  | BS EN ISO 1463 : 1995 <i>Metallic and oxide coatings — Measurement of coating thickness — Microscopical method</i>                                                                                                    |
| ISO 2178 : 1982                          | BS EN ISO 2178 : 1995 <i>Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method</i>                                                                                        |
| ISO 5348 : 1987                          | BS 7129 : 1989 <i>Recommendations for mechanical mounting of accelerometers for measuring mechanical vibration and shock</i>                                                                                          |

The work on EN 23744 has been cancelled; ISO 3744 : 1981 has been superseded by ISO 3744 : 1994, which has been adopted as BS EN ISO 3744 : 1995 *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane.*

*Product certification.* Attention is drawn to the fact that products conforming to this British Standard may be approved by BSI Product Certification, and that such certification may be used for the purposes of participation in the CENELEC Certification Agreement. (Details of the BSI certification mark are given on the inside back cover.)

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**



English version

## Safety of hand-held electric motor operated tools Part 1: General requirements

Sécurité des outils électroportatifs à moteur  
Partie 1: Règles générales

Sicherheit von handgeführten motorbetriebenen  
Elektrowerkzeugen  
Teil 1: Allgemeine Anforderungen

This European Standard was approved by CENELEC on 1994-07-05. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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### CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B-1050 Brussels**

Foreword

This European Standard has been prepared by Technical Committee CENELEC TC 61F, Hand-held and transportable electric motor operated tools.

It was submitted to the Unique Acceptance Procedure (UAP) in March 1993 and was approved by CENELEC as EN 50144-1 on 1994-07-05.

A draft for an amendment was submitted to the Unique Acceptance Procedure in April 1994 and was approved by CENELEC on 1994-10-04 for inclusion into the European Standard.

NOTE. Finland and Sweden have no obligation to implement this European Standard.

The following date was fixed:

- latest date of publication of an identical national standard (dop) 1995-10-01

This European Standard replaces HD 400.1 S1 : 1980 and its amendment A1 : 1991.

However HD 400.1 S1 remains valid until all Harmonization Documents which are used in conjunction with it have been withdrawn. No date of withdrawal of conflicting standards (dow) has therefore been fixed.

Other harmonized standards referred to in this European Standard are listed in annex F. The annex lists the valid edition of those documents at the time of issue of this EN. All references are however to be understood as references to the latest edition.

This standard is divided into two parts:

Part 1: General requirements, comprising clauses of a general character.

Part 2: Particular requirements, dealing with particular types of appliances. The clauses of these particular requirements supplement or modify the corresponding clauses in Part 1. Where the text of Part 2 indicates ‘addition’ or ‘replacement’, the relevant text of Part 1 is to be adapted accordingly. Where no change is necessary, the words ‘This clause of Part 1 is applicable’ are used.

NOTE. In this standard the following print types are used:

- Requirements proper.
- *Test specifications.*
- Explanatory matter.

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## 1 Scope

**1.1** This standard applies to hand-held electric motor operated or magnetically driven tools, intended for indoor or outdoor use.

NOTES. Hand-held electric motor-operated tools, hereinafter referred to as tools, which can be mounted on a support for use as fixed tools without any alteration of the tool itself, are within the scope of this standard.

Additional requirements for such support may be necessary.

This standard applies to tools having any rated frequency.

It also applies, as far as is reasonable, to tools not mentioned in Part 2, Particular requirements, and to those designed on basically new principles.

This standard does not apply to tools for food processing or preparation.

This standard does not apply to battery-operated tools.

Tools with an electric heating element incorporated are within the scope of this standard, but such tools should also comply with the EN 60335-1, as far as it reasonably applies.

For tools intended to be used in locations where special conditions prevail, as in ships and vehicles, and in hazardous locations, for example, where explosions are liable to occur, special constructions may be required.

## 2 Definitions

**2.1** Where the terms voltage and current are used, they imply the r.m.s. values, unless otherwise specified.

**2.2** The following definitions apply for the purpose of this standard.

### 1. hand-held tool

An electric motor-operated or magnetically driven machine intended to do mechanical work and so designed that the motor and the machine form an assembly which can easily be brought to its place of operation and which is held by hand or suspended during operation.

NOTE. Hand-held tools may be provided with a flexible shaft, the motor being fixed or portable.

### 2. rated voltage

The voltage (for three-phase supply, the voltage between phases) assigned to the tool by the manufacturer.

### 3. rated voltage range

The voltage range assigned to the tool by the manufacturer expressed by its lower and upper limits.

### 4. rated input

The input in watts, assigned to the tool by the manufacturer.

### 5. rated current

The current at rated voltage or at the lower limit of the rated voltage range, assigned to the tool by the manufacturer.

NOTE. If no current is assigned to the tool, the rated current for the purpose of this standard is the current measured when the tool is operating under normal load, at rated voltage or at the lower limit of the rated voltage range.

### 6. rated frequency

The frequency assigned to the tool by the manufacturer.

### 7. rated frequency range

The frequency range assigned to the tool by the manufacturer, expressed by its lower and upper limits.

### 8. rated no-load speed

No-load speed at rated voltage or at the upper limit of the rated voltage range, assigned to the tool by the manufacturer.

### 9. non-detachable flexible cable or cord

Flexible cable or cord which can only be removed from the tool with the aid of a tool.

### 10. basic insulation

Denotes the insulation applied to live parts to provide basic protection against electric shock.

NOTE. Basic insulation does not necessarily include insulation used exclusively for functional purposes.

### 11. supplementary insulation (protective insulation)

An independent insulation provided in addition to the basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation.

### 12. double insulation

An insulation comprising both basic insulation and supplementary insulation.

### 13. reinforced insulation

An improved basic insulation with such mechanical and electrical qualities that it provides the same degree of protection against electric shock as double insulation.

### 14. Class I tool

A tool having at least basic insulation throughout and provided with either an appliance inlet with earthing contact, or a non-detachable flexible cable or cord with earthing conductor.

