Designation: F 1505 – 01

Standard Specification for Insulated and Insulating Hand Tools[1]

This standard is issued under the fixed designation F 1505; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the testing of insulated and insulating hand tools used for working on, or in close proximity to, energized electrical apparatus or conductors operating at maximum voltage of 1000 V ac or 1500 V dc.

1.2 The use and maintenance of these tools are beyond the scope of this specification.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.4 The following precautionary caveat pertains to the test method portion only, Section 7, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 This specification does not purport to address all of the safety problems associated with the use of tools on, or in close proximity to, energized electrical apparatus.

2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[2]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

2.2 *ASME/ANSI Standard:*

ASME/ANSI B107 Series[4]

2.3 *IEC Standards:*

IEC 60900 (IEC 900:1987 + amend. 1995) Hand Tools for Live Working up to 1000 V a.c. and 1500 V d.c.[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *insulated hand tools*, *n*—those covered with insulating material in order to protect the user from electric shock and to minimize the risk of short circuits between parts at different potentials.

3.1.2 *insulating hand tools*, *n*—those made predominantly of insulating material, except for metal inserts at the working head or active part or used for reinforcement but with no exposed metal parts. In either case, to protect the user from electric shocks, as well as, to prevent short-circuits between exposed parts at different potentials.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *acceptance test*, *n*—a contractual test to prove to the customer that the device meets certain conditions of its specification.

3.2.2 *formation of lots or batches*, *n*—the product is assembled into identifiable lots, sub-lots, batches, or in such other manner as may be prescribed. Each lot or batch, as far as practicable, consists of units of product of a single type, grade, class, size, and composition, manufactured under essentially the same conditions and essentially the same time.

3.2.3 *routine test*, *n*—a test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria.

3.2.4 *sampling test*, *n*—a test on a number of devices taken at random from a batch.

3.2.5 *type test*, *n*—a test of one or more devices made to a certain design to show that the design meets certain specifications.

4. Performance Requirements

4.1 Insulated and insulating tools shall be designed and manufactured in such a way that they do not constitute a danger for the user or the installation if they are used properly.

4.2 The mechanical specifications for insulated and insulating hand tools having the same function shall comply with the corresponding ANSI or ISO standards. The mechanical performance of the working parts shall be maintained even after the application of any insulating layer(s). The insulation material shall be such that it will adequately withstand the electrical, mechanical, and thermal stresses to which it may be exposed during normal use. Insulating hand tools specially designed for

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[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] Available from American Society of Mechanical Engineers, 345 E. 47th Street, New York, NY 10017.

[5] Available from the Institute of Electrical and Electronics Engineers, Inc., 345 E. 47th Street, New York, NY 10017.

live working in an environment of live parts at different potentials (boxes with electrical equipment, live working on underground cables, etc.), that generally are used to hold or move live conductors or to cut wires of small section, must have adequate mechanical properties to avoid the risk of breaking and the possible corresponding electrical consequences. These tools shall be checked for compliance with 7.8.

4.3 All insulating material shall be flame resistant in accordance with 7.7.

4.4 The insulating coating may consist of one or more layers. If two or more layers are utilized, contrasting colors shall be employed.

4.5 The design and construction of the handles shall provide a secure handhold and prevent unintentional slipping.

4.6 The tool shall have an operating temperature range from – 20 to + 70°C.

4.7 The insulating material shall adhere securely to the conductive parts of the tool and any outer layer of the material over the temperature range from – 20 to + 70°C.

4.8 Tools intended for use at extremely low temperatures (–40°C) shall be designated "Category C" and shall be designed for this purpose.

4.9 Double-ended tools such as box wrenches, keys for hexagonal socket screws, double ended socket wrenches, double-head open-end wrenches, etc., are not allowed for insulated tools but are allowed for insulating tools.

4.10 Tools capable of being assembled shall have retaining devices to avoid unintentional separation of the assembly.

4.11 In the case of connecting parts of tools capable of being assembled, the insulation shall be applied in such a manner that if any part becomes detached during use, no conductive part, which may still be live, can be touched inadvertently or cause a flashover.

4.12 Tools capable of being assembled and designed to be interchangeable between different manufacturers shall be specifically categorized and marked as such.