NOTE. Class I tools may have parts with double insulation or reinforced insulation, or parts operating at safety extra-low voltage.

### 15. Class II tool

A tool with double insulation and/or reinforced insulation throughout and without provision for earthing.

Such a tool may be of one of the following types:

- i) a tool having a durable and substantially continuous enclosure of insulating material which envelopes all metal parts, with the exception of small parts, such as nameplates, screws and rivets, which are isolated from live parts by insulation at least equivalent to reinforced insulation; such a tool is called an insulation-encased Class II tool;

ii) a tool having a substantially continuous metal enclosure, in which double insulation is used throughout, except for those parts where reinforced insulation is used, because the application of double insulation is manifestly impracticable; such a tool is called a metal-encased Class II tool;

iii) a tool, which is a combination of types (i) and (ii).

NOTES. The enclosure of an insulation-encased Class II tool may form a part or the whole of the supplementary insulation or of the reinforced insulation.

If a tool with double insulation and/or reinforced insulation throughout has an earthing terminal or earthing contact, it is considered to be of Class I construction.

Class II tools may have parts operating at safety extra-low voltage.

### 16. Class III tool

A tool designed for operation at safety extra-low voltage, and which has no circuits, either internal or external, which operate at a voltage other than safety extra-low voltage.

### 17. safety extra-low voltage

A nominal voltage not exceeding 42 V between conductors and between conductors and earth or, for three-phase supply, not exceeding 24 V between conductors and neutral, the no-load voltage not exceeding 50 V and 29 V respectively.

NOTES. When safety extra-low voltage is obtained from the supply mains, it must be through a safety isolating transformer or a convertor with separate windings.

The voltage limits specified are based on the assumption that the safety isolating transformer is operated at its rated supply voltage.

### 18. normal load

The load to be applied to the tool so that the stress imposed corresponds to that occurring under normal conditions of use, any marking of short-time or intermittent operation being observed and heating elements, if any, being operated as in normal use.

NOTE. The normal load is based on the rated voltage or on the upper limit of the rated voltage range.

### 19. accessible part

Any part which can be touched by the standard test finger shown in figure 1; for accessible metal parts, it includes any other metal part which is in electrical contact with such parts.

### 20. detachable part

A part which can be removed without the aid of a tool.

### 21. rated operating time

The operating time assigned to the tool by the manufacturer.

### 22. continuous operation

Operation under normal load for an unlimited period.

### 23. short-time operation

Operation under normal load for a specified period, starting from cold, the intervals between successive periods of operation being sufficiently long to allow the tool to cool down to approximately room temperature.

### 24. intermittent operation

Operation in a series of specified identical cycles, each cycle being composed of a period of operation under normal load, followed by a rest period with the tool running idle or switched off.

### 25. thermal cut-out

A device which, during abnormal operation, limits the temperature of a tool, or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.

### 26. non self-resetting thermal cut-out

A thermal cut-out which requires resetting by hand, or replacement of a part, in order to restore the current.

### 27. creepage distance

The shortest path between two conductive parts, or between a conductive part and the bounding surface of the tool, measured along the surface of the insulating material.

NOTE. The bounding surface of the tool is the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material.

### 28. clearance

The shortest distance between two conductive parts, or between a conductive part and the bounding surface of the tool, measured through air.

### 29. 'aid of a tool', 'use of a tool'

Where such expressions occur, the word tool means a screwdriver, a coin or any other object which may be used to operate a screw or other fixing means.

30. The term **body** includes all accessible metal parts, shafts or handles, knobs, grips and the like and metal foil in contact with all accessible surfaces of insulating material; it does not include inaccessible metal parts.

### 31. safety isolating transformer

Transformer, the input winding of which is electrically separated from the output winding by an insulation at least equivalent to double insulation or reinforced insulation and which is designed to supply a tool or circuit of safety extra-low voltage.

## 3 General requirements

3.1 Tools shall be so designed and constructed that in normal use they function safely and cause no danger to persons or surroundings, even in the event of such careless use as may occur in normal service.

NOTES. The materials used for the construction of the tool should not introduce additional hazards during use or disposal of the tool.

The risks due to noise and vibration should be reduced to the lowest level practicable, taking into account the appropriate European Standards.

*In general, compliance is checked by carrying out all the relevant tests.*

## 4 General conditions for the tests

**4.1** Tests according to this standard are type tests.

**4.2** Unless otherwise specified, the tests are made on a single sample as supplied, which shall withstand all the relevant tests.

NOTES. If the tool is designed for different supply voltages, for both a.c. and d.c., for different speeds, etc., more than one sample may be required.

If the test of subclause 11.2 has to be made, three or possibly six additional samples are required.

If it is necessary to dismantle a Class II tool for the tests of clauses 12 and 15, one additional sample may be required.

The testing of components may necessitate the submission of additional samples of these components. When the submission of such samples is necessary, they should be submitted together with the tool.

**4.3** Unless otherwise specified, the tests are carried out in the order of the clauses of this standard.

NOTE. Before testing is started, the tool is operated at rated voltage or at the lower limit of the rated voltage range, in order to verify that it is in working order.

**4.4** Unless otherwise specified, the tests are carried out at an ambient temperature of  $(20 \pm 5)^\circ\text{C}$ , the tool being placed in the most unfavourable position which may occur in normal use.

**4.5** Tools for a.c. only are tested with a.c., at rated frequency, if marked. Tools for d.c. only are tested with d.c. Tools not marked with rated frequency are tested at 50 Hz. Tools designed for more than one rated voltage, or for both a.c. and d.c., are tested at the most unfavourable voltage and nature of supply.

When it is specified that the supply voltage is equal to the rated voltage multiplied by a factor, the supply voltage for tools marked with a rated voltage range is equal to:

- the upper limit of the rated voltage range multiplied by this factor, if greater than 1;
- the lower limit of the rated voltage range multiplied by this factor, if smaller than 1.

When testing tools designed for d.c. only, the possible influence of polarity on the operation of the tool is taken into consideration.

Tools marked with a rated frequency range are tested at 50 Hz, if this frequency is within the range; otherwise, they are tested at the most unfavourable frequency within the range.

NOTES. If the tool is designed for more than one rated voltage or rated voltage range, it may be necessary to make some of the tests more than once, in order to establish the most unfavourable voltage.

For tools designed for more than one rated voltage or rated voltage range, the rated voltage to be used for the tests is the most unfavourable voltage mentioned above.

**4.6** Heating elements incorporated in the tool are connected to a separate supply, unless otherwise specified, and are tested according to the relevant EN 60335.

*If, in normal use, the heating element cannot be operated unless the motor is running, the element is tested with the motor running. If the heating element can be operated without the motor running, the element is tested with or without the motor running, whichever is the more unfavourable.*

**4.7** Tools provided with a regulating device or a similar control, shall be tested with these controls adjusted to their most unfavourable setting within the range specified by the manufacturer for the particular application, if the setting can be altered by the user.

NOTES. If the adjusting means of the control is accessible without the aid of a tool, this subclause applies whether the setting can be altered by hand or with the aid of a tool; if the adjusting means is not accessible without the aid of a tool, this subclause applies only if the setting can be altered by hand.

Adequate sealing is regarded as preventing alteration of the setting by the user.

**4.8** Electronic speed control devices shall be set for the highest speed.

**4.9** Tools intended to be used with a non-detachable flexible cable or cord shall be tested with the flexible cable or cord connected to the tool.

**4.10** When the conditions of normal load are specified in Part 2, the tool shall be loaded according to these conditions, irrespective of any marking of short-time operation or intermittent operation, unless it is evident from the design of the tool that these conditions will not occur in normal use.

When the conditions of normal load are not specified in Part 2, the tool shall be loaded according to the manufacturer's instructions; in the absence of such instructions, the tool shall be operated continuously at a load such that rated input is attained.

Tools for which alternative accessories are available shall be tested with that accessory within the manufacturer's specification which gives the most unfavourable results.

For accessories performing a function which is within the scope of one of the Parts 2, the tests are made in accordance with the relevant Part.

For other accessories, the tests shall be made in accordance with the manufacturer's instructions; in the absence of such instructions, the tool shall be operated continuously at a load such that rated input is attained.

**4.11** If a torque is to be applied, the method of loading shall be chosen so as to avoid additional stresses, such as those caused by side thrust. Additional loads necessary for the correct operation of the tool shall be, however, taken into consideration.

**4.12** Tools intended to be operated at safety extra-low voltage supplied by a transformer delivered together with the tool, shall be tested together with the transformer.

**4.13** *If Class I tools have parts with double insulation or reinforced insulation, such parts shall also be checked for compliance with the appropriate requirements specified for Class II tools.*

*Similarly, if Class I or Class II tools have parts operating at safety extra-low voltage, such parts shall also be checked for compliance with the appropriate requirements specified for Class III tools.*

**4.14** *Tools with overload protection devices incorporated in the plug shall be tested without regard being paid to such protection device.*

**4.15** *For tools incorporating electronic circuits see annex B.*

## 5 Rating

**5.1** The maximum rated voltage is:

250 V for d.c. tools;

440 V for other tools.

*Compliance is checked by inspection of the marking.*

NOTE. The requirements of this standard are based on the assumption that in normal use the voltage between the supply lines and earth does not exceed 250 V.

## 6 Classification

**6.1** Tools are classified:

1) according to protection against electric shock:

Class I tools;

Class II tools;

Class III tools.

2) according to degree of protection against moisture:

ordinary tools;

splash-proof tools;

watertight tools.

## 7 Marking

**7.1** Tools shall be marked with:

- rated voltage(s) or rated voltage range(s) in volts;
- symbol for nature of supply, if applicable;
- rated frequency or rated frequency range in hertz, unless the tool is designed for d.c. only, or for a.c. of any frequency not exceeding 60 Hz;
- rated input in watts or kilowatts, if greater than 25 W;
- rated current in amperes, if greater than 10 A;
- manufacturer's name or trade mark;
- manufacturer's address or country of origin;
- manufacturer's model or type reference and serial number (if any);
- any mandatory mark showing compliance with legislation by reference to this standard;

- rated operating time, or rated operating time and rated resting time, in hours, minutes or seconds, if applicable;
- symbol for Class II construction, for Class II tools only;
- symbol for degree of protection against moisture, if applicable;
- rated no-load speed in revolutions per minute, if exceeding 10,000.

NOTES. Tools for star-delta connection must be clearly marked with the two rated voltages (e.g. 230  $\Delta$ /400 Y).

For tools with heating elements incorporated, the rated input is considered to be equal to the total maximum rated input of the motor and of the heating elements that can be in operation simultaneously.

Additional markings are allowed, provided they do not give rise to misunderstanding.

If the motor of a tool is marked separately, the marking of the tool and that of the motor shall be such that there can be no doubt with regard to the rating and manufacturer of the tool itself.

**7.2** For tools with heating elements incorporated, the complete marking for heating elements required in the EN 60335-1 shall, in addition, be given on the marking plate of the tool.

**7.3** Tools for short-time operation or intermittent operation shall be marked with rated operating time or rated operating time and rated resting time respectively, unless the operating time is either limited by the construction or corresponds to the description of normal load given in Part 2.

The marking of short-time operation or intermittent operation shall correspond to normal use.

The marking of intermittent operation shall be such that the rated operating time precedes the rated resting time, the marking being separated by an oblique stroke.

**7.4** If the tool can be adjusted to suit different rated voltages or different rated inputs, the voltage or input to which the tool is adjusted shall be easily and clearly discernible. This requirement does not apply to tools for star-delta connection.

NOTE. For tools where frequent changes in voltage setting are not required, this requirement is considered to be met if the rated voltage or the rated input to which the tool is adjusted, can be determined from a wiring diagram fixed to the tool; the wiring diagram may be on the inside of a cover which has to be removed to connect the supply conductors. This diagram may be on a card which is riveted to the cover, or on a paper or similar label secured to the cover by an adhesive, but it must not be on a label loosely attached to the tool.