5. Additional Requirements

5.1 *Screwdrivers and Wrenches*—The following uninsulated areas on the working head are permissible:

5.1.1 *Screwdrivers* for slotted head screws, 15-mm (9⁄16-in.) maximum length,

5.1.2 *Other Types of Screwdrivers*, 18-mm (3⁄4-in.) maximum length, and

5.1.3 *Box Wrenches, Socket Wrenches, and Tee Wrenches*—The working surfaces that contact the fastener.

5.1.4 *Engineer's Wrenches*—The working surface.

5.2 The blade insulation of screwdrivers shall be bonded to the handle. The outer diameter of the insulation, over a length of 30 mm (13⁄16 in.), in Area C of Fig. 1, shall not exceed the width of the blade at the tip by more than 2 mm (1⁄16 in.). This area may be parallel or tapered towards the tip.

5.3 *Pliers, Strippers, Cable Cutting Tools, Cable Scissors*:

5.3.1 The handle insulation shall have a guard so that the hand is prevented from slipping towards the uncovered metal parts of the head (see Fig. 2(*a*) as an example). The height of the guard shall be sufficient to resist slippage of the fingers towards the conductive part during work. For pliers, the minimum dimensions of the guard shall be 10 mm (3⁄8in.) on the left and the right side of the pliers positioned on a flat surface, 5 mm (3⁄16 in.) on the upper and lower part of the pliers positioned on a flat surface (see Fig. 2(*a*)).

5.3.2 The minimum insulated distance between the inner edge of the guard and the non-insulated part shall be 12 mm (1⁄2 in.) (see Fig. 2(*a*).). The insulating material shall extend as far as possible towards the working end of the tool.

5.3.3 In the case of a slip joint, a guard of 5 mm (3⁄16 in.) minimum shall be provided for the inner part of the handles.

5.3.4 In the case of "micro tools," the hand guard may be reduced.

5.3.5 If the handles of the tools exceed the length of 400 mm (16 in.), a guard is not required.

5.4 *Knives*—The minimum length of the insulated handle shall be 100 mm (4 in.). The handle shall have a guard on the side (see Fig. 2(*b*)) toward the blade to prevent the slipping of the hand onto the conductive blade. The minimum height of the guard shall be 5 mm (3⁄16 in.). The minimum insulated distance between the inner edge of the guard and the non-insulated part shall be 12 mm (1⁄2 in.) (see Fig. 2(*b*), letter b). The length of the uninsulated part of the knife blade shall not be longer than 65 mm (2 1⁄2-in.) (see Fig. 2b, letter c).

5.5 *Tweezers (see* Fig. 3*)*:

5.5.1 The total length (*l*) shall be 130-mm (5-in.) minimum and 200-mm (8-in.) maximum. The length of the handle (*g*) shall be 80-mm (3-in.) minimum.

5.5.2 Both handles of the tweezers shall have a guard towards the working head. The guard shall not be movable. Its height *h* and width *b* shall be sufficient (5 mm (3⁄16 in.) minimum, to prevent any slipping of the fingers during the work towards the uninsulated working head *u*. On both handles, the insulated part between the guard and the working head *e* shall be 12-mm (1⁄2-in.) minimum and 35-mm (1-3⁄8-in.) maximum.

5.5.3 In the case of tweezers with a metallic working head, the metallic part shall have a minimum hardness of HCR 35 (Rockwell Hardness – C Scale) at least from the working head to the handles.

5.5.4 The uninsulated length *u* of the working head shall not exceed a length of 20 mm (3⁄4 in.).

5.5.5 Insulating tweezers shall not have exposed conductive parts.

5.6 *Marking*—Each tool or tool component, or both, shall be marked permanently and legibly with the following information:

5.6.1 On the insulating material layer or on the metal conductive part include the manufacturer's name or trademark.

5.6.2 On the insulating material layer include the following:

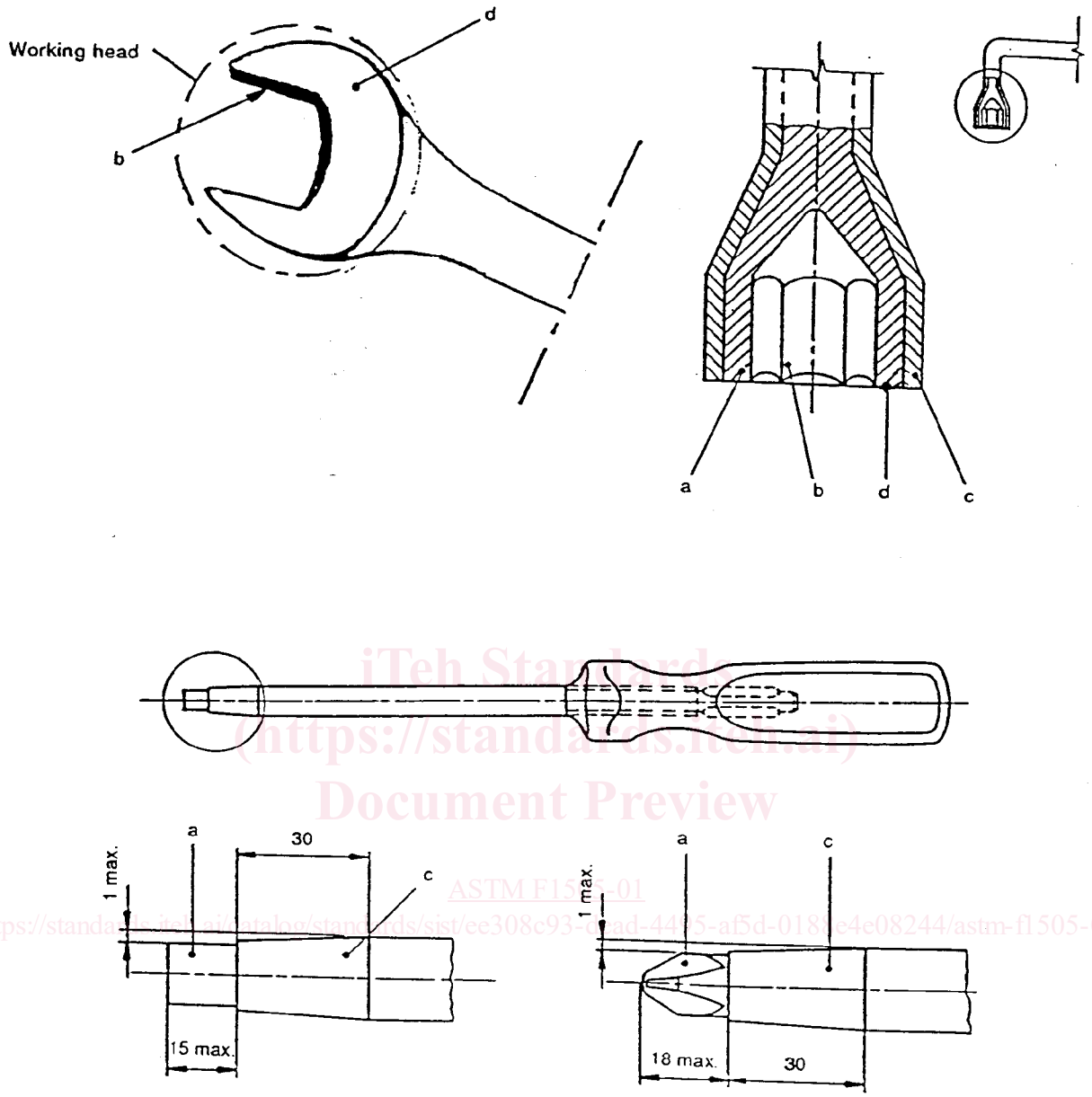
5.6.2.1 Type or product reference,

5.6.2.2 The double triangle symbol (see Fig. 4),

5.6.2.3 1000-V (the electrical working limit for alternating current), and

5.6.2.4 Year of manufacture (at least the last two digits of the year).

5.6.2.5 For tools designed for use at extremely low temperatures (–40°C), include letter "C".



NOTE 1—Dimensions in millimetres.
NOTE 2—a = conductive part,
b = working part,
c = insulation, and
d = contact part.

FIG. 1 Illustrations of Insulation of Typical Tools (Examples)

5.6.3 The double triangle symbol shall be at least 3 mm (⅛ in.) high. The letters and the figures shall be at least 2 mm (1⁄16in.) high (see Fig. 4).