**7.5** For tools marked with more than one rated voltage or rated voltage range, the rated input for each of these voltages or ranges shall be marked, if greater than 25 W.

The upper and lower limits of the rated input shall be marked on the tool so that the relation between input and voltage appears distinctly, unless the difference between the limits of a rated voltage range does not exceed 10 % of the mean value of the range, in which case the marking for rated input may be related to the mean value of this range.

**7.6** The following symbols shall be used as appropriate.<sup>1)</sup>

|                                                                                                                |                                              |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| n                                                                                                              | Speed of normal load                         |
| $n_o$                                                                                                          | Rated no load speed                          |
| V                                                                                                              | Volts                                        |
| A                                                                                                              | Amperes                                      |
| Hz                                                                                                             | Hertz                                        |
| W                                                                                                              | Watts                                        |
| kW                                                                                                             | Kilowatts                                    |
| h                                                                                                              | Hours                                        |
| min                                                                                                            | Minutes                                      |
| s                                                                                                              | Seconds                                      |
| $\text{min}^{-1}$ or .../min                                                                                   | Revolutions or reciprocations per minute     |
| $\sim$                                                                                                         | Alternating current                          |
| 3 $\sim$                                                                                                       | Three-phase alternating current              |
| 3N $\sim$                                                                                                      | Three-phase alternating current with neutral |
| ---                                                                                                            | Direct current                               |
|                              | Class II construction                        |
| <br>(one drop in a triangle) | Splash-proof construction                    |
| <br>(two drops)              | Watertight construction                      |

The symbol for nature of supply shall be placed next to the marking for rated voltage.

The dimensions of the symbol for Class II construction shall be such that the length of the sides of the outer square is about twice the length of the sides of the inner square. The length of the sides of the outer square shall not be less than 5 mm, unless the largest dimension of the tool does not exceed 15 cm, in which case the dimensions of the symbol may be reduced, but the length of the sides of the outer square shall not be less than 3 mm.

The symbol for Class II construction shall be so placed that it will be obvious that it is a part of the technical information and is unlikely to be confused with the manufacturer's name or trade mark.

**7.7** Terminals intended exclusively for the neutral conductor shall be indicated by the letter N.

Earthing terminals shall be indicated by the symbol 

These indications shall not be placed on screws, removable washers or other parts which might be removed when conductors are being connected.

**7.8** Tools to be connected to more than two supply conductors shall be provided with a wiring diagram, unless the correct mode of connection is obvious.

NOTES. The earthing conductor is not a supply conductor.

For tools for star-delta connection, the wiring diagram must show how the windings are to be connected.

The wiring diagram may be that referred to in subclause 7.4.

**7.9** A push-button shall be coloured red only if it serves to open the circuit to be controlled and has no other function.

NOTE. This requirement does not apply to push-buttons used for locking the mains switch.

**7.10** For tools that might cause danger when started unexpectedly, the 'off' position of the mains switch shall be indicated, unless this position is obvious to the user; the indication, if required, shall be the figure 0.

The figure 0 shall not be used for any other indication.

**7.11** Regulating devices and the like, intended to be adjusted during operation of the tool, shall be provided with an indication for the direction of adjustment to increase or to decrease the value of the characteristic being adjusted.

This requirement does not apply to regulating devices provided with reciprocating adjusting means, if its 'fully-on' position is opposite to its 'off' position.

If figures are used for indicating the different positions, the 'off' position shall be indicated by the figure 0 and the position of a greater output, input, speed, etc., shall be indicated by a higher figure.

NOTES. An indication of + and - is considered to be sufficient.

The indications for the different positions of the operating means of a control device need not be placed on the device itself.

**7.12** Tools provided with electronic regulating devices shall either have a special marking or be accompanied by an instruction sheet giving the necessary instructions for the use of the tool.

**7.13** The tool shall be accompanied by an instruction sheet, relevant to the tool concerned, in one of the official languages of the country in which it is to be sold.

<sup>1)</sup> NOTE. This does not exclude the use of other symbols for other purposes.

**7.13.1** The instruction sheet shall include at least the following:

- the name and address of the manufacturer or the country of origin;
- a repeat of the safety markings (e.g. maximum speed, capacity, etc.) that are to be marked on the tool;
- an explanation of any symbols or pictograms marked on the tool relevant to safe use;
- instructions related to safe use including normal operating conditions, assembly, adjustment, maintenance, etc. and draw attention to ways in which the tool shall not be used (which shall include the warning ‘Remove the plug from the socket before carrying out any adjustment, servicing or maintenance’);
- list of accessories to be used with the tool;
- the noise emission (measured in accordance with subclause **13.2**) as follows:

- a) the continuous A-weighted equivalent sound pressure level at the operator's ear if over 70 dB(A), or a statement to the effect if it does not exceed 70 dB(A);
- b) the peak C-weighted instantaneous sound pressure level if over 63 Pa (130 dB in relation to 20  $\mu$ Pa);
- c) the sound power level emitted by the tool where the equivalent continuous sound pressure level exceeds 85 dB(A).

when necessary, instructions concerning the use of ear protection shall be given;

- the vibration level, if applicable (measured in accordance with subclause **13.3**), as follows:
  - a) the weighted root mean square acceleration value if it exceeds 2,5 m/s<sup>2</sup>;
  - b) a statement to the effect if it does not exceed 2,5 m/s<sup>2</sup>;
- information concerning dust extraction effectiveness (optional) as measured in accordance with subclause **13.1**.

**7.13.2** The general safety instructions shall include the substance of the following text, as appropriate.

**WARNING!** When using electric tools, basic safety precautions, including the following, should always be followed to reduce the risk of fire, electric shock and personal injury.

Read all these instructions before operating this product and save these instructions.

For safe operation:

- 1) Keep work area clean.
  - Cluttered areas and benches invite injuries.
- 2) Consider work area environment.
  - Do not expose power tools to rain. Do not use power tools in damp or wet locations. Keep work area well lit. Do not use power tools where there is risk to cause fire or explosion.

3) Guard against electric shock.

- Avoid body contact with earthed or grounded surfaces (e.g. pipes, radiators, ranges, refrigerators).

4) Keep children away.

- Do not let visitors touch the tool or extension cord. All visitors should be kept away from work area.

5) Store idle tools.

- When not in use, tools should be stored in a dry, high or locked up place, out of reach of children.

6) Do not force the tool.

- It will do the job better and safer at the rate for which it was intended.

7) Use the right tool.

- Do not force small tools or attachments to do the job of a heavy duty tool. Do not use tools for purposes not intended; for example, do not use circular saws to cut tree limbs or logs.

8) Dress properly.

- Do not wear loose clothing or jewellery, they can be caught in moving parts. Rubber gloves and non-skid footwear are recommended when working outdoors. Wear protecting hair covering to contain long hair.

9) Use safety glasses.

- Also use face or dust mask if the cutting operation is dusty.

10) Connect dust extraction equipment.

- If devices are provided for the connection of dust extraction and collection facilities ensure these are connected and properly used.

11) Do not abuse the cord.

- Never carry the tool by the cord or yank it to disconnect it from the socket. Keep the cord away from heat, oil and sharp edges.

12) Secure work.

- Use clamps or a vice to hold the work. It is safer than using your hand and it frees both hands to operate the tool.

13) Do not overreach.

- Keep proper footing and balance at all times.

14) Maintain tools with care.

- Keep cutting tools sharp and clean for better and safer performance. Follow instructions for lubrication and changing accessories. Inspect tool cord periodically and if damaged have it repaired by an authorized service facility. Inspect extension cords periodically and replace, if damaged. Keep handles dry, clean and free from oil and grease.

- 15) Disconnect tools.
  - When not in use, before servicing and when changing accessories such as blades, bits and cutters.
- 16) Remove adjusting keys and wrenches.
  - Form the habit of checking to see that keys and adjusting wrenches are removed from the tool before turning it on.
- 17) Avoid unintentional starting.
  - Do not carry a plugged-in tool with a finger on the switch. Ensure switch is off when plugging in.
- 18) Use outdoor extension leads.
  - When tool is used outdoors, use only extension cords intended for outdoor use.
- 19) Stay alert.
  - Watch what you are doing. Use common sense. Do not operate tool when you are tired.
- 20) Check damaged parts.
  - Before further use of the tool, a guard or other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, free running of moving parts, breakage of parts, mounting and any other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced by an authorized service centre unless otherwise indicated in this instruction manual. Have defective switches replaced by an authorized service facility. Do not use the tool if the switch does not turn it on and off.
- 21) Warning.
  - The use of any accessory or attachment, other than those recommended in this instruction manual, may present a risk of personal injury.
- 22) Have your tool repaired by a qualified person.
  - This electric tool is in accordance with the relevant safety requirements. Repairs should only be carried out by qualified persons using original spare parts, otherwise this may result in considerable danger to the user.

**7.14** Marking specified in subclauses **7.1** to **7.5** shall be placed on the main part of the tool in such a way that it is clearly discernible when the tool is ready for use.

Marking on indications for switches, thermal cut-outs and similar control devices, shall be placed in the vicinity of these components; they shall not be placed on removable parts if these parts can be replaced in such a way that the marking is misleading.

*Compliance with the requirements of subclauses **7.1** to **7.14** is checked by inspection.*

**7.15** Marking shall be easily legible and durable.

*Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit. After all the tests of this specification, the marking shall be easily legible, it shall not be easily possible to remove marking plates and they shall show no curling.*

NOTE 1. Self-adhesive labels glued in recesses in the enclosure of the tool, are allowed for ordinary tools.

NOTE 2. The petroleum spirit to be used for the test is aliphatic solvent hexane having a maximum aromatics content of 0,1 % by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a specific mass of approximately 0,66 kg/l.

## 8 Protection against electric shock

**8.1** Tools shall be so constructed and enclosed that there is adequate protection against accidental contact with live parts and, for Class II tools, with metal parts separated from live parts by basic insulation only, even after removal of detachable parts. There shall be in addition adequate protection against risk of contact with basic insulation.

Enclosures shall have no openings giving access to live parts other than openings necessary for the use and working of the tool. The insulating properties of lacquer, enamel, cotton, paper, oxide film on metal parts, beads, sealing compound and similar coverings shall not be relied upon to give the required degree of protection against accidental contact with live parts.

Unless otherwise specified, uninsulated parts operating at safety extra-low voltage are considered to be live parts.

*Compliance is checked by inspection and, if necessary, by a test with the standard test finger shown in figure 1.*

*In addition, apertures in Class II tools and apertures in Class I tools, other than those in metal parts connected to an earthing terminal or earthing contact, are tested with the test pin shown in figure 2.*

*After removal of detachable parts, the test finger and the test pin are applied in every possible position, the test finger being applied without appreciable force and the test pin with a force of 10 N. Apertures preventing the entry of the test finger are further tested by means of a straight unjointed test finger of the same dimensions, which is applied with a force of 50 N; if this finger enters, the test with the test finger shown in figure 1 is repeated, except that the force necessary to push the finger through the aperture is exerted. An electrical contact indicator is used to show contact.*

*It shall not be possible to touch bare live parts or live parts protected by lacquer, enamel, paper, cotton, oxide film, beads, sealing compound or similar covering only, with the test finger or, for Class II tools, with the test pin.*

*It shall not be possible to touch with the test finger basic insulation or unearthed metal parts separated from live parts by basic insulation only.*

*For Class II tools, it shall not be possible to touch metal parts separated from live parts by basic insulation only, with the test finger.*

NOTES. The standard test finger must be so designed that each of the jointed sections can be turned through an angle of 90° with respect to the axis of the finger in the same direction only.

It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

**8.2** Parts providing protection against electric shock shall have adequate mechanical strength and shall not work loose in normal use. It shall not be possible to remove them without the aid of a tool.