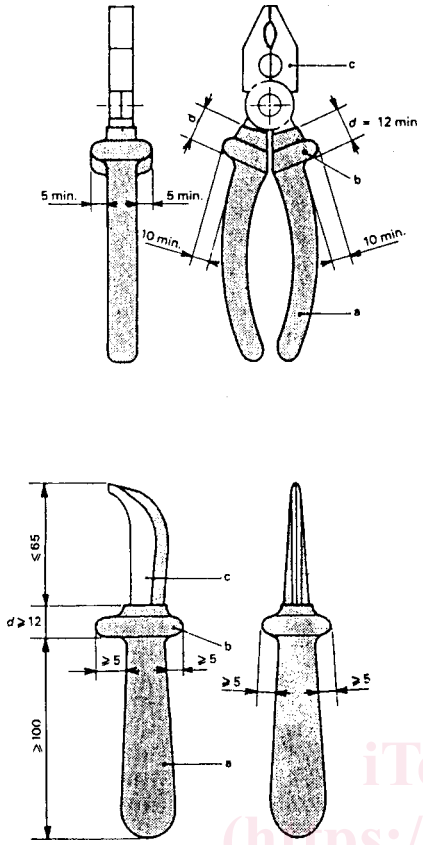
5.6.4 The voltage markings shown in 5.6.2 shall be the only voltage shown on the tool.

NOTE 1—The indication of a test voltage may lead to the erroneous assumption that the tool is suitable for work at that voltage.

5.6.5 Additional markings where specified by the customer.

5.6.6 Additional markings for tools capable of being assembled and designed by to interchangeable between different manufacturers.

5.7 *Instructions for Use*—In the case of tools that require assembly, the proper method shall be stated in the instructions for use. Other instructions, such as verification before use and test methods should be given by the manufacturer, distributor, or user (see Appendix X4).



(*a*) Insulation of Pliers
(*b*) Insulation of Knives

NOTE 1—Dimensions in millimetres.
NOTE 2—a = insulated handle or leg,
b = guard,
c = working head (not insulated), and
d = distance between the inner edge of the guard and the non-insulated part.

FIG. 2 Illustrations of Insulation of Pliers and Knives

6. Significance and Use

6.1 The performance and durability of the tools covered in this specification are not covered beyond those referenced in the applicable ASME, ANSI, or ISO standards.

6.2 The technical requirements of this specification are in compliance with IEC 60900 at the time of issue.

7. Type Tests

7.1 *General Test Specification*—The following tests shall be utilized to check compliance with the requirements outlined in Sections 4 and 5:

7.1.1 Carry out the test procedures in 7.2-7.10 on each specimen sample in the sequence listed.

7.1.2 Carry out the type tests on at least three samples of the same batch.

7.1.3 If there is any change in the design or manufacture of the tool since the last type test, repeat the type test.

7.1.4 Should a sample fail any part of the type tests, repeat the type tests on at least six additional samples of the same batch. Should any one sample then fail in any part of the repeated type test, the whole test is to be regarded as having failed.

7.1.5 Unless stated in the specification, carry out the test after a minimum storage time of 16 h under IEC climatic conditions; 23 ± 5°C, relative humidity 45 to 75 %.

7.1.6 Unless otherwise stated, deviations of 5 % from any test values required are permissible.

7.1.7 All tools that have failed the test shall be either destroyed or rendered unsuitable for use in live working. This also applies to any other tools from the batch unless the test is nondestructive. In this case, all tools shall be tested.

7.2 *Visual and Dimensional Check*:

7.2.1 *Visual*—The tool and insulation shall be visually checked and shall be determined to be free from external defects. The marking shall be checked for legibility and completeness in accordance with 5.6.

7.2.2 *Dimensional*—Check the dimensions in accordance with Section 5.

7.3 *Impact Test*:

7.3.1 Carry out the test in accordance with one of the two alternatives shown in Fig. 5(a) and 4(b). The hardness of the hammer shall be at least 20 HRC.

7.3.2 Select at least three points of the insulating material or insulating layer as testing points, these being points that could be damaged when the tool drops on a flat surface.

7.3.3 The test is passed if the insulating material shows no breaks, exfoliation, or cracks penetrating the insulating layer of the insulated tool, or are likely to reduce the solidity of the insulating tool.

7.3.4 *Ambient Temperature Test*:

7.3.4.1 Test the tool at the ambient temperature (23 ± 5°C) of the test room.

7.3.4.2 Determine the fall height H as a function of its weight, P, so that the energy, W, of impact on the tool to be tested shall be equal to that of this tool falling from a height of 2 mm onto a hard surface:

$$H = (W) / (P) = (2 \times F) / (P) \quad (1)$$

where:
H = fall height of the hammer, m,
F = weight of the tool tested, N, and
P = weight of the hammer, N.