*Compliance is checked by inspection, by manual test and by the tests of clauses 16 and 19.*

**8.3** Shafts of operating knobs, handles, levers and the like shall not be live.

*Compliance is checked by inspection.*

**8.4** For Class II tools, capacitors shall not be connected to accessible metal parts, and their casings, if of metal, shall be separated from accessible metal parts by supplementary insulation.

*Compliance is checked by inspection and by the test specified for supplementary insulation.*

**8.5** Tools shall be so designed that in normal use there is no risk of electric shock from charged capacitors.

*Compliance is checked by the following test, which is made ten times.*

*The tool is operated at rated voltage or at the upper limit of the rated voltage range. The mains switch, if any, is then moved to the 'off' position and the tool is disconnected from the supply by means of the plug. One second after disconnection, the voltage between the pins of the plug shall not exceed 34 V.*

NOTES. Care is taken that the voltage is measured with an instrument which does not appreciably affect the value to be measured.

Capacitors having a rated capacitance not exceeding 0,1 µF are not considered as liable to entail a risk of electric shock.

## 9 Starting

**9.1** Motors shall start under all normal voltage conditions which may occur in use.

Centrifugal and other automatic starting switches shall operate reliably and without contact chattering.

*Compliance is checked by operating the tool, with no load, ten times in succession at a voltage equal to 0,85 times rated voltage, regulating devices, if any, being set as in normal use. Tools provided with a centrifugal or other automatic starting switch are, in addition, operated ten times in succession at a voltage equal to 1,1 times rated voltage.*

*In all cases, the tool shall function correctly.*

## 10 Input and current

**10.1** The input of the tool, at rated voltage and under normal load, shall not exceed the rated input by more than the deviation shown in table 1.

| Table 1                           |           |
|-----------------------------------|-----------|
| Rated input<br>W                  | Deviation |
| Up to and including 33,3          | 10 W      |
| Over 33,3 up to and including 150 | 30 %      |
| Over 150 up to and including 300  | 45 W      |
| Over 300                          | 15 %      |

*Compliance is checked by measuring the input of the tool operating at rated voltage and under normal load, when the input has stabilized.*

NOTES. A lower limit of the input is not required.

For tools marked with one or more rated voltage ranges, the test is made at both the upper and lower limits of the ranges, unless the marking of the rated input is related to the mean value of the relevant voltage range, in which case the test is made at a voltage equal to the mean value of that range.

**10.2** If the tool is marked with rated current, the current taken by the tool shall not exceed the rated current by more than 15 %.

*Compliance is checked by measuring the current taken by the tool operating under normal load and at rated voltage or at the mean value of the rated voltage range.*

## 11 Heating

**11.1** Tools shall not attain excessive temperatures in normal use.

*Compliance is checked by determining the temperature rise of the various parts under the conditions specified in subclauses 11.2 to 11.6.*

**11.2** The tool is operated in still air, under normal load or under the torque load necessary to attain rated input, whichever causes the higher temperature rise, and at a voltage equal to 0,94 times rated voltage, 1,00 times rated voltage or 1,06 times rated voltage, whichever is the most unfavourable.

*The torque is kept constant at the value corresponding to normal load or to the torque load necessary to attain rated input, whichever is the higher.*

*The measurement is carried out in the direction of rotation in which the device is chiefly used.*

NOTE. When applying the torque load necessary to attain rated input, the operating time to be chosen is that specified for normal load.

**11.3** Heating elements, if any, are operated as indicated in subclause 4.6, the conditions being as specified in the EN 60335-1 when the tool is operated at a voltage equal to 1,06 times rated voltage. When the tool is operated at a voltage equal to 0,94 times rated voltage, the input of the heating elements is reduced to 0,90 times rated input.

NOTE. If it is necessary to make the test at a voltage equal to 1,00 times rated voltage, the input of the heating elements is adjusted proportionally.

**11.4** *Temperature rises of windings are determined by the resistance method; other temperature rises are determined by means of thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.*

*The temperature rise of electrical insulation, other than that of windings, is determined on the surface of the insulation, at places where failure could cause a short-circuit, contact between live parts and accessible metal parts, bridging of insulation or reduction of creepage distances or clearances below the values specified in subclause 27.1.*

*In determining the temperature rises of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and, if of insulating material, to parts in contact with hot metal.*

**11.5** *The tool is operated:*

- *for the rated operating time for tools for short-time operation;*
- *on consecutive cycles of operation, until steady conditions are established, for tools for intermittent operation, the ‘on’ and ‘off’ periods being the rated ‘on’ and ‘off’ periods;*
- *until steady conditions are established for tools for continuous operation.*

**11.6** During the test, overload protection devices shall not operate, the temperature rises shall not exceed the values shown in table 2 and sealing compound, if any, shall not flow out.

If other materials are used, they shall not be exposed to temperatures in excess of those which have been proved permissible for these materials.

Immediately after this test, the test of clause 12 is made.

NOTES. The values in the table are based on an ambient temperature not normally exceeding 25 °C, but occasionally reaching 35 °C. However the temperature rise values are based on 25 °C.

The value of the temperature rise of windings is calculated from the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1} (234,5 + t_1) - (t_2 - t_1)$$

(for copper)

$$\Delta t = \frac{R_2 - R_1}{R_1} (225,0 + t_1) - (t_2 - t_1)$$

(for electrical conductor grade aluminium)

where

$\Delta t$  is the temperature rise;

$R_1$  is the resistance at the beginning of the test;

$R_2$  is the resistance at the end of the test;

$t_1$  is the room temperature at the beginning of the test;

$t_2$  is the room temperature at the end of the test.

At the beginning of the test, the windings must be at room temperature.

It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

**11.7** *If the temperature rise of a winding or core lamination exceeds the value specified for the test of subclause 11.1, three additional samples are subjected to the following tests.*

- 1. The temperature rise of the windings and core laminations is determined by the test of subclause 11.1;*
- 2. The samples are then dismantled as far as is possible without damaging any part. Windings and core laminations are kept for 10 days (240 h) in a heating cabinet, the temperature of which is  $(80 \pm 1)^\circ\text{C}$  in excess of the temperature rise determined according to item 1.*
- 3. After this treatment, the samples are reassembled and no interturn short-circuit shall occur.*
- 4. Immediately afterwards, the samples shall withstand the tests of clause 15.*
- 5. The samples are then subjected to a humidity treatment as specified in subclause 14.3. After this treatment, they shall again withstand the tests of clause 15.*

*Tools are considered not to comply with the requirement of subclause 11.1, if there are more failures than that of one sample in one of the tests of items 3 to 5. If one sample fails in a test, the tests of items 1 to 5 are repeated on another set of three samples, all of which shall then comply with the repeated tests.*

NOTE. Faults which may occur in insulation which did not show an excessive temperature rise during the test of item 1, are ignored and are repaired, if necessary, in order to complete the tests of this subclause.

## 12 Leakage current

**12.1** The leakage current in normal use shall not be excessive.

*Compliance is checked by the test of 12.2, carried out immediately after the test of clause 11, the tool being operated under the conditions specified in 11.2, but at a supply voltage equal to 1,06 times rated voltage.*

*Three-phase tools which are also suitable for single-phase supply are tested as single-phase tools with the three sections connected in parallel. The tests are made while the tool is connected to the supply.*

**12.2** *The leakage current is measured between any pole of the supply and:*

- *accessible metal parts and metal foil with an area not exceeding 20 cm × 10 cm in contact with accessible surfaces of insulating material connected together;*
- *metal parts of Class II tools separated from live parts by basic insulation only.*



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| Table 2                                                                                                        |                       |
|----------------------------------------------------------------------------------------------------------------|-----------------------|
| Parts                                                                                                          | Temperature rise<br>K |
| Windings and core laminations in contact therewith, if the winding insulation is:                              |                       |
| of Class A material <sup>1)</sup>                                                                              | 75                    |
| of Class E material <sup>1)</sup>                                                                              | 90                    |
| of Class B material <sup>1)</sup>                                                                              | 95                    |
| of Class F material <sup>1)</sup>                                                                              | 115                   |
| of other material <sup>2)</sup>                                                                                | —                     |
| Pins of appliance inlets:                                                                                      |                       |
| for very hot conditions                                                                                        | 130                   |
| for hot conditions                                                                                             | 95                    |
| for cold conditions                                                                                            | 40                    |
| Ambient of switches without <i>T</i> -marking <sup>5)</sup>                                                    | 30                    |
| Ambient of switches with <i>T</i> -marking <sup>5)</sup>                                                       | $T - 25$              |
| Rubber or polyvinyl chloride insulation of internal and external wiring including power supply cords:          |                       |
| without <i>T</i> -marking <sup>3)</sup>                                                                        | 50                    |
| with <i>T</i> -marking                                                                                         | $T - 25$              |
| Cord sheaths used as supplementary insulation                                                                  | 35                    |
| Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety: |                       |
| when used as supplementary insulation or as reinforced insulation                                              | 40                    |
| in other cases                                                                                                 | 50                    |
| Material used as insulation other than for wires and windings:                                                 |                       |
| impregnated or varnished textile, paper or press board                                                         | 70                    |
| laminates bonded with:                                                                                         |                       |
| melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins                                           | 85                    |
| urea-formaldehyde resin                                                                                        | 65                    |
| mouldings of:                                                                                                  |                       |
| phenol-formaldehyde with cellulose fillers                                                                     | 85                    |
| phenol-formaldehyde with mineral fillers                                                                       | 100                   |
| melamine-formaldehyde                                                                                          | 75                    |
| urea-formaldehyde                                                                                              | 65                    |
| polyester with glass-fibre reinforcement                                                                       | 110                   |
| silicone rubber                                                                                                | 145                   |
| thermoplastic material <sup>4)</sup>                                                                           | —                     |
| Wood                                                                                                           | 65                    |
| Outer surface of capacitors:                                                                                   |                       |
| with marking of maximum operating temperature ( <i>T</i> )                                                     | $T - 25$              |
| without marking of maximum operating temperature:                                                              |                       |
| small ceramic capacitors for radio and television interference suppression                                     | 50                    |
| other capacitors                                                                                               | 20                    |
| External enclosure, except handles held in normal use                                                          | 60                    |

| Table 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Parts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Temperature rise<br>K |
| Handles, knobs, grips and the like which, in normal use, are continuously held:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       |
| of metal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30                    |
| of porcelain or vitreous material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 40                    |
| of moulded material, rubber or wood                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 50                    |
| Handles, knobs, grips and the like which, in normal use, are held for short periods only (e.g. of switches):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| of metal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 35                    |
| of porcelain or vitreous material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 45                    |
| of moulded material, rubber or wood                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 60                    |
| Parts in contact with oil having a flash-point of $t\text{ }^{\circ}\text{C}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $t - 50$              |
| <p><sup>1)</sup> The classification is in accordance with IEC publication 85.</p> <p>Examples of Class A material are:</p> <p>    impregnated cotton, silk, artificial silk and paper;<br/>    enamels based on oleo resins or polyamide resins.</p> <p>Examples of Class B material are:</p> <p>    asbestos;<br/>    glass fibre;<br/>    melamine-formaldehyde resins;<br/>    phenol-formaldehyde resins.</p> <p>Examples of Class E material are:</p> <p>    mouldings with cellulose fillers, cotton fabric laminates and paper laminates, bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins;<br/>    cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;<br/>    varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;<br/>    enamels based on polyvinylformal, polyurethane or epoxy resins.</p> <p>Examples of Class F material are:</p> <p>    glass fibre and asbestos;<br/>    varnished glass-fibre textile, varnished asbestos and built-up mica (with or without supporting materials) bonded with alkyd, epoxy, cross-linked polyester and polyurethane resins with superior thermal stability or with silicone-alkyd resins.</p> <p><sup>2)</sup> There is no limit specified for windings insulated with materials other than those of Class A, Class E, Class B or Class F, but they shall withstand the tests of subclause 11.7. These tests are always made when there is doubt with regard to the classification of the winding insulation except when the temperature rise of windings or core laminations does not exceed 75 K.</p> <p><sup>3)</sup> The grades of rubber and polyvinyl chloride insulation are those covered by CENELEC HD 21 and 22 respectively.</p> <p><sup>4)</sup> There is no specific limit for thermoplastic material, which must withstand the tests of subclause 28.1 or 28.2, for which purpose the temperature rise must be determined.</p> <p><sup>5)</sup> <math>T</math> signifies the maximum operating temperature.</p> |                       |