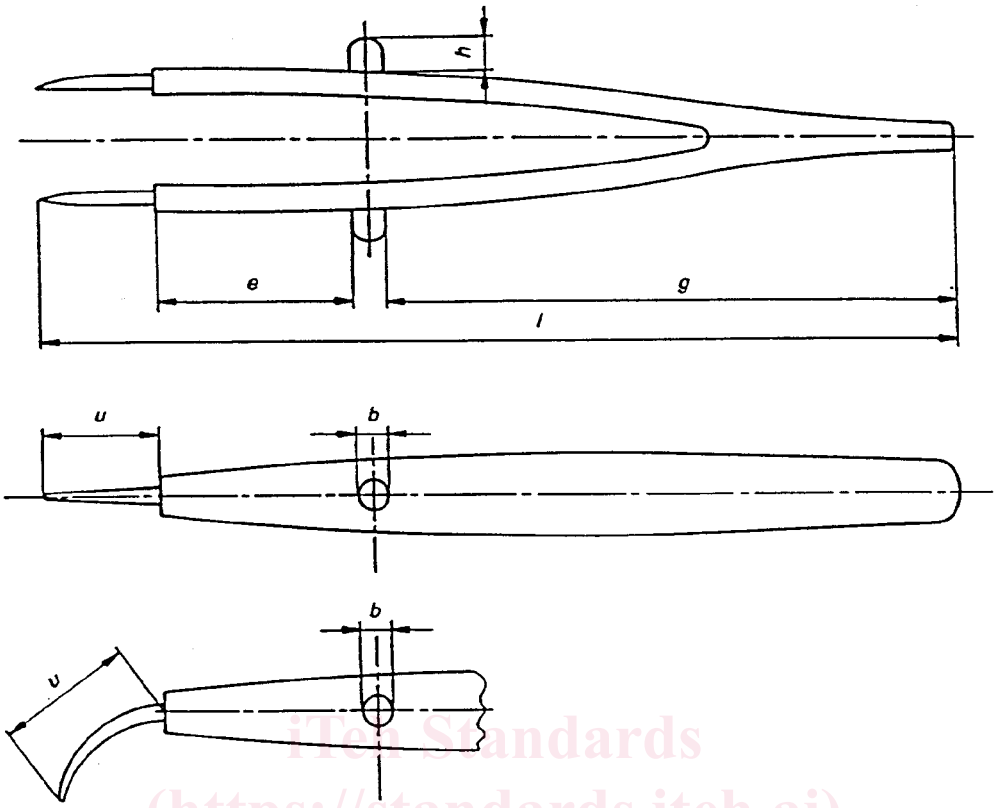
7.3.5 *Low-Temperature Test*:

7.3.5.1 Condition the tool by placement in a cooling chamber for 2 h at – 25± 3°C.

7.3.5.2 The impact test shall take place within 2 min after removal from the cooling chamber. The ambient temperature shall be 23± 5°C.

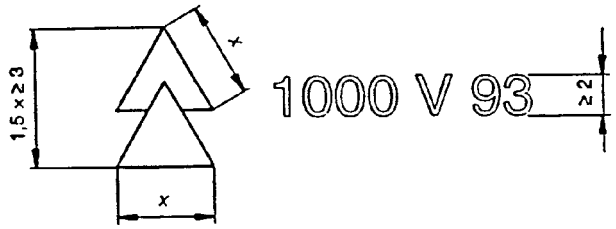
7.3.5.3 Determine the fall height H as a function of its weight, P, so that the energy, W, of the impact on the tool to be tested shall be equal to that of the tool falling from a height of 0.6 m onto a hard surface:

$$H = (W) / (P) = (0.6 \times F) / (P) \quad (2)$$



l = total length of the tweezers
g = length of the handle (grip)
b = width of the guard
h = height of the guard
e = insulated part of the handle between the guard and the working head
u = uninsulated part of the working head

FIG. 3 Example for Insulation of the Handles of Tweezers



NOTE 1—Dimensions in millimetres

FIG. 4 Marking Symbol

where:
H = fall height of the hammer, m,
F = weight of the tool tested, N, and
P = weight of the hammer, N.

7.3.6 *Extreme Low Temperature Test*—The tool shall be conditioned by placement in a cooling chamber for 2 h at –40°C +/– 3°C. The impact test shall be carried out according to 7.3.5.

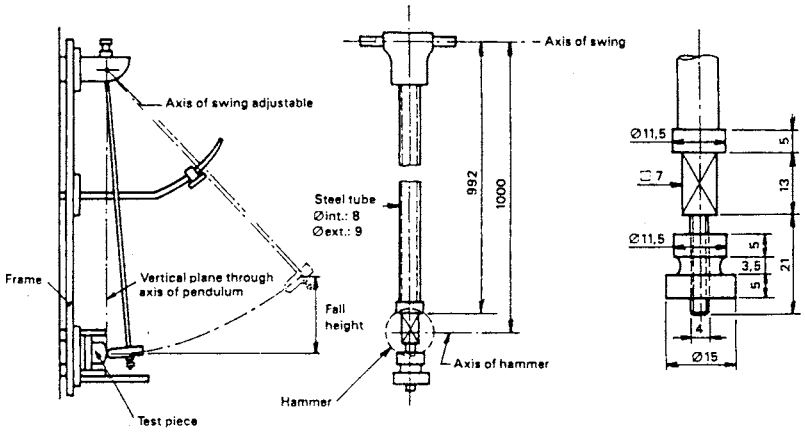
7.4 *Dielectric Test Conditioning Before Testing*—Condition the tools by total immersion in a bath of tap water at room temperature (23 ± 5°C) for a period of 24 ± 0.5 h.

7.4.1 In the case of tools capable of being field assembled, the water immersion shall be replaced by a storage at a relative humidity between 91 % and 95 % at a temperature of 23 ± 5°C for 48 h. Tools shall not be assembled prior to conditioning.

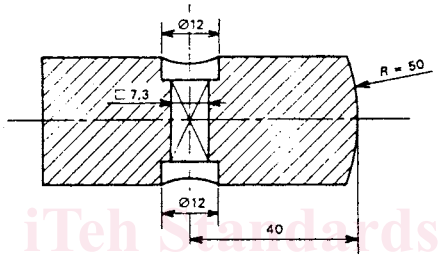
NOTE 2—This humidity may be obtained by storage in a closed chamber which contains a saturated solution of sodium sulfate decahydrate Na2, SO4, $10H_2O$ (Glauber's salt) having a large exposed surface.

7.4.2 After this conditioning, wipe the tools dry and submit to the dielectric tests:

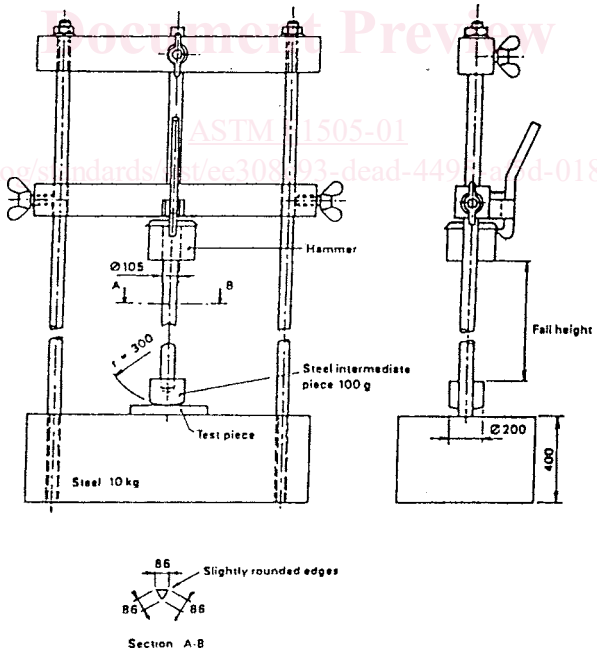
7.4.3 *Insulated Tools*—Immerse the sample tool with its insulated part in a bath of tap water to a level of 24 ± 2 mm (1 ± 1⁄16 in.) from the nearest non-insulated part. The conductive part shall be above water level (see Fig. 6).



Pendulum for impact test



(*a*) Method A



(*b*) Method B

NOTE 1—Dimensions in millimetres.

FIG. 5 Example of Test Arrangements for the Low-Temperature Impact Test