*The measuring circuit is shown in the following figures:*

- *for single-phase tools having a rated voltage not exceeding 250 V and for three-phase tools to be tested as single-phase tools;*
  - \* *if of Class II, figure 3;*
  - \* *if other than Class II, figure 4;*
- *for three-phase tools not suitable for single-phase supply;*
  - \* *if of Class II, figure 5;*
  - \* *if other than Class II, figure 6.*

*The measuring circuit has a total resistance of  $1750\text{ }\Omega \pm 250\text{ }\Omega$  and is shunted by a capacitor such that the time constant of the circuit is  $225\text{ }\mu\text{s} \pm 15\text{ }\mu\text{s}$ . The test is made with a.c. unless the tool is for d.c. only, in which case the test is not made.*

*For single-phase tools having a rated voltage not exceeding 250 V and for three-phase tools to be tested as single-phase tools, the leakage current is measured with the selector switch shown in figures 3 and 4, in each of the positions 1 and 2.*

For three-phase tools not suitable for single-phase supply, the leakage current is measured with the switches a, b, and c, shown in figures 5 and 6 closed; the measurements are repeated with each of the switches a, b and c open in turn, the other two switches being closed. For tools intended to be connected in star connection only the neutral is not connected.

After an operating time as specified in 11.5, the leakage current shall not exceed the following values:

- for Class III tools 0,5 mA
- for Class I tools 0,75 mA
- for Class II tools 0,25 mA
- to metal parts of Class II tools separated from live parts by basic insulation only, if the tool is classified according to degree of protection against moisture as:
  - for ordinary tools 5,0 mA
  - for tools other than ordinary 3,5 mA

If the tool incorporates one or more capacitors and is provided with a single-pole switch, the measurements are repeated with the switch in the 'off' position.

For tools incorporating heating elements the total leakage current shall be either within the limits specified above or within those specified in EN 60335-1, 13.2, whichever is the greater; the two limits shall not be added.

#### NOTES.

- Details of a suitable circuit for measuring leakage currents are given in annex D.
- It is recommended that the tool be supplied through an isolating transformer; otherwise, it must be insulated from earth.
- The metal foil has the largest area possible on the surface under test, without exceeding the dimensions specified. If its area is smaller than the surface under test, it is moved so as to test all parts of the surface; the heat dissipation of the appliance must, however, not be affected by the metal foil.
- The test with the switch in the 'off' position is made to verify that capacitors connected behind a single-pole switch do not cause an excessive leakage current.
- If the tool incorporates a thermal control which operates during the test of clause 11, the leakage current is measured immediately before the control opens the circuit.

## 13 Environmental requirements

### 13.1 Dust measurements

If the manufacturer gives information on dust collection efficiency, the effectiveness of any dust collection devices provided in accordance with clause 20.21 shall be measured under the following test conditions.

Tests under working conditions, including appropriate rest periods, are carried out in the test cabin (see figure 7) specified in the appropriate European standard and measurements of dust emission are made in accordance with that specification.

A test shall be of one hour duration including all running and rest periods.

The orientation within the cabin is such that the passage of dust towards the measuring tunnel is not impeded.

The material to be used for the test shall be appropriate for the intended use of the tool and shall be of the following specification:

- wood/beech or oak with a moisture content of  $10\% \pm 2\%$ ;
- chipboard to ISO 820 general purpose three layer type, with a density of  $500 \text{ kg/m}^3$  to  $750 \text{ kg/m}^3$  and a moisture content of  $8\% \pm 2\%$ ;
- steel — 'T' section or round bar according to ISO 630;
- concrete with the formulation cast into blocks or paving slabs (see table 3).

**Table 3. Concrete formulation (per cubic metre)**

| Cement                                                          | Water | Aggregate     |              |
|-----------------------------------------------------------------|-------|---------------|--------------|
| 330 kg                                                          | 99 kg | 1844 kg       |              |
|                                                                 |       | Particle size | Fraction (%) |
|                                                                 |       | 0 to 2 mm     | 38 ± 3       |
|                                                                 |       | 0 to 8 mm     | 50 ± 5       |
|                                                                 |       | 0 to 16 mm    | 80 ± 5       |
|                                                                 |       | 0 to 32 mm    | 100          |
| Compressive strength after 28 days to be 35 N/mm <sup>2</sup> . |       |               |              |

Tests are carried out at rated voltage and rated frequency and at maximum speed setting, of any.

The tool bit/cutter/abrasive etc. to be used shall be as specified by the manufacturer for the material to be worked.

The air velocity of externally connected suction and dust collection system to be as specified by the tool manufacturer, or if not specified  $20 \text{ m}\cdot\text{s}^{-1} \pm 2 \text{ m}\cdot\text{s}^{-1}$ . Velocity to be measured in the connecting tube at the point of connection to the tool, with the tool connected but not running.

Integral dust collection systems shall be emptied during the rest periods of the test cycle.

The tests are carried out with the tool/work piece resting on the test bench shown in figure 8.

Tests are to be conducted in all configurations within the manufacturer's specification (e.g. hand-held or in a stand).

The number of tests carried out should be sufficient to ensure a statistically reliable result, but in all cases not less than two tests shall be performed.

### 13.2 Noise measurement

Noise emission values to be quoted in the user instructions as required by clause 7.13.1 shall be measured by the test procedure described in subclauses 13.2.1 to 13.2.